THE UNIVERSITY OF TEXAS
MD Anderson Cancer Center
Making Cancer History®

CRB ANIMAL AREA RENOVATION
UNIVERSITY OF TEXAS
M.D. ANDERSON CANCER CENTER

MDACC Project No. 12-0545

DESIGN DEVELOPMENT 100%

Project Manual
Volume 1 of 1

Perkins+Will Project No: 185108.000
March 22, 2013

PERKINS
+WILL

1001 McKinney
Suite 1300
Houston, TX 77002

t: 713.366.4000
f: 713.528.3339
www.perkinswill.com

SET ___

Project Manual

for

The University of Texas MD Anderson Cancer Center
Houston, Texas

CRB ANIMAL AREA RENOVATION

MD ANDERSON PROJECT : 12-0545

AE PROJECT : 185108.000

PROJECT DELIVERY METHOD : Competitive Sealed Proposals (CSP)

Design Development 100% – March 22, 2013

OWNER'S REPRESENTATIVE
Layne Slavin
Senior Facilities Project Manager

MD Anderson Cancer Center
6900 Fannin
Ninth Floor - FHB 9.1028 *713-563-4139*
Houston, TX 77030 *Fax 713-563-4143*

PROJECT ARCHITECT
Ed Cordes, AIA
1001 McKinney St, Suite 1300 *713-366-4000*
Houston, TX 77002 *Fax 713-528-3339*

PROJECT ARCHITECT/ENGINEER'S CONSULTANTS
MEP Engineers
Shah Smith & Associates *713-780-7563*
2825 Wilcrest, Suite 350 *Fax 713-780-9209*
Houston, TX 77042

Structural Engineers
Rogers Moore Engineers, LLC *713-430-5806*
2411 Fountainview, Suite 222 *Fax 281-582-5955*
Houston, TX 77057

Telecommunication

4b Technology Group *832-249-9379*
12600 Northborough Dr. *Fax 832-249-9756*
Suite 290
Houston, TX 77067

Code/Life Safety
Rolf Jensen & Associates *281-640-7100*
8827 W. Sam Houston Pkwy N. *Fax 281-640-7101*
Suite 150
Houston, Texas 77040

DOCUMENT 00 01 07 - PROFESSIONAL SEALS PAGE

The following Documents and Specifications have been furnished by the Owner for this Project, and were not prepared by or under the direct supervision of the Architect or any of the Architect's consultants:

OWNER

University of Texas
MD Anderson Cancer Center
Research & Education Facilities Lab Design and Construction
6900 Fannin, Ninth Floor - FHB 9.1028
Houston, Texas 77030
Telephone: 713-563-4139
Contact: M. Layne Slavin, Senior Facilities Project Manager
Electronic Mail: mlslavin@mdanderson.org

CONTRACTING REQUIREMENTS

00 01 01	Project Title Page
	2010 Uniform General and Supplementary General Conditions for the University of Texas System Building Construction Contracts.
00 25 00	Owner's Special Conditions
	Attachment "A" – Mimimum Wage Rate Determination

GENERAL REQUIREMENTS SUBGROUP

DIVISION 01 - GENERAL REQUIREMENTS

01 31 00	Project Administration
01 32 00	Project Planning and Scheduling
01 35 16	Alteration Project Procedures
01 35 25	Owner Safety Requirements
	Attachment "A" Maintaining Indoor Air Quality During Construction and Maintenance Activities Policy
01 45 00	Project Quality Control
01 77 00	Project Closeout Procedures
01 91 00	General Commissioning Requirements

The following Documents and Specification Sections have been prepared by or under the direct supervision of the Architect:

ARCHITECT

Perkins+Will – Houston
1001 McKinney, Suite 1300
Houston, Texas 77002
Telephone: 713-366-4000
Contact: Ed Cordes, Principal-in-Charge
Electronic Mail: edwin.cordes@perkinswill.com

DOCUMENTS & SPECIFICATIONS

INTRODUCTORY INFORMATION

00 01 07 Professional Seals Page
00 01 10 Table of Contents

DIVISION 1 - GENERAL REQUIREMENTS

01 10 00 Summary of Work

DIVISION 02 - GENERAL REQUIREMENTS

02 41 19 Selective Demolition

DIVISION 05 - METALS

05 50 00 Metal Fabrications

DIVISION 06 – WOOD, PLASTICS, AND COMPOSITES

06 10 00 Miscellaneous Carpentry
06 40 00 Architectural Woodwork
06 61 16 Solid Surfacing Fabrications
06 81 13 Glass Fiber Reinforced Plastic Paneling

DIVISION 07 - THERMAL AND MOISTURE PROTECTION

07 21 00 Thermal Insulation
07 81 00 Applied Fireproofing
07 84 13 Penetration Firestopping
07 84 46 Fire-Resistive Joint Systems
07 92 00 Joint Sealants

DIVISION 08 - OPENINGS

08 11 13 Hollow Metal Doors and Frames
08 14 16 Flush Wood Doors
08 31 13 Access Doors

08 71 11 Finish Hardware
08 81 00 Glass and Glazing

DIVISION 09 - FINISHES

09 22 16 Non-Structural Metal Framing
09 29 00 Gypsum Board
09 30 00 Tile
09 51 13 Acoustical Ceilings
09 67 23 Resinous Flooring
09 91 00 Painting
09 97 00 Special Coatings

DIVISION 10 - SPECIALTIES

10 21 13 Toilet Compartments
10 26 00 Wall and Corner Guards
10 28 13 Toilet and Bath Accessories
10 44 00 Fire Extinguisher Cabinets and Accessories
10 51 13 Metal Lockers
10 71 19 Flood Barriers
10 90 00 Animal Monitoring System
10 90 10 Animal Automated Drinking Water System

DIVISION 11 - EQUIPMENT

11 06 00 Laboratory Equipment – Owner Furnished Owner Installed
11 53 43 Laboratory Service Fittings
11 53 53 Biological Safety Cabinets

DIVISION 12 - FURNISHINGS

12 35 53 Laboratory Casework

The following Specification Sections have been prepared by or under the direct supervision of the Structural Engineer:

STRUCTURAL ENGINEER

Rogers Moore Engineers, LLC
2411 Fountainview, Suite 222
Houston, Texas 77057
Telephone: 713-430-5806
Contact: Matthew J. Brightman, P.E., Principal-in-Charge
Electronic Mail: mbrightman@walterpmoore.com

GENERAL REQUIREMENTS SUBGROUP

Division 01 - GENERAL REQUIREMENTS

01 45 29 Structural Testing Laboratory Services

SPECIFICATIONS

DIVISION 03 - CONCRETE

03 30 00 Concrete

DIVISION 05 - METALS

05 12 00 Structural Steel Framing
05 31 13 Steel Floor Decking
05 31 33 Steel Form Decking
05 40 00 Cold-Formed Metal Framing

The following Specification Sections have been prepared by or under the direct supervision of the Mechanical, Electrical and Plumbing Engineer:

MECHANICAL, ELECTRICAL, and PLUMBING ENGINEER

Shah Smith & Associates
2825 Wilcrest Drive, Suite 350
Houston, Texas 77042
Telephone: 713-780-7563
Contact: Scott Sevigny, Mechanical Engineer
Electronic Mail: ssevigny@shahsmith.com

SPECIFICATIONS

DIVISION 20 - COMMON FIRE SUPPRESSION, PLUMBING AND HVAC REQUIREMENTS

20 01 00	Basic Fire Suppression, Plumbing and HVAC Requirements
20 05 13	Motors
20 05 16	Piping Expansion Compensation
20 05 29	Supports and Sleeves
20 05 48	Vibration Isolation
20 05 53	Piping and Equipment Identification
20 07 16	Equipment Insulation
20 07 19	Piping Insulation
20 08 00	Fire Suppression, Plumbing and HVAC Systems Commissioning
20 08 13	Fire Suppression, Plumbing & HVAC Systems Prefunctional Checklists and Start-Ups
20 08 16	Fire Suppression, Plumbing and HVAC Systems Functional Performance Tests

DIVISION 21 – FIRE SUPPRESSION

21 10 14	Wet Standpipe and Sprinkler Systems Renovation

DIVISION 22 - PLUMBING

22 10 00	Plumbing Piping
22 10 30	Plumbing Specialties
22 40 00	Plumbing Fixtures
22 45 00	Emergency Shower and Eye Wash Equipment
22 60 53	Laboratory Vacuum and Gas Piping
22 62 21	Laboratory Vacuum Pump Systems (Rotary Claws)

DIVISION 23 – HEATING, VENTILATING, AND AIR CONDITIONING

23 05 13	Variable Frequency Drives
23 05 90	Contractor Coordination with Testing, Adusting and Balancing
23 05 93	System Testing, Adjusting and Balancing
23 07 13	Ductwork Insulation
23 09 10	Laboratory Tracking Systems and Constant Volume Air Valves

23 21 13 Hydronic Piping
23 21 30 Hydronic Specialties
23 25 00 Water Treatment for Mechanical Systems
23 31 00 Ductwork
23 33 00 Ductwork Accessories
23 33 19 Sound Attenuators
23 34 43 Laboratory High Plume Exhaust Fans
23 36 00 Air Terminal Units
23 37 00 Air Outlets and Inlets
23 82 16 Duct Mounted Air Coils
23 82 19 Fan Coil Units

DIVISION 25 - INTEGRATED AUTOMATION

25 00 10 Building Automation Systems (BAS) General (Retrofit Projects)
25 08 10 BAS Commissioning (Retrofit Projects)
25 11 10 BAS Basic Materials Interface Devices and Sensors (Retrofit Projects)
25 11 19 BAS Operator Interfaces (Retrofit Projects)
25 14 10 BAS Field Panels (Retrofit Projects)
25 15 10 BAS Software And Programming (Retrofit Projects)
25 30 10 BAS Communication Devices (Retrofit Projects)

DIVISION 26 – ELECTRICAL

26 01 00 Basic Electrical Requirements
26 01 05 Demolition
26 05 19 Cable, Wire and Connectors, 600 Volt
26 05 26 Grounding
26 05 29 Metal Framing and Supports
26 05 33 Raceways, Conduits, and Boxes
26 05 73 Protective Relay and Device Coordination
26 08 00 Electrical Systems Commissioning
26 08 13 Electrical Systems Prefunctional Checklists and Start-Ups
26 08 16 Functional Performance Tests
26 24 16 Panelboards
26 27 26 Wiring Devices
26 28 13 Fuses, 600 Volt
26 28 17 Motor and Circuit Disconnects
26 43 13 Transient Voltage Surge Suppressors
26 51 00 Lighting Fixtures

The following Specification Sections have been prepared by or under the direct supervision of the Telecommunication Consultant:

TELECOMMUNICATION

4b Technology Group
12600 Northborough Dr., Suite 290
Houston, Texas 77067
Telephone: 832-249-9379
Contact: Geoff Basford, Technology Consultant
Electronic Mail: Geoff.basford@4btechnology.com

SPECIFICATIONS

DIVISION 27 - COMMUNICATIONS

27 00 00	Communications
27 05 26	Grounding and Bonding for Communications Systems
27 05 28	Pathways for Communications Systems
27 05 53	Identification for Low-Voltage Cables
27 11 00	Communications Equipment Room Fittings
27 13 00	Communications Backbone Cabling
27 15 00	Communications Horizontal Cabling

The following Specification Sections have been prepared by or under the direct supervision of the Code/Life Safety Consultant:

CODE/LIFE SAFETY CONSULTANT

Rolf Jensen & Associates
13831 Northwest Freeway, Ste. 330
Houston, Texas 77040
Telephone: 281.640.7100
Contact: Jeffery Evans, Associate
Electronic Mail: jdevans@rjagroup.com

SPECIFICATIONS

DIVISION 28 - ELECTRONIC SAFETY AND SECURITY

28 30 00 Fire Alarm and Smoke Detector Systems

END OF DOCUMENT

PROJECT MANUAL TABLE OF CONTENTS

A – PROCUREMENT AND CONTRACTING REQUIREMENTS GROUP

B - SPECIFICATIONS GROUP

END OF SECTION 00 01 10

2013 Uniform General Conditions

for

University of Texas System Building Construction Contracts

For use on all UT System and Institutional Construction Projects executed on or after August 23, 2013

Table of Contents

Article 1. Definitions

Unless the context clearly requires another meaning, the following terms have the meaning assigned herein.

1.1 *Application for Payment* means Contractor's monthly partial invoice for payment that includes any portion of the Work that has been completed for which an invoice has not been submitted and performed in accordance with the requirements of the Contract Documents. The Application for Payment accurately reflects the progress of the Work, is itemized based on the Schedule of Values, bears the notarized signature of Contractor, and shall not include subcontracted items for which Contractor does not intend to pay.

1.2 *Application for Final Payment* means Contractor's final invoice for payment that includes any portion of the Work that has been completed for which an invoice has not been submitted, amounts owing to adjustments to the final Contract Sum resulting from approved change orders, and release of remaining Contractor's retainage.

1.3 *Architect/Engineer (A/E)* means a person registered as an architect pursuant to Tex. Occ. Code Ann., Chapter 1051, as a landscape architect pursuant to Tex. Occ. Code Ann., Chapter 1052, a person licensed as a professional engineer pursuant Tex. Occ. Code Ann., Chapter 1001, and/or a firm employed by Owner or Design-Build Contractor to provide professional architectural or engineering services and to exercise overall responsibility for the design of a Project or a significant portion thereof, and to perform the contract administration responsibilities set forth in the Contract.

1.4 *Baseline Schedule* means the initial time schedule prepared by Contractor for Owner's information and acceptance that conveys Contractor's and Subcontractors' activities (including coordination and review activities required in the Contract Documents to be performed by A/E and ODR), durations, and sequence of work related to the entire Project to the extent required by the Contract Documents. The schedule clearly demonstrates the critical path of activities, durations and necessary predecessor conditions that drive the end date of the schedule. The Baseline Schedule shall not exceed the time limit current under the Contract Documents.

1.5 *Certificate of Final Completion* means the certificate issued by A/E that documents, to the best of A/E's knowledge and understanding, Contractor's completion of all Contractor's Punchlist items and pre-final Punchlist items, final cleanup and Contractor's provision of Record Documents, operations and maintenance manuals, and all other Close-Out documents required by the Contract Documents.

1.6 *Change Order* means a written modification of the Contract between Owner and Contractor, signed by Owner, Contractor and A/E.

1.7 *Close-out Documents* mean the product brochures, submittals, product/equipment maintenance and operations instructions, manuals, and other documents/warranties, record documents, affidavit of payment, release of lien and claim, and as may be further defined, identified, and required by the Contract Documents.

1.8 *Contract* means the entire agreement between Owner and Contractor, including all of the Contract Documents.

1.9 *Contract Date* is the date when the agreement between Owner and Contractor becomes effective.

1.10 *Contract Documents* mean those documents identified as a component of the agreement (Contract) between Owner and Contractor. These may include, but are not limited to, Drawings; Specifications; these General Conditions and Owner's Special Conditions; and all pre-bid and/or pre-proposal addenda.

1.11 *Contract Sum* means the total compensation payable to Contractor for completion of the Work in

accordance with the terms of the Contract.

1.12 *Contract Time* means the period between the start date identified in the Notice to Proceed with construction and the Substantial Completion date identified in the Notice to Proceed or as subsequently amended by a Change Order.

1.13 *Contractor* means the individual, corporation, limited liability company, partnership, firm, or other entity contracted to perform the Work, regardless of the type of construction contract used, so that the term as used herein includes a Construction Manager-at-Risk or a Design-Build firm as well as a general or prime Contractor. The Contract Documents refer to Contractor as if singular in number.

1.14 *Construction Documents* mean the Drawings, Specifications, and other documents issued to build the Project. Construction Documents become part of the Contract Documents when listed in the Contract or any Change Order.

1.15 *Construction Manager-at-Risk*, in accordance with Tex. Educ. Code § 51.782, means a sole proprietorship, partnership, corporation, or other legal entity that assumes the risk for construction, rehabilitation, alteration, or repair of a facility at the contracted price as a general contractor and provides consultation to Owner regarding construction during and after the design of the facility.

1.16 *Date of Commencement* means the date designated in the Notice to Proceed for Contractor to commence the Work.

1.17 *Day* means a calendar day unless otherwise specifically stipulated.

1.18 *Design-Build* means a project delivery method in which the detailed design and subsequent construction is provided through a single contract with a Design-Build firm; a team, partnership, or legal entity that includes design professionals and a builder. The Design-Build Project delivery shall be implemented in accordance with Tex. Educ. Code § 51.780.

1.19 *Drawings* mean that product of A/E which graphically depicts the Work.

1.20 *Final Completion* means the date determined and certified by A/E and Owner on which the Work is fully and satisfactorily complete in accordance with the Contract.

1.21 *Final Payment* means the last and final monetary compensation made to Contractor for any portion of the Work that has been completed and accepted for which payment has not been made, amounts owing to adjustments to the final Contract Sum resulting from approved change orders, and release of Contractor's retainage.

1.22 *Historically Underutilized Business (HUB)* pursuant to Tex. Gov't Code, Chapter 2161, means a business that is at least 51% owned by an Asian Pacific American, a Black American, a Hispanic American, a Native American and/or an American Woman; is an entity with its principal place of business in Texas; and has an owner residing in Texas with proportionate interest that actively participates in the control, operations, and management of the entity's affairs.

1.23 *Notice to Proceed* means written document informing Contractor of the dates beginning Work and the dates anticipated for Substantial Completion.

1.24 *Open Item List* means a list of work activities, Punchlist items, changes or other issues that are not expected by Owner and Contractor to be complete prior to Substantial Completion.

1.25 *Owner* means the State of Texas, and any agency of the State of Texas, acting through the responsible entity of the State of Texas identified in the Contract as Owner.

1.26 *Owner's Designated Representative (ODR)* means the individual assigned by Owner to act on its

behalf and to undertake certain activities as specifically outlined in the Contract. ODR is the only party authorized to direct changes to the scope, cost, or time of the Contract.

1.27 *Owner's Special Conditions* mean the documents containing terms and conditions which may be unique to the Project. Owner's Special Conditions are a part of the Contract Documents and have precedence over the Uniform General Conditions

1.28 *Project* means all activities necessary for realization Owner's desired building or other structure including all ancillary and related work. This includes design, contract award(s), execution of the Work itself, work by Owner's forces and/or other contractors and fulfillment of all Contract and warranty obligations.

1.29 *Progress Assessment Report (PAR)* means the monthly compliance report to Owner verifying compliance with the HUB subcontracting plan (HSP).

1.30 *Proposed Change Order (PCO)* means a document that informs Contractor of a proposed change in the Work and appropriately describes or otherwise documents such change including Contractor's response of pricing for the proposed change.

1.31 *Punchlist* means a list of items of Work to be completed or corrected by Contractor before Final Completion. Punchlists indicate items to be finished, remaining Work to be performed, or Work that does not meet quality or quantity requirements as required in the Contract Documents.

1.32 *Record Documents* mean the drawing set, Specifications, and other materials maintained by Contractor that documents all addenda, Architect's Supplemental Instructions, Change Orders and postings and markings that record the as-constructed conditions of the Work and all changes made during construction.

1.33 *Request for Information (RFI)* means a written request by Contractor directed to A/E or ODR for a clarification of the information provided in the Contract Documents or for direction concerning information necessary to perform the Work that may be omitted from the Contract Documents.

1.34 *Samples* mean representative physical examples of materials, equipment, or workmanship used to confirm compliance with requirements and/or to establish standards for use in execution of the Work.

1.35 *Schedule of Values* means the detailed breakdown of the cost of the materials, labor, and equipment necessary to accomplish the Work as described in the Contract Documents, submitted by Contractor for approval by Owner and A/E.

1.36 *Shop Drawings* mean the drawings, diagrams, illustrations, schedules, performance charts, brochures, and other data prepared by Contractor or its agents which detail a portion of the Work.

1.37 *Site* means the geographical area of the location of the Work.

1.38 *Specifications* mean the written product of A/E that establishes the quality and/or performance of products utilized in the Work and processes to be used, including testing and verification for producing the Work.

1.39 *Subcontractor* means a business entity that enters into an agreement with Contractor to perform part of the Work or to provide services, materials, or equipment for use in the Work.

1.40 *Submittal Register* means a list provided by Contractor of all items to be furnished for review and approval by A/E and Owner and as identified in the Contract Documents including anticipated sequence and submittal dates.

1.41 *Substantial Completion* means the date determined and certified by Contractor, A/E, and Owner when

the Work, or a designated portion thereof, is sufficiently complete, in accordance with the Contract, so as to be operational and fit for the use intended.

1.42 *Unit Price Work* means the Work, or a portion of the Work, paid for based on incremental units of measurement.

1.43 *Unilateral Change Order (ULCO)* means a Change Order issued by Owner without the complete agreement of Contractor, as to cost and/or time.

1.44 *Work* means the administration, procurement, materials, equipment, construction and all services necessary for Contractor, and/or its agents, to fulfill Contractor's obligations under the Contract.

1.45 *Work Progress Schedule* means the continually updated time schedule prepared and monitored by Contractor that accurately indicates all necessary appropriate revisions as required by the conditions of the Work and the Project while maintaining a concise comparison to the Baseline Schedule.

Article 2. Wage Rates and Other Laws Governing Construction

2.1 Environmental Regulations. Contractor shall conduct activities in compliance with applicable laws and regulations and other requirements of the Contract relating to the environment and its protection at all times. Unless otherwise specifically determined, Owner is responsible for obtaining and maintaining permits related to stormwater run-off. Contractor shall conduct operations consistent with stormwater run-off permit conditions. Contractor is responsible for all items it brings to the Site, including hazardous materials, and all such items brought to the Site by its Subcontractors and suppliers, or by other entities subject to direction of Contractor. Contractor shall not incorporate hazardous materials into the Work without prior approval of Owner, and shall provide an affidavit attesting to such in association with request for Substantial Completion inspection.

2.2 Wage Rates. Contractor shall not pay less than the wage scale of the various classes of labor as shown on the prevailing wage schedule provided by Owner in the bid or proposal specifications. The specified wage rates are minimum rates only. Owner is not bound to pay any claims for additional compensation made by any Contractor because the Contractor pays wages in excess of the applicable minimum rate contained in the Contract. The prevailing wage schedule is not a representation that qualified labor adequate to perform the Work is available locally at the prevailing wage rates.

2.2.1 Notification to Workers. Contractor shall post the prevailing wage schedule in a place conspicuous to all workers on the Project Site and shall notify each worker, in writing, of the following as they commence work on the Contract: the worker's job classification, the established minimum wage rate requirement for that classification, as well as the worker's actual wage. The notice must be delivered to and signed in acknowledgement of receipt by the worker and must list both the wages and fringe benefits to be paid or furnished for each classification in which the worker is assigned duties. When requested by Owner, Contractor shall furnish evidence of compliance with the Texas Prevailing Wage Law and the addresses of all workers.

2.2.1.1 Contractor shall submit a copy of each worker's wage-rate notification to ODR with the application for progress payment for the period during which the worker was engaged in activities on behalf of the Project.

2.2.1.2 The prevailing wage schedule is determined by Owner in compliance with Tex. Gov't Code, Chapter 2258. Should Contractor at any time become aware that a particular skill or trade not reflected on Owner's prevailing wage schedule will be or is being employed in the Work, whether by Contractor or by Subcontractor, Contractor shall promptly inform ODR of the proposed wage to be paid for the skill along with a justification for same and ODR shall promptly concur with or reject the proposed wage and classification. Contractor is responsible for

determining the most appropriate wage for a particular skill in relation to similar skills or trades identified on the prevailing wage schedule. In no case, shall any worker be paid less than the wage indicated for laborers.

2.2.2 Penalty for Violation. Contractor, and any Subcontractor, will pay to the State a penalty of sixty dollars ($60) for each worker employed for each day, or portion thereof, that the worker is paid less than the wage rates stipulated in the prevailing wage schedule.

2.2.3 Complaints of Violations.

2.2.3.1 Owner's Determination of Good Cause. Upon receipt of information concerning a violation, Owner will conduct an investigation in accordance with Tex. Gov't Code, Chapter 2258 and make an initial determination as to whether good cause exists that a violation occurred. Upon making a good cause finding, Owner will retain the full amounts claimed by the claimant or claimants as the difference between wages paid and wages due under the prevailing wage schedule and any supplements thereto, together with the applicable penalties, such amounts being subtracted from successive progress payments pending a final decision on the violation.

2.2.3.2 No Extension of Time. If Owner's determination proves valid that good cause existed to believe a violation had occurred, Contractor is not entitled to an extension of time for any delay arising directly or indirectly from the arbitration procedures.

2.3 Venue for Suits. The venue for any suit arising from the Contract will be in a court of competent jurisdiction in Travis County, Texas, or as may otherwise be designated in the Owner's Special Conditions.

2.4 Licensing of Trades. Contractor shall comply with all applicable provisions of State law related to license requirements for skilled tradesmen, contractors, suppliers and or laborers, as necessary to accomplish the Work. In the event Contractor, or one of its Subcontractors, loses its license during the term of performance of the Contract, Contractor shall promptly hire or contract with a licensed provider of the service at no additional cost to Owner.

2.5 Royalties, Patents, and Copyrights. Contractor shall pay all royalties and license fees, defend suits or claims for infringement of copyrights and patent rights, and shall hold Owner harmless from loss on account thereof, but shall not be responsible for such defense or loss when a particular design, process or product of a particular manufacturer or manufacturers is required by the Contract Documents, or where the copyright violations are contained in Drawings, Specifications or other documents prepared by Owner or A/E. However, if Contractor has reason to believe that the required design, process, or product is an infringement of a copyright or a patent, Contractor shall be responsible for such loss unless such information is promptly furnished to A/E.

2.6 State Sales and Use Taxes. Owner qualifies for exemption from certain State and local sales and use taxes pursuant to the provisions of Tex. Tax Code, Chapter 151. Upon request from Contractor, Owner shall furnish evidence of tax exempt status. Contractor may claim exemption from payment of certain applicable State taxes by complying with such procedures as prescribed by the State Comptroller of Public Accounts. Owner acknowledges not all items qualify for exemption. Owner is not obligated to reimburse Contractor for taxes paid on items that qualify for tax exemption.

Article 3. General Responsibilities of Owner and Contractor

3.1 Owner's General Responsibilities. Owner is the entity identified as such in the Contract and referred to throughout the Contract Documents as if singular in number.

3.1.1 Preconstruction Conference. Prior to, or concurrent with, the issuance of Notice to Proceed with construction, a conference will be convened for attendance by Owner, Contractor, A/E and appropriate Subcontractors. The purpose of the conference is to establish a working understanding among the parties as to the Work, the operational conditions at the Project Site, and general administration of the Project. Topics include communications, schedules, procedures for handling Shop Drawings and other submittals, processing Applications for Payment, maintaining required records and all other matters of importance to the administration of the Project and effective communications between the Project team members.

3.1.2 Owner's Designated Representative. Prior to the start of construction, Owner will identify Owner's Designated Representative (ODR), who has the express authority to act and bind Owner to the extent and for the purposes described in the various Articles of the Contract, including responsibilities for general administration of the Contract.

3.1.2.1 Unless otherwise specifically defined elsewhere in the Contract Documents, ODR is the single point of contact between Owner and Contractor. Notice to ODR, unless otherwise noted, constitutes notice to Owner under the Contract.

3.1.2.2 All directives on behalf of Owner will be conveyed to Contractor and A/E by ODR in writing.

3.1.2.3 Owner will furnish or cause to be furnished, free of charge, the number of complete sets of the Drawings, Specifications, and addenda as provided in the Agreement or Owner's Special Conditions.

3.1.3 Owner Supplied Materials and Information.

3.1.3.1 Owner will furnish to Contractor those surveys describing the physical characteristics, legal description, limitations of the Site, Site utility locations, and other information used in the preparation of the Contract Documents.

3.1.3.2 Owner will provide information, equipment, or services under Owner's control to Contractor with reasonable promptness.

3.1.4 Availability of Lands. Owner will furnish, as indicated in the Contract, all required rights to use the lands upon which the Work occurs. This includes rights-of-way and easements for access and such other lands that are designated for use by Contractor. Contractor shall comply with all Owner identified encumbrances or restrictions specifically related to use of lands so furnished. Owner will obtain and pay for easements for permanent structures or permanent changes in existing facilities, unless otherwise required in the Contract Documents.

3.1.5 Limitation on Owner's Duties.

3.1.5.1 Owner will not supervise, direct, control or have authority over or be responsible for Contractor's means, methods, technologies, sequences or procedures of construction or the safety precautions and programs incident thereto. Owner is not responsible for any failure of Contractor to comply with laws and regulations applicable to the Work. Owner is not responsible for the failure of Contractor to perform or furnish the Work in accordance with the Contract Documents. Except as provided in Section 2.5, Owner is not responsible for the acts or omissions of Contractor, or any of its Subcontractors, suppliers or of any other person or organization performing or furnishing any of the Work on behalf of Contractor.

3.1.5.2 Owner will not take any action in contravention of a design decision made by A/E in preparation of the Contract Documents, when such actions are in conflict with

statutes under which A/E is licensed for the protection of the public health and safety.

3.2 Role of Architect/Engineer. Unless specified otherwise in the Contract between Owner and Contractor, A/E shall provide general administration services for Owner during the construction phase of the project. Written correspondence, requests for information, and Shop Drawings/submittals shall be directed to A/E for action. A/E has the authority to act on behalf of Owner to the extent provided in the Contract Documents, unless otherwise modified by written instrument, which will be furnished to Contractor by ODR, upon request.

3.2.1 Site Visits.

3.2.1.1 A/E will make visits to the Site at intervals as provided in the A/E's Contract with Owner, to observe the progress and the quality of the various aspects of Contractor's executed Work and report findings to Owner.

3.2.1.2 A/E has the authority to interpret Contract Documents and inspect the Work for compliance and conformance with the Contract. Except as referenced in Paragraph 3.1.5.2, Owner retains the sole authority to accept or reject Work and issue direction for correction, removal, or replacement of Work.

3.2.2 Clarifications and Interpretations. It may be determined that clarifications or interpretations of the Contract Documents are necessary. Upon direction by ODR, such clarifications or interpretations will be provided by A/E consistent with the intent of the Contract Documents. A/E will issue these clarifications with reasonable promptness to Contractor as A/E's supplemental instruction ("ASI") or similar instrument. If Contractor believes that such clarification or interpretation justifies an adjustment in the Contract Sum or the Contract Time, Contractor shall so notify Owner in accordance with the provisions of Article 11.

3.2.3 Limitations on Architect/Engineer Authority. A/E is not responsible for:

3.2.3.1 Contractor's means, methods, techniques, sequences, procedures, safety, or programs incident to the Project, nor will A/E supervise, direct, control or have authority over the same;

3.2.3.2 The failure of Contractor to comply with laws and regulations applicable to the furnishing or performing the Work;

3.2.3.3 Contractor's failure to perform or furnish the Work in accordance with the Contract Documents; or

3.2.3.4 Acts or omissions of Contractor, or of any other person or organization performing or furnishing any of the Work.

3.3 Contractor's General Responsibilities. Contractor is solely responsible for implementing the Work in full compliance with all applicable laws and the Contract Documents and shall supervise and direct the Work using the best skill and attention to assure that each element of the Work conforms to the Contract requirements. Contractor is solely responsible for all construction means, methods, techniques, safety, sequences, coordination and procedures.

Contractor shall visit the Site before commencing the Work and become familiar with local conditions such as the location, accessibility and general character of the Site and/or building.

3.3.1 Project Administration. Contractor shall provide Project administration for all Subcontractors, vendors, suppliers, and others involved in implementing the Work and shall coordinate administration efforts with those of A/E and ODR in accordance with these general

conditions, Division 1 of the Specifications and other provisions of the Contract, and as outlined in the pre-construction conference.

3.3.1.1 At the request of Owner and at no additional cost, Contractor shall furnish to the ODR one copy of the current edition of the RSMeans Facilities Construction Cost Data Book in hard copy format or digital medium as directed by the ODR.

3.3.2 Contractor's Management Personnel. Contractor shall employ a competent person or persons who will be present at the Project Site during the progress of the Work to supervise or oversee the work. The competent persons are subject to the approval of ODR. Contractor shall not change approved staff during the course of the project without the written approval of ODR unless the staff member leaves the employment of Contractor. Contractor shall provide additional quality control, safety and other staff as stated in the Contract Documents.

3.3.3 Labor. Contractor shall provide competent, suitably qualified personnel to survey, lay-out, and construct the Work as required by the Contract Documents and maintain good discipline and order at the Site at all times.

3.3.4 Services, Materials, and Equipment. Unless otherwise specified, Contractor shall provide and assume full responsibility for all services, materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary facilities, and all other facilities, incidentals, and services necessary for the construction, performance, testing, start-up, inspection and completion of the Work.

3.3.5 Contractor General Responsibility. For Owner furnished equipment or material that will be in the care, custody, and control of Contractor, Contractor is responsible for damage or loss.

3.3.6 Non-Compliant Work. Should A/E and/or ODR identify Work as non-compliant with the Contract Documents, A/E and/or ODR shall communicate the finding to Contractor, and Contractor shall correct such Work at no additional cost to the Owner. The approval of Work or the failure to find non-compliant Work by either A/E or ODR does not relieve Contractor from the obligation to comply with all requirements of the Contract Documents.

3.3.7 Subcontractors. Contractor shall not employ any Subcontractor, supplier or other person or organization, whether initially or as a substitute, against whom Owner shall have reasonable objection. Owner will communicate such objections in writing within ten (10) days of receipt of Contractor's intent to use such Subcontractor, supplier, or other person or organization. Contractor is not required to employ any Subcontractor, supplier or other person or organization to furnish any of the work to whom Contractor has reasonable objection. Contractor shall not substitute Subcontractors without the acceptance of Owner.

3.3.7.1 All Subcontracts and supply contracts shall be consistent with and bind the Subcontractors and suppliers to the terms and conditions of the Contract Documents including provisions of the Contract between Contractor and Owner.

3.3.7.2 Contractor shall be solely responsible for scheduling and coordinating the Work of Subcontractors, suppliers and other persons and organizations performing or furnishing any of the Work under a direct or indirect contract with Contractor. Require all Subcontractors, suppliers and such other persons and organizations performing or furnishing any of the Work to communicate with Owner only through Contractor. Contractor shall furnish to Owner a copy, at Owner's request, of each first-tier subcontract promptly after its execution. Contractor agrees that Owner has no obligation to review or approve the content of such contracts and that providing Owner such copies in no way relieves Contractor of any of the terms and conditions of the Contract, including, without limitation, any provisions

of the Contract which require the Subcontractor to be bound to Contractor in the same manner in which Contractor is bound to Owner.

3.3.8 Continuing the Work. Contractor shall carry on the Work and adhere to the progress schedule during all disputes, disagreements, or alternative resolution processes with Owner. Contractor shall not delay or postpone any Work because of pending unresolved disputes, disagreements or alternative resolution processes, except as Owner and Contractor may agree in writing.

3.3.9 Cleaning. Contractor shall at all times, keep the Site and the Work clean and free from accumulation of waste materials or rubbish caused by the construction activities under the Contract. Contractor shall ensure that the entire Project is thoroughly cleaned prior to requesting Substantial Completion inspection and, again, upon completion of the Project prior to the final inspection.

3.3.10 Acts and Omissions of Contractor, its Subcontractors and Employees. Contractor shall be responsible for acts and omissions of his employees and all its Subcontractors, their agents and employees. Owner may, in writing, require Contractor to remove from the Project any of Contractor's or its Subcontractor's employees whom ODR finds to be careless, incompetent, unsafe, uncooperative, disruptive, or otherwise objectionable.

3.3.11 Ancillary Areas. Contractor shall operate and maintain operations and associated storage areas at the site of the Work in accordance with the following:

3.3.11.1 All Contractor operations, including storage of materials and employee parking upon the Site of Work, shall be confined to areas designated by Owner.

3.3.11.2 Contractor may erect, at its own expense, temporary buildings that will remain its property. Contractor shall remove such buildings and associated utility service lines upon completion of the Work, unless Contractor requests and Owner provides written consent that it may abandon such buildings and utilities in place.

3.3.11.3 Contractor shall use only established roadways or construct and use such temporary roadways as may be authorized by Owner. Contractor shall not allow load limits of vehicles to exceed the limits prescribed by appropriate regulations or law. Contractor shall provide protection to road surfaces, curbs, sidewalks, trees, shrubbery, sprinkler systems, drainage structures and other like existing improvements to prevent damage and repair any damage thereto at the expense of Contractor.

3.3.11.4 Owner may restrict Contractor's entry to the Site to specifically assigned entrances and routes.

3.3.12 Separate Contracts. Owner reserves the right to award other contracts in connection with the Project under the same or substantially similar contract terms, including those portions related to insurance and waiver of subrogation. Owner reserves the right to perform operations related to the Project with Owner's own forces.

3.3.13 Under a system of separate contracts, the conditions described herein continue to apply except as may be amended by change order.

3.3.14 Contractor shall cooperate with other contractors or forces employed on the Project by Owner, including providing access to Site, integration of activities within Contractor's Work Progress Schedule and Project information as requested.

3.3.15 Owner shall be reimbursed by Contractor for costs incurred by Owner which are payable to a separate contractor because of delays, improperly timed activities, or defective construction

by Contractor. Owner will equitably adjust the Contract by Change Order for costs incurred by Contractor because of delays, improperly timed activities, damage to the Work or defective construction by a separate contractor.

3.4 Indemnification of Owner.

3.4.1 Contractor covenants and agrees to FULLY INDEMNIFY and HOLD HARMLESS**, Owner and the elected and appointed officials, employees, officers, directors, volunteers, and representatives of Owner, individually or collectively, from and against any and all costs, claims, liens, damages, losses,** expenses**, fees, fines, penalties, proceedings, actions, demands, causes of action, liability and suits of any kind and nature, including but not limited to, personal or bodily injury, death or property damage, made upon Owner directly or indirectly arising out of, resulting from or related to Contractor's activities under this Contract, including any acts or omissions of Contractor, or any agent, officer, director, representative, employee, consultant or the Subcontractor of Contractor, and their respective officers, agents, employees, directors and representatives while in the exercise of performance of the rights or duties under this Contract. The indemnity provided for in this paragraph does not apply to any liability resulting from the negligence of the Owner, its officers or employees, separate contractors or assigned contractors, in instances where such negligence causes personal injury, death or property damage. IN THE EVENT CONTRACTOR AND OWNER ARE FOUND JOINTLY LIABLE BY A COURT OF COMPETENT JURISDICTION, LIABILITY WILL BE APPORTIONED COMPARATIVELY IN ACCORDANCE WITH THE LAWS OF THE STATE OF TEXAS, WITHOUT WAIVING ANY GOVERNMENTAL IMMUNITY AVAILABLE TO THE STATE UNDER TEXAS LAW AND WITHOUT WAIVING ANY DEFENSES OF THE PARTIES UNDER TEXAS LAW.**

3.4.2 **Contractor shall protect and indemnify the Owner from and against all claims, damages, judgments and losses arising from infringement or alleged infringement of any United States patent, or copyright that arise out of any of the work performed by the Contractor or the use by Contractor, or by Owner at the direction of Contractor, of any article or material. Upon becoming aware of a suit or threat of suit for patent or copyright infringement, Owner shall promptly notify Contractor and Contractor shall be given full opportunity to negotiate a settlement. Contractor does not warrant against infringement by reason of Owner's or Project Architect's design of articles or their use in combination with other materials or in the operation of any process. In the event of litigation, Owner agrees to cooperate reasonably with Contractor and parties shall be entitled, in connection with any such litigation, to be represented by counsel at their own expense.**

3.4.3 The provisions of this indemnification are solely for the benefit of the parties hereto and not intended to create or grant any rights, contractual or otherwise, to any other person or entity.

3.4.4 Contractor shall promptly advise Owner in writing of any claim or demand against Owner or against Contractor which involves Owner and known to Contractor and related to or arising out of Contractor's activities under this Contract.

3.4.5 These indemnitie provisions shall survive the termination of this Agreement regardless of the reason for termination.

Article 4. Historically Underutilized Business (HUB) Subcontracting Plan

4.1 General Description. The purpose of the Historically Underutilized Business (HUB) program is to promote equal business opportunities for economically disadvantaged persons (as defined by Tex. Gov't Code, Chapter 2161) to contract with the State of Texas in accordance with the goals specified

in the State of Texas Disparity Study. The HUB program annual procurement utilization goals are defined in 34 T.A.C. § 20.13(b).

4.1.1 State agencies are required by statute to make a good faith effort to assist HUBs in participating in contract awards issued by the State. 34 T.A.C. § 20.13(b) outlines the State's policy to encourage the utilization of HUBs in State contracting opportunities through race, ethnic and gender neutral means.

4.1.2 A Contractor who contracts with the State in an amount of $100,000 or greater is required to make a good faith effort to award subcontracts to HUBs in accordance with 34 T.A.C. § 20.14(a)(2)(A) by submitting a HUB subcontracting plan within twenty-four (24) hours after the bid or response is due and complying with the HUB subcontracting plan after it is accepted by Owner and during the term of the Contract.

4.2 Compliance with Approved HUB Subcontracting Plan. Contractor, having been awarded this Contract in part by complying with the HUB program statute and rules, hereby covenants to continue to comply with the HUB program as follows:

4.2.1 Prior to adding or substituting a Subcontractor, promptly notify Owner in the event a change is required for any reason to the accepted HUB subcontracting plan.

4.2.2 Conduct the good-faith effort activities required and provide Owner with necessary documentation to justify approval of a change to the approved HUB subcontracting plan.

4.2.3 Cooperate in the execution of a Change Order or such other approval of the change in the HUB subcontracting plans as Contractor and Owner may agree to.

4.2.4 Maintain and make available to Owner upon request business records documenting compliance with the accepted HUB subcontracting plan.

4.2.5 Upon receipt of payment for performance of Work, submit to Owner a compliance report, in the format required by Owner that demonstrates Contractor's performance of the HUB subcontracting plan.

4.2.5.1 Progress Assessment Report (PAR): monthly compliance reports to Owner (contracting agency), verifying their compliance with the HUB subcontracting plan, including the use/expenditures they have made to Subcontractors. (The PAR is available at **http://www.window.state.tx.us/procurement/prog/hub/hub-forms/progressassessmentrpt.xls**).

4.2.6 Promptly and accurately explain and provide supplemental information to Owner to assist in Owner's investigation of Contractor's good-faith effort to fulfill the HUB subcontracting plan and the requirements under 34 T.A.C. § 20.14(a)(1).

4.3 Failure to Demonstrate Good-Faith Effort. Upon a determination by Owner that Contractor has failed to demonstrate a good-faith effort to fulfill the HUB subcontracting plan or any Contract covenant detailed above, Owner may, in addition to all other remedies available to it, report the failure to perform to the Comptroller of Public Accounts, Texas Procurement and Support Services Division, Historically Underutilized Business Program and may bar Contractor from future contracting opportunities with Owner.

Article 5. Bonds and Insurance

5.1 Construction Bonds. Contractor is required to tender to Owner, prior to commencing the Work, performance and payment bonds, as required by Tex. Gov't Code, Chapter 2253. On Construction Manager-at-Risk and Design-Build Projects the Owner shall require a security bond, as described in

Subsection 5.1.2 below.

5.1.1 Bond Requirements. Each bond shall be executed by a corporate surety or sureties authorized to do business in the State of Texas and acceptable to Owner, on Owner's form, and in compliance with the relevant provisions of the Texas Insurance Code. If any bond is for more than ten (10) percent of the surety's capital and surplus, Owner may require certification that the company has reinsured the excess portion with one or more reinsurers authorized to do business in the State. A reinsurer may not reinsure for more than ten (10) percent of its capital and surplus. If a surety upon a bond loses its authority to do business in the State, Contractor shall, within thirty (30) days after such loss, furnish a replacement bond at no added cost to Owner.

5.1.1.1 A Performance bond is required if the Contract Sum is in excess of $100,000. The performance bond is solely for the protection of Owner. The performance bond is to be for the Contract Sum to guarantee the faithful performance of the Work in accordance with the Contract Documents. The form of the bond shall be approved by the Office of the Attorney General of Texas. The performance bond shall be effective through Contractor's warranty period.

5.1.1.2 A Payment bond is required if the Contract price is in excess of $25,000. The payment bond is to be for the Contract Sum and is payable to Owner solely for the protection and use of payment bond beneficiaries. The form of the bond shall be approved by the Office of the Attorney General of Texas.

5.1.2 Security Bond. The security bond provides protection to Owner if Contractor presents an acceptable guaranteed maximum price ("GMP") to Owner but is unable to deliver the required payment and performance bonds within the time period stated below.

5.1.3 When Bonds Are Due

5.1.3.1 Security bonds are due before execution of a Construction Manager-at-Risk or Design-Build Contract.

5.1.3.2 Payment and performance bonds are due before execution of a contract on competitively bid or competitively sealed proposal projects or before execution of a GMP proposal on Construction Manager-at-Risk projects or Design-Build projects.

5.1.4 Power of Attorney. Each bond shall be accompanied by a valid power of attorney (issued by the surety company and attached, signed and sealed with the corporate embossed seal, to the bond) authorizing the attorney-in-fact who signs the bond to commit the company to the terms of the bond, and stating any limit in the amount for which the attorney can issue a single bond.

5.1.5 Bond Indemnification. The process of requiring and accepting bonds and making claims thereunder shall be conducted in compliance with Tex. Gov't Code, Chapter 2253. IF FOR ANY REASON A STATUTORY PAYMENT OR PERFORMANCE BOND IS NOT HONORED BY THE SURETY, CONTRACTOR SHALL FULLY INDEMNIFY AND HOLD OWNER HARMLESS OF AND FROM ANY COSTS, LOSSES, OBLIGATIONS OR LIABILITIES IT INCURS AS A RESULT.

5.1.6 Furnishing Bond Information. Owner shall furnish certified copies of the payment bond and the related Contract to any qualified person seeking copies who complies with Tex. Gov't Code § 2253.026.

5.1.7 Claims on Payment Bonds. Claims on payment bonds must be sent directly to Contractor and

his surety in accordance with Tex. Gov't Code § 2253.041. All payment bond claimants are cautioned that no lien exists on the funds unpaid to Contractor on such Contract, and that reliance on notices sent to Owner may result in loss of their rights against Contractor and/or his surety. Owner is not responsible in any manner to a claimant for collection of unpaid bills, and accepts no such responsibility because of any representation by any agent or employee.

5.1.8 Payment Claims when Payment Bond not Required. The rights of Subcontractors regarding payment are governed by Tex. Prop. Code §§ 53.231 – 53.239 when the value of the Contract between Owner and Contractor is less than $25,000.00. These provisions set out the requirements for filing a valid lien on funds unpaid to Contractor as of the time of filing the claim, actions necessary to release the lien and satisfaction of such claim.

5.1.9 Sureties. A surety shall be listed on the US Department of the Treasury's Listing of Approved Sureties maintained by the Bureau of Financial Management Service (FMS), www.fms.treas.gov/c570, stating companies holding Certificates of Authority as acceptable sureties on Federal bonds and acceptable reinsuring companies (FMS Circular 570).

5.2 Insurance Requirements. Contractor shall carry insurance in the types and amounts indicated in this Article for the duration of the Contract. The required insurance shall include coverage for Owner's property prior to construction, during construction and during the warranty period. The insurance shall be evidenced by delivery to Owner of certificates of insurance executed by the insurer or its authorized agent stating coverages, limits, expiration dates and compliance with all applicable required provisions. Upon request, Owner, and/or its agents, shall be entitled to receive without expense, copies of the policies and all endorsements. Contractor shall update all expired policies prior to submission for monthly payment. Failure to update policies shall be reason for withholding of payment until renewal is provided to Owner.

5.2.1 Contractor, consistent with its status as an independent contractor, shall provide and maintain all insurance coverage with the minimum amounts described below until the end of the warranty period unless otherwise stated in Owner's Special Conditions. Failure to maintain insurance coverage, as required, is grounds for suspension of Work for cause pursuant to Article 14. The Contractor will be notified of the date on which the Builder's Risk insurance policy may be terminated by any means deemed appropriate by Owner.

5.2.2 Coverage shall be written on an occurrence basis by companies authorized and admitted to do business in the State of Texas and rated A-, VII or better by A.M. Best Company or similar rating company or otherwise acceptable to Owner.

5.2.2.1 Insurance Coverage Required.

5.2.2.1.1 Workers' Compensation. Insurance with limits as required by the Texas Workers' Compensation Act and Employer's Liability Insurance with limits of not less than:

$1,000,000 each accident;

$1,000,000 disease each employee ; and

$1,000,000 disease policy limit.

Policies must include (a) Other States Endorsement to include TEXAS if business is domiciled outside the State of Texas, and (b) a waiver of all rights of subrogation in favor of Owner.

5.2.2.1.2 Commercial General Liability Insurance, including premises,

operations, independent contractor's liability, products and completed operations and contractual liability, covering, but not limited to, the liability assumed under the indemnification provisions of this Contract, fully insuring Contractor's (or Subcontractor's) liability for bodily injury (including death) and property damage with a minimum limit of:

$1,000,000 per occurrence;

$2,000,000 general aggregate;

$2,000,000 products and completed operations aggregate; and

Coverage shall be on an "occurrence" basis.

The policy shall include coverage extended to apply to completed operations and explosion, collapse, and underground hazards. The policy shall include endorsement CG2503 Amendment of Aggregate Limits of Insurance (per Project) or its equivalent.

If the Work involves any activities within fifty (50) feet of any railroad, railroad protective insurance as may be required by the affected railroad, written for not less than the limits required by such railroad.

5.2.2.1.3 Asbestos Abatement Liability Insurance, including coverage for liability arising from the encapsulation, removal, handling, storage, transportation, and disposal of asbestos containing materials. *This requirement applies if the Work or the Project includes asbestos containing materials.

The combined single limit for bodily injury and property damage will be a minimum of $1,000,000 per occurrence.

*Specific requirement for claims-made form: Required period of coverage will be determined by the following formula: continuous coverage for life of the Contract, plus one (1) year (to provide coverage for the warranty period), and an extended discovery period for a minimum of five (5) years which shall begin at the end of the warranty period.

Employer's liability limits for asbestos abatement will be:

$1,000,000 each accident;

$1,000,000 disease each employee; and

$1,000,000 disease policy limit.

If this Contract is for asbestos abatement only, the All-Risk Builder's Risk or all-risk installation floater (5.2.2.1.5.e) is not required.

5.2.2.1.4 Business Automobile Liability Insurance, covering all owned, hired, and non-owned vehicles, with a minimum combined single limit for bodily injury (including death) and property damage of $1,000,000

per occurrence. No aggregate shall be permitted for this type of coverage.

Such insurance is to include coverage for loading and unloading hazards.

Contractor or any subcontractor responsible for transporting asbestos or other hazardous materials defined as asbestos shall provide pollution coverage for any vehicle hauling asbestos containing cargo. The policy must include a MCS 90 endorsement with a $5,000,000 limit and the CA 9948 Pollution Endorsement, or its equivalent.

5.2.2.1.5 All-Risk Builder's Risk Insurance, if applicable (or all-risk installation floater for instances in which the project involves solely the installation of material and/or equipment). Coverage is determined by the Contract Sum, as detailed, below.

BUILDERS RISK REQUIREMENT FOR PROJECTS WITH A CONTRACT SUM <$20 MILLION

5.2.2.1.5.1 Contractor shall purchase and maintain in force builders risk insurance on the entire Work. Such insurance shall be written in the amount of the original contract, plus any subsequent change orders and plus the cost of materials supplied or installed by others, comprising Total Value for the entire Project at the site. The insurance shall apply on a replacement cost basis with no coinsurance provision. A sublimit may be applicable to flood coverage, but sublimit must be at least 20% of the Total Value of the Project. The limit for all other perils, including Named Windstorm, Wind, and Hail, must be equal to the Total Value for the entire Project at the site. (If Installation Floater, limit shall be equal to 100 percent of the contract cost.)

5.2.2.1.5.2 This insurance shall name as insureds the Owner, the Contractor, and all subcontractors and sub-subcontractors in the Work.

5.2.2.1.5.3 Builders risk insurance shall be on an "all risk" or equivalent policy form and shall include, without limitation, insurance against fire and extended coverage perils, theft, vandalism, malicious mischief, collapse, earthquake, flood, windstorm, boiler and machinery/mechanical breakdown, testing and startup, and terrorism.

5.2.2.1.5.4 This insurance shall cover the entire work at the site as required in 5.2.2.1.5.1, including, but not limited to, the following:

- Temporary works including but not limited to scaffolding, form work, fences, shoring, hoarding, falsework and temporary buildings
- Offsite Storage
- Portions of the work in transit
- Debris removal
- Extra Expense
- Expediting Expenses
- Demolition and Increased Cost of Construction
- Pollutant Clean-Up and Removal
- Trees, Shrubs, Plants, Lawns and Landscaping (if applicable)
- Errors & Omissions (applicable to purchase of Builders Risk policy only)

5.2.2.1.5.5 This insurance shall not contain an occupancy clause suspending or reducing coverage should the Owner occupy, or begin beneficial occupancy before the Owner has accepted final completion.

5.2.2.1.5.6 This insurance shall be specific as to coverage and shall be primary to any permanent insurance or self-insurance that may be maintained on the property by Owner.

5.2.2.1.5.7 This insurance shall include a waiver of subrogation in favor of Owner, the Contractor, and all subcontractors and sub-subcontractors in the work.

5.2.2.1.5.8 As applicable, Flood deductible shall not exceed $250,000 for Zone A, $100,000 for Zone B and $50,000 for all other Zones. For Tier 1 and Tier 2, Named Windstorm deductible shall not exceed 2% of the project values in place at the time of the loss.

5.2.2.1.5.9 Before the commencement of the work, Contractor shall provide to Owner an accurate certificate of insurance that provides specific evidence of all requirements outlined in Section 5.2.2.1.5. A copy of the policy itself shall be provided to Owner within 30 days after Notice to Proceed.

5.2.2.1.5.10 Refer to Owner's Special Conditions for possible additional Builders Risk insurance requirements.

BUILDERS RISK REQUIREMENT FOR PROJECTS WITH A CONTRACT SUM ≥$20 MILLION

5.2.2.1.5.1 Contractor shall purchase and maintain in force builders risk insurance on the entire Work. Such insurance shall be written in the amount of the original contract, plus any subsequent change orders and plus the cost of materials supplied or installed by others, comprising Total Value for the entire Project at the site. The insurance shall apply on a replacement cost basis with no coinsurance provision and shall include a margin clause of plus/minus 10% on project value. A sublimit may be applicable to flood coverage, but sublimit must be at least 20% of the Total Value of the Project. A sublimit of $50 million or the Total Value of the Project, whichever is less, is acceptable for Earthquake. The limit for all other perils, including Named Windstorm, Wind, and Hail, must be equal to the Total Value for the entire Project at the site. (If Installation Floater, limit shall be equal to 100 percent of the contract cost.)

5.2.2.1.5.2 This insurance shall name as insureds the Owner, the Contractor, and all subcontractors and sub-subcontractors in the Work.

5.2.2.1.5.3 Builders risk insurance shall be on an "all risk" or equivalent policy form and shall include, without limitation, insurance against fire and extended coverage perils, theft, vandalism, malicious mischief, collapse, earthquake, flood, windstorm, boiler and machinery/mechanical breakdown, testing and startup, and terrorism.

5.2.2.1.5.4 This insurance shall cover the entire work at the site as required in 5.2.2.1.5.1, including, but not limited to, the following:

Coverage	Minimum Limit Required
Temporary works including but not limited to scaffolding, form work, fences, shoring, hoarding, falsework and temporary buildings	$1 million
Offsite Storage	Sufficient to cover the anticipated maximum values stored offsite
Portions of the work in Transit	Sufficient to cover the anticipated maximum values in transit
Debris Removal	25% of Physical damage amount subject to maximum of $5 million or 25% of Total Value of Project whichever is higher
Expediting Expenses	$1 million
Extra Expense	$5 million
Demolition and Increased Cost of Construction	$2 million or 10% of Total Value of Project whichever is higher
Pollutant Clean-Up and Removal	$250,000
Trees, Shrubs, Plants, Lawns and Landscaping (if applicable)	$2,500 per item subject to a maximum of $1 million

Errors & Omissions (applicable to purchase of Builders Risk policy only)	$2.5 million

5.2.2.1.5.5 This insurance shall not contain an occupancy clause suspending or reducing coverage should the Owner occupy, or begin beneficial occupancy before the Owner has accepted final completion.

5.2.2.1.5.6 This insurance shall be specific as to coverage and shall be primary to any permanent insurance or self-insurance that may be maintained on the property by Owner.

5.2.2.1.5.7 This insurance shall include a waiver of subrogation in favor of Owner, the Contractor, and all subcontractors and sub-subcontractors in the work.

5.2.2.1.5.8 As applicable, Flood deductible shall not exceed $250,000 for Zone A, $100,000 for Zone B and $50,000 for all other Zones. For Tier 1 and Tier 2, Named Windstorm deductible shall not exceed 2% of the project values in place at the time of the loss.

5.2.2.1.5.9 Before the commencement of the work, Contractor shall provide to Owner an accurate certificate of insurance that provides specific evidence of all requirements outlined in Section 5.2.2.1.5. A copy of the policy itself shall be provided to Owner within 30 days after Notice to Proceed.

5.2.2.1.5.10 Refer to Owner's Special Conditions for possible additional Builders Risk insurance requirements.

5.2.2.1.6 "Umbrella" Liability Insurance. On Projects that are not insured under the Owner's Revolving Owner Controlled Insurance Program (ROCIP) or any project requiring demolition services, Contractor shall obtain, pay for and maintain umbrella liability insurance during the Contract term, insuring Contractor (or Subcontractor) that provides coverage at least as broad as and applies in excess and follows form of the primary liability coverages required above. The policy shall provide "drop down" coverage where underlying primary insurance coverage limits are insufficient or exhausted.

5.2.2.1.7 "Umbrella" Liability Insurance coverage shall be in the following amounts:

- If Contract sum is $1,000,000 or less:
  No Umbrella Required
- If Contract Sum is greater than $1,000,000 up to $3,000,000:
  $1,000,000 each occurrence and $2,000,000 annual aggregate
- If Contract Sum is greater than $3,000,000 up to $5,000,000:
  $5,000,000 each occurrence and $5,000,000 annual aggregate
- If Contract Sum is greater than $5,000,000:
  $10,000,000 each occurrence and $10,000,000 annual aggregate

5.2.3 All Policies must include the following clauses, as applicable:

5.2.3.1 Contractor must provide to Owner immediate notice of cancellation, material change, or non-renewal to any insurance coverages required herein above. This requirement may be satisfied by the Contractor providing a copy of the notice received by the insurer to Owner within two business days of date of receipt or by Endorsement of the policies that require Insurer to provide notice to Owner.

5.2.3.2 It is agreed that Contractor's insurance shall be deemed primary with respect to any insurance or self insurance carried by Owner for liability arising out of operations under the Contract with Owner.

5.2.3.3 Owner, its officials, directors, employees, representatives, and volunteers are added as additional insureds as respects operations and activities of, or on behalf of the named insured performed under Contract with Owner. The additional insured status must cover completed operations as well. This is not applicable to workers' compensation policies.

5.2.3.4 A waiver of subrogation in favor of Owner shall be provided in all policies.

5.2.3.5 If Owner is damaged by the failure of Contractor (or Subcontractor) to maintain insurance as required herein and/or as further described in Owner's Special Conditions, then Contractor shall bear all reasonable costs properly attributable to that failure.

5.2.4 Without limiting any of the other obligations or liabilities of Contractor, Contractor shall require each Subcontractor performing work under the Contract, at Subcontractor's own expense, to maintain during the term of the Contract, the same stipulated minimum insurance including the required provisions and additional policy conditions as shown above. As an alternative, Contractor may include its Subcontractors as additional insureds on its own coverage as prescribed under these requirements. Contractor's certificate of insurance shall note in such event that Subcontractors are included as additional insureds and that Contractor agrees to provide workers' compensation for Subcontractors and their employees. Contractor shall obtain and monitor the certificates of insurance from each Subcontractor in order to assure compliance with the insurance requirements. Contractor must retain the certificates of insurance for the duration of the Contract plus five (5) years and shall have the responsibility of enforcing these insurance requirements among its Subcontractors. Owner shall be entitled, upon request and without expense, to receive copies of these certificates.

5.2.5 Workers' compensation insurance coverage must meet the statutory requirements of Tex. Lab. Code § 401.011(44) and specific to construction projects for public entities as required by Tex. Lab. Code § 406.096.

5.2.5.1 Definitions:

5.2.5.1.1 Certificate of coverage ("certificate")- A copy of a certificate of insurance, a certificate of authority to self-insure issued by the commission, or a coverage agreement (DWC-81, DWC-82, DWC-83, or DWC-84), showing statutory workers' compensation insurance coverage for the person's or entity's employees providing services on a project, for the duration of the project.

5.2.5.1.2 Duration of the project - includes the time from the beginning of the work on the project until the contractor's/person's work on the project has been completed and accepted by the governmental entity.

5.2.5.1.3 Persons providing services on the project ("subcontractor" in §406.096) – includes all persons or entities performing all or part of the services the contractor has undertaken to perform on the project, regardless of whether that person contracted directly with the contractor and regardless of whether that person has employees. This includes, without limitation, independent contractors, subcontractors, leasing companies, motor carriers, owner-operators, employees of any such entity, or employees of any entity which furnishes persons to provide services on the project. "Services" include, without limitation, providing, hauling, or delivering equipment or materials, or providing labor, transportation, or other service related to a project. "Services" does not include activities unrelated to the project, such as food/beverage vendors, office supply deliveries, and delivery of portable toilets.

5.2.5.2 The contractor shall provide coverage, based on proper reporting of classification codes and payroll amounts and filing of any coverage agreements, which meets the statutory requirements of Texas Labor Code, Section 401.011(44) for all employees of the contractor providing services on the project, for the duration of the project.

5.2.5.3 The Contractor must provide a certificate of coverage to the governmental entity prior to being awarded the contract.

5.2.5.4 If the coverage period shown on the contractor's current certificate of coverage ends during the duration of the project, the contractor must, prior to the end of the coverage period, file a new certificate of coverage with the governmental entity showing that coverage has been extended.

5.2.5.5 The contractor shall obtain from each person providing services on a project, and provide to the governmental entity:

(1) a certificate of coverage, prior to that person beginning work on the project, so the governmental entity will have on file certificates of coverage showing coverage for all persons providing services on the project; and

(2) no later than seven days after receipt by the contractor, a new certificate of coverage showing extension of coverage, if the coverage period shown on the current certificate of coverage ends during the duration of the project.

5.2.5.6 The contractor shall retain all required certificates of coverage for the duration of the project and for one year thereafter.

5.2.5.7 The contractor shall notify the governmental entity in writing by certified mail or personal delivery, within 10 days after the contractor knew or should have known, of any change that materially affects the provision of coverage of any person providing services on the project.

5.2.5.8 The contractor shall post on each project site a notice, in the text, form and manner prescribed by the Texas Depart of Insurance Division of Workers' Compensation, informing all persons providing services on the project that they are required to be covered, and stating how a person may verify coverage and report lack of coverage.

5.2.5.9 The contractor shall contractually require each person with whom it contracts to provide services on a project, to:

(1) provide coverage, based on proper reporting of classification codes and payroll amounts and filing of any coverage agreements, which meets the statutory requirements of Texas Labor Code, Section 401.011(44) for all of its employees providing services on the project, for the duration of the project;

(2) provide to the contractor, prior to that person beginning work on the project, a certificate of coverage showing that coverage is being provided for all employees of the person providing services on the project, for the duration of the project;

(3) provide the contractor, prior to the end of the coverage period, a new certificate of coverage showing extension of coverage, if the coverage period shown on the current certificate of coverage ends during the duration of the project;

(4) obtain from each other person with whom it contracts, and provide to the contractor:

(a) a certificate of coverage, prior to the other person beginning work on the project; and

(b) a new certificate of coverage showing extension of coverage, prior to the end of the coverage period, if the coverage period shown on the current certificate of coverage ends during the duration of the project;

(5) retain all required certificates of coverage on file for the duration of the project and for one year thereafter;

(6) notify the governmental entity in writing by certified mail or personal delivery, within 10 days after the person knew or should have known, of any change that materially affects the provision of coverage of any person providing services on the project; and

(7) contractually require each person with whom it contracts, to perform as required by paragraphs (1) - (7), with the certificates of coverage to be provided to the person for whom they are providing services.

5.2.5.10 By signing this contract or providing or causing to be provided a certificate of coverage, the contractor is representing to the governmental entity that all employees of the contractor who will provide services on the project will be covered by workers' compensation coverage for the duration of the project, that the coverage will be based on proper reporting of classification codes and payroll amounts, and that all coverage agreements will be filed with the appropriate insurance carrier or, in the case of a self-insured, with the commission's Division of Self-Insurance Regulation. Providing false or misleading information may subject the contractor to administrative penalties, criminal penalties, civil penalties, or other civil actions.

5.2.5.11 The contractor's failure to comply with any of these provisions is a breach of contract by the contractor which entitles the governmental entity to declare the contract void if the contractor does not remedy the breach within ten days after receipt of notice of breach from the governmental entity.

Article 6. Construction Documents, Coordination Documents, and Record Documents

6.1 Drawings and Specifications.

6.1.1 Copies Furnished. Contractor will be furnished, free of charge, the number of complete sets of the Drawings, Specifications, and addenda as provided in the Agreeement or the Owner's Special Conditions. Additional complete sets of Drawings and Specifications, if requested, will be furnished at reproduction cost to the entity requesting such additional sets. Electronic copies of such documents will be provided to Contractor without charge.

6.1.2 Ownership of Drawings and Specifications. All Drawings, Specifications and copies thereof furnished by A/E are to remain A/E's property. These documents are not to be used on any other project, and with the exception of the Contract record set and electronic versions needed for warranty operations, are to be returned to the A/E, upon request, following completion of the Work.

6.1.3 Interrelation of Documents. The Contract Documents as referenced in the Contract between Owner and Contractor are complementary, and what is required by one shall be as binding as if required by all.

6.1.4 Resolution of Conflicts in Documents. Where conflicts may exist within the Contract Documents, the documents shall govern in the following order: (a) Change Orders, addenda, and written amendments to the Contract; (b) the Contract; (c) Drawings; (d) Specifications

(but Specifications shall control over Drawings as to quality of materials and installation); and (e) other Contract Documents. Among other categories of documents having the same order of precedence, the term or provision that includes the latest date shall control. Contractor shall notify A/E and ODR for resolution of the issue prior to executing the Work in question.

6.1.5 Contractor's Duty to Review Contract Documents. In order to facilitate its responsibilities for completion of the Work in accordance with and as reasonably inferable from the Contract Documents, prior to commencing the Work, Contractor shall examine and compare the Contract Documents, information furnished by Owner, relevant field measurements made by Contractor and any visible or reasonably anticipated conditions at the Site affecting the Work. This duty extends throughout the construction phase prior to commencing each particular work activity and/or system installation.

6.1.6 Discrepancies and Omissions in Drawings and Specifications.

6.1.6.1 Promptly report to ODR and to A/E the discovery of any apparent error, omission or inconsistency in the Contract Documents prior to execution of the Work.

6.1.6.2 It is recognized that Contractor is not acting in the capacity of a licensed design professional, unless it is performing as a Design-Build firm.

6.1.6.3 It is further recognized that Contractor's examination of Contract Documents is to facilitate construction and does not create an affirmative responsibility to detect errors, omissions or inconsistencies or to ascertain compliance with applicable laws, building codes or regulations, unless it is performing as a Design-Build firm or a Construction Manager-at-Risk.

6.1.6.4 When performing as a Design-Build firm, Contractor has sole responsibility for discrepancies, errors, and omissions in the Drawings and Specifications.

6.1.6.5 When performing as a Construction Manager-at-Risk, Contractor has a shared responsibility with A/E for discovery and resolution of discrepancies, errors, and omissions in the Contract Documents. In such case, Contractor's responsibility pertains to review, coordination, and recommendation of resolution strategies within budget constraints.

6.1.6.6 Contractor has no liability for errors, omissions, or inconsistencies unless Contractor knowingly failed to report a recognized problem to Owner or the Work is executed under a Design-Build or Construction Manager-at-Risk Contract as outlined above. Should Contractor fail to perform the examination and reporting obligations of these provisions, Contractor is responsible for avoidable costs and direct and/or consequential damages.

6.1.6.7 Owner does not warrant or make any representations as to the accuracy, suitability or completeness of any information furnished to Contractor by Owner or it representatives.

6.2 Requirements for Record Documents. Contractor shall:

6.2.1 Maintain at the Site one copy of all Drawings, Specifications, addenda, approved submittals, Contract modifications, and all Project correspondence. Keep current and maintain Drawings and Specifications in good order with postings and markings to record actual conditions of Work and show and reference all changes made during construction. Provide Owner and A/E access to these documents.

6.2.2 Maintain the Record Documents which reflect the actual field conditions and representations

of the Work performed, whether it be directed by addendum, Change Order or otherwise. Make available the Record Documents and all records prescribed herein for reference and examination by Owner and its representatives and agents.

6.2.3 Update the Record Documents at least monthly prior to submission of periodic partial pay estimates. Failure to maintain current Record Documents constitutes cause for denial of a progress payment otherwise due.

6.2.4 Prior to requesting Substantial Completion inspection Contractor shall furnish a copy of its marked-up Record Documents and a preliminary copy of each instructional manual, maintenance and operating manual, parts catalog, wiring diagrams, spare parts, specified written warranties and like publications, or parts for all installed equipment, systems, and like items and as described in the Contract Documents.

6.2.5 Once determined acceptable by ODR with input from A/E, provide one (1) reproducible copy and one (1) electronic media copy in a format acceptable to the ODR `of all Record Documents, unless otherwise required by the Owner's Special Conditions.

6.2.6 Contractor shall be responsible for updating the Record Documents for all Contractor initiated documents and changes to the Contract Documents due to coordination and actual field conditions, including RFIs.

6.2.7 A/E shall be responsible for updating the Record Documents for any addenda, Change Orders, A/E supplemental instructions and any other alterations to the Contract Documents generated by A/E or Owner.

Article 7. Construction Safety

7.1 General. It is the duty and responsibility of Contractor and all of its Subcontractors to be familiar with, enforce and comply with all requirements of Public Law No. 91-596, 29 U.S.C. § 651 et. seq., the Occupational Safety and Health Act of 1970, (OSHA) and all amendments thereto. Contractor shall prepare a safety plan specific to the Project and submit it to ODR and A/E prior to commencing Work. In addition, Contractor and all of its Subcontractors shall comply with all applicable laws and regulations of any public body having jurisdiction for safety of persons or property to protect them from damage, injury or loss and erect and maintain all necessary safeguards for such safety and protection.

7.2 Notices. Contractor shall provide notices as follows:

7.2.1 Notify owners of adjacent property including those that own or operate utility services and/or underground facilities, and utility owners, when prosecution of the Work may affect them or their facilities, and cooperate with them in the protection, removal, relocation and replacement, and access to their facilities and/or utilities.

7.2.2 Coordinate the exchange of material safety data sheets (MSDSs) or other hazard communication information required to be made available to or exchanged between or among employers at the site in connection with laws and regulations. Maintain a complete file of MSDSs for all materials in use on site throughout the construction phase and make such file available to Owner and its agents as requested.

7.3 Emergencies. In any emergency affecting the safety of persons or property, Contractor shall act to minimize, mitigate, and prevent threatened damage, injury or loss.

7.3.1 Have authorized agents of Contractor respond immediately upon call at any time of day or night when circumstances warrant the presence of Contractor to protect the Work or adjacent

property from damage or to take such action pertaining to the Work as may be necessary to provide for the safety of the public.

7.3.2 Give ODR and A/E prompt notice of all such events.

7.3.3 If Contractor believes that any changes in the Work or variations from Contract Documents have been caused by its emergency response, promptly notify Owner within seventy-two (72) hours of the emergency response event.

7.3.4 Should Contractor fail to respond, Owner is authorized to direct other forces to take action as necessary and Owner may deduct any cost of remedial action from funds otherwise due Contractor.

7.4 Injuries. In the event of an incident or accident involving outside medical care for an individual on or near the Work, Contractor shall notify ODR and other parties as may be directed promptly, but no later than twenty-four (24) hours after Contractor learns that an event required medical care.

7.4.1 Record the location of the event and the circumstances surrounding it, by using photography or other means, and gather witness statements and other documentation which describes the event.

7.4.2 Supply ODR and A/E with an incident report no later than thirty-six (36) hours after the occurrence of the event. In the event of a catastrophic incident (one (1) fatality or three (3) workers hospitalized), barricade and leave intact the scene of the incident until all investigations are complete. A full set of incident investigation documents, including facts, finding of cause, and remedial plans shall be provided within one (1) week after occurrence, unless otherwise directed by legal counsel. Contractor shall provide ODR with written notification within one week of such catastrophic event if legal counsel delays submission of full report.

7.5 Environmental Safety. Upon encountering any previously unknown potentially hazardous material, or other materials potentially contaminated by hazardous material, Contractor shall immediately stop work activities impacted by the discovery, secure the affected area, and notify ODR immediately.

7.5.1 Bind all Subcontractors to the same duty.

7.5.2 Upon receiving such notice, ODR will promptly engage qualified experts to make such investigations and conduct such tests as may be reasonably necessary to determine the existence or extent of any environmental hazard. Upon completion of this investigation, ODR will issue a written report to Contractor identifying the material(s) found and indicate any necessary steps to be taken to treat, handle, transport or dispose of the material.

7.5.3 Owner may hire third-party contractors to perform any or all such steps.

7.5.4 Should compliance with ODR's instructions result in an increase in Contractor's cost of performance, or delay the Work, Owner will make an equitable adjustment to the Contract Sum and/or the time of completion, and modify the Contract in writing accordingly.

7.6 Trenching Plan. When the project requires excavation which either exceeds a depth of four (4) feet, or results in any worker's upper body being positioned below grade level, Contractor is required to submit a trenching plan to ODR prior to commencing trenching operations unless an engineered plan is part of the Contract Documents. The plan is required to be prepared and sealed by a professional engineer registered in the State of Texas, and hired or employed by Contractor or Subcontractor to perform the work. Said engineer cannot be anyone who is otherwise either directly or indirectly engaged on this project.

Article 8. Quality Control

8.1 Materials & Workmanship. Contractor shall execute Work in a good and workmanlike matter in accordance with the Contract Documents. Contractor shall develop and provide a quality control plan specific to this Project and acceptable to Owner. Where Contract Documents do not specify quality standards, complete and construct all Work in compliance with generally accepted construction industry standards. Unless otherwise specified, incorporate all new materials and equipment into the Work under the Contract.

8.2 Testing.

8.2.1 Owner is responsible for coordinating and paying for routine and special tests required to confirm compliance with quality and performance requirements, except as stated below or otherwise required by the Contract Documents.

8.2.2 Contractor shall provide the following testing as well as any other testing required of Contractor by the Specifications:

8.2. 2.1 Any test of basic material or fabricated equipment included as part of a submittal for a required item in order to establish compliance with the Contract Documents.

8.2. 2.2 Any test of basic material or fabricated equipment offered as a substitute for a specified item on which a test may be required in order to establish compliance with the Contract Documents.

8.2. 2.3 Preliminary, start-up, pre-functional and operational testing of building equipment and systems as necessary to confirm operational compliance with requirements of the Contract Documents.

8.2. 2.4 All subsequent tests on original or replaced materials conducted as a result of prior testing failure.

8.2. 3 All testing shall be performed in accordance with standard test procedures by an accredited laboratory, or special consultant as appropriate, acceptable to Owner. Results of all tests shall be provided promptly to ODR, A/E, and Contractor.

8.2. 4 Non-Compliance (Test Results). Should any of the tests indicate that a material and/or system does not comply with the Contract requirements, the burden of proof remains with Contractor, subject to:

8.2. 4.1 Contractor selection and submission of the laboratory for Owner acceptance.

8.2. 4.2 Acceptance by Owner of the quality and nature of tests.

8.2. 4.3 All tests taken in the presence of A/E and/or ODR, or their representatives.

8.2. 4.4 If tests confirm that the material/systems comply with Contract Documents, Owner will pay the cost of the test.

8.2. 4.5 If tests reveal noncompliance, Contractor will pay those laboratory fees and costs of that particular test and all future tests, of that failing Work, necessary to eventually confirm compliance with Contract Documents.

8.2. 4.6 Proof of noncompliance with the Contract Documents will make Contractor liable for any corrective action which ODR determines appropriate, including complete

removal and replacement of non-compliant work or material.

8.2. 5 Notice of Testing. Contractor shall give ODR and A/E timely notice of its readiness and the date arranged so ODR and A/E may observe such inspection, testing, or approval.

8.2. 6 Test Samples. Contractor is responsible for providing Samples of sufficient size for test purposes and for coordinating such tests with their Work Progress Schedule to avoid delay.

8.2. 7 Covering Up Work. If Contractor covers up any Work without providing Owner an opportunity to inspect, Contractor shall, if requested by ODR, uncover and recover the work at Contractor's expense.

8.3 Submittals.

8.3.1 Contractor's Submittals. Contractor shall submit with reasonable promptness consistent with the Project schedule and in orderly sequence all Shop Drawings, Samples, or other information required by the Contract Documents, or subsequently required by Change Order. Prior to submitting, Contractor shall review each submittal for general compliance with Contract Documents and approve submittals for review by A/E and Owner by an approval stamp affixed to each copy. Submittal data presented without Contractor's stamp of approval will be returned without review or comment. Any delay resulting from Contractor's failure to certify approval of the Submittal is Contractor's responsibility.

8.3.1.1 Contractor shall within twenty-one (21) days of the effective date of the Notice To Proceed with construction, submit to ODR and A/E, a submittal schedule/register, organized by specification section, listing all items to be furnished for review and approval by A/E and Owner. The list shall include Shop Drawings, manufacturer's literature, certificates of compliance, materials Samples, materials colors, guarantees, and all other items identified throughout the Specifications.

8.3.1.2 Contractor shall indicate the type of item, Contract requirements reference, and Contractor's scheduled dates for submitting the item along with the requested dates for approval answers from A/E and Owner. The submittal register shall indicate the projected dates for procurement of all included items and shall be updated at least monthly with actual approval and procurement dates. Contractor's Submittal Register must be reasonable in terms of the review time for complex submittals. Contractor's submittal schedule must be consistent with the Work Progress Schedule and identify critical submittals. Show and allow a minimum of fifteen (15) days duration after receipt by A/E and ODR for review and approval. If re-submittal required, allow a minimum of an additional fifteen (15) days for review. Submit the updated Submittal Register with each request for progress payment. Owner may establish routine review procedures and schedules for submittals at the preconstruction conference and/or elsewhere in the Contract Documents. If Contractor fails to update and provide the Submittal Register as required, Owner may, after seven (7) days notice to Contractor withhold a reasonable sum of money that would otherwise be due Contractor.

8.3.1.3 Contractor shall coordinate the Submittal Register with the Work Progress Schedule. Do not schedule Work requiring a submittal to begin prior to scheduling review and approval of the related submittal. Revise and/or update both schedules monthly to ensure consistency and current project data. Provide to ODR the updated Submittal Register and schedule with each application for progress payment. Refer to requirements for the Work Progress Schedule for inclusion of procurement activities therein. Regardless, the Submittal Register shall identify dates submitted and returned and shall be used to confirm status and disposition of particular items submitted, including approval or other action taken and other

information not conveniently tracked through the Work Progress Schedule.

8.3.1.4 By submitting Shop Drawings, Samples or other required information, Contractor represents that it has determined and verified all applicable field measurements, field construction criteria, materials, catalog numbers and similar data; and has checked and coordinated each Shop Drawing and Sample with the requirements of the Work and the Contract Documents.

8.3.2 Review of Submittals. A/E and ODR review is only for conformance with the design concept and the information provided in the Contract Documents. Responses to submittals will be in writing. The approval of a separate item does not indicate approval of an assembly in which the item functions. The approval of a submittal does not relieve Contractor of responsibility for any deviation from the requirements of the Contract unless Contractor informs A/E and ODR of such deviation in a clear, conspicuous, and written manner on the submittal transmittal and at the time of submission, and obtains Owner's written specific approval of the particular deviation.

8.3.3 Correction and Resubmission. Contractor shall make any corrections required to a submittal and resubmit the required number of corrected copies promptly so as to avoid delay, until submittal approval. Direct attention in writing to A/E and ODR, when applicable, to any new revisions other than the corrections requested on previous submissions.

8.3.4 Limits on Shop Drawing Review. Contractor shall not commence any Work requiring a submittal until review of the submittal under Subsection 8.3.2. Construct all such work in accordance with reviewed submittals. Comments incorporated as part of the review in Subsection 8.3.2 of Shop Drawings and Samples is not authorization to Contractor to perform extra work or changed work unless authorized through a Change Order. A/E's and ODR's review, if any, does not relieve Contractor from responsibility for defects in the Work resulting from errors or omissions of any kind on the submittal, regardless of any approval action.

8.3.5 No Substitutions Without Approval. ODR and A/E may receive and consider Contractor's request for substitution when Contractor agrees to reimburse Owner for review costs and satisfies the requirements of this section. If Contractor does not satisfy these conditions, ODR and A/E will return the request without action except to record noncompliance with these requirements. Owner will not consider the request if Contractor cannot provide the product or method because of failure to pursue the Work promptly or coordinate activities properly. Contractor's request for a substitution may be considered by ODR and A/E when:

8.3.5.1 The Contract Documents do not require extensive revisions; and

8.3.5.2 Proposed changes are in keeping with the general intent of the Contract Documents and the design intent of A/E and do not result in an increase in cost to Owner; and

8.3.5.3 The request is timely, fully documented, properly submitted and one or more of the following apply:

8.3.5.3.1 Contractor cannot provide the specified product, assembly or method of construction within the Contract Time;

8.3.5.3.2 The request directly relates to an "or-equal" clause or similar language in the Contract Documents;

8.3.5.3.3 The request directly relates to a "product design standard" or "performance standard" clause in the Contract Documents;

8.3.5.3.4 The requested substitution offers Owner a substantial advantage in cost, time, energy conservation or other considerations, after deducting additional responsibilities Owner must assume;

8.3.5.3.5 The specified product or method of construction cannot receive necessary approval by an authority having jurisdiction, and ODR can approve the requested substitution;

8.3.5.3.6 Contractor cannot provide the specified product, assembly or method of construction in a manner that is compatible with other materials and where Contractor certifies that the substitution will overcome the incompatibility;

8.3.5.3.7 Contractor cannot coordinate the specified product, assembly or method of construction with other materials and where Contractor certifies they can coordinate the proposed substitution; or

8.3.5.3.8 The specified product, assembly or method of construction cannot provide a warranty required by the Contract Documents and where Contractor certifies that the proposed substitution provides the required warranty.

8.3.6 Unauthorized Substitutions at Contractor's Risk. Contractor is financially responsible for any additional costs or delays resulting from unauthorized substitution of materials, equipment or fixtures other than those specified. Contractor shall reimburse Owner for any increased design or contract administration costs resulting from such unauthorized substitutions.

8.4 Field Mock-up.

8.4.1 Mock-ups shall be constructed prior to commencement of a specified scope of work to confirm acceptable workmanship.

8.4.1.1 As a minimum, field mock-ups shall be constructed for roofing systems, exterior veneer / finish systems, glazing systems, and any other Work requiring a mock-up as identified throughout the Contract Documents. Mock-ups for systems not part of the Project scope shall not be required.

8.4.1.2 Mock-ups may be incorporated into the Work if allowed by the Contract Documents and if acceptable to ODR. If mock-ups are freestanding, they shall remain in place until otherwise directed by Owner.

8.4.1.3 Contractor shall include field mock-ups in their Work Progress Schedule and shall notify ODR and A/E of readiness for review sufficiently in advance to coordinate review without delay.

8.5 Inspection During Construction.

8.5.1 Contractor shall provide sufficient, safe, and proper facilities, including equipment as necessary for safe access, at all reasonable times for observation and/or inspection of the Work by Owner and its agents.

8.5.2 Contractor shall not cover up any Work with finishing materials or other building components prior to providing Owner and its agents an opportunity to perform an inspection of the Work.

8.5.2.1 Should corrections of the Work be required for approval, Contractor shall not over

up corrected Work until Owner indicates approval.

8.5.2.2 Contractor shall provide notification of at least five (5) working days or otherwise as mutually agreed, to ODR of the anticipated need for a cover-up inspection. Should ODR fail to make the necessary inspection within the agreed period, Contractor may proceed with cover-up Work, but is not relieved of responsibility for Work to comply with requirements of the Contract Documents.

Article 9. Construction Schedules

9.1 Contract Time. **TIME IS AN ESSENTIAL ELEMENT OF THE CONTRACT**. The Contract Time is the time between the dates indicated in the Notice to Proceed for commencement of the Work and for achieving Substantial Completion. The Contract Time can be modified only by Change Order. Failure to achieve Substantial Completion within the Contract Time ***or*** as otherwise agreed to in writing will cause damage to Owner and may subject Contractor to liquidated damages as provided in the Contract Documents. If Contractor fails to achieve Final Completion in a reasonable time after Substantial Completion, Contractor shall be responsible for Owner's damages including, but not limited to, additional inspection, project management, and maintenance cost to the extent caused by Contractor's failure to achieve Final Completion.

9.2 Notice to Proceed. Owner will issue a Notice to Proceed which shall state the dates for beginning Work and for achieving Substantial Completion of the Work.

9.3 Work Progress Schedule. Refer to Owner's Special Conditions and Division 1 of the Specifications for additional schedule requirements. Unless indicated otherwise in those documents, Contractor shall submit their initial Work Progress Schedule for the Work in relation to the entire Project not later than twenty-one (21) calendar days after the effective date of the Notice to Proceed to ODR and A/E. Unless otherwise indicated in the Contract Documents, the Work Progress Schedule shall be computerized Critical Path Method (CPM) with fully editable logic. This initial schedule shall indicate the dates for starting and completing the various aspects required to complete the Work, including mobilization, procurement, installation, testing, inspection, delivery of Close-out Documents and acceptance of all the Work of the Contract. When acceptable to Owner, the initially accepted schedule shall be the Baseline Schedule for comparison to actual conditions throughout the Contract duration.
Note: This article pertains to construction phase schedules. Additional requirements for design phase scheduling for Construction Manager-at-Risk and Design-Build contracts are outlined in Division 1 Project Planning and Scheduling Specifications.

9.3.1 Schedule Requirements. Contractor shall submit electronic and paper copy of the initial Work Progress Schedule reflecting accurate and reliable representations of the planned progress of the Work, the Work to date if any, and of Contractor's actual plans for its completion. Contractor shall organize and provide adequate detail so the schedule is capable of measuring and forecasting the effect of delaying events on completed and uncompleted activities.

9.3.1.1 Contractor shall re-submit initial schedule as required to address review comments from A/E and ODR until such schedule is accepted as the Baseline Schedule.

9.3.1.2 Submittal of a schedule, schedule revision or schedule update constitutes Contractor's representation to Owner of the accurate depiction of all progress to date and that Contractor will follow the schedule as submitted in performing the Work.

9.3.2 Schedule Updates. Contractor shall update the Work Progress Schedule and the Submittal Register monthly, as a minimum, to reflect progress to date and current plans for completing the Work, while maintaining original schedule as Baseline Schedule and submit paper and electronic copies of the update to A/E and ODR as directed, but as a minimum with each

request for payment. Owner has no duty to make progress payments unless accompanied by the updated Work Progress Schedule. Show the anticipated date of completion reflecting all extensions of time granted through Change Order as of the date of the update. Contractor may revise the Work Progress Schedule when in Contractor's judgment it becomes necessary for the management of the Work. Contractor shall identify all proposed changes to schedule logic to Owner and to A/E via an executive summary accompanying the updated schedule for review prior to final implementation of revisions into a revised Baseline Schedule. Schedule changes that materially impact Owner's operations shall be communicated promptly to ODR and shall not be incorporated into the revised Baseline Schedule without ODR's consent.

9.3.3 The Work Progress Schedule is for Contractor's use in managing the Work and submittal of the schedule, and successive updates or revisions, is for the information of Owner and to demonstrate that Contractor has complied with requirements for planning the Work. Owner's acceptance of a schedule, schedule update or revision constitutes Owner's agreement to coordinate its own activities with Contractor's activities as shown on the schedule.

9.3.3.1 Acceptance of the Work Progress Schedule, or update and/or revision thereto does not indicate any approval of Contractor's proposed sequences and duration.

9.3.3.2 Acceptance of a Work Progress Schedule update or revision indicating early or late completion does not constitute Owner's consent, alter the terms of the Contract, or waive either Contractor's responsibility for timely completion or Owner's right to damages for Contractor's failure to do so.

9.3.3.3 Contractor's scheduled dates for completion of any activity or the entire Work do not constitute a change in terms of the Contract. Change Orders are the only method of modifying the Substantial Completion Date(s) and Contract Time.

9.4 Ownership of Float. Unless indicated otherwise in the Contract Documents, Contractor shall develop its schedule, pricing, and execution plan to provide a minimum of ten (10) percent total float at acceptance of the Baseline Schedule. Float time contained in the Work Progress Schedule is not for the exclusive benefit of Contractor or Owner, but belongs to the Project and may be consumed by either party. Before Contractor uses any portion of the float Contractor must submit a written request to do so to the Owner and receive Owner's written authorization to use the float. Owner's approval shall not be unreasonably withheld.

9.5 Completion of Work. Contractor is accountable for completing the Work within the Contract Time stated in the Contract, or as otherwise amended by Change Order.

9.5.1 If, in the judgment of Owner, the work is behind schedule and the rate of placement of work is inadequate to regain scheduled progress to insure timely completion of the entire work or a separable portion thereof, Contractor, when so informed by Owner, shall immediately take action to increase the rate of work placement by:

9.5.1.1 An increase in working forces.

9.5.1.2 An increase in equipment or tools.

9.5.1.3 An increase in hours of work or number of shifts.

9.5.1.4 Expedite delivery of materials.

9.5.1.5 Other action proposed if acceptable to Owner.

9.5.2 Within ten (10) days after such notice from ODR, Contractor shall notify ODR in writing of the specific measures taken and/or planned to increase the rate of progress. Contactor shall

include an estimate as to the date of scheduled progress recovery and an updated Work Progress Schedule illustrating Contractor's plan for achieving timely completion of the Project. Should ODR deem the plan of action inadequate, Contractor shall take additional steps or make adjustments as necessary to its plan of action until it meets with ODR's approval.

9.6 Modification of the Contract Time.

9.6.1 Delays and extension of time as hereinafter described are valid only if executed in accordance with provisions set forth in Article 11.

9.6.2 When a delay defined herein as excusable prevents Contractor from completing the Work within the Contract Time, Contractor is entitled to an extension of time. Owner will make an equitable adjustment and extend the number of days lost because of excusable delay or Weather Days, as measured by Contractor's progress schedule. All extensions of time will be granted in calendar days. In no event, however, will an extension of time be granted for delays that merely extend the duration of non-critical activities, or which only consume float without delaying the project Substantial Completion date(s).

9.6.2.1 A "Weather Day" is a day on which Contractor's current schedule indicates Work is to be done, and on which inclement weather and related site conditions prevent Contractor from performing seven (7) hours of Work between the hours of 7:00 a.m. and 6:00 p.m. Weather days are excusable delays. When weather conditions at the site prevent work from proceeding, Contractor shall immediately notify ODR for confirmation of the conditions. At the end of each calendar month, Contractor shall submit to ODR and A/E a list of Weather Days occurring in that month along with documentation of the impact on critical activities. Based on confirmation by ODR, any time extension granted will be issued by Change Order. If Contractor and Owner cannot agree on the time extension, Owner may issue a ULCO for fair and reasonable time extension.

9.6.2.2 Excusable Delay. Contractor is entitled to an equitable adjustment of the Contract Time, issued via change order, for delays caused by the following:

9.6.2.2.1 Errors, omissions and imperfections in design, which A/E corrects by means of changes in the Drawings and Specifications.

9.6.2.2.2 Unanticipated physical conditions at the Site, which A/E corrects by means of changes to the Drawings and Specifications or for which ODR directs changes in the Work identified in the Contract Documents.

9.6.2.2.3 Changes in the Work that effect activities identified in Contractor's schedule as "critical" to completion of the entire Work, if such changes are ordered by ODR or recommended by A/E and ordered by ODR.

9.6.2.2.4 Suspension of Work for unexpected natural events (sometimes called "acts of God"), civil unrest, strikes or other events which are not within the reasonable control of Contractor.

9.6.2.2.5 Suspension of Work for convenience of ODR, which prevents Contractor from completing the Work within the Contract Time.

9.6.3 Contractor's relief in the event of such delays is the time impact to the critical path as determined by analysis of Contractor's schedule. In the event that Contractor incurs

additional direct costs because of the excusable delays other than described in Subparagraph 9.6.2.2.4 and within the reasonable control of Owner, the Contract price and Contract Time are to be equitably adjusted by Owner pursuant to the provisions of Article 11.

9.7 No Damages for Delay. An extension of the Contract Time shall be the sole remedy of Contractor for delays in performance of the Work, whether or not such delays are foreseeable, except for delays caused solely by acts of Owner that constitute intentional interference with Contractor's performance of the Work and then only to the extent such acts continue after Contractor notifies Owner in writing of such interference. For delays caused by any act(s) other than the sole intentional interference of Owner, Contractor shall not be entitled to any compensation or recovery of any damages including, without limitation, consequential damages, lost opportunity costs, impact damages, loss of productivity, or other similar damages. Owner's exercise of any of its rights or remedies under the Contract including, without limitation, ordering changes in the Work or directing suspension, rescheduling, or correction of the Work, shall not be construed as intentional interference with Contractor's performance of the Work regardless of the extent or frequency of Owner's exercise of such rights or remedies.

9.8 Concurrent Delay. When the completion of the Work is simultaneously delayed by an excusable delay and a delay arising from a cause not designated as excusable, Contractor may not be entitled to a time extension for the period of concurrent delay.

9.9 Other Time Extension Requests. Time extensions requested in association with changes to the Work directed or requested by Owner shall be included with Contractor's proposed costs for such change. Time extensions requested for inclement weather are covered by Paragraph 9.6.2.1 above. If Contractor believes that the completion of the Work is delayed by a circumstance other than for changes directed to the Work or weather, they shall give ODR written notice, stating the nature of the delay and the activities potentially affected, within five (5) days after the onset of the event or circumstance giving rise to the excusable delay. Contractor shall provide sufficient written evidence to document the delay. In the case of a continuing cause of delay, only one notice of claim is necessary. State claims for extensions of time in numbers of whole or half days.

9.9.1 Within ten (10) days after the cessation of the delay, Contractor shall formalize its request for extension of time in writing to include a full analysis of the schedule impact of the delay and substantiation of the excusable nature of the delay. All changes to the Contract Time or made as a result of such claims is by Change Order, as set forth in Article 11.

9.9.2 No extension of time releases Contractor or the Surety furnishing a performance or payment bond from any obligations under the Contract or such a bond. Those obligations remain in full force until the discharge of the Contract.

9.9.3 Contents of Time Extension Requests. Contractor shall provide with each Time Extension Request a quantitative demonstration of the impact of the delay on project completion time, based on the Work Progress Schedule. Contractor shall include with Time Extension Requests a reasonably detailed narrative setting forth:

9.9.3.1 The nature of the delay and its cause; the basis of Contractor's claim of entitlement to a time extension.

9.9.3.2 Documentation of the actual impacts of the claimed delay on the critical path indicated in Contractor's Work Progress Schedule, and any concurrent delays.

9.9.3.3 Description and documentation of steps taken by Contractor to mitigate the effect of the claimed delay, including, when appropriate, the modification of the Work Progress Schedule.

9.9.4 Owner's Response. Owner will respond to the Time Extension Request by providing to

Contractor written notice of the number of days granted, if any, and giving its reason if this number differs from the number of days requested by Contractor.

9.9.4.1 Owner will not grant time extensions for delays that do not affect the Contract Substantial Completion date.

9.9.4.2 Owner will respond to each properly submitted Time Extension Request within fifteen (15) days following receipt. If Owner cannot reasonably make a determination about Contractor's entitlement to a time extension within that time, Owner will notify Contractor in writing. Unless otherwise agreed by Contractor, Owner has no more than fifteen (15) additional days to prepare a final response. If Owner fails to respond within forty-five (45) days from the date the Time Extension Request is received, Contractor's request for a time extension shall be deemed rejected by Owner.

9.10 Failure to Complete Work Within the Contract Time. **TIME IS AN ESSENTIAL ELEMENT OF THE CONTRACT.** Contractor's failure to substantially complete the Work within the Contract Time or to achieve Substantial Completion as required will cause damage to Owner. These damages ~~shall~~ ***may*** be liquidated by agreement of Contractor and Owner, in the amount per day as set forth in the Contract Documents.

9.11 Liquidated Damages. Owner may collect liquidated damages due from Contractor directly or indirectly by reducing the Contract Sum in the amount of liquidated damages stated in the Agreement or the Owner's Special Conditions.

Article 10. Payments

10.1 Schedule of Values. Contractor shall submit to ODR and A/E for acceptance a Schedule of Values accurately itemizing material and labor for the various classifications of the Work based on the organization of the specification sections and of sufficient detail acceptable to ODR. The accepted Schedule of Values will be the basis for the progress payments under the Contract.

10.1.1 No progress payments will be made prior to receipt and acceptance of the Schedule of Values, provided in such detail as required by ODR, and submitted not less than twenty-one (21) days prior to the first request for payment. The Schedule of Values shall follow the order of trade divisions of the Specifications and include itemized costs for general conditions, costs for preparing ~~close out~~ Close-Out documents, fees, contingencies, and Owner cash allowances, if applicable, so that the sum of the items will equal the Contract price. As appropriate, assign each item labor and/or material values, the subtotal thereof equaling the value of the work in place when complete.

10.1.1.1 Owner requires that the Work items be inclusive of the cost of the Work items only. Any contract markups for overhead and profit, general conditions, etc., shall be contained within separate line items for those specific purposes which shall be divided into at least two (2) lines, one (1) for labor and one (1) for materials.

10.1.2 Contractor shall retain a copy of all worksheets used in preparation of its bid or proposal, supported by a notarized statement that the worksheets are true and complete copies of the documents used to prepare the bid or proposal. Make the worksheets available to ODR at the time of Contract execution. Thereafter Contractor shall grant Owner during normal business hours access to said copy of worksheets at any time during the period commencing upon execution of the Contract and ending one year after final payment.

10.2. Progress Payments. Contractor will receive periodic progress payments for Work performed, materials in place, suitably stored on Site, or as otherwise agreed to by Owner and Contractor. Payment is not due until receipt by ODR or his designee of a correct and complete Pay Application in electronic

and/or hard copy format as set forth in the Agreement or the Owner's Special Conditions, and certified by A/E. Progress payments are made provisionally and do not constitute acceptance of work not in accordance with the Contract Documents. Owner will not process progress payment applications for Change Order Work until all parties execute the Change Order.

10.2.1 Preliminary Pay Worksheet. Once each month that a progress payment is to be requested, the Contractor shall submit to A/E and ODR a complete, clean copy of a preliminary pay worksheet or preliminary pay application, to include the following:

10.2.1.1 Contractor's estimate of the amount of Work performed, labor furnished and materials incorporated into the Work, using the established Schedule of Values;

10.2.1.2 An updated Work Progress Schedule including the executive summary and all required schedule reports;

10.2.1.3 HUB subcontracting plan Progress Assessment Report as required in Paragraph 4.2.5.1;

10.2.1.4 Such additional documentation as Owner may require as set forth in the elsewhere in the Contract Documents; and

10.2.1.5 Construction payment affidavit.

10.2.2 Contractor's Application for Payment. As soon as practicable, but in no event later than seven (7) days after receipt of the preliminary pay worksheet, A/E and ODR will meet with Contractor to review the preliminary pay worksheet and to observe the condition of the Work. Based on this review, ODR and A/E may require modifications to the preliminary pay worksheet prior to the submittal of an Application for Payment, and will promptly notify Contractor of revisions necessary for approval. As soon as practicable, Contractor shall submit its Application for Payment on the appropriate and completed form, reflecting the required modifications to the Schedule of Values required by A/E and/or ODR. Attach all additional documentation required by ODR and/or A/E, as well as an affidavit affirming that all payrolls, bills for labor, materials, equipment, subcontracted work and other indebtedness connected with Contractor's Application for Payment are paid or will be paid within the time specified in Tex. Gov't Code, Chapter 2251. No Application for Payment is complete unless it fully reflects all required modifications, and attaches all required documentation including Contractor's affidavit.

10.2.3 Certification by Architect/Engineer. Within five (5) days or earlier following A/E's receipt of Contractor's formal Application for Payment, A/E will review the Application for Payment for completeness, and forward it to ODR. A/E will certify that the application is complete and payable, or that it is incomplete, stating in particular what is missing. If the Application for Payment is incomplete, Contractor shall make the required corrections and resubmit the Application for Payment for processing.

10.3 Owner's Duty to Pay. Owner has no duty to pay the Contractor except on receipt by ODR of: 1) a complete Application for Payment certified by A/E; 2) Contractor's updated Work Progress Schedule; and 3) confirmation that Contractor has maintained and updated the Record Documents kept at the Site.

10.3.1 Payment for stored materials and/or equipment confirmed by Owner and A/E to be on-site or otherwise properly stored is limited to eighty-five (85) percent of the invoice price or eighty-five (85) percent of the scheduled value for the materials or equipment, whichever is less.

10.3.2 Retainage. Owner will withhold from each progress payment, as retainage, five (5) percent of the total earned amount, the amount authorized by law, or as otherwise set forth in the Owner's Special Conditions. Retainage is managed in conformance with Tex. Gov't Code,

Chapter 2252, Subchapter B.

10.3.2.1 Contractor shall provide written consent of its surety for any request for reduction or release of retainage.

10.3.2.2 At least sixty-five (65) percent of the Contract, or such other discrete Work phase as set forth in Subsection 12.1.6 or Work package delineated in the Contract Documents, must be completed before Owner can consider a retainage reduction or release.

10.3.2.3 Contractor shall not withhold retainage from their Subcontractors and suppliers in amounts that are any percentage greater than that withheld in its Contract with Owner under this subsection, unless otherwise acceptable to Owner.

10.3.3 Price Reduction to Cover Loss. Owner may reduce any Application for Payment, prior to payment to the extent necessary to protect Owner from loss on account of actions of Contractor including, but not limited to, the following:

10.3.3.1 Defective or incomplete Work not remedied;

10.3.3.2 Damage to Work of a separate Contractor;

10.3.3.3 Failure to maintain scheduled progress or reasonable evidence that the Work will not be completed within the Contract Time;

10.3.3.4 Persistent failure to carry out the Work in accordance with the Contract Documents;

10.3.3.5 Reasonable evidence that the Work cannot be completed for the unpaid portion of the Contract Sum;

10.3.3.6 Assessment of fines for violations of prevailing wage rate law; or

10.3.3.7 Failure to include the appropriate amount of retainage for that periodic progress payment.

10.3.4 Title to all material and Work covered by progress payments transfers to Owner upon payment.

10.3.4.1 Transfer of title to Owner does not relieve Contractor and its Subcontractors of the sole responsibility for the care and protection of materials and Work upon which payments have been made until final acceptance, or the restoration of any damaged Work, or waive the right of Owner to require the fulfillment of all the terms of the Contract.

10.4 Progress Payments. Progress payments to Contractor do not release Contractor or its surety from any obligations under the Contract.

10.4.1 Upon Owner's request, Contractor shall furnish manifest proof of the status of Subcontractor's accounts in a form acceptable to Owner.

10.4.2 Pay estimate certificates must be signed by a corporate officer or a representative duly authorized by Contractor.

10.4.3 Provide copies of bills of lading, invoices, delivery receipts or other evidence of the location and value of such materials in requesting payment for materials.

10.4.4 For purposes of Tex. Gov't Code § 2251.021(a)(2), the date the performance of service is complete is the date when ODR approves the Application for Payment.

10.5 Off-Site Storage. With prior approval by Owner and in the event Contractor elects to store materials at an off-site location, abide by the following conditions, unless otherwise agreed to in writing by Owner.

10.5.1 Store materials in a commercial warehouse meeting the criteria stated below.

10.5.2 Provide insurance coverage adequate not only to cover materials while in storage, but also in transit from the off-site storage areas to the Project Site. Copies of duly authenticated certificates of insurance, made out to insure the State agency which is signatory to the Contract, must be filed with Owner's representative.

10.5.3 Inspection by Owner's representative is allowed at any time. Owner's inspectors must be satisfied with the security, control, maintenance, and preservation measures.

10.5.4 Materials for this Project are physically separated and marked for the Project in a sectioned-off area. Only materials which have been approved through the submittal process are to be considered for payment.

10.5.5 Owner reserves the right to reject materials at any time prior to final acceptance of the complete Contract if they do not meet Contract requirements regardless of any previous progress payment made.

10.5.6 With each monthly payment estimate, submit a report to ODR and A/E listing the quantities of materials already paid for and still stored in the off-site location.

10.5.7 Make warehouse records, receipts and invoices available to Owner's representatives, upon request, to verify the quantities and their disposition.

10.5.8 In the event of Contract termination or default by Contractor, the items in storage off-site, upon which payment has been made, will be promptly turned over to Owner or Owner's agents at a location near the jobsite as directed by ODR. The full provisions of performance and payment bonds on this Project cover the materials off-site in every respect as though they were stored on the Project Site.

10.6 Time for Payment by Contractor Pursuant to Tex. Gov't Code § 2255.022.

10.6.1 Contractor who receives a payment from a governmental entity shall pay Subcontractor the appropriate share of the payment not later than the tenth (10th) day after the date Contractor receives the payment.

10.6.2 The appropriate share is overdue on the eleventh (11th) day after the date Contractor receives the payment.

Article 11. Changes

11.1 Change Orders. A Change Order issued after execution of the Contract is a written order to Contractor, signed by ODR, Contractor, and A/E, authorizing a change in the Work or an adjustment in the Contract Sum or the Contract Time. The Contract Sum and the Contract Time can only be changed by Change Order. A Change Order signed by Contractor indicates his agreement therewith, including the adjustment in the Contract Sum and/or the Contract Time. ODR may issue a written authorization for Contractor to proceed with Work of a Change Order in advance of final execution by all parties in accordance with Section 11.9.

11.1.1 Owner, without invalidating the Contract ***and without approval of Contractor's Surety***, may order changes in the Work within the general scope of the Contract consisting of additions, deletions or other revisions, and the Contract Sum and the Contract Time will be adjusted accordingly. All such changes in the Work shall be authorized by Change Order or ULCO, and shall be performed under the applicable conditions of the Contract Documents. If such changes cause an increase or decrease in Contractor's cost of, or time required for, performance of the Contract, an equitable adjustment shall be made and confirmed in writing in a Change Order or a ULCO.

11.1.2 Owner and Contractor acknowledge and agree that the Specifications and Drawings may not be complete or free from errors, omissions and imperfections and that they may require changes or additions in order for the Work to be completed to the satisfaction of Owner. Therefore, any minor errors, omissions or imperfections in the Specifications or Drawings, or any changes in or additions to the Specifications or Drawings to correct minor errors or omissions or to the Work ordered by Owner shall not constitute or give rise to any claim, demand or cause of action of any nature whatsoever in favor of Contractor, whether for breach of Contract, or otherwise. However, should the nature of the errors or omissions necessitate substantial changes in the Work such that a Change Order is appropriate, Owner shall be liable to Contractor for the sum stated to be due Contractor in any Change Order approved and signed by both parties. The sum established in any Change Order, together with any extension of time contained in said Change Order, shall constitute full compensation to Contractor for all costs, expenses and damages to Contractor for the changes in the Work described in the Change Order, as permitted under Tex. Gov't Code, Chapter 2260.

11.1.3 Procedures for administration of Change Orders shall be established by Owner and stated in the Owner's Special Conditions, or elsewhere in the Contract Documents.

11.1.4 No verbal order, verbal statement, or verbal direction of Owner or his duly appointed representative shall be treated as a change under this article or entitle Contractor to an adjustment.

11.1.5 Contractor agrees that Owner or any of its duly authorized representatives shall have access and the right to examine any directly pertinent books, documents, papers, and records of Contractor. Further, Contractor agrees to include in all its subcontracts a provision to the effect that Subcontractor agrees that Owner or any of its duly authorized representatives shall have access to and the right to examine any directly pertinent books, documents, papers and records of such Subcontractor relating to any claim arising from the Contract, whether or not the Subcontractor is a party to the claim. The period of access and examination described herein which relates to appeals under the Disputes article of the Contract, litigation, or the settlement of claims arising out of the performance of the Contract shall continue until final disposition of such claims, appeals or litigation.

11.2 Unit Prices. If unit prices are stated in the Contract Documents or subsequently agreed upon and if the quantities originally contemplated in setting the unit prices are so changed in a Proposed Change Order that application of the agreed unit prices to the quantities of work proposed will cause substantial inequity to Owner or Contractor, the applicable unit prices shall be equitably adjusted as provided in the Owner's Special Conditions or as agreed to by the parties and incorporated into a Change Order.

11.3 Claims for Additional Costs.

11.3.1 If Contractor wishes to make a claim for an increase in the Contract Sum not related to a requested change, it shall give Owner and A/E written notice thereof within twenty-one (21) days after the occurrence of the event or discovery of any conditions giving rise to such claim. Contractor must notify Owner and A/E before proceeding to execute any Work considered to add additional cost or time, except in an emergency endangering life or property in which case Contractor shall act in accordance with Subsection 7.2.1., and failure to provide the

required notice will invalidate any subsequent notice or claim for additional cost or time for the Work. If Owner and Contractor cannot agree on the amount of the adjustment in the Contract Sum, it shall be determined as set forth under Article 15. Any change in the Contract Sum resulting from such claim shall be authorized by a Change Order or a ULCO.

11.3.2 If Contractor claims that additional cost is involved because of, but not limited to, 1) any written interpretation of the Contract Documents, 2) any order by Owner to stop the Work pursuant to Article 14 where Contractor was not at fault, or 3) any written order for a minor change in the Work issued pursuant to Section 11.4, Contractor shall make such claim as provided in Subsection 11.3.1.

11.3.3 Should Contractor or his Subcontractors fail to call attention of A/E to discrepancies or omissions in the Contract Documents, but claim additional costs for corrective Work after Contract award, Owner may assume intent to circumvent competitive bidding for necessary corrective Work. In such case, Owner may choose to let a separate Contract for the corrective Work, or issue a ULCO to require performance by Contractor. Claims for time extensions or for extra cost resulting from delayed notice of patent Contract Document discrepancies or omissions will not be considered by Owner.

11.4 Minor Changes. A/E, with concurrence of ODR, will have authority to order minor changes in the Work not involving an adjustment in the Contract Sum or an extension of the Contract Time. Such changes shall be effected by written order which Contractor shall carry out promptly and record on the Record Documents.

11.5 Concealed Site Conditions. Contractor is responsible for visiting the Site and being familiar with local conditions such as the location, accessibility, and general character of the Site and/or building. If, in the performance of the Contract, subsurface, latent, or concealed conditions at the Site are found to be materially different from the information included in the Contract Documents, or if unknown conditions of an unusual nature are disclosed differing materially from the conditions usually inherent in Work of the character shown and specified, ODR and A/E shall be notified in writing of such conditions before they are disturbed. Upon such notice, or upon its own observation of such conditions, A/E, with the approval of ODR, will promptly make such changes in the Drawings and Specifications as they deem necessary to conform to the different conditions, and any increase or decrease in the cost of the Work, or in the time within which the Work is to be completed, resulting from such changes will be adjusted by Change Order, subject to the prior approval of ODR.

11.6 Extension of Time. All changes to the Contract Time shall be made as a consequence of requests as required under Section 9.6, and as documented by Change Order as provided under Section 11.1.

11.7 Administration of Change Order Requests. All changes in the Contract shall be administered in accordance with procedures approved by Owner, and when required, make use of such electronic information management system(s) as Owner may employ.

11.7.1 Routine changes in the construction Contract shall be formally initiated by A/E by means of a PCO form detailing requirements of the proposed change for pricing by Contractor. This action may be preceded by communications between Contractor, A/E and ODR concerning the need and nature of the change, but such communications shall not constitute a basis for beginning the proposed Work by Contractor. Except for emergency conditions described below, approval of Contractor's cost proposal by A/E and ODR will be required for authorization to proceed with the Work being changed. Owner will not be responsible for the cost of Work changed without prior approval and Contractor may be required to remove Work so installed.

11.7.2 All proposed costs for change order Work must be supported by itemized accounting of material, equipment and associated itemized installation costs in sufficient detail, following the outline and organization of the established Schedule of Values, to permit analysis by A/E

and ODR using current estimating guides and/or practices. Photocopies of Subcontractor and vendor proposals shall be furnished unless specifically waived by ODR. Contractor shall provide written response to a change request within twenty-one (21) days of receipt.

11.7.3 Any unexpected circumstance which necessitates an immediate change in order to avoid a delay in progress of the Work may be expedited by verbal communication and authorization between Contractor and Owner, with written confirmation following within twenty-four (24) hours. A limited scope not-to-exceed estimate of cost and time will be requested prior to authorizing Work to proceed. Should the estimate be impractical for any reason, ODR may authorize the use of detailed cost records of such work to establish and confirm the actual costs and time for documentation in a formal Change Order.

11.7.4 Emergency changes to save life or property may be initiated by Contractor alone (see Section 7.3) with the claimed cost and/or time of such work to be fully documented as to necessity and detail of the reported costs and/or time.

11.7.5 The method of incorporating approved Change Orders into the parameters of the accepted Schedule of Values must be coordinated and administered in a manner acceptable to ODR.

11.8 Pricing Change Order Work. The amounts that Contractor and/or its Subcontractor adds to a Change Order for profit and overhead will also be considered by Owner before approval is given. The amounts established hereinafter are the maximums that are acceptable to Owner.

11.8.1 For Work performed by its forces, Contractor will be allowed its actual costs paid for materials, the total amount of its actual wages paid for labor, plus its actual cost paid for ~~of~~ State and Federal payroll taxes and for ~~of~~ worker's compensation and comprehensive general liability insurance, plus its actual additional bond and builders risk insurance cost if the change results in an increase in the premium paid by Contractor. To the total of the above costs, Contractor will be allowed to add a percentage as noted below to cover overhead and profit combined. Overhead shall be considered to include insurance other than mentioned above, field and office supervisors and assistants, including safety and scheduling personnel, use of small tools, incidental job burdens and general Home Office expenses, and no separate allowance will be made therefore.

Allowable percentages for overhead and profit on changes will not exceed 15 percent if the total of self-performed work is less than or equal to $10,000, 10 percent if the total of self-performed work is between $10,000 and $20,000 and 7.5 percent if the total of self-performed work is over $20,000, for any specific change priced.

11.8.2 For subcontracted Work each affected Subcontractor shall figure its costs, overhead and profit as described above for Contractor's Work, all Subcontractor costs shall be combined, and to that total Subcontractor cost Contractor will be allowed to add a maximum mark-up of ten (10) percent if the total of all subcontracted work is less than or equal to $10,000, seven and half (7.5) percent if the total of all subcontracted work is between $10,000 and $20,000 and five (5) percent if the total of all subcontractor work is over $20,000.

11.8.3 On changes involving both additions and deletions, percentages for overhead and profit will be allowed only on the net addition. Owner does not accept and will not pay for additional Contract cost identified as indirect or consequential damages or as damages caused by delay.

11.8.4 For Contracts based on a Guaranteed Maximum Price (GMP), the Construction Manager-at-Risk or Design Builder shall NOT be entitled to a percentage mark-up on any Change Order Work unless the Change Order increases the Guaranteed Maximum Price.

11.9 Unilateral Change Order (ULCO). Owner may issue a written ULCO directing a change in the Work prior to reaching agreement with Contractor on the adjustment, if any, in the Contract price and/or the Contract Time.

11.9.1 Owner and Contractor shall negotiate for appropriate adjustments, as applicable, to the Contract Sum or the Contract Time arising out of a ULCO. As the changed Work is performed, Contractor shall submit its costs for such Work with its Application for Payment beginning with the next Application for Payment within thirty (30) days of the issuance of the ULCO. The Parties reserve their rights to dispute the ULCO amount, subject to Article 15.

11.10 Finality of Changes—Contractor. Upon execution of a Change Order and /or a ULCO by Owner, Contractor and A/E, all costs and time issues claimed by Contractor regarding that change are final and not subject to increase.

11.11 Audit of Changes—Owner. All Changes Orders are subject to audit by Owner or its representative at any time in accordance with Article 16.4 and Change Order amounts may be adjusted lower as a result of such audit.

Article 12. Project Completion and Acceptance

12.1 Closing Inspections.

12.1.1 Substantial Completion Inspection. When Contractor considers the entire Work or part thereof Substantially Complete, it shall notify ODR in writing that the Work will be ready for Substantial Completion inspection on a specific date. Contractor shall include with this notice Contractor's Punchlist to indicate that it has previously inspected all the Work associated with the request for inspection, noting items it has corrected and included all remaining work items with date scheduled for completion or correction prior to final inspection. The failure to include any items on this list does not alter the responsibility of Contractor to complete all Work in accordance with the Contract Documents. If any of the items on this list prevents the Project from being used as intended, Contractor shall not request a Substantial Completion Inspection. Owner and its representatives will review the list of items and schedule the requested inspection, or inform Contractor in writing that such an inspection is premature because the Work is not sufficiently advanced or conditions are not as represented on Contractor's list.

12.1.1.1 Prior to the Substantial Completion inspection, Contractor shall furnish a copy of its marked-up Record Documents and a preliminary copy of each instructional manual, maintenance and operating manual, parts catalog, wiring diagrams, spare parts, specified written warranties, and like publications or parts for all installed equipment, systems, and like items as described in the Contract Documents. Delivery of these items is a prerequisite for requesting the Substantial Completion inspection.

12.1.1.2 On the date requested by Contractor, or as mutually agreed upon pending the status of the Open Items List, A/E, ODR, Contractor, and other Owner representatives as determined by Owner will jointly attend the Substantial Completion inspection, which shall be conducted by ODR or their delegate. If ODR concurs with the determination of Contractor and A/E that the Work is Substantially Complete, ODR will issue a Certificate of Substantial Completion to be signed by A/E, Owner, and Contractor establishing the date of Substantial Completion and identifying responsibilities for security, insurance and maintenance. A/E will provide with this certificate a list of Punchlist items (the pre-final Punchlist) for completion prior to final inspection. This list may include items in addition to those on Contractor's Punchlist, which the inspection team deems necessary to correct or complete prior to final inspection. If Owner

occupies the Project upon determination of Substantial Completion, Contractor shall complete all corrective Work at the convenience of Owner, without disruption to Owner's use of the Project for its intended purposes.

12.1.2 Final Inspection. Contractor shall complete the list of items identified on the pre-final Punchlist prior to requesting a final inspection. Unless otherwise specified, or otherwise agreed in writing by the parties as documented on the Certificate of Substantial Completion, Contractor shall complete and/or correct all Work within thirty (30) days of the Substantial Completion date. Upon completion of the pre-final Punchlist work, Contractor shall give written notice to ODR and A/E that the Work will be ready for final inspection on a specific date. Contractor shall accompany this notice with a copy of the updated pre-final Punchlist indicating resolution of all items. On the date specified or as soon thereafter as is practicable, ODR, A/E and Contractor will inspect the Work. A/E will submit to Contractor a final Punchlist of open items that the inspection team requires corrected or completed before final acceptance of the Work.

12.1.2.1 Correct or complete all items on the final Punchlist before requesting Final Payment. Unless otherwise agreed to in writing by the parties, complete this work within seven (7) days of receiving the final Punchlist. Upon completion of the final Punchlist, notify A/E and ODR in writing stating the disposition of each final Punchlist item. A/E, Owner, and Contractor shall promptly inspect the completed items. When the final Punchlist is complete, and the Contract is fully satisfied according to the Contract Documents ODR will issue a certificate establishing the date of Final Completion. Completion of all Work is a condition precedent to Contractor's right to receive Final Payment.

12.1.3 Annotation. Any Certificate issued under this Article may be annotated to indicate that it is not applicable to specified portions of the Work, or that it is subject to any limitation as determined by Owner.

12.1.4 Purpose of Inspection. Inspection is for determining the completion of the Work, and does not relieve Contractor of its overall responsibility for completing the Work in a good and competent fashion, in compliance with the Contract. Work accepted with incomplete Punchlist items or failure of Owner or other parties to identify Work that does not comply with the Contract Documents or is defective in operation or workmanship does not constitute a waiver of Owner's rights under the Contract or relieve Contractor of its responsibility for performance or warranties.

12.1.5 Additional Inspections.

12.1.5.1 If Owner's inspection team determines that the Work is not substantially complete at the Substantial Completion inspection, ODR or A/E will give Contractor written notice listing cause(s) of the rejection. Contractor will set a time for completion of incomplete or defective work acceptable to ODR. Contractor shall complete or correct all work so designated prior to requesting a second Substantial Completion inspection.

12.1.5.2 If Owner's inspection team determines that the Work is not complete at the final inspection, ODR or A/E will give Contractor written notice listing the cause(s) of the rejection. Contractor will set a time for completion of incomplete or defective work acceptable to ODR. Contractor shall complete or correct all Work so designated prior to again requesting a final inspection.

12.1.5.3 The Contract contemplates three (3) comprehensive inspections: the Substantial Completion inspection, the Final Completion inspection, and the inspection of completed final Punchlist items. The cost to Owner of additional inspections

resulting from the Work not being ready for one or more of these inspections is the responsibility of Contractor. Owner may issue a ULCO deducting these costs from Final Payment. Upon Contractor's written request, Owner will furnish documentation of any costs so deducted. Work added to the Contract by Change Order after Substantial Completion inspection is not corrective Work for purposes of determining timely completion, or assessing the cost of additional inspections.

12.1.6 Phased Completion. The Contract may provide, or Project conditions may warrant, as determined by ODR, that designated elements or parts of the Work be completed in phases. Where phased completion is required or specifically agreed to by the parties, the provisions of the Contract related to closing inspections, occupancy, and acceptance apply independently to each designated element or part of the Work. For all other purposes, unless otherwise agreed by the parties in writing, Substantial Completion of the Work as a whole is the date on which the last element or part of the Work completed receives a Substantial Completion certificate. Final Completion of the Work as a whole is the date on which the last element or part of the Work completed receives a Final Completion certificate or notice.

12.2 Owner's Right of Occupancy. Owner may occupy or use all or any portion of the Work following Substantial Completion, or at any earlier stage of completion. Should Owner wish to use or occupy the Work, or part thereof, prior to Substantial Completion, ODR will notify Contractor in writing and identify responsibilities for security, insurance and maintenance Work performed on the premises by third parties on Owner's behalf does not constitute occupation or use of the Work by Owner for purposes of this Article. All Work performed by Contractor after occupancy, whether in part or in whole, shall be at the convenience of Owner so as to not disrupt Owner's use of, or access to occupied areas of the Project.

12.3 Acceptance and Payment

12.3.1 Request for Final Payment. Following the certified completion of all work, including all final Punchlist items, cleanup, and the delivery of record documents, Contractor shall submit a certified Application for Final Payment and include all sums held as retainage and forward to A/E and ODR for review and approval.

12.3.2 Final Payment Documentation. Contractor shall submit, prior to or with the Application for Final Payment, final copies of all Close-Out documents, maintenance and operating instructions, guarantees and warranties, certificates, Record Documents and all other items required by the Contract. Contractor shall submit evidence of return of access keys and cards, evidence of delivery to Owner of attic stock, spare parts, and other specified materials. Contractor shall submit consent of surety to Final Payment form and an affidavit that all payrolls, bills for materials and equipment, subcontracted work and other indebtedness connected with the Work, except as specifically noted, are paid, will be paid, after payment from Owner or otherwise satisfied within the period of time required by Tex. Gov't Code, Chapter 2251. Contractor shall furnish documentation establishing payment or satisfaction of all such obligations, such as receipts, releases and waivers of claims and liens arising out of the Contract. Contractor may not subsequently submit a claim on behalf of Subcontractor or vendor unless Contractor's affidavit notes that claim as an exception.

12.3.3 Architect/Engineer Approval. A/E will review a submitted Application for Final Payment promptly but in no event later than ten (10) days after its receipt. Prior to the expiration of this deadline, A/E will either: 1) return the Application for Final Payment to Contractor with corrections for action and resubmission; or 2) accept it, note their approval, and send to Owner.

12.3.4 Offsets and Deductions. Owner may deduct from the Final Payment all sums due from Contractor. If the Certificate of Final Completion notes any Work remaining, incomplete, or defects not remedied, Owner may deduct the cost of remedying such deficiencies from the

Final Payment. On such deductions, Owner will identify each deduction, the amount, and the explanation of the deduction on or by the twenty-first (21st) day after Owner's receipt of an approved Application for Final Payment. Such offsets and deductions shall be incorporated via a final Change Order, including a ULCO as may be applicable.

12.3.5 Final Payment Due. Final Payment is due and payable by Owner, subject to all allowable offsets and deductions, on the thirtieth (30th) day following Owner's approval of the Application for Payment. If Contractor disputes any amount deducted by Owner, Contractor shall give notice of the dispute on or before the thirtieth (30th) day following receipt of Final Payment. Failure to do so will bar any subsequent claim for payment of amounts deducted.

12.3.6 Effect of Final Payment. Final Payment constitutes a waiver of all claims by Owner, relating to the condition of the Work except those arising from:

12.3.6.1 Faulty or defective Work appearing after Substantial Completion (latent defects);

12.3.6.2 Failure of the Work to comply with the requirements of the Contract Documents;

12.3.6.3 Terms of any warranties required by the Contract, or implied by law; or

12.3.6.4 Claims arising from personal injury or property damage to third parties.

12.3.7 Waiver of Claims. Final payment constitutes a waiver of all claims and liens by Contractor except those specifically identified in writing and submitted to ODR prior to the application for Final Payment.

12.3.8 Effect on Warranty. Regardless of approval and issuance of Final Payment, the Contract is not deemed fully performed by Contractor and closed until the expiration of all warranty periods.

Article 13. Warranty and Guarantee

13.1 Contractor's General Warranty and Guarantee. Contractor warrants to Owner that all Work is executed in accordance with the Contract, complete in all parts and in accordance with approved practices and customs, and of the required finish and workmanship. Contractor further warrants that unless otherwise specified, all materials and equipment incorporated in the Work under the Contract are new. Owner may, at its option, agree in writing to waive any failure of the Work to conform to the Contract, and to accept a reduction in the Contract price for the cost of repair or diminution in value of the Work by reason of such defect. Absent such a written agreement, Contractor's obligation to perform and complete the Work in accordance with the Contract Documents is absolute and is not waived by any inspection or observation by Owner, A/E or others, by making any progress payment or final payment, by the use or occupancy of the Work or any portion thereof by Owner, at any time, or by any repair or correction of such defect made by Owner.

13.2 Warranty Period. Except as may be otherwise specified or agreed, Contractor shall repair all defects in materials, equipment, or workmanship appearing within one year from the date of Substantial Completion of the Work. If Substantial Completion occurs by phase, then the warranty period for ~~that~~ the Work performed for each phase begins on the date of Substantial Completion of that phase, or as otherwise stipulated on the Certificate of Substantial Completion for the particular phase.

13.3 Limits on Warranty. Contractor's warranty and guarantee hereunder excludes defects or damage caused by:

13.3.1 Modification or improper maintenance or operation by persons other than Contractor, Subcontractors, or any other individual or entity for whom Contractor is not responsible, unless Owner is compelled to undertake maintenance or operation due to the neglect of

Contractor.

13.3.2 Normal wear and tear under normal usage after acceptance of the Work by Owner.

13.4 Events Not Affecting Warranty. Contractor's obligation to perform and complete the Work in a good and workmanlike manner in accordance with the Contract Documents is absolute. None of the following will constitute an acceptance of Work that is not in accordance with the Contract Documents or relieve the Contractor from its obligation to perform the Work in accordance with the Contract Documents:

13.4.1 Observations by Owner and/or A/E;

13.4.2 Recommendation to pay any progress or final payment by A/E;

13.4.3 The issuance of a certificate of Substantial Completion or any payment by Owner to Contractor under the Contract Documents;

13.4.4 Use or occupancy of the Work or any part thereof by Owner**;**

13.4.5 Any acceptance by Owner or any failure to do so;

13.4.6 Any review of a Shop Drawing or sample submittal; or

13.4.7 Any inspection, test or approval by others.

13.5 Separate Warranties. If a particular piece of equipment or component of the Work for which the Contract requires a separate warranty is placed in continuous service before Substantial Completion, the warranty period for that equipment or component will not begin until Substantial Completion, regardless of any warranty agreements in place between suppliers and/or Subcontractors and Contractor. ODR will certify the date of service commencement in the Substantial Completion certificate.

13.5.1 In addition to Contractor's warranty and duty to repair, Contractor expressly assumes all warranty obligations required under the Contract for specific building components, systems and equipment.

13.5.2 Contractor may satisfy any such obligation by obtaining and assigning to Owner a complying warranty from a manufacturer, supplier, or Subcontractor. Where an assigned warranty is tendered and accepted by Owner which does not fully comply with the requirements of the Contract, Contractor remains liable to Owner on all elements of the required warranty not provided by the assigned warranty.

13.6 Correction of Defects. Upon receipt of written notice from Owner, or any agent of Owner designated as responsible for management of the warranty period, of the discovery of a defect, Contractor shall promptly remedy the defect(s), and provide written notice to Owner and designated agent indicating action taken. In case of emergency where delay would cause serious risk of loss or damage to Owner, or if Contractor fails to remedy within thirty (30) days, or within another period agreed to in writing, Owner may correct the defect and be reimbursed the cost of remedying the defect from Contractor or its surety.

Article 14. Suspension and Termination

14.1 Suspension of Work for Cause. Owner may, at any time without prior notice, suspend all or any part of the Work if, after reasonable observation and/or investigation, Owner determines it is necessary to do so to prevent or correct any condition of the Work which constitutes an immediate safety hazard or which may reasonably be expected to impair the integrity, usefulness or longevity of the Work when

completed.

14.1.1 Owner will give Contractor a written notice of suspension for cause, setting forth the reason for the suspension and identifying the Work suspended. Upon receipt of such notice, Contractor shall immediately stop the Work so identified. As soon as practicable following the issuance of such a notice, Owner will initiate and complete a further investigation of the circumstances giving rise to the suspension, and issue a written determination of the findings.

14.1.2 If it is confirmed that the cause was within the control of Contractor, Contractor will not be entitled to an extension of time for delay resulting from the suspension. If the cause is determined not to have been within the control of Contractor, and the suspension has prevented Contractor from completing the Work within the Contract Time, the suspension is an excusable delay and a time extension will be granted through a Change Order.

14.1.3 Suspension of Work under this provision will be no longer than is reasonably necessary to remedy the conditions giving rise to the suspension.

14.2 Suspension of Work for Owner's Convenience. Upon seven (7) days written notice to Contractor, Owner may at any time without breach of the Contract suspend all or any portion of the Work for a period of up to sixty (60) days for its own convenience. Owner will give Contractor a written notice of suspension for convenience, which sets forth the number of suspension days for which the Work, or any portion of it, and the date on which the suspension of Work will cease. When such a suspension prevents Contractor from completing the Work within the Contract Time, it is an excusable delay. A notice of suspension for convenience may be modified by Owner at any time on seven (7) days written notice to Contractor. If Owner suspends the Work for its convenience for more than sixty (60) consecutive days, Contractor may elect to terminate the Contract pursuant to the provisions of the Contract.

14.3 Termination by Owner for Cause.

14.3.1 Upon thirty (30) days written notice to Contractor and its surety, Owner may, without prejudice to any right or remedy, terminate the Contract and take possession of the Site and of all materials, equipment, tools, construction equipment, and machinery thereon owned by Contractor under any of the following circumstances:

14.3.1.1 Persistent or repeated failure or refusal, except during complete or partial suspensions of work authorized under the Contract, to supply enough properly skilled workmen or proper materials;

14.3.1.2 Persistent disregard of laws, ordinances, rules, regulations or orders of any public authority having jurisdiction, including ODR;

14.3.1.3 Persistent failure to prosecute the Work in accordance with the Contract, and to ensure its completion within the time, or any approved extension thereof, specified in the Contract;

14.3.1.4 Failure to remedy defective work condemned by ODR;

14.3.1.5 Failure to pay Subcontractors, laborers, and material suppliers pursuant to Tex. Gov't Code, Chapter 2251;

14.3.1.6 Persistent endangerment to the safety of labor or of the Work;

14.3.1.7 Failure to supply or maintain statutory bonds or to maintain required insurance, pursuant to the Contract;

14.3.1.8 Any material breach of the Contract; or

14.3.1.9 Contractor's insolvency, bankruptcy, or demonstrated financial inability to perform the Work.

14.3.2 Failure by Owner to exercise the right to terminate in any instance is not a waiver of the right to do so in any other instance.

14.3.3 Upon receipt of a termination notice, the Contractor or its Surety has thirty (30) days to cure the reasons for the termination or demonstrate to the satisfaction of the Owner that it is prepared to remedy to the condition(s) upon which the notice of termination was based with diligence and promptness. If the Owner is satisfied that the Contractor or its Surety can remedy the reasons for the termination and complete the Work as required, the notice of termination shall be rescinded in writing by the Owner and the Work shall continue without an extension of time.

14.3.4 If at the conclusion of the thirty (30) day cure period the Contractor or its Surety is unable to demonstrate to the satisfaction of the Owner its ability to remedy the reasons for termination, the Owner may immediately terminate the employment of the Contractor, make alternative arrangements for completion of the Work and deduct the cost of completion from the unpaid Contract Sum.

14.3.4.1 Owners cost to complete the Work includes, but is not limited to, fees for additional services by A/E and other consultants, and additional contract administration costs.

14.3.4.2 Owner will make no further payment to Contractor or its surety unless the costs to complete the Work are less than the Contract balance, then the difference shall be paid to Contractor or its surety. If such costs exceed the unpaid balance, Contractor or its surety will pay the difference to Owner.

14.3.4.3 This obligation for payment survives the termination of the Contract.

14.3.4.4 Owner reserves the right in termination for cause to take assignment of all the Contracts between Contractor and its Subcontractors, vendors, and suppliers. ODR will promptly notify Contractor of the contracts Owner elects to assume. Upon receipt of such notice, Contractor shall promptly take all steps necessary to effect such assignment.

14.4 Conversion to Termination for Convenience. In the event that any termination of Contractor for cause under Section 14.3 is later determined to have been improper, the termination shall automatically convert to a termination for convenience under Section 14.5 and Contractor's recovery for termination shall be strictly limited to the payments allowable under Section 14.5.

14.5 Termination for Convenience of Owner. Owner reserves the right, without breach, to terminate the Contract prior to, or during the performance of the Work, for any reason. Upon such an occurrence, the following shall apply:

14.5.1 Owner will notify Contractor and A/E in writing specifying the reason for and the effective date of the Contract termination. The notice may also contain instructions necessary for the protection, storage or decommissioning of incomplete work or systems, and for safety.

14.5.2 Upon receipt of the notice of termination, Contractor shall immediately proceed with the following obligations, regardless of any dispute in determining or adjusting any amounts due at that point in the Contract:

14.5.2.1 Stop all work.

14.5.2.2 Place no further subcontracts or orders for materials or services.

14.5.2.3 Terminate all subcontracts for convenience.

14.5.2.4 Cancel all materials and equipment orders as applicable.

14.5.2.5 Take appropriate action that is necessary to protect and preserve all property related to the Contract which is in the possession of Contractor.

14.5.3 When the Contract is terminated for Owner's convenience, Contractor may recover from Owner payment for all Work executed. Contractor may not claim lost profits or lost business opportunities.

14.6 Termination By Contractor. If the Work is stopped for a period of ninety (90) days under an order of any court or other public authority having jurisdiction, or as a result of an act of government, such as a declaration of a national emergency making materials unavailable, through no act or fault of Contractor or Subcontractor or their agents or employees or any other persons performing any of the Work under a contract with Contractor, then Contractor may, upon thirty (30) additional days written notice to ODR, terminate the Contract and recover from Owner payment for all Work executed, but not lost profits or lost business opportunities. If the cause of the Work stoppage is removed prior to the end of the thirty (30) day notice period, Contractor may not terminate the Contract.

14.7 Settlement on Termination. When the Contract is terminated for any reason, at any time prior to one hundred eighty (180) days after the effective date of termination, Contractor shall submit a final termination settlement proposal to Owner based upon recoverable costs as provided under the Contract. If Contractor fails to submit the proposal within the time allowed, Owner may unilaterally determine the amount due to Contractor because of the termination and pay the determined amount to Contractor.

Article 15. Dispute Resolution

15.1 Unresolved Contractor Disputes. To the extent that it is applicable, the dispute resolution process provided for in Tex. Gov't Code, Chapter 2260, shall be used by Contractor to resolve any claim for breach of Contract made by Contractor that is not resolved under procedures described in these Uniform General Conditions or Owner's Special Conditions of the Contract.

15.2 Alternative Dispute Resolution Process. Owner may establish a dispute resolution process to be utilized in advance of that outlined in Tex. Gov't Code, Chapter 2260.

15.3 Nothing herein shall hinder, prevent, or be construed as a waiver of Owner's right to seek redress on any disputed matter in a court of competent jurisdiction.

15.4 In any litigation between the Owner and the Contractor arising from this Contract or this Project, neither party will be entitled to an award of legal fees or costs in any judgment regardless which one is deemed the prevailing party.

15.5 Nothing herein shall waive or be construed as a waiver of the State's sovereign immunity.

Article 16. Certification of No Asbestos Containing Material or Work

16.1 Contractor shall insure that Texas Department of State Health Services licensed individuals, consultants or companies are used for any required asbestos work including asbestos inspection, asbestos abatement plans/specifications, asbestos abatement, asbestos project management and third-party asbestos monitoring.

16.2 Contractor shall provide a notarized certification to Owner that all equipment and materials used in fulfillment of its Contract responsibilities are non-Asbestos Containing Building Materials (ACBM). This certification must be provided no later than Contractor's application for Final Payment.

16.3 The Contractor shall insure compliance with the following acts from all of his subcontractors and assigns:

- Asbestos Hazard Emergency Response Act (AHERA—40 CFR 763-99 (7));
- National Emission Standards for Hazardous Air Pollutants (NESHAP—EPA 40 CFR 61, Subpart M—National Emission Standard for Asbestos;
- Texas Asbestos Health Protection Rules (TAHPR—Tex. Admin. Code Title 25, Part 1, Ch. 295C, Asbestos Health Protection

Article 17 Miscellaneous

17.1 Owner's Special Conditions. When the Work contemplated by Owner is of such a character that the foregoing Uniform General Conditions of the Contract cannot adequately cover necessary and additional contractual relationships, the Contract may include Owner's Special Conditions that relate to the Project. In the event of a conflict between the UTUGCs and the Owner's Special Conditions, the Owner's Special Conditions will govern.

17.2 Federally Funded Projects. On Federally funded projects, Owner may waive, suspend or modify any Article in these Uniform General Conditions which conflicts with any Federal statue, rule, regulation or procedure, where such waiver, suspension or modification is essential to receipt by Owner of such Federal funds for the Project. In the case of any Project wholly financed by Federal funds, any standards required by the enabling Federal statute, or any Federal rules, regulations or procedures adopted pursuant thereto, shall be controlling.

17.3 Internet-based Project Management Systems. At its option, Owner may administer its design and construction management through an Internet-based management system. In such cases, Contractor shall conduct communication through this media and perform all Project related functions utilizing this database system. This includes correspondence, submittals, Requests for Information, vouchers or payment requests and processing, amendment, Change Orders and other administrative activities.

17.3.1 Accessibility and Administration.

17.3.1.1 When used, Owner will make the software accessible via the Internet to all Project team members.

17.3.1.2 Owner shall administer the software.

17.3.2 Training. When used, Owner shall provide training to the Project team members.

17.4 Right to Audit.

17.4.1 Contractor understands that acceptance of funds under this Contract acts as acceptance of the authority of the State Auditor's Office, Owner, any successor agency and their representatives, including independent auditors, to conduct an audit or investigation in connection with those funds. Contractor further agrees to cooperate fully with any party conducting the audit or investigation, including providing all records requested.

17.4.2 Contractor shall maintain and retain supporting fiscal and any other documents relevant to showing that any payments under this Contract funds were expended in accordance with the terms of this Contact, the requirements of Owner, and with the laws and regulations of the State of Texas including, but not limited to, requirements of the Comptroller of the State of

Texas and the State Auditor. Contractor shall maintain all such documents and other records relating to this Contract and Owner's property for a period of four (4) years after the date of submission of a request for Final Payment or until a resolution of all billing questions, whichever is later. Contractor shall make available at reasonable times and upon reasonable notice and for reasonable periods all documents and other information related to the Work of this Contract.

17.4.3 Contractor shall ensure that this clause concerning the authority to audit funds received indirectly by subcontractors through the Contractor and the requirement to cooperate is included in any subcontract it awards.

End of Uniform General Conditions

REVISIONS

DATE	REVISED	INITIALS
9-1-2013	2010 Uniform General and Supplementary Conditions merged into and Reissued as new document: 2013 Uniform General Conditions for UT System Building Construction Projects (UTUGCs); *Special Conditions* and *Supplementary General Conditions* deleted from Definitions; *Owner's Special Conditions* added to Definitions; Para. 3.3.11, *Indemnification*, moved to new Para. 3.4; Para 5.2.2.1.4 added Asbestos Transportation Insurance Coverage; Para. 5.2.2.1.7 added Umbrella Insurance Coverage; Para. 13.7, *Certification of No Asbestos Containing Material* moved to renamed Article 16 and revised; Article 15, *Dispute Resolution*, revised; Existing Article 16, *Miscellaneous*, re-numbered as Article 17.	

SECTION 00 25 00 – OWNER'S SPECIAL CONDITIONS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

C. The Contractor's attention is specifically directed, but not limited, to the Uniform General and Supplementary General Conditions for University of Texas System Building Construction Contracts (UGC) for other requirements.

D. Attachment "A" (To Owner's Special Conditions) – Minimum Wage Rate Determination. Pursuant to the UGC, the attached schedule identifies the Prevailing Wage Rate determination as applicable to the Project location.

E. Attachment "B" (To Owner's Special Conditions) – Facilities Planned Utility Outages Policy.

F. Attachment "C" (To Owner's Special Conditions) - Project Sign Layout. [May not be applicable to all Projects].

G. Attachment "D" (To Owner's Special Conditions) - Bastrop Visitation and Tour Policy Statement and Medical Documentation Requirements. [Applicable to Bastrop Projects only].

1.02 SUMMARY

A. Terms and conditions set forth in this document are for the Contractor only, and are valid regardless of the project delivery method. For Construction Manager at Risk or Design/Build, the final version of the document shall be confirmed by the Owner, and included by the Construction Manager or Design/Build Contractor in the Guaranteed Maximum Price Proposal. For projects for which the construction phase is divided into multiple stages, these Owner's Special Conditions shall be reviewed, updated as warranted, and resubmitted with GMP Proposal associated with that stage of the construction work.

1.03 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with all applicable requirements and standards.

1. Texas Medical Center Architectural Standards and Texas Medical Center Stormwater Management Design Guidelines are applicable to all Projects located within the Texas Medical Center.

2. Owner's underwriter requirements are applicable to all Projects.

1.04 DEFINITIONS

A. The term "Owner's Project Manager" as used throughout the Contract Documents means an individual authorized by the Owner to administer the Project.

B. Outage - A temporary disruption of normal operation or use of utilities, sidewalks, parking areas, driveways or facility access.

C. Planned Utility Outage - An event that can be foreseen and has a plan of action in place to accomplish specific tasks during a utility outage.

D. Utility - Any service provided by an outside source or manufactured in house (gas, water, electricity, fire suppression water, telecommunications, data systems, building automation systems, fire alarm systems, etc.) which facilitates building operations.

E. The terms "outage" and "shutdown" are used interchangeably throughout the Contract Documents.

F. Work Day - A day in which work is planned, excluding weekends and holidays.

G. The terms "work day" and "business day" are used interchangeably throughout the Contract Documents.

H. Normal working hours are considered as work being performed between 6:00 A.M. and 6:00 P.M. Monday through Friday, excluding holidays.

I. The terms "normal hours" and "regular hours" are used interchangeably throughout the Contract Documents.

J. Weather Day – A "weather day" is a day on which the Contractor's current schedule indicates Work is to be done, and on which inclement weather occurs and resultant site conditions or inaccessibility to the site prevent the Contractor from performing five hours of Work associated with the Project's critical activities during normal working hours.

1.05 OWNER'S RIGHT OF OCCUPANCY

A. The Owner may occupy or use all or any portion of the Work following Substantial Completion, or at any earlier stage of completion. Should the Owner wish to use or occupy the Work, or part thereof, prior to Substantial Completion, the Owner's Project Manager will notify the Contractor in writing and identify responsibilities for security, maintenance, and insurance.

B. Work performed on the premises by third parties on the Owner's behalf does not constitute occupation or use of the Work by the Owner for purposes of this Article.

C. All Work performed by the Contractor after occupancy, whether in part or in whole, shall be at the convenience of the Owner so as to not disrupt Owner's use of, or access to occupied areas of the project.

D. Contractor shall follow the Planned Utility Outage Procedure specified within this section when performing Work affecting any occupied facility.

1.06 MINIMUM WAGE RATE DETERMINATION

A. The Contractor shall comply with all requirements of Texas Government Code Chapter 2258, Prevailing Wage Rates.

B. Wage rates identified in Attachment “A” (To Owner’s Special Conditions) are titled “Prevailing Wage Determination, dated December 31, 2009.

C. The Owner may verify wage rate compliance in the field by interviewing workers. The Contractor shall assist the Construction Inspector (CI) with this task, including providing translation for non-English speaking workers.

1.07 WEATHER DAYS

A. Weather days are excusable delays. When weather conditions at the site prevent work from proceeding, immediately notify the Owner’s Project Manager for confirmation of the conditions. At the end of each calendar month, submit to the Owner’s Project Manager a list of Weather Days occurring in that month along with documentation of the impact on critical activities. Based on confirmation by the Owner’s Project Manager, any time extension granted will be issued by Change Order. If the Contractor and Owner cannot agree on the time extension, the Owner may issue a Unilateral Change Order for fair and reasonable time extension.

1.08 SEPARATE CONTRACTS

A. As provided in the UGC, the Owner may award other contracts for other portions of the Project. Additional separate contracts are not identified at this point.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.02 ALTERNATES

A. Alternates are not identified at this time.

2.03 OWNER’S SPECIAL CASH ALLOWANCES

A. Cash allowances are not identified at this time.

2.04 BUILDERS RISK ENDORSEMENTS

A. For Coverage of Existing Building Structures:

1. Contractor shall include an endorsement on the Builders Risk Insurance policy to provide coverage for the existing building structure(s), including its/their contents, as described below. Coverage shall be in the amount equal to either $5 million or the estimated replacement value of the existing building structure and its contents, whichever is less.

2. The purpose of this coverage is to fund the $5 million deductible under the Owner's existing property insurance policy which addresses the risk and possible cost of claims to repair damage to existing structure(s) (this purpose should be explained to the Builders Risk Insurance carrier when requesting the quote). The existing building structure(s) to be covered is the Clinical Research building, and its estimated building replacement value is greater than $5,000,000. Its estimated contents value is greater than $5,000,000

B. Soft Costs, Loss of Rents, Gross Earnings:

1. Contractor shall provide an alternate price to include an endorsement on the Builders Risk Insurance policy to provide the following additional coverage:

a. Period of Indemnity [ENTER 365 DAYS OR TIME PERIOD ON THE WORKSHEET]

b. Maximum Deductible: 14 Days

2. For Non-ROCIP Projects, Limits as follows:

a. No Umbrella Required

3. If Contract Sum is greater than $1,000,000 up to $3,000,000:

a. $1,000,000 each occurrence and $2,000,000 annual aggregate

4. If Contract Sum is greater than $3,000,000 up to $5,000,000:

a. $5,000,000 each occurrence and $5,000,000 annual aggregate

5. If Contract Sum is greater than $5,000,000:

a. $10,000,000 each occurrence and $10,000,000 annual aggregate

C. Builder's Risk Limits

1. For purpose of purchasing builder's risk insurance on the entire Work, the cost of materials supplied or installed by others is currently estimated to be greater than $5,000,000.

2.05 TEMPORARY FIELD OFFICE STRUCTURES, FURNISHINGS AND EQUIPMENT

A. The Contractor shall coordinate and direct the Work of the Project from the Site.

B. The Contractor shall use an existing space within the area of renovation as temporary field office. Contractor shall use and maintain this temporary field office and needs to be adequately staffed, furnished, and equipped.

C. All arrangements for temporary field offices shall be as agreed upon with the Owner's Project Manager. Costs for temporary field office(s) shall be included in the Contractor's Schedule of Values Breakdown and included with the Contractor's regular monthly Progress Payment.

D. Temporary field office(s) shall be secure, well-lighted, air-conditioned, heated, and shall include provisions for telephones, copier, facsimile machines, internet connection services, conference area(s), functioning toilet facilities, and maintenance of all Project files.

1. Contractor will use existing toilet facilities for all contractors and visitors. Contractor is responsible to clean, maintain and provide supplies for these toilet facilities throughout the length of the construction period.

2. The Contractor shall provide weekly janitorial services for all temporary field office(s) including, but not limited to, supplying and servicing of toilet facilities.

E. Temporary field office(s) shall have adequate and safe entries, including steps with railings and landings or stoops as required, and shall provide hard surface walkways to connect the field office structures to one another and to site entry or exit.

F. Conference areas shall include at least one (1) primary area suitable for up to fifteen (15) persons to participate in Project progress and coordination meetings. The walls of this conference area are to serve as display surfaces for maintaining current prints of Work Progress Schedules and work placement plans.

G. The Contractor shall provide and maintain temporary field office(s) until Final Completion and shall remove temporary field office(s) only after obtaining concurrence from the Owner.

2.06 TOILET FACILITIES

A. Contractor shall use existing toilet facilities for workers within the area of renovation, shall post notices, and take such precautions as may be necessary. Refer to Section 01 35 23 - Project Safety, for additional requirements.

B. Contractor shall use existing toilet facilities within the area of renovation from Notice to Proceed until Final Completion that comply with OSHA regulations and as required herein. Toilet facilities shall comply with all applicable State and local regulations. Quantity, type, and location of facilities shall be subject to acceptance by Owner.

C. Contractor shall service, clean, and sanitize toilet facilities at least daily and as frequently as necessary to maintain them in a safe, clean, and sanitary condition. Contractor shall maintain at the Site, a record of the servicing, cleaning, and sanitizing of the facilities for the duration of the Project.

D. The use of toilet facilities installed under this Project and/or existing campus facilities is allowed with a written approval from Owner.

1. If Owner authorizes the use of specific campus toilet facilities, Contractor shall assure all persons employed on the Project use only authorized toilet facilities. Contractor shall post notices and take such precautions as may be necessary to assure compliance.

E. Where the Project extends over multiple floor levels, toilet facilities shall be located at least at each fifth floor so that workers do not have to walk more than two floors to reach the facilities.

2.07 PROJECT COMMUNICATIONS PLAN

A. Depending upon the project, the Owner may develop a Project Communications Plan to inform the Owner's faculty, employees, patients, visitors, and others concerning construction activities affecting them. Contractor shall participate and support this effort as required by Owner. Typical support by Contractor may include attendance at communications meetings, preparation of graphic and narrative construction impact updates, and the furnishing of targeted signage.

2.08 PROJECT SIGNAGE

A. For renovation projects, signage shall be in accordance with the Project Communications Plan or as directed by the Owner.

B. All hazard warning signage shall be OSHA 29 CFR Part 1926 compliant. All signs shall be prominently displayed at all entrances to the Site. Postings must be constructed of a durable material that will resist wear and damage.

C. Additional Contractor or Subcontractor signs or advertisements shall not be erected without the Owner's written approval.

2.09 TEMPORARY WATER

A. The Contractor shall provide temporary lines for all water required during the Project and shall make arrangements with the Owner's Administrative Facilities and Campus Operations Department for water service. This shall include all means of conveying and the necessary metering devices. In lieu of temporary connections, with the Owner's approval, the Contractor may make permanent connections and such may serve for the construction period.

B. In the event water is not available at the Site from the Owner's existing distribution system, the Contractor shall negotiate with the local distributor for water and pay all fees and rates required by the local water utility.

2.10 TEMPORARY POWER AND LIGHTING

A. The Contractor shall make arrangements with the Owner or the local utility company for temporary construction power. If power is available only through the Owner's system, the Contractor shall make arrangements for and provide metering equipment. The Contractor may energize the permanent power system in the building only when approved by the Owner.

B. The Contractor shall provide adequate lighting about the Site for security, inspections of excavations, night shift work should such occur, and shall also provide adequate temporary interior lighting throughout the building enclosure to facilitate quality workmanship and appropriate inspection conditions.

C. Contractor shall ensure, and shall use emergency power equipment and connections if necessary to ensure, adequate lighting for egress and life safety.

2.11 TEMPORARY MECHANICAL SERVICES

A. If temporary heating, cooling, ventilation or humidity control equipment is required for protection of the Work or for implementation of indoor air quality measures, the Contractor shall provide Owner-approved equipment and proper operation such that no Work shall be damaged or life safety compromised.

B. All equipment and filters shall be maintained in good operation and all filters and controls shall be changed as a result of damage or expiration to ensure acceptable air quality. If necessary, all equipment must have current certifications.

C. After the permanent mechanical equipment has been installed and connected to the local chilled water and steam distribution systems, the equipment may be operated by the Contractor to heat or cool the building if acceptable to the Owner. Contractor must flush and clean all new mechanical piping systems before connecting to local systems.

D. During operation of the mechanical equipment, prior to achieving Substantial Completion, the Contractor shall keep the mechanical equipment in good operating condition, properly maintained, including cleaning and changing of all filters. New, non-construction filters shall be installed prior to the Owner's acceptance of the mechanical equipment. The warranty period shall start for the respective equipment as delineated in the UGC.

2.12 REMOVAL OF TEMPORARY FACILITY

A. When a temporary facility is no longer needed for the proper conduct of the Work, the Contractor shall completely remove it from the Project and shall repair or replace any material, equipment, or finished surface damaged in doing so.

2.13 PROJECT PARKING

A. Contractor is responsible for securing adequate parking for Contractor's employees. Parking of Contractor's vehicles at the Site shall be as approved by the Owner.

1. Some remote parking spaces may be provided on the campus. Such parking shall require permits, issued by the campus police department, for all vehicles. Such remote parking is provided for the convenience of the Contractor with the understanding that the Contractor is responsible for all workers and vehicles while they are on the campus. The Owner may remove such parking convenience at Owner's sole discretion.

PART 3 - EXECUTION

3.01 PARTNERING

A. The Owner desires to create a cohesive team for this project, to include all primary parties. The Contractor and its primary Subcontractors shall join the Owner and the rest of the Project Team in project "Partnering" as a means of achieving success. The Partnering process is entirely voluntary and the Owner and Contractor shall equally share all costs with no impact to the Construction Contract price. The results of the workshop are not legally binding, but do represent a commitment by the parties to work together cooperatively toward common goals.

3.02 CONTRACTOR SITE ACCESS AND LIMITS OF CONSTRUCTION

A. Upon authorization to mobilize, the Contractor shall submit a plan layout showing location of field offices, size and arrangement of spaces, area of construction, site control points, and utility tie-in locations for Owner review.

B. All Project personnel shall confine and limit their work and use of the Site to those areas within the defined limits of construction. All public and University rules, laws and requirements shall be obeyed and enforced by the Contractor. No tools, construction vehicles, or construction material other than those in transit, shall be permitted beyond the Site limits of construction, including Owner's existing mechanical, plumbing, and electrical rooms, equipment rooms, and storage rooms.

C. All campus roads, drives, and fire lanes as well as all sidewalks and pedestrian routes, other than those specifically indicated to be in the Contractor's area of control, must be kept open at all times. The Contractor shall proactively schedule and obtain security clearance for all significant material deliveries, vehicle traffic, street closures, cranes, concrete trucks, etc., through and around the campus and Site.

3.03 ON-GOING CAMPUS OPERATIONS

A. The Project is surrounded by and/or adjacent to continuously functioning campus facilities, including patient care, academic, and research efforts. The Contractor shall make every effort to avoid disruptions to ongoing campus activities and to maintain a safe environment for patients, students, faculty, and staff in the areas adjacent to the Project.

B. The Contractor shall obtain all Owner’s in-house approvals and permits. Operation of utilities and building systems must not be interrupted except when scheduled and approved in advance through established channels. The Contractor should be always mindful and proactive with regard to containment of noise, fumes, dust and debris.

3.04 CONTRACTOR’S RESPONSIBILITY OF THE PROJECT WORKFORCE

A. The Contractor is responsible for the actions of the entire Project workforce, including, but not limited to, subcontractors' and suppliers' employees, whenever they are on the campus. The Contractor shall submit a plan for identifying and controlling all workers, and for management of personnel records, including payroll records. Identification badges for workers, busing of workers from remote parking lot(s), written and verbal reminders to workforce of appropriate behavior and avoidance of campus facilities, and publishing of established access and egress routes for vehicular and pedestrian traffic are required, as a minimum, in order to maintain control of the work force.

1. Unacceptable behavior on the part of a worker anywhere on campus, including parking lots, the Site, and the accessing route(s) through the Site and through the campus, or failure to obtain parking permits, or traffic violations while on campus may lead to cancellation of any Owner provided parking. Identifiable offending worker(s) shall be permanently removed from the Project.

2. Harassment of any person, whether a patient, student, faculty, staff, or visitor to the campus, is strictly forbidden. Harassment includes any action such as jeering, whistling, calling-out, staring, snickering, making rude or questionable comments, or similar behavior. Identifiable offending worker(s) will be removed from the Project.

3.05 SECURITY

A. The Contractor is responsible for security of the Project. The University of Texas Police Department will not provide security for the Contractor's areas unless under Project-specific agreement and terms of compensation.

B. The Contractor shall secure the Site at nights and weekends, or when no work is being performed, to prevent the entry of unauthorized personnel. Locks shall be of an approved type and have special keying as required by the Owner. Keys for all door locks shall be made available to The University of Texas Police Department. All doors accessing the construction site shall be properly latched and have closers to maintain closed doors at all times. All doors accessing the construction site shall have MD Anderson standard construction signage, provided by Owner's Project Manager, to ensure that only authorized construction personnel access the site.

C. The Contractor shall not retain the services of outside guard or law enforcement services in connection with Work on campus without the specific prior written approval of the Chief of The University of Texas Police Department.

3.06 PROTECTION OF WORK

A. The Contractor shall properly and effectively protect all materials and equipment furnished during and after installation. Building materials, Contractor's equipment, etc., may be stored on the premises, but the placing of it shall be within the construction fence. When any room in the building is used as a shop, store room, etc., the Contractor shall be held responsible for any repairs, patching, or cleaning arising from such use. Contractor shall protect and be responsible for any damage to Contractor's Work or material, from the date of the agreement until the final payment is made, and shall make good without cost to the Owner, any damage or loss that may occur during this period. The Contractor shall handle all material as directed, so that the Architect/Engineer's representative may inspect it. All material affected by weather shall be covered and protected to keep it free from damage while being transported to the Site and while stored on the Site.

1. During the execution of the Work, open ends of all piping and conduit, and all openings in equipment shall be closed when Work is not in progress, and shall be capped and sealed prior to completion of final connections, so as to prevent the entrance of foreign matter.

2. All heating, ventilating, plumbing and electrical equipment shall be protected during the execution of the Work. All ductwork and equipment shall be sealed with heavy plastic and tape to prevent build-up of items such as dust, mold, and debris.

3. All ductwork and air handling mechanical equipment shall be wiped down with a damp cloth immediately before installation to ensure complete removal of accumulated dusts and foreign matter.

4. All plumbing fixtures shall be protected and covered so that no one can use them. All drains shall be covered until placed in service to prevent the entrance of foreign matter.

5. Contractor shall protect trees and shrubs within the Site assigned to be saved and maintained, with strong open slat fences at least six (6) feet high, completely surrounding them, all maintained in sound condition until the Owner gives the Contractor permission for removal. Contractor shall not remove, cut, or trim any trees or shrubs without the Owner's written approval, unless specifically identified on the approved Construction Documents.

3.07 PLANNED UTILITY OUTAGE PROCEDURE

A. The Contractor shall not activate or de-activate any campus system, or component of any such system, without express written direction from the Owner.

B. Contractor shall schedule and obtain facilities approval for any necessary outage of campus utilities planning for a minimum of fifteen (15) work days in advance through the Owner's Project Manager, using the Owner provided "Contractor's Request for Utility Shutdown" form and process. All outages shall be performed outside the normal working hours or as determined by the Owner.

3.08 NOISE CONTROL

A. Contractor shall coordinate equipment locations and timing or sequence of work operations so as to avoid conflict with the Owner's continuing use of adjacent buildings and/or avoid any interference with Owner's scheduled meetings, events, or business activities.

3.09 TEMPORARY SHORING

A. Contractor shall provide all temporary shoring required for the installation of Work. Contractor assumes all responsibility for this work and shall repair any damage caused by improper supports or failure of shoring in any respect. Any provisions that are installed to assure the stability of adjacent structures, trees, roadways, or infrastructure, shall be in accordance with the plans provided by the Contractor.

3.10 CUTTING, PATCHING, AND INSTALLATION OF SLEEVES

A. If cutting and/or patching of holes or openings is required for the execution of the Work, the Contractor shall consult with the Architect/Engineer prior to the commencement of any cutting and/or patching. Contractor shall leave all chases, holes, or openings straight, true, and of proper size as may be necessary for the proper installation of Work.

1. No excessive cutting of the structure shall be permitted, nor shall any piers or other structural members be cut without the written approval of the Architect/Engineer. After such Work has been installed, the Contractor shall carefully fit around, close up, repair, patch, and point-up as directed to the entire satisfaction of the Architect/Engineer.

2. All cutting and patching for utility penetrations shall be done carefully, with proper tools by qualified workers, without additional cost to the Owner. The Contractor shall build into the Work, as indicated on the Plans and/or Specifications, any and all items furnished by others. Cutting and repairing of work in place, as a result of negligence by the Contractor, shall be paid for by the party at fault.

3. The Work performed within each Section of the Specifications, unless otherwise indicated in the Plans and/or Specifications, includes all cutting, patching, and digging for work in that trade section required for proper accommodations of work of other trades. Execute such work with competent workers skilled in trade required for restoration. Contractor shall arrange and pay for cutting and patching required for installation of Contractor's Work.

4. Contractor shall seal penetrations through all rated partitions, walls and floors with U.L. tested assemblies to provide and maintain a rating equal to or greater than the partition, wall or floor. In addition, Contractor shall seal penetrations through all floors to provide and maintain a watertight installation.

3.11 ASBESTOS ABATEMENT

A. In the event the Contractor encounters material reasonably believed to be asbestos at the Site, the Contractor shall immediately stop work in the area affected and report the condition to the Owner. If in fact the material is asbestos and has not been abated, the Contractor shall not resume the non-asbestos-related Work in the affected area until the asbestos has been abated.

B. The abatement action may be performed in any of three ways, as the Owner may decide. The Owner may perform the abatement by Owner's own forces, or the Owner may contract with a third party to perform the abatement, or the Contractor may perform the abatement by an appropriate means acceptable to the Owner such as performing the Work through Contractor's own employees if they are appropriately certified or by hiring an abatement subcontractor.

C. If the Contractor is to perform the abatement, the Owner and the Contractor will negotiate a change order in accordance with the contract terms relative to extra work. In such a case, the Owner specifically agrees that the cost of any special comprehensive general liability insurance that may be required relative to the abatement Work will be considered a direct cost of the extra work, on which, like the other direct costs, the Contractor will be allowed to add the applicable markup per the UGC.

3.12 CONTRACTOR LICENSURE

A. Contractor shall ensure that a Master Plumber licensed with the State of Texas directly supervises all plumbing Work. At least one plumber holding a State of Texas journeyman license shall be present at each Site during any plumbing Work.

B. Contractor shall ensure that Contractor's mechanical subcontractor is licensed with the State of Texas to install all HVAC Work.

C. Contractor shall ensure that a Master Electrician licensed with the State of Texas directly supervises all electrical Work. At least one electrician holding a State of Texas journeyman license shall be present at each Site involving Electrical Work.

3.13 SAFETY PRECAUTIONS AND PROGRAMS

A. MD Anderson Environmental Health and Safety (EH&S) has the authority to take intervening action in the event it deems patient, visitor, or staff of MD Anderson are in danger. Contractor shall adhere to requirements stated in Section 01 35 25 - Owner Safety Requirements.

B. Contractors shall familiarize themselves with, receive required training on, and abide by all policies and procedures of MD Anderson and any governmental body [i.e. NFPA, OSHA, EPA, TDLR (Texas Department of Licensing and Regulation), TCEQ (Texas Commission on Environmental Quality), etc.] having authority to control the manner and/or methods of completing the tasks contained in the Contract.

3.14 TEST, ADJUST, AND BALANCE

A. Owner may hire a Test, Adjust, and Balance firm. If Owner directly hires a Test, Adjust, and Balance firm, Contractor shall support the firm's efforts to perform work as required.

3.15 MISCELLANEOUS

A. All gas lines that are involved with the Project must have ends capped with proper cap and sealant, even if valves are locked off.

B. Contractor shall install temporary equipment in such a manner that finish work will not be damaged by smoke, falling mortar, concrete, or other causes. Location and arrangement of temporary equipment shall be subject to the approval of the Owner's Project Manager.

C. Change Room Facilities:

1. Where workers are required to change clothes and wear special protective clothing to work with toxic or dangerous substances, an appropriate facility for decontamination, separate from other sanitary and washing accommodations shall be provided. In these cases, change room facilities shall be duplicated and storage shall be provided for protective clothing in one room and for personal clothing in the other.

2. Protective clothing and personal clothing shall not come into contact with each other or be stored in the same facilities. Protective clothing and work clothing, which may have become wet by the process of decontamination, must be stored in a separate, well-ventilated area.

3. Change rooms shall be gender separated and provided with inside and outside locking mechanisms.

3.16 SITE AND AREA MAINTENANCE

A. A thorough cleanup of the Site and the Site's surroundings is required no less than once per week or more often as directed by the Owner. Contractor shall be responsible to ensure that the debris and trash resulting from site operations are removed from the building and the property on a daily basis. Solid debris, such as brick bats, mortar and plaster droppings, may not be dumped on the grounds about the Site. All combustible material including scrap from lumber, crating, excelsior, paper, and similar types of trash shall be removed from the building site on a daily basis. Trash shall not to be allowed to accumulate.

B. The Contractor shall not allow food to be consumed or food wastes to accumulate at the Site in an effort to eliminate pests and insects.

C. Contractor shall be required to clean all streets of mud, dirt, dust, debris, and construction material produced during Contractor's construction activities on a daily basis. Contractor shall repair any damage to existing streets, parking, facilities, and any other area of the Site, including areas used for lay down or storage.

3.17 OPERATING AND MAINTENANCE MANUALS

A. Certain requirements of the UGC are supplemented by Section 01 77 00 – Project Closeout Procedures.

3.18 RECORD DOCUMENTS

A. Certain requirements of the UGC are supplemented by Section 01 77 00 – Project Closeout Procedures.

3.19 SHOP DRAWINGS AND SUBMITTALS

A. Certain requirements of the UGC are supplemented by Section 01 31 00 – Project Administration.

END OF SECTION 00 25 00

ATTACHMENT "A"
(to Owner's Special Conditions)
MINIMUM WAGE RATE DETERMINATION

The University of Texas System is the contracting agency for this construction project. The following statute requires the contracting agency to specify the generally minimum rates of wages in contracts that are bid.

Government Code 2258
"Construction of Public Works in State and
Municipal or Political Subdivisions; Prevailing
Wage Rates to be maintained"
and
The Uniform General and Supplementary General Conditions
for University of Texas System Building Construction Contracts

Pursuant to the requirements of this statute, we have determined that the following rates of wages are paid to various classifications of workers in the locality of this project.

Total hourly compensations to each worker must equal or exceed the minimum wage rates stated in the following attachment. Contributions by a worker toward health, pension, vacation, and the like are part of the worker's pay; contributions by the employer are not. Any dollar amounts shown in columns for health, pension, and vacation may be paid either in cash or in kind. Workers in classifications where rates are not identified shall be paid not less than the general minimum rate of "laborer" for the various classifications of work therein listed.

All hours of work over 40 hours per week are overtime and will be compensated at the rate of 1 and ½ times the regular wage.

Trainees/helpers, where not otherwise specified above, may be compensated at a rate determined mutually by the worker and employer, commensurate with the experience and skill of the worker but a rate not less than 60% of the journeyman's wage or less than the Laborers (General) rate. At no time shall a journeyman supervise more than two of apprentices, trainees or helpers. All apprentices/trainees/helpers shall be under the direct supervision of a journeyman working as a crew.

ATTACHMENT "A"

PREVAILING WAGE DETERMINATION

HOUSTON-GALVESTON AREA

The University of Texas System
Office of Facilities Planning and Construction

Date: December 31, 2009
Construction Type: Building
Area: Houston-Galveston

Building Construction Trade Classification	Prevailing Wage Rate (1)
Carpenter	$14.38
Concrete Finisher	$14.63
Drywall/Ceiling Installer	$14.00
Electrician	$16.00
Elevator Mechanic	$23.61
Fire Proofing Installer	$13.88
Flooring Installer	$13.63
Glazier	$9.00
Heavy Equipment Operator	$13.25
Ironworker	$17.00
Laborer	$10.00
Light Equip Operator/Driver	$13.88
Mason/Bricklayer	$18.00
Painter	$14.25
Pipefitter	$14.87
Piping/Ductwork Insulator	$15.00
Plumber	$18.06
Roofer	$11.00
Sheetmetal Worker	$17.75
Sprinkler Fitter	$15.40
Tile Setter	$13.50
Waterproofer	$13.63

(1) Wages shown are for entry level, minimum wages for each classification and do not include fringe benefits

Unlisted classifications needed for work not included within the scope of the classifications listed may not be added after award. The job classifications are not inclusive of all possible trades on the construction project.

It is the responsibility of the contractor to classify the worker in accordance with the published classifications, and demonstrate that workers are paid commensurate with determined rates.

ATTACHMENT "B"
(to Owner's Special Conditions)
PROJECT SIGN LAYOUT

NAME OF PROJECT — 2 1/2" Univers LT Std - 75 Black*

ARCHITECT/ENGINEER — 2" Univers LT Std - 65 Bold*
Name of Firm — 2" Univers LT Std - 45 Light*

GENERAL CONTRACTOR — 2" Univers LT Std - 65 Bold*
Name of Contractor — 2" Univers LT Std - 45 Light*

THE UNIVERSITY OF TEXAS SYSTEM — 1 1/4" Univers LT Std - 65 Bold

DEPARTMENT OF CAPITAL PLANNING & MANAGEMENT — 1 1/4" Univers LT Std - 65 Bold

* Adjust letter size as required for length

Submit a one-quarter scale shop drawing of the sign complete with all lettering to the owner for approval before construction. The sign shall be constructed of 3/4" thick A-C Grade exterior plywood. The sign shall receive two coats of an approved white semi-gloss exterior enamel on all surfaces before lettering. The owner will designate the colors for the lettering on the shop drawing.

SECTION 00 73 16 - PROJECT INSURANCE (OCIP)

PART 1 - GENERAL

1.1. DEFINTIONS

1.1.1. The term “OCIP”, as used throughout the Contract documents, shall refer to the Owner Controlled Insurance Program.

1.1.2. The term “OCIP Administrator”, as used throughout the Contract documents, shall refer to those employees of the firm that acts as the Owner’s Insurance broker who confirm Contractor and Subcontractor enrollments, track monthly payroll reports, order final payroll audits, and report program costs to the Owner.

1.1.3. The term “OCIP Loss Control Representative”, as used throughout the Contract documents, shall refer to those employees of the firm that acts as the Owner’s Insurance broker who conduct Project site safety services, track insurance claims, and issue reports concerning Contractor management of safety and insurance claims.

1.2. PURPOSE

1.2.1. The purpose is to have one (1) major insurance program in place to address those risks associated with Workers' Compensation and Employer's Liability, and General Liability which will exist on the Owner's property during construction. The Owner expects the majority of employers performing construction work under this Contract to enroll in the OCIP.

1.2.2. The Owner shall provide, at its own expense, specific insurance policies and coverage for the Contractor and for all enrolled Subcontractors on the Project, as described in Article 2.1 of this Section.

1.2.3. The Contractor and all enrolled Subcontractors shall provide all other insurance coverages, including those described in Articles 2.2 and 2.3 in this Section and as necessary or required to address all other risks for the Project.

1.2.4. **The Contractor and all enrolled Subcontractors shall delete those Articles of the Uniform General Conditions for University of Texas Building Construction Contracts (UGSGC) which are in conflict with this Section and shall recognize and agree to the requirements described in this Section.**

1.2.5. **The Subcontractors and all other parties to the Contract that are not enrolled shall furnish proof of insurance in accord with the UGSGC.**

1.3. RELATED DOCUMENTS

1.3.1. In addition to specific references indicated herein, the Contractor's attention is directed, but not limited, to the following Sections and Documents, which include additional administrative requirements.

1.3.1.1. Current Edition of the Uniform General Conditions for University of Texas Building Construction Contracts (UGSGC).

1.3.1.2. Owner’s Special Conditions.

PART 2 – PRODUCTS

2.1 INSURANCE COVERAGE FURNISHED BY OWNER (OCIP): The following insurance shall be furnished to the Contractor and all enrolled Subcontractors in separately issued coverage.

2.1.1 Workers' Compensation and Employer's Liability

2.1.1.1 Coverage A - Statutory Benefits: Liability imposed by the Workers' Compensation and/ or Occupational Disease statute of the State of Texas and any other State or governmental authority having jurisdiction over or related to the work performed on the Project.

2.1.1.2 Coverage B - Employer's Liability Limits:

2.1.1.2.1 $1,000,000.00 bodily injury per accident/employee;

2.1.1.2.2 $1,000,000.00 bodily injury per disease/employee;

2.1.1.2.3 $1,000,000.00 policy limit by disease.

2.1.1.3 Extensions of Coverage

2.1.1.3.1 Other States Endorsement(s)

2.1.1.3.2 Voluntary Compensation, if exposure exists

2.1.1.3.3 United States Longshoreman's & Harborworker's Act, may be added if needed

2.1.1.3.4 Sixty (60) day Notice of Cancellation from the Insurance Provider, except 10 days for non-payment of premium

2.1.1.3.5 Amendment of Notice of Occurrence

2.1.2 Commercial General Liability (Primary and Excess)

2.1.2.1 Limits:

2.1.2.1.1 $2,000,000.00 Each Occurrence/all insured

2.1.2.1.2 $2,000,000.00 Personal Injury and Advertising Injury limit

2.1.2.1.3 $5,000,000.00 Completed Operations aggregate/all insured

2.1.2.1.4 $5,000,000.00 General Aggregate/all insured (Annual Aggregate Per Project)

2.1.2.1.5 $10,000.00 Medical Payments

2.1.2.1.6 $100,000.00 Fire Legal Liability

2.1.2.2 Policy Form:

2.1.2.2.1 2001 Insurance Service Office "Occurrence" form – CG00 01 (12 04)

2.1.2.3 Extensions of Coverage:

2.1.2.3.1 Incidental Medical Malpractice Liability

2.1.2.3.2 Completed Operations Liability coverage for a period of ten (10) years after final acceptance by the Owner or ten (10) years after each project is placed in operation, whichever occurs first.

2.1.2.3.3 Waiver of Subrogation Endorsement, if required by written contract

2.1.2.3.4 Sixty (60) day Notice of Cancellation from the Insurance Provider, except 10 days for non-payment of premium

2.1.2.3.5 Engineers, Architects or Surveyors Professional Liability Exclusions

2.1.2.4 Excess Liability Coverage:

2.1.2.4.1 As following form over Employer's Liability and Commercial General Liability, $50,000,000.00 of excess insurance has been obtained by the Owner for the benefit of the Owner, Contractor and all enrolled Subcontractors of every tier. This limit is written on an occurrence/annual aggregate basis.

2.1.2.5 Issue of Policies and Certificates:

2.1.2.5.1 The OCIP Administrator and/or Insurance Carriers will issue separate Certificates of Insurance for Workers' Compensation, Comprehensive General Liability and Excess Liability to the Contractor and each enrolled Subcontractor. Copies of holder policies will be issued following receipt of written request from the OCIP Certificate holders to the OCIP Administrator and copied to the ODR.

2.2 INSURANCE POLICIES AND AMOUNTS OF COVERAGE FURNISHED BY CONTRACTOR AND ENROLLED SUBCONTRACTORS: All Project insurance not identified in Article 2.1 above shall be provided by the Contractor and all enrolled Subcontractors to meet or exceed terms and amounts of coverage as per requirements of the UGSGC. Liability coverages shall include the following (as applicable to the Work):

2.2.1 “All Risk” Builder’s Risk Insurance (provided by the Contractor only)

2.2.2 Business Automobile Liability Owned/Leased

2.2.3 Equipment (covering total value of owned/rented equipment)

2.2.4 Workers' Compensation/Employers' Liability (**Off Site Only**)

2.2.5 General Liability (**Off Site Only**)

2.2.6 Professional Liability Insurance (Errors and Omissions)

2.2.6.1 In the event any Contract specifications require a contractor to provide professional services, such as, but not limited to, architectural, engineering, construction management, surveying, design, etc., a Certificate of Insurance must be provided prior to commencing work evidencing such coverage with a limit of not less than $1,000,000.00. Any material change in limits, coverage or loss of aggregate limit due to outstanding claims must be reported to the Owner within thirty (30) days of any such event.

2.2.7 Aviation Insurance - $10,000,000.00 (as applicable)

2.2.7.1 In the event any fixed-wing or rotary aircraft are used in connection with this Agreement and/or in the execution of the work, a minimum of $10,000,000 of Aviation Liability Insurance must be maintained with the following requirements: The Owner must be named as an "additional insured" and a waiver of hull damage must be provided in favor of the Owner.

2.2.7.2 If any aircraft is to be used to perform lifts at the Project site, a "slung cargo" endorsement must be included to cover the full replacement value of any equipment or material being lifted. All such lifts must be coordinated with the Owner for approval prior to lift execution.

2.2.8 Environmental and Asbestos Abatement Insurance - $5,000,000.00 per claim (as applicable)

2.2.8.1 If this Agreement involves environmentally sensitive operations (such as the removal of asbestos, the removal/replacement of underground tanks or operations involving toxic chemicals, heavy metals and/or carcinogenic substances), the Contractor and/or involved Subcontractors shall submit proof of full coverage for such exposures subject requirements and obtain approval of the Owner prior to commencement of such operations. Subcontractors that are directly and actively involved in the performance of work associated with environmentally sensitive operations will be excluded from the OCIP. If Environmental Coverage is written on a Claims Made basis, five years Completed Operations shall be included.

2.2.9 Maritime Insurance -Hull, Protection and Indemnity (including crew) -$10,000,000.00 (as applicable)

2.2.9.1 In the event any watercraft is used in connection with the Project, the Contractor and/or involved Subcontractor shall submit proof of a “Hull and Protection and Indemnity Policy”. The amount of insurance on the Hull shall be sufficient to cover the watercraft, its equipment and all additional equipment aboard during the time it is in use on the Project. Protection and Indemnity shall have limits of liability of no less than $10,000,000.00 including coverage of the construction activity for which the watercraft is used. Master and Crew coverage shall include General Maritime Liability, Jones Act and Wages, Transportation, Maintenance and Care.

2.2.10 Waiver of Subrogation

2.2.10.1 To meet the requirements of Article 2.2, all policies shall contain a Waiver of Subrogation in favor of the Board of Regents of The University of Texas System, their respective agents, consultants, servants and employees of each and all other indemnities.

2.2.11 Names of Additional Insured

2.2.11.1 To meet the requirements of Article 2.2, for each of the preceding coverages, excepting Workers Compensation, all policies shall endorse the Board of Regents of The University of Texas System, its respective agents, consultants, servants and employees of each and all other indemnities as "Additional Insured".

2.2.12 Waiver of Property Damage and Right of Recovery

2.2.12.1 To meet the requirements of the UGSGC, all policies shall contain written agreement to waive the Contractor’s and each enrolled Subcontractor’s right for recovery of physical damage or loss to their respective properties against each other for damages, losses or claims arising out of or in connection with this Project and this

Contract. This written waiver shall also extend to the benefit of the Board of Regents of The University of Texas System, its respective agents, consultants, servants and employees. This waiver of the right of recovery for property damage shall be binding upon any property (real or personal), builders risk, automobile, aircraft, watercraft, tools or equipment insurer as respects any subrogation rights that such insurer may possess by virtue of any payments of damage or loss.

2.3 CONTRACTOR ASSURANCE OF SAVINGS

2.3.1 The Contractor and all enrolled Subcontractors shall agree, warrant, and represent that any proposal(s) for Construction services exclude all costs associated with Owner furnished insurance coverage as specified in Article 2.1 of this Section.

2.3.2 The Contractor and all enrolled Subcontractors shall agree to be subject to audits for payroll, work hours and insurance costs by the respective insurance companies providing coverage under the OCIP. The purpose of such audits is to validate insurance premiums and compare wages and other OCIP costs. The Contractor and all Subcontractors shall agree to furnish payroll and insurance cost information in the forms and formats as requested by the OCIP Administrator. Further, the Contractor and all Subcontractors agree to cooperate fully with any and all audits by supplying the required information in the manner required and as expeditiously as possible. No resources may be denied. If proprietary information is involved, the Contractor and all enrolled Subcontractors will be allowed to guard the material while it is being reviewed by the Owner or any of its agents.

2.3.3 The Contractor and enrolled Subcontractors agree, warrant, and represent that all Changes to the Contract as described in the UGSGC, shall exclude any cost for the insurance provided by the OCIP.

2.4 EXCLUSION FROM OCIP ENROLLMENT: Prior to commencement of any work at the Project site and until completion and final acceptance of Work, Subcontractors that are allowed by the Owner to be excluded from enrollment in the OCIP shall maintain, at their sole expense, insurance coverage as per the UGSGC and Article 2.2 of this Section.

2.4.1 Automatic Exclusion

2.4.1.1 Temporary workforce agencies, consultants, vendors, suppliers, material dealers, and delivery service companies shall not be considered as a Contractor or Subcontractor and therefore shall be automatically excluded from enrollment in the OCIP. In addition, the erection and dismantling of tower cranes and hoists used for personnel, material or both shall be automatically excluded from enrollment in the OCIP. The erection and dismantling of scaffolds shall be automatically excluded from enrollment in the OCIP unless the erection and dismantling work is performed by an enrolled Contractor and the erection and dismantling work is incidental to that Contractor's normal construction activities on the Project. The Contractor shall confirm that the companies in these categories produce copies of proof of proper insurance for the risk exposures that each one will create or experience while on the Project.

2.4.1.2 Subcontractors performing environmentally sensitive or highly hazardous work will be required to furnish proof of special coverage in adequate amounts for Aviation Insurance, Environmental and Asbestos Abatement Insurance, Maritime Insurance and any other policies of such nature.

2.4.1.2.1 Before performing any work the Subcontractor shall provide to the Contractor and the OCIP Administrator, a Certificate of Insurance that matches the

requirements described in the UGSGC and 2.2 above.

2.4.1.3 Excluded Subcontractor(s) shall install adhere to all project safety requirements and take all necessary precautions to all other persons in the vicinity from the risk exposures that the excluded Subcontractor may create while performing work on the Project.

2.4.2 Discretionary Exclusion

2.4.2.1 The Contractor may issue a written request on behalf of a Subcontractor of any tier for a discretionary exclusion from enrollment in the OCIP. To be considered, the Subcontractor must be bound to a scope of Work that anticipates a total labor value of less than $5,000.00. A Certificate of Insurance with coverage amounts and language as required by the UGSGC and 2.2 above shall be furnished to the OCIP Administrator. The OCIP Administrator, in concurrence with the ODR, will review issues such as prior enrollment, scope of work and associated risk. Based on this evaluation, exclusion may or may not be granted. The final decision to grant an exclusion shall be determined by the Owner.

2.4.3 Excluded Subcontractors

2.4.3.1 Excluded Subcontractors shall submit Certificates of Insurance for Owner acceptance for adequacy of protection and for the satisfactory character of the Insurer prior to performing any work on the Project. Each Certificate must have a thirty (30) day prior written notice of cancellation showing the Board of Regents of The University of Texas System as the Certificate Holder.

2.4.3.2 In the event of failure of the excluded Subcontractor to furnish and maintain said insurance and to furnish satisfactory evidence thereof, the Owner and/or Contractor shall have the right to take out and maintain coverage for all parties on behalf of the excluded Subcontractor who agrees to furnish all necessary information to bind such coverage and to allow deduction for the cost thereof immediately upon presentation of an invoice.

2.5 GOVERNING CONDITIONS

2.5.1 The Owner's payment of premiums for the insurance described in this section shall in no way be interpreted as relieving the Contractor and/or any enrolled Subcontractor of any responsibility of liability under this agreement.

2.5.2 The amount and types of insurance coverage required herein shall not be construed to be a limitation of liability on the part of the Contractor or any of its Subcontractors.

2.6 ELECTIVE INSURANCE FURNISHED BY A CONTRACTOR

2.6.1 The Contractor and any enrolled Subcontractor may elect to maintain a supplementary insurance policy(s) to extend the coverage terms and/ or conditions that are described in this Section. The cost of any policy(s) shall be at the sole expense of the contractor, and shall not be reimbursed by the Owner.

PART 3 – EXECUTION

3.1 OCIP ENROLLMENT PROCESS

3.1.1 The Contractor and all enrolled Subcontractors shall submit completed forms including all

insurance, underwriting, payroll, rating or loss history information as required by the Owner to the OCIP Administrator for enrollment and issuance of OCIP "Certificates of Insurance". Forms shall be provided within five (5) working days of the request. No contractor shall perform any work on the Project until it is recognized as having been enrolled in or excluded from the OCIP by the OCIP Administrator.

3.1.2 The Contractor and enrolling Subcontractors shall provide all information necessary to bind coverage under the OCIP. The OCIP Administrator will notify the Contractor and respective Subcontractor when an application has been approved and coverage afforded.

3.1.3 OCIP enrollment will not be complete and work shall not commence until the OCIP Administrator has issued the OCIP "Certificates of Insurance" to the applicant.

3.2 PROJECT ADMINISTRATION AND FORMS

3.2.1 The Contractor shall manage and transmit all administrative and safety documentation, including subcontractor insurance and payroll information, as required and directed by the Owner.

3.2.2 The Contractor and all enrolled Subcontractors shall include those administrative costs in the Construction Contract Limitation (CCL) or Guaranteed Maximum Price (GMP) proposal which are necessary to properly comply with the Contract.

3.3 OCIP DOCUMENTATION COMPLIANCE

3.3.1 Failure by the Contractor and/or any Subcontractor to submit documentation and forms as directed by the Owner, or the OCIP Administrator, as described in the Owner's OCIP guidelines may result in an Owner-issued deductive Change Order to the Contractor for each delinquent document. The Contractor will be held accountable for all costs and schedule impacts associated with this action.

3.3.2 Persistent failures by the Contractor and/or any enrolled Subcontractors may result in a "stop work" order by the Owner. The Contractor will be held accountable for all costs and schedule impacts associated with this action.

3.3.3 Incident Notification and Claims Management:

3.3.3.1 Workers' Compensation claims are to be immediately reported to the ODR by the General Contractor, Project Safety Coordinator (PSC) or his/her designee. The claims will be submitted to the OCIP insurance carrier within twenty-four (24) hours or one work day of the occurrence or immediately upon the acknowledgment of the an injury from a worker. This notification will be completed by the ODR unless otherwise directed by the ODR. The contractor PSC will provide a completed First Report of Injury form (DWC Form 1) to the ODR as soon after the injury occurs as is practicable. The following charges may apply for failure to comply with this requirement:

3.3.3.1.1 $1,500.00 for reports that are 2 – 3 workdays beyond the date of occurrence

3.3.3.1.2 $5,000.00 for reports that are 4 – 30 workdays beyond the date of occurrence

3.3.3.1.3 $7,500.00 for reports that are 31 – 60 workdays beyond the date of occurrence

3.3.3.1.4 $10,000.00 for reports that are more than 60 days beyond the date of occurrence

3.3.3.2 General Liability claims are to be initiated immediately and shall be within twenty-four (24) hours or one (1) workday of the occurrence, whichever is later. The mechanism for initiating such a claim shall be the completion and transmittal of a Notice of Occurrence / Claim form to the ODR. Late reporting has been proven to substantially escalate the cost of claims and may therefore result in action on the part of the Owner to recover these avoidable costs from the Contractor by applying the following charges:

3.3.3.2.1 $1,500.00 for reports that are 2 – 3 workdays beyond the date of occurrence

3.3.3.2.2 $5,000.00 for reports that are more than 3 workdays beyond the date of occurrence

3.3.3.3 General Liability – Property Damage:

3.3.3.3.1 If the Owner determines that the Contractor failed to take proper precautions prior to an incident that results in a property damage claim against the General Liability coverage, the Owner may recover from the Contractor the first $5,000.00 of incurred cost against the claim.

3.4 WORKERS COMPENSATION PROCEEDINGS

3.4.1 The ODR may require the Contractor and/or the enrolled employer of an injured worker to provide knowledgeable representation at legally binding proceedings scheduled by the Texas Department of Insurance. The proceedings that affect the amount of compensation are “Benefit Review Conferences” and “Contested Case Hearings”. Failure to provide such representation may result in Owner issuance of a recovery charge to the Contractor of $5,000.00 per proceeding.

3.5 EMPLOYEE RETURN TO WORK REQUIREMENTS

3.5.1 The Contractor and every Subcontractor shall provide viable “Return to Work” (RTW) for all workers that are injured on an OCIP project. There are no exceptions. Any injury that results in restrictions to the worker will be included in this requirement.

3.5.2 The Contractor and Subcontractor may be required to provide the following to comply with this requirement:

3.5.1.1 Job descriptions that clearly identify and explain essential job functions and tasks required for each position. Minimum physical limits, motor skills, and endurance times shall be included.

3.5.1.2 Procedures and responsibilities shall help physicians understand the RTW requirements, the employee’s typical work assignments and activities, and available alternate assignments.

3.5.1.3 A commitment to the continuous employee education about the RTW requirements shall include monitoring of assignments, record keeping, and communications with physician(s) and injured worker(s), and tracking of compensation reports.

3.5.1.4 Full compliance with the Americans with Disabilities Act, Family Medical Leave Act, the Texas Worker’s Compensation Act, and any other State or federal law.

3.5.3 Employment for Workers with Medical Restrictions (“Return to Work” or “Light Duty” policy):

3.5.3.1.1 Failure to comply with the RTW requirements and restoring medically restricted workers to full duty may result in an assessment of a recovery charge by the Owner to the Contractor of $5,000 per finding.

3.5.3.1.2 If the Owner determines that the Contractor or any enrolled Subcontractor deliberately obstructs a reasonable request that is intended to restore an injured worker to gainful employment, the Owner will assess a recovery charge against the Contractor of $5,000.00 per claim per month until the worker is returned to employment. If the Contractor or enrolled Subcontractor believes that the medical restrictions prohibit any possible employment, the Contractor will be required to prove this to the Owner's satisfaction.

3.5.3.1.3 Failure to pass or refusal to take any substance impairment screening will result in Owner requirement that the involved worker be removed from the Project and all MD Anderson projects.

3.5.3.1.4 The cost of all post-accident screening is the responsibility of the injured worker's employer.

3.6 EXPIRATION AND AVAILABILITY OF COVERAGE

3.6.1 Termination of OCIP Coverage

3.6.1.1 Except for Extended Completed Operations coverage or Extended Ongoing Operations coverage for Repair Work, the General Liability and Excess Liability insurance furnished by the Owner under this agreement will cease for the Contractor and each enrolled Subcontractor at the earlier of OCIP program expiration or when all work called for in the Contract has been completed. Workers Compensation coverage will continue until the earlier of OCIP program expiration or when all work called for in the Contract has been completed.

3.6.2 Availability and Cancellation

3.6.2.1 Subject to market availability, all insurance specified herein shall be maintained continuously until the scheduled completion/termination date. All insurance shall provide for Owner to take occupancy of the Work or any part thereof during the term of said insurance. If coverage is diminished or cannot be renewed due to market constraints and limitations, all insured Contractors will be notified within the sixty (60) day cancellation or non-renewal period as provided in the policies. Upon termination of the Owner-provided insurance, the Contractor and all enrolled Subcontractors shall be responsible for furnishing all insurance as described in the UGSGC and Article 2.2 above.

3.6.2.2 Owner-furnished insurance may also be discontinued in the event the Project is substantially delayed for an extended period of time, or the Project is permanently terminated for any cause.

END OF SECTION 00 73 16

REVISION LOG

The following is provided for convenience to the Owner, Architect/Engineer and Contractor to track changes between document issuances and is not to be considered by any party to be contractual or 100% complete.

Date	**Paragraph Revised**
02/01/08	3.4 - Revised Texas Worker's Compensation Commission to Texas Department of Insurance.
5/1/08	3.5.2 – Relocate Employment for Workers with Medical Restrictions ("Return to Work" or "Light Duty" policy)
10/1/08	Title changed to "ROCIP", 2.1.2.3.2 – Change "3 years" to "10 years", 2.1.2.4.1 change "$25 M" extended coverage to "$50 M"
9/01/09	Title changed to "OCIP"; corrected spelling of "SUBCONTRACTOR" in Article 2.2 and revised all Article 3.6 subsections.
12/13/12	Clarifications of UGS abbreviation, exemption and drug testing clarifications and miscellaneous clarifications.
01/08/13	Clarified Article 2.4.1.1 on erection and dismantling work.

SECTION 01 10 00 - SUMMARY OF WORK

PART 1 – GENERAL

1.1 SECTION INCLUDES:

A. Work covered by Contract Documents.

B. Contract Method.

C. Starting Work.

D. Work by Others.

E. Contractor's Use of Premises.

F. Partial Owner Occupancy.

1.2 WORK COVERED BY CONTRACT DOCUMENTS

A. Architect Identification: The Contract Documents, dated March 22, 2013, were prepared for the Project by Perkins+Will, 1001 McKinney, Suite 1300, Houston, Texas 77002; telephone 713-366-4000; facsimile 713-528-3339.

B. This vivarium renovation is a core facility supporting all M.D. Anderson research programs on the North Campus. This project is to renovate existing large animal holding rooms into small animal holding and procedure space within the basement level vivarium areas and replacement of mechanical equipment to provide the required redundancy for the basement vivarium. The project is located within the Clinical Research Building (CRB) and partially within the Basic Sciences and Research Building (BSRB), which are adjacent and connected to each other.

C. The Work of this Contract comprises the general construction (renovation) of the existing CRB vivarium space in the basement level of the M.D. Anderson North Campus Vivarium (NCV).

1. The first objective is to renovate, expand, and equip procedure and housing areas in the NCV facility, to increase the capacity by approximately 8500 cages of mice and add critically needed specialized rodent procedure space. Approximately 12,254 sq. ft. of the CRB basement level will be involved in this renovation to add rodent housing and support space, while preserving adequate large animal housing and support space. This includes:
   - Expanded rodent housing and support space
   - Quarantine space for modified barrier health status rodents
   - Procedure space for specialized research needs
   - Rightsizing of large animal housing and support space

2. The second component is the augmentation of facility infrastructure to promote the efficient use of personnel and resources. These enhancements include:

   - Addition of materials management corridor
   - Extension of the Edstrom Watchdog and Viewport systems to CRB. The new system will include the following:
     - Monitor animal rack water pressure
     - Control room lighting
     - Monitor room lighting
     - Monitor room temperature
     - Monitor room humidity

- (Option - to be determined in DD phase) Control access to Animal Holding Rooms

- Edstrom Animal Watering System for small animals. Connection of new system to the existing large animal rooms will be included.
- Relocation of administrative office space, approximately 16,186 sq. ft.

a. The Contract Documents describe the essential elements sufficiently to determine the scope of the Project.

b. Provide all items required for complete operating systems including items not necessarily shown in these Contract Documents, but that can be reasonably inferred as being required for a complete operating system.

c. The Drawings and Specifications indicate the basic quality of material and quality of construction required for the overall project.

1.3 CONTRACT METHOD:

A. Construct the Work under a general construction contract for a single lump sum.

1.4 USE OF PREMISES

A. Contractor shall have limited use of premises for construction operations, including use of Project site, during construction period. Contractor's use of premises is limited to areas indicated or approved by the Owner, and by Owner's right to perform work or to retain other contractors on portions of Project.
   1. Allow for Owner occupancy and use by the public of, and to and from, the existing building.

B. Make each entity engaged in work on the project aware that the present buildings house operating facilities that must continue in operation during the construction period, except as the Architect and Owner may otherwise direct. Continue function of plumbing, heating, ventilating, electrical, fire alarm, and telephone systems with a minimum of interruptions in service. Do not block any required fire exits.

C. Confine operations at site to areas permitted by Law, Ordinances, Permits, and Contract Documents.

D. Do not unreasonably encumber site with materials or equipment.

E. Assume full responsibility for protection and safekeeping of products stored on premises.

F. Move any stored products which interfere with operations of Owner or other contractors.

G. Obtain and pay for use of additional storage or work areas needed for operations.

H. Limit use of site for work and storage as follows:
   1. Do not use completed paving areas for storage without Owner’s approval.
   2. Do not store materials where trees are located.
   3. Restrict Work and storage to areas indicated on Drawings or approved by Owner.
   4. Access site in areas approved by Owner.
   5. Restrict parking to areas approved by Owner.
   6. Do not perform operations that would interrupt or delay Owner's daily operations.

I. Driveways and Entrances: Keep driveways and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials

1.5 PROTECTION OF WORK AND PROPERTY

A. The Contractor shall maintain adequate protection of the Work from damage and shall protect the Owner's and adjacent property from injury or loss arising from the Work. Contractor shall provide and maintain at all times any OSHA-required danger signs, guards, and obstructions necessary to protect the public and construction personnel from any dangers inherent with or created by the Work in progress.
   1. All federal, state, and city rules and requirements pertaining to safety, and all EPA standards, OSHA standards, and NESHAP regulations pertaining to asbestos as required shall be complied with.

B. Twenty-four (24) Hour Call: The Contractor shall have personnel on call 24 hours per day, for emergencies during the course of the Project. The Owner shall be provided with a 24- hour emergency contact number of Contractor’s personnel. Contractor shall be able to respond to any emergency call and have personnel on-site within two (2) hours after contact. Numbers to be made available to the Owner shall include home, office and mobile numbers for the following:
   1. Contractor’s project manager.
   2. Contractor’s field superintendent.
   3. Owner or company officer of Contractor.

1.6 PARTIAL OWNER OCCUPANCY:

A. The Owner reserves right to use and occupy in whole or any part of the improvements which have been completed sufficiently to permit use and occupancy without delaying Contractor's work. Use and occupancy by Owner shall not, however, be construed as an acceptance of Work of any part, and any claim which Owner may have against Contractor shall not be deemed to have been waived by occupancy. Refer to General Conditions Article I. and IX. for Beneficial Occupancy requirements.

   1. For each partial use and occupancy prior to Beneficial Occupancy, Owner agrees to obtain written consent of Contractor, secure endorsement from insurance carriers, and consent of Surety.

   2. Prior to each use and occupancy, Owner and Contractor shall make mutually acceptable arrangements for security, protection and insurance for people and property; warranties; and operation, maintenance and payment for utilities and services for each such partial use and occupancy.

1.7 OWNER’S OCCUPANCY REQUIREMENTS

A. Partial Owner Occupancy: Owner will occupy the premises during entire construction period, with the exception of areas under construction. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's operations. Maintain existing exits, unless otherwise indicated.
   1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and authorities having jurisdiction.
   2. Provide not less than 72 hours' notice to Owner of activities that will affect Owner's operations.

1.8 OWNER-FURNISHED CONTRACTOR-INSTALLED PRODUCTS

A. Owner’s and Contractor’s Responsibilities:
   1. Contractor shall provide support systems to receive Owner's equipment as well as plumbing, mechanical, and electrical connections.
   2. Owner will arrange for and deliver Shop Drawings, Product Data, and Samples to Contractor.

3. Owner will arrange and pay for delivery of Owner-furnished items according to Contractor's Construction Schedule.
4. After delivery, Owner will inspect delivered items for damage. Contractor shall be present for and assist in Owner's inspection.
5. If Owner-furnished items are damaged, defective, or missing, Owner will arrange for replacement.
6. Owner will arrange for manufacturer's field services and for delivery of manufacturer's warranties to Contractor.
7. Owner will furnish Contractor the earliest possible delivery date for Owner-furnished products. Using Owner-furnished earliest possible delivery dates, Contractor shall designate delivery dates of Owner-furnished items in Contractor's Construction Schedule.
8. Contractor shall review Shop Drawings, Product Data, and Samples and return them to Architect noting discrepancies or anticipated problems in use of product.
9. Contractor is responsible for receiving, unloading, and handling Owner-furnished items at Project site.
10. Contractor is responsible for protecting Owner-furnished items from damage during storage and handling, including damage from exposure to the elements.
11. If Owner-furnished items are damaged as a result of Contractor's operations, Contractor shall repair or replace them.
12. Contractor shall install and otherwise incorporate Owner-furnished items into the Work.

1.9 SPECIFICATION FORMATS AND CONVENTIONS

A. Specification Format: The Specifications are organized into Divisions and Sections using CSI/CSC's "MasterFormat 2004" 50-Division format and numbering system.
   1. Section Identification: The Specifications use section numbers and titles to help cross-referencing in the Contract Documents. Sections in the Project Manual are in numeric sequence; however, the sequence is incomplete. Consult the Table of Contents at the beginning of the Project Manual to determine numbers and names of sections in the Contract Documents.
   2. Division 01: Sections in Division 01 govern the execution of the Work of all Sections in the Specifications.

B. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
   1. Abbreviated Language: Language used in the Specifications and other Contract Documents is abbreviated. Words and meanings shall be interpreted as appropriate. Words implied, but not stated, shall be inferred as the sense requires. Singular words shall be interpreted as plural, and plural words shall be interpreted as singular where applicable as the context of the Contract Documents indicates.
   2. Imperative mood and streamlined language are generally used in the Specifications. Requirements expressed in the imperative mood are to be performed by Contractor. Occasionally, the indicative or subjunctive mood may be used in the Section Text for clarity to describe responsibilities that must be fulfilled indirectly by Contractor or by others when so noted.
      a. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.

1.10 PROVISIONS FOR ELECTRONIC MEDIA

A. Website:
   1. Construction Documents and Reference Documents for this project will be kept on a website created by Newforma.
   2. Refer to the Website for constant changes and updates. Ensure use of current documents and information at all times, and verify most recent version of each document.

3. Coordinate use of website and provide access as required to subcontractors and suppliers. Obtain access information from Architect.

PART 2 – PRODUCTS NOT USED

PART 3 – EXECUTION NOT USED

END OF SECTION 01 10 00

SECTION 01 31 00 - PROJECT ADMINISTRATION

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

1.1.1. The Contractor's attention is specifically directed, but not limited, to the Uniform General and Supplementary General Conditions for University of Texas System Building Construction Contracts (UGC) for other requirements.

1.2. SUMMARY

1.2.1. This Section provides Project administrative and procedural requirements for the Contractor to supplement requirements defined in the UGC.

1.3. DEFINTIONS

1.3.1. Refer to the UGC for Contract definitions used throughout the Contract Documents.

1.4. NOTICE TO PROCEED

1.4.1. The Owner may issue a formal Notice to Proceed (NTP) with Construction, which will establish the start date, the Substantial Completion date, and the Final Completion date of the Work for contractual purposes.

1.5. CONTRACT SUBSTANTIAL COMPLETION

1.5.1. In order to obtain an inspection for Substantial Completion, the Contractor shall fulfill all requirements as specified in the UGC and Section 01 77 00 - Project Closeout Procedures.

1.5.2. The Owner may elect to accept the Project as a whole, or in segments as completed. When the Owner accepts the project, the Owner will issue a letter or certificate of Substantial Completion acceptance to the Contractor, defining continuing responsibilities of the parties and establishing date(s) for the completion of punch list items.

1.6. SUBCONTRACTS

1.6.1. Refer to the UGC for requirements not identified in this Section. Contractor shall furnish to the Owner a list of all first tier subcontractors to the Owner as subcontracts are executed. The Contractor agrees to bind every subcontractor and every subcontractor agrees to be bound by all the terms and conditions of the Contract Documents for the benefit of the Owner and the Architect/Engineer.

1.7. PREVAILING WAGE RATE

1.7.1. The Contractor must comply with all aspects of the UGC. Contractor shall require all workers to complete a “Worker Wage Rate Notification Form” before starting Work on the Project. The Contractor shall maintain certified payrolls, for the Contractor and all subcontractors, at the jobsite throughout construction.

1.7.2. The Owner’s Project Manager may verify wage rate compliance in the field by interviewing workers, or otherwise. The Contractor shall assist the Owner’s Project Manager with verification of wage rate compliance, including provisions for non-English speaking workers.

1.8. FLOW OF COMMUNICATIONS

1.8.1. Refer to the UGC for requirements not identified in this Section.

1.8.2. The Architect/Engineer is responsible for document control and general Project administration and is the key contact for written communications. The Owner's written instructions to the Contractor will generally be issued through the Architect/Engineer. On Design/Build projects, the construction management staff may provide this service if approved by the Owner.

1.8.3. All subcontractor correspondence shall be routed through the Contractor. All written Contractor correspondence shall be directed to the Architect/Engineer, with simultaneous copies to the Owner's Project Manager, Owner's Construction Inspector, and the OFPC Representative, if applicable. The actual parties for this Project will be confirmed at the Pre-Construction Conference.

1.8.4. The Owner's Project Manager and the Owner's Construction Inspector are the Owner's primary representatives for the Project. The Owner's Construction Inspector is the key contact for verbal communications and Site issue coordination.

1.8.5. The Owner's Project Manager and the Owner's Construction Inspector are the only parties authorized to direct changes in the Work, and issue written and/or oral instructions directly to the Contractor.

1.8.5.1. All ORAL instructions must be issued by the Owner's Construction Inspector and/or the Owner's Project Manager, or in their presence, and shall be promptly confirmed in writing by the Contractor. Any oral instructions or discussions with subcontractors in the absence of the Contractor are not contractual and are not binding on either party.

1.8.6. Per the UGC, the Architect/Engineer may issue clarification and other information not affecting the Contract cost or time by means of an Architect/Engineer's Supplemental Instruction form, (ASI), or similar clarification form, which will be sequentially numbered. Both the Architect/Engineer and the Contractor shall maintain a separate ASI register.

1.8.7. All subcontractor Requests for Information (RFI) shall be submitted by and under cover of the Contractor, who is to carefully review and ensure the completeness and appropriateness of the question, sequentially number each, and submit to the Architect/Engineer with copies to the Owner's Project Manager, Owner's Construction Inspector, and Institution representative (if requested). The Contractor and Architect/Engineer shall maintain separate RFI logs.

1.8.8. All Project correspondence shall include the University of Texas MD Anderson Cancer Center (MD Anderson) Project Number and Project Name in the title or reference.

1.8.9. Contractor shall process Pay Estimates, Requests for Information, Changes, and Submittals as shown in the Owner's Pre-Construction Conference Brochure.

1.9. CHANGED CONDITIONS

1.9.1. Refer to the UGC for requirements not identified in this Section. If the Contractor finds conditions at the Site to be materially different from that indicated in the Contract Documents, Contractor shall notify the Architect/Engineer, the Owner's Construction Inspector, and the Owner's Project Manager immediately in writing and prior to disturbing such conditions.

1.10. PROJECT CHANGES

1.10.1. All changes shall be administered per the UGC.

1.10.2. Upon authorization by the Owner, the Owner or Architect/Engineer will prepare and issue all changes to the Contract affecting cost, scope and/or time as a formal Change Order to the Contract on the standard University of Texas MD Anderson Cancer Center Change Order form. The Change Order may include separate change issues, identified as Change Proposals and Field Orders.

1.10.3. Upon authorization by the Owner, Change Proposals may be issued to the Architect/Engineer for pricing by the Contractor. Contractor shall submit pricing to the Owner within twenty-one (21) calendar days and pricing shall be indicated on the standard Owner "Change in Work Cost Analysis" ("Cost Analysis") form provided in the Pre-Construction Conference Brochure. Contractor may not include a Change Proposal within a Change Order unless the Owner has accepted the Change Proposal.

1.10.3.1. The Contractor shall summarize all costs for each change at each level of subcontractor and supplier by preparing the "Cost Analysis" form, and shall provide each subcontractor's cost summary on separate "Cost Analysis" forms as backup. Additional support documentation from both the Contractor and Contractor's subcontractors is encouraged, but such will not replace use of the standard form.

1.10.3.2. When the Contractor believes it is entitled to a time extension, Contractor shall so state as part of Contractor's response to the Change Proposal, including a justification for a time extension. Owner may grant time extensions only if a Change Proposal affects the activities on the Longest Path of an Owner approved Project Schedule; i.e., when the Work impacts the "Contract Substantial Completion Date".

1.10.3.3. If the Owner's Project Manager and Contractor cannot mutually agree upon a fair and reasonable cost and time settlement, the Owner's Project Manager may: 1) Reject the quotation and void the Change Proposal, 2) Issue instructions to the Contractor to proceed on a time and material basis for a price to be determined later not to exceed a fixed maximum dollar and time, or 3) Issue a Unilateral Change Order.

1.10.3.4. The Owner's Construction Inspector and/or Owner's Project Manager may issue Field Orders directly to the Contractor for minor changes to the Contract, which can be negotiated in the field. Pricing backup is at the discretion of the Owner's Construction Inspector, but pricing backup is required for any Field Order, the pricing backup is to be outlined on the "Cost Analysis" form. When the Owner and Contractor have signed the Field Order, the Work is authorized and the Field Order may be included in the next Change Order.

1.10.4. Request for payment for Change Order work may be submitted only after the Change Order has been fully executed.

1.11. CLAIMS FOR ADDITIONAL COST

1.11.1. Contractor shall timely and officially certify all claims for additional cost and shall specifically comply with all provisions of the UGC to be considered valid. Note that only the Contractor can make a claim for additional cost under the terms of the Contract Documents.

1.12. TIME EXTENSIONS OTHER THAN CHANGE PROPOSALS

1.12.1. Refer to the UGC for requirements.

1.13. LIQUIDATED DAMAGES

1.13.1. If assessed, Owner may withhold liquidated damages from progress payments beginning with the first payment after the adjusted Contract completion date and continuing through any subsequent progress payments until all Work of the Contract is complete. Owner may assess liquidated damages by deducting the liquidated damages from the Contract price or Guaranteed Maximum Price (GMP) Proposal through a unilaterally written deductive Change Order.

1.14. SITE USE ISSUES

1.14.1. Refer to the UGC and to Owner's Special Conditions for site use requirements not identified in this Section. The Contractor shall manage, coordinate, and direct the Work from the Site.

1.14.2. The Contractor is responsible for actions of the entire workforce whenever the workforce is at the Site, or passing through campus to the Site. Harassment of any kind toward any person will not be tolerated; offending workers will be removed from the Project immediately and permanently.

1.14.3. The Contractor shall provide and submit a program plan for worker orientation, identification of workers, and control of access to the Site. Any and all workers on the Project shall participate in this program before beginning Work on the Project. The program plan shall include, as a minimum:

1.14.3.1. An overview of the Contractor's plan for instruction of Site rules and regulations to all employees who participate on the Project, including but not limited to safety, restricted use of Owner's facilities, parking conduct/behavior, dress, sanitary facilities, security, etc.

1.14.3.2. Employee identification badges with a photograph of the employee, the employer, and employee's name. Badges shall be provided for all employees and produced by a system on Site. This identification shall be worn at all times while on the Site. Lack of an authorized identification badge shall be grounds for removal from the Site.

1.14.3.3. A detailed written plan indicating how the Contractor proposes to control pedestrian and vehicular traffic into and out of the Site. Contractor shall provide a separate plan for normal working hours, nights, after normal hours, weekends, holidays, etc. This plan may be incorporated into the Contractor's staging plan.

1.15. HISTORICALLY UNDERUTILIZED BUSINESS (HUB) PLAN

1.15.1. Refer to the UGC and Exhibit H of the Agreement for HUB requirements not identified in this Section.

1.15.2. The Contractor agrees to the Good Faith Effort procurement of historically underutilized businesses in accordance with the Historically Underutilized Business Plan (HUB) included in the Contract.

1.15.3. No subcontractor may be changed or added without the Owner's written consent.

PART 2 - PRODUCTS

2.1 SCHEDULING REQUIREMENTS

2.1.1 Refer to the UGC and Section 01 32 00 – Project Planning and Scheduling for detailed scheduling requirements not identified in this Section.

2.2 SHOP DRAWINGS AND SUBMITTALS

2.2.1 Refer to the UGC for requirements not identified in this Section.

2.2.2 Submittal Procedures: Contractor shall transmit each item using Owner's standard form. Contractor shall identify the project by Owner's assigned project number, Contractor, Subcontractor and supplier. Contractor shall identify pertinent drawing sheet and detail number and specification section number as appropriate. Contractor shall deliver submittals to Owner and Architect/Engineer as determined in the Pre-Construction Conference.

2.2.3 The Contractor shall include a Material Safety Data Sheet (MSDS) for any and all materials incorporated into the Project.

2.2.3.1 Contractor shall attach one copy of the MSDS to the submittal and shall keep one copy in a separate three-ring binder at the site. Contractor shall organize the three-ring binder by the appropriate section of the specifications.

2.2.4 The Contractor shall assign an identifying number to each submittal following a format to be established at the Pre-Construction Conference. The same number with a numerical or alphabetical suffix will be used to identify re-submittals.

2.2.5 Submittal Product Data: Contractor shall collect and organize manufacturer's product data into a single submittal for each element of construction or system. Contractor shall include printed product data such as manufacturer's installation instructions, compliance with recognized trade association standards and testing agency standards, catalog data sheets, standard color charts, roughing-in diagrams and templates, standard wiring diagrams and performance curves. Where product data must be specially prepared because standard printed data is not suitable for use, Contractor shall submit as Shop Drawings.

2.2.6 Shop Drawings: Contractor shall submit newly prepared information and drawn to accurate scale. Contractor shall highlight, encircle, or otherwise indicate deviations from the Contract Documents. Contractor shall not reproduce Contract Documents or copy standard information as the basis of Shop Drawings. Standard information prepared without specific reference to the Project is acceptable as Shop Drawings.

2.2.6.1 Shop Drawings include fabrication and installation drawings, setting diagrams, schedules, patterns, templates and similar drawings. Contractor shall include at least the following information:

2.2.6.1.1 Dimensions.

2.2.6.1.2 Identification of products and materials included.

2.2.6.1.3 Compliance with specified standards.

2.2.6.1.4 Notation of coordination requirements.

2.2.6.1.5 Notation of dimensions established by field measurement.

2.2.6.1.6 Except for templates, patterns and similar full-size Drawings, submit Shop Drawings on sheets at least 8-1/2" x 11" but no larger than 36" x 48".

2.2.7 The Architect/Engineer and the Contractor shall maintain separate registers showing the number and a brief identification of each submittal. The separate registers must show dates of actions on the submittal such as receipt, forwarding to another office, and approval status.

2.2.8 The burden of timeliness to complete the submittal process is on the Contractor. The Contractor shall allow sufficient time within the Project Schedule for the Architect/Engineer and Owner to review and approve all submittals, including time for all re-submittals on any unaccepted/rejected submittals.

2.2.9 The Contractor shall carefully examine all data submitted for approval and shall certify that the data has been carefully reviewed and found to be correct with respect to the Contract Documents.

2.2.9.1 Any deviation from the Contract Documents shall be conspicuously noted on the submittal and the transmittal cover sheet. Contractor's failure to conspicuously note deviations will void any action taken on the submittal.

2.2.9.2 All manufacturer's data contained within the submittal shall have all inapplicable features crossed out or deleted in a manner that will clearly indicate exactly what is to be furnished.

2.2.9.3 Equipment of larger sizes than shown, even though of a specified manufacturer, will not be acceptable unless it can be demonstrated that ample space exists for proper installation, operation, and maintenance.

2.2.9.4 Should the Architect/Engineer, on initiating Architect/Engineer's review, find the submittal unstamped or uncertified, non-responsive and/or incomplete, Architect/Engineer shall return the submittal to the Contractor immediately. Such returned documents will not be recognized as having been an official submittal.

2.2.10 The Owner will not be responsible for payment of any item that has not been submitted and approved through the established submittal process.

2.2.11 The exact number of submittal copies required for distribution will be determined at the Pre-construction Conference. The Contractor should anticipate providing electronic copies and a minimum of twelve (12) hard copies of each submittal <u>in addition to those needed by the Contractor or Contractor's subcontractors</u>. Contractor shall set aside two (2) of the approved copies returned to the Contractor for subsequent turn over to Owner at Project Closeout. Contractor shall also submit approved submittals to Owner in original electronic file format as described in Section 01 77 00 – Project Closeout Procedures.

2.2.12 Samples: As required by individual Sections of the Contract Documents, Contractor shall submit full-size, fully fabricated samples cured and finished as specified and physically identical with the material or product proposed. Samples shall include partial sections of manufactured or fabricated components, cuts or containers of materials, color range sets, and swatches showing color, texture and pattern.

2.2.12.1 Contractor shall mount, display, or package samples in the manner specified to facilitate review by Owner and Architect/Engineer. Contractor shall prepare samples to match the Architect/Engineer's sample, which shall include at least the following information:

2.2.12.1.1 Generic description of the Sample.

2.2.12.1.2 Sample source.

2.2.12.1.3 Product name or name of manufacturer.

2.2.12.1.4 Compliance with recognized standards.

2.2.12.1.5 Availability and delivery time.

2.2.12.2 Contractor shall submit samples for review of kind, color, pattern, and texture, for a final check of these characteristics with other elements, and for a comparison of these characteristics between the final submittal and the actual product delivered and installed.

2.2.12.3 When variation in color, pattern, texture or other characteristics are inherent in the material or product represented, Contractor shall submit no less than three (3) multiple units that show approximate limits of the variations.

2.2.13 Refer to individual Technical Specification Sections for additional submittal requirements.

2.3 SUBSTITUTION OF MATERIALS, LABOR AND EQUIPMENT

2.3.1 Refer to the UGC for requirements not identified in this Section.

2.3.2 The specified products used in preparing the Contract Documents establish minimum qualities. Substitutions must be at least equal to the minimum qualities for consideration by Owner as an acceptable substitution. The burden of proof of equality rests with the Contractor. The Owner retains sole authority for acceptance of substitutions.

2.3.3 Contractor shall clearly and boldly mark all substitutions as such on the transmittal cover sheet for the submittals. Contractor shall submit all substitutions within ninety (90) days of the Notice to Proceed for Construction.

2.3.4 The Contractor shall allow a minimum of six (6) weeks for review of each substitution by the Architect/Engineer and/or Owner in addition to the requirements identified in Section 2.2 above.

2.3.5 When requested by the Architect/Engineer, the Contractor shall provide a sample of the proposed substitution item. Owner may require Contractor to provide samples of both the specified item and the proposed item for comparison.

2.3.6 Owner may base acceptance of materials and equipment on the supplier/ manufacturer's published data and may be tentative subject to the submission of complete shop drawings and/or specifications indicating compliance with the Contract Documents. Owner's acceptance of materials and/or equipment under this provision shall not be construed as authorizing any deviation from the Contract Documents, unless specifically directed in writing from the Owner and/or Architect/Engineer.

2.3.6.1 Contractor shall be solely responsible for all additional costs resulting from the acceptance of any substitution. Additional costs include direct and indirect costs that are not presented at the time of the substitution request and costs that become known after the approval of the substitution.

2.3.7 Should the Owner accept a substitution and should the substitute prove defective or otherwise unsatisfactory for the service intended within the guarantee period, Contractor shall replace the substitute with the material or equipment specified in the Contract Documents at no additional cost to the Owner.

2.4 INITIAL APPLICATION FOR PROGRESS PAYMENT

2.4.1 Refer to the UGC and Section 01 32 00 – Project Planning and Scheduling for requirements not identified in this Section.

2.4.2 The Contractor may submit a request for a progress payment once per month. Such request shall be presented on the University of Texas MD Anderson Cancer Center Application for Payment and Schedule of Values (refer to Attachment No. 1 and No. 2) forms supplemented by columnar continuation sheets, which represent updates to the original Contract Price or GMP Schedule of Values.

2.4.3 The Contractor shall keep Project accounting records on the basis of generally accepted accounting principles in accordance with cost accounting standards issued by the Federal Office of Management and Budget Cost Accounting Standards Board and organized by each Application for Payment period.

2.4.4 Prior to the submission of the first Application for Payment and within twenty-one (21) calendar days of issuance of the Notice to Proceed with Construction, the Contractor shall submit the following documents to the Architect/Engineer, Owner's Project Manager, and Owner's Construction Inspector for review, using the Owner's Standard Schedule of Values format.

2.4.4.1 Contract Price or GMP Schedule of Values: Contractor shall submit a single document itemizing the breakdown of the Contract Price/GMP, including general conditions, contingencies and allowances using the Owner Standard Schedule of Values format. The Contractor shall submit a draft breakdown at least twenty-one (21) calendar days prior to the initial Application for Payment and such submittal shall be a condition precedent to the processing of the first payment application. The Contractor shall submit subsequent draft copies of the Schedule of Values at least seven (7) calendar days prior to formal submission of each monthly payment.

2.4.4.1.1 The Schedule of Values breakdown shall follow the trade divisions of the specifications and shall be itemized by submittal, floor, area, elevation or other building systems, as a minimum. The breakdown shall include a labor and material breakdown for each line item and be of such detail as may be required by the Owner and/or Architect/Engineer, but in general shall limit each line item to less than $100,000.

2.4.4.1.2 No adjustment to the original detailed breakdown of a Contract line item shall be made once accepted by the Owner and Architect/Engineer. Once accepted, the breakdown will form the basis for all periodic payments.

2.4.4.1.2.1 Contracts with Construction Manager at Risk or Design/Build Agreements may adjust the detailed breakdown of a General Conditions line item if the total invoices for a General Conditions line item exceeds one hundred percent (100%). A corresponding amount shall be deducted from another General Condition line item(s) or the Construction Phase Fee to pay for the General Conditions' line item overage.

2.4.4.1.3 Contractor shall not use subcontractor invoices/pay applications in lieu of a single Schedule of Values from the Contractor.

2.4.4.1.4 The breakdown shall anticipate future Change Orders and make provisions for incorporating all changes into the Schedule of Values listing. If issued, Change Orders shall be identified separately and shall itemize the GMP Change Orders, Change Proposals and/or Field Orders, which are

incorporated into each Change Order for payment on a line-item basis as required by this section.

2.4.4.1.4.1 Payments shall not be made for work contained in unexecuted Change Orders.

2.4.4.1.5 Contracts with Guaranteed Maximum Price proposals shall repeat the process outlined in this section every time a subcontract is added to the monthly Schedule of Values for payment.

2.4.4.2 Work Progress Schedule: Refer to Section 01 32 00 – Project Planning and Scheduling for all Project schedule requirements.

2.4.4.3 Shop Drawing/Submittal Schedule: Contractor shall provide the Owner and Architect/Engineer with a Submittal Schedule of all items requiring submittal review showing the items' anticipated submission dates and late finish dates for completion of the review process. The Submittal Schedule shall be incorporated with the Work Progress Schedule, and each will be updated monthly and submitted to the Architect/Engineer and Owner with each draft payment request.

2.4.4.4 Equipment List/Matrix: Section 01 91 00 – General Commissioning Requirements requires a matrix of all operable devices and building system components be submitted to the Owner. This matrix may be incorporated into equipment documentation required in Operating and Maintenance Manuals as indicated in Section 01 77 00 – Project Closeout Procedures.

2.4.4.5 The Contractor is encouraged to integrate these documents to the extent practical to avoid duplication, both in initial setup and ongoing updates to each.

2.4.5 When the Owner and Contractor agree to the Schedule of Values line item amounts, the Contractor shall submit eight (8) copies of the formal payment application to the Architect/Engineer, utilizing the University of Texas MD Anderson Cancer Center form, with original signatures of an officer of the contracting firm and original notarization. The Contractor shall furnish a certificate designating a person(s) who has authority to sign pay applications on behalf of the firm if such is not an officer of the firm.

2.4.5.1 The Contractor shall provide attachments to each month's payment request per the UGC. Contractor should verify the number of copies of each attachment with Owner prior to submission.

2.4.5.1.1 Six (6) copies of the monthly HUB Progress Assessment report (Attachment H to Exhibit H).

2.4.5.1.2 Four (4) copies of the updated Submittal Schedule.

Four (4) copies of all invoices required by the Contract.

2.4.5.1.3 Three (3) copies of the wage rate notification form for each member of the workforce not previously submitted.

2.4.5.1.4 Copies of an appropriately updated Work Progress Schedule as specified in Section 01 32 00 – Project Planning and Scheduling.

2.4.5.1.5 Documentation of partial Release of Liens and Claims in accordance with the value of the monthly Application for Payment.

2.4.5.2 The formal payment requests with attachments shall be organized and distributed according to the flow chart included in the Pre-Construction Brochure.

2.4.6 The formal monthly pay applications shall be first certified by the Architect/Engineer and then submitted to the Owner's Project Manager for signature and processing. The Contractor can expect receipt of payment within thirty (30) calendar days after the Owner's Project Manager receives the formal Pay Application.

2.5 MONTHLY APPLICATION FOR PROGRESS PAYMENTS

2.5.1 Refer to the UGC and Section 01 77 00 – Project Closeout Procedures, for requirements not identified in this Section.

2.5.2 For regular monthly applications for payment, the Contractor shall submit for review and approval a draft payment request to the Owner's Project Manager and the Architect/Engineer no less than seven (7) calendar days prior to formal submission. The Contractor shall be prepared to review the draft copy at the project Site with the Owner and the Architect/Engineer. Failure to comply with the requirements outlined in Section 2.4 above shall relieve the Owner from Owner's obligation to make payments on any and all line items until the Contractor meets all requirements.

2.5.2.1 Payments cannot exceed the Contract, work in-place, or subcontract amounts as depicted on Schedule of Values line items.

2.5.2.2 All as-built drawings shall be reviewed to ensure updates are current.

2.5.2.3 Retainage shall not be used to cover "punch-list" work items.

2.5.3 Requests for payments in association with release of, or reduction in, retainage or completion of Work have additional requirements as outlined in the UGC and Section 01 77 00 – Project Closeout Procedures.

2.6 PROCUREMENT OF SUBCONTRACTS – CM-R AND DB AGREEMENTS ONLY

2.6.1 The Construction Manager at Risk (CM-R) or Design/Build Contractor (DB) shall provide a written Bid/Proposal Package Strategy (B/PPS) for procuring subcontracts including self-performance Work (other than General Conditions), prior to the approval of the Guaranteed Maximum Price, but no later than twenty (20) calendar days prior to the first advertisement for proposals. The B/PPS shall be a written plan submitted to and reviewed by the Owner and the Architect/Engineer.

2.6.1.1 The plan shall identify bid packages that are most advantageous to the Project and align with the CM-R/DB's HUB Good Faith Effort (Exhibit H) by providing at least three (3) qualified respondents (including the CM-R/DB). Each bid package shall include the UGC, Owner's Special Conditions, the Owner's Division 1 Specifications, Drawings and Specifications and any other Owner requirements included in the CM-R/DB Agreement pertaining to the scope of work covered in the packages.

2.6.1.2 The B/PPS shall conspicuously identify any and all work that the CM-R/DB will submit a bid/proposal for, but will not perform with CM-R/DB's own forces (i.e. subcontract to someone else if determined to be "best value").

2.6.1.3 The B/PPS shall include the following for each bid package contemplated:

2.6.1.3.1 Anticipated scope of work to be procured.

2.6.1.3.2 Anticipated selection criteria and questions.

2.6.1.3.3 Self-perform work proposals to be submitted by the CM-R/DB.

2.6.1.3.4 Proposed advertising dates.

2.6.1.3.5 Proposed pre-proposal/HUB/ROCIP meetings.

2.6.1.3.6 Proposed Receipt, review and award dates.

2.6.1.3.7 Anticipated notice to proceed dates.

2.6.1.4 The CM-R/DB shall update the B/PPS monthly as a minimum or whenever conditions change or proposed dates are revised.

2.6.2 For CM-R contracts, Texas Education Code 51.782 mandates: “A construction manager-at-risk shall publicly advertise, in the manner prescribed by the institution, and receive bids or proposals from trade contractors or subcontractors for the performance of all major elements of the work other than general conditions work. A construction manager-at-risk may seek to perform major elements of the work itself if the construction manager-at-risk submits its bid or proposal for that work in the same manner as all other trade contractors or subcontractors and if the board determines that the construction manager-at-risk's bid or proposal provides the best value for the institution.”

2.6.3 The goal of the Project Team shall be to have all work procured through advertised competitive proposals, however, if a “minor procurement” condition arises during the process, the following procurement guidelines may be used by the CM-R/DB, with Owner approval, for procurement of work:

2.6.3.1 Less than $15,000.00: No requirements

2.6.3.2 Between $15,000.01 and $50,000.00: Obtain three (3) informal proposals

2.6.3.3 Greater than $50,000.00: Advertised competitive proposals

2.6.4 This specification does not pertain to Change Orders to existing subcontracts.

2.6.5 Work may be divided into reasonable lots; however, material or labor acquired through purchase order/vendor type agreements are subject to the entire Project (i.e. concrete material shall be procured as a unit price times an estimated total project quantity provided by the CM-R/DB to equal a total construction cost). Work shall not be incrementally divided for the purpose of circumventing the procurement guidelines.

2.6.6 The CM-R/DB may establish selection criteria for each phase of work for review by the Project Team. Criteria shall be qualifications based and consistent with the information needed by the CM-R/DB to make a proper evaluation and selection. The CM-R/DB shall establish a selection matrix including cost, criteria, weighting and ranking procedures for evaluation. The CM-R/DB shall work with the Project Team to tailor the selection criteria to be project and scope specific, and ensure that the questions are proper and relevant to the goals of the Project. The CM-R/DB shall follow the Good Faith Effort (HUB) requirements identified in Exhibit H of the Agreement, including attachments to be completed by first tier subcontractors. However, HUB participation/status cannot be used as criteria for determining “best value”, only for determining if the respondent is responsive.

2.6.6.1 The CM-R/DB shall establish clear criteria and questions so that those reading the Request for Proposals will understand how they will be evaluated.

2.6.6.2 If criteria are not included in the advertisement for proposals, the proposal shall be considered a lump sum bid, and the CM-R/DB shall award the work to the lowest qualified, responsive bidder.

2.6.6.3 After selection criteria have been established, the CM-R/DB shall publicly advertise the work in general circulations and trade associations in accordance with Texas Education Code 51.782 for CM-R, Article 5 of the current Agreement for DB and Texas Administrative Code 111.14 – "HUB" for both CM-R and DB. This advertisement shall include, at a minimum, the following:

2.6.6.3.1 Owner Project Number and Owner Project Name.

2.6.6.3.2 Institution/Campus name.

2.6.6.3.3 CM-R/DB name and address.

2.6.6.3.4 CM-R/DB contact name and phone number.

2.6.6.3.5 Location for viewing plans and specifications.

2.6.6.3.6 Date, time and location of Pre-proposal/HUB/ROCIP meeting.

2.6.6.3.7 Date, time deadline(s), and location for receiving proposals.

2.6.6.3.8 Instructions to respondents for submitting proposals.

2.6.6.3.9 Selection criteria, questions and submittal requirements.

2.6.7 At the time and location identified in the advertisement, the CM-R/DB shall hold a Pre-proposal/HUB/ROCIP meeting for all potential subcontractors with the Project Team and Owner's HUB Coordinator. The CM-R/DB shall review as a minimum:

2.6.7.1 The general scope of the Project and the specific scope of work included in this package.

2.6.7.2 Instructions to respondents for submitting proposals.

2.6.7.3 Selection criteria and questions.

2.6.7.4 HUB Good Faith Effort requirements (Exhibit H).

2.6.7.5 Project Safety requirements.

2.6.7.6 OCIP requirements (if applicable).

2.6.7.7 Project Schedule requirements.

2.6.7.8 Payment procedures and requirements, including retainage.

2.6.7.9 Commissioning and Close-out requirements.

2.6.8 If the CM-R/DB identifies any self-performance in the B/PPS (work to be performed by CM-R/DB's own employees), the CM-R/DB shall submit a proposal to the Owner at the advertised time and location in a manner so as not to compromise the competitive process.

2.6.8.1 Regardless of the work or method of accepting proposals, all CM/DB self-performance proposals shall be:

2.6.8.1.1 Estimated and submitted by a separate estimating team that is not associated with the CM/DB's pre-construction and/or construction team;

2.6.8.1.2 Submitted in a sealed envelope;

2.6.8.1.3 The final proposal price and not subject to change for any reason prior to recommendation of subcontract award.

2.6.9 The CM-R/DB shall accept all proposals at the advertised location until the advertised deadline. Upon receipt, the Owner's Project Manager will initial the proposal to indicate the time and date received. Any proposals received after the deadline shall not be considered by the CM-R/DB, and shall be returned to the respondent unopened.

2.6.9.1 Fax proposals will not be accepted unless the Owner, prior to the initial advertisement for proposals, approves a detailed plan by the CM-R/DB of care and custody.

2.6.10 After compiling, reviewing and verifying the costs and scope associated with all proposals, the CM-R/DB shall provide a "bid tabulation" matrix and a proposed Schedule of Values (refer to Attachment No. 2) for review by the Project Team.

2.6.10.1 The "bid tabulation" matrix shall compare all equivalent scope proposals to the CM-R/DB's estimate.

2.6.10.2 Each matrix shall indicate the CM-R/DB estimate(s) for each scope of work and identify the respective cost savings/over-runs.

2.6.10.3 The CM-R/DB may use values/quantities from CM-R/DB's own estimate to provide full scope comparisons between each respondent, however, these "plug" numbers shall be clearly identified in the matrix to the Project Team and be used only to compare the various proposals.

2.6.10.4 The proposed updated Schedule of Values shall summarize all executed and recommended "best value" subcontracts to provide a current status of the Guaranteed Maximum Price Proposal.

2.6.10.5 Once the proposals are compiled into a "bid tabulation" matrix and the proposed Schedule of Values has been updated, the CM-R/DB shall request a meeting with the Project Team to review the proposals.

2.6.11 The CM-R/DB shall lead the proposal review meeting by reviewing the scope of work, the proposals received, any exclusions or conditions, identify any non-qualified respondents and any other problems that may have occurred during the process.

2.6.11.1 The CM-R/DB shall confirm that the respondents are qualified, meet the established selection criteria (if applicable), and identify the amount of the proposals.

2.6.11.2 The CM-R/DB shall identify the "best value" and the current status of the buy-out savings to the Project Team. If the "best value" causes the CM-R/DB to exceed the Cost of Work line item, including contingencies in the GMP the CM-R/DB shall acknowledge that the overage will be deducted from the CM-R/DB's Construction Phase Fee.

2.6.12 Once the "best value" respondent has been identified by the CM-R/DB, without exception by the Owner, the CM-R/DB shall finalize negotiations with the selected "best value" respondent.

2.6.12.1 The CM-R/DB shall identify and confirm with the Owner's Project Manager the competitive proposal "plug" numbers CM-R/DB intends to use in CM-R/DB's negotiations. "Plug" numbers may be established through the CM-R/DB's own estimate (if submitted to the Owner's Project Manager before the advertised deadline) or values included in other non-selected respondent competitive sealed proposals.

2.6.12.2 If the CM-R/DB cannot reach an agreement with the selected respondent, the CM-R/DB shall notify the Owner's Project Manager that CM-R/DB intends to begin negotiations with the second "best value" respondent.

2.6.12.3 The CM-R/DB shall issue a letter to the Owner indicating that CM-R/DB intends to write a subcontract to the selected "best value" respondent (including self-perform work), identifying the following:

2.6.12.3.1 The bid package number.

2.6.12.3.2 The base bid from the selected respondent and any alternates included in the proposal.

2.6.12.3.3 The total value of the proposed subcontract with a description of any changes from bid day values.

2.6.12.3.4 Drawings and/or specifications related to the subcontract.

2.6.12.3.5 Additional scope items added to the subcontract (as previously agreed to by the Owner) and their value.

2.6.12.3.6 Current status of the GMP identifying current savings/overages.

2.6.12.3.7 A copy of the bid tabulation matrix.

2.6.12.3.8 A copy of the executed subcontract or purchase order, etc. is required prior to any request for payment by the CM-R/DB for applicable work.

2.6.12.4 If the Owner objects to the "best value" identified by the CM-R/DB, the Owner may conduct an evaluation of the selection process and/or results.

2.6.12.4.1 If, after evaluation, the Owner disagrees with the CM-R/DB "best value" recommendation, the Owner may instruct the CM-R/DB to either re-bid the scope of work or use the Owner's "best value" selection.

2.6.12.4.2 If the value of the Owner's selection causes an increase in the Contract Sum, the increase will be the responsibility of the Owner.

2.6.12.5 The CM-R/DB shall provide one (1) complete copy of all recommendation letters and proposals to the Owner's Project Manager for record, as they occur until final payment.

2.6.13 For additional bid packages, the CM-R/DB shall repeat the steps identified in this section as many times as identified in the current B/PPS for the entire Project.

2.7 DAILY REPORT

2.7.1 The Contractor shall provide the Architect/Engineer, Owner's Project Manager and Owner's Construction Inspector with a report detailing Contractor's daily activities on the Project using a format acceptable to Owner. All tests that Contractor performs and all work reports required of subcontractors shall be attached to the Contractor's daily report.

2.7.1.1 The report shall include, as a minimum, the following information as it relates to the day's activities on the Site: subcontractors on the Site (including number of employees for each subcontractor); equipment; areas of work and type of work performed; material received; tests performed; any injuries and/or accidents; total number of employees on the Site (including Contractor); any oral instructions received; any material damage; any change in personnel; and anything else that might impact quality or schedule.

2.7.2 Contractor shall submit these reports to the Owner's Project Manager and Owner's Construction Inspector on a daily basis.

2.8 AS-BUILT DRAWINGS AND RECORD DOCUMENTS

2.8.1 Contractor shall continuously annotate "As-Built" drawings, specifications, Operating and Maintenance manuals, shop drawings, and submittals to reflect actual record conditions, addenda, issuance of Change Orders and clarifications, and actual dimensional records for underground and other services. Refer to Section 01 77 00 – Project Closeout Procedures for detailed instructions.

2.8.2 Contractor is required to maintain current documentation in order to process pay applications. The Owner's Project Manager and the Architect/Engineer will review the status of such documentation monthly, at a minimum.

2.8.3 Refer to Section 01 91 00 –General Commissioning Requirements for requirements regarding the Commissioning and Closeout Manual tracking of these documents.

PART 3 – EXECUTION

3.1 PRE-CONSTRUCTION CONFERENCE (WITH OR WITHOUT A PARTNERING WORKSHOP)

3.1.1 Architect/Engineer will prepare a Pre-Construction Brochure using the standard Owner Pre-Construction Brochure, as an overview of administrative procedures for the Project. A review of the Brochure, including this Section, identification of key Project personnel, diagrams illustrating documentation routing, Owner's sample administrative forms, and other information will be conducted at the Pre-Construction Conference.

3.1.2 Upon mutual agreement, a Partnering Workshop may be held with or near the time of the Pre-Construction Conference. The Contractor shall pay for the Pre-Construction Conference and/or Partnering Workshop in total and the Owner will reimburse the Contractor for fifty percent (50%) of the mutually agreed-upon costs (100% of the costs will be reimbursed to the Contractor as part of the General Conditions in the GMP for CM-R and DB contracts).

3.1.2.1 The Pre-Construction Conference and/or Partnering Workshop is intended to provide further understanding among the parties, to establish mutual goals for the Project, and to develop strategies for achieving those goals.

3.1.3 The Owner will schedule a Pre-Construction Conference to generally coincide with issuance of Notice to Proceed with Construction. The Pre-Construction Conference agenda will cover broad Project issues followed by detail review of administrative procedures.

3.1.3.1 The UGC requires the Contractor to comply with the Owner's administrative requirements as outlined herein and as reviewed at the Pre-Construction Conference.

3.1.3.1.1 For projects with Guaranteed Maximum Price contracts the Owner may require a Pre-Construction meeting prior to Notice to Proceed with Construction.

3.1.3.1.2 For projects with Guaranteed Maximum Price contracts and multiple bid packages, the Owner may schedule additional Pre-Construction Conferences to include any subcontractors added to the Project after the initial Pre-Construction Conference.

3.1.4 Attendance is required at the conference by all appropriate representatives of the Contractor, mechanical, electrical, plumbing subcontractors, and any additional subcontractors (proposed or engaged), whose scope of work represents five percent (5%) or more of the total construction cost. The Contractor shall request all HUB subcontractors also be represented. Each firm is to be represented by personnel directly involved in the Project, including Project Managers and Project Superintendents or labor foremen, as a minimum.

3.1.4.1 Project representatives of the Contractor and all other parties directly involved with the processing or executing of Project submittals, changes and/or payments should attend the Pre-Construction Conference.

3.1.5 Prior to the scheduled time of the Pre-Construction Conference, the Contractor shall provide the Architect/Engineer a written outline of all involved firms, Contractor's key personnel, including mailing address and phone numbers to be incorporated into a Project Directory and included in the Pre-Construction Brochure.

3.1.6 The Architect/Engineer will provide to the Contractor, a minimum of eight (8) copies of the Pre-Construction Brochure prior to the scheduled date of the Pre-Construction Conference. The Contractor shall review the contents of the Pre-Construction Brochure with Contractor's key Project personnel and those of Contractor's subcontractors in preparation for the Pre-Construction Conference.

3.2 OWNER'S MONTHLY PROJECT PROGRESS MEETINGS

3.2.1 In addition to specific coordination meetings, pre-installation contractor meetings for each element of Work, and other Project meetings for other purposes, the Owner may schedule and conduct a Project Progress Meeting at least once each month with the timing generally coinciding with preparation of payment request and submission of the updated Project Schedule.

3.2.2 The Contractor shall coordinate with Contractor's subcontractors so that each entity then involved in planning, coordination, or performance of Work will be properly represented at each meeting.

3.2.2.1 Prior to the monthly Project Progress Meeting, the Contractor shall convene a similar progress meeting with Contractor's subcontractors to review each of the subcontractor's present and future needs including interface requirements, utility outages required, sequences, deliveries, access, Site utilization, temporary facilities and services, hours of work, hazards and risks, housekeeping, change orders, and documentation of information for payment requests in order to be fully prepared to discuss all pertinent issues with the Owner. The Contractor shall notify the Owner and Architect/Engineer in advance of such meetings with subcontractors.

3.2.3 Owner's monthly Project Progress Meetings may include review of Contractor's updated Project Schedule and forecast of operations for the coming period, coordination issues, anticipated utility outages, status of requested change proposals and other cost impact

issues, status of the commissioning process, status of the HUB Plan, and other Project issues.

3.2.4 The Contractor and Architect/Engineer shall provide separate tracking logs for submittals, RFIs, ASIs, and changes in a package for each primary meeting participant. On Design/Build contracts, a single set of tracking logs may be utilized if accepted in advance by the Owner.

3.2.5 The Owner's Project Manager will chair the Project Progress Meetings. The Contractor shall be specifically prepared to discuss the following at each Project Progress Meeting:

3.2.5.1 Project Schedule Update Reports as required in Section 01 32 00 – Project Planning and Scheduling.

3.2.5.2 Status of "action" items from the previous Project Progress Meeting.

3.2.5.3 Status of buyout on Guaranteed Maximum Price projects.

3.2.5.4 Current status of product submittals and shop drawings, requests for information (RFI), and Architect/Engineer's clarifications (ASI).

3.2.5.5 Status of Project changes and other items of significance, which could affect progress.

3.2.5.6 Status of the commissioning process for the Project.

3.2.6 In addition to the monthly Project Progress Meeting, the Owner may also schedule bi-monthly, weekly, or other Project meetings at various stages of the Project as conditions may dictate. However, the complete report requirements noted above will apply only to the monthly Project Progress Meetings.

3.3 UTILITY OUTAGES

3.3.1 The Contractor shall notify the Owner's Construction Inspector and the Owner's Project Manager, in writing, of any planned utility outages in accordance with Owner's Special Conditions.

3.3.2 A standard form for processing a request for utility shutdown or any other campus disruption is included in the Pre-Construction Brochure. The Contractor shall utilize this form, with attachments as necessary, in requesting an outage.

3.3.3 The Contractor shall not turn services on or off, without prior written authorization from Owner. Unless directed otherwise, the Owner will turn services on and off.

3.4 TESTING

3.4.1 Refer to the UGC and Section 01 45 00 – Project Quality Control for additional requirements.

3.4.2 Where specific testing is specified in a technical section of the Specifications or indicated in the Contract Documents, the Contractor shall bear the costs of all tests unless the Contract specifically states that it is to be paid for by the Owner.

3.5 INSPECTIONS

3.5.1 Refer to the UGC and Section 01 45 00 – Project Quality Control for inspection requirements not identified in this Section.

3.5.2 The Contractor shall provide sufficient, safe and proper facilities at all reasonable times for observation and/or inspection of the Work by the Owner and Owner's consultants. This shall include any and all equipment necessary for access to various aspects of the Work.

3.6 FINAL ACCEPTANCE AND PAYMENT

3.6.1 The Contractor shall notify the Architect/Engineer and Owner's Project Manager and Owner's Construction Inspector, in writing that the Work will be ready for final acceptance verification on a definite date, a minimum of ten (10) calendar days prior to such proposed date.

3.6.2 In addition to requirements noted for Substantial Completion in the UGC and Section 01 77 00 – Project Closeout Procedures, final payment and/or release of remaining retainage requires submission of the following:

3.6.2.1 Consent of Surety.

3.6.2.2 Release of Liens and Claims.

3.6.2.3 Affidavit of payment of Debts and Claims.

3.6.2.4 Final Historically Underutilized Business Plan.

3.6.2.5 Completed and signed EPA Notice Of Termination.

3.6.2.6 Closeout of Owner's Contingency Allowance and/or Owner's Special Cash Allowance to a zero ($0) balance.

3.7 ONE-YEAR WARRANTY

3.7.1 If informed of a defect, the Contractor shall remedy the defect at Contractor's own cost and respond in writing to the Owner's Project Manager and the notifying party within ten (10) calendar days indicating the action taken to resolve the defect. Refer to the UGC.

3.7.2 The Contractor shall attend any and all meetings to resolve warranty issues. The Contractor will provide a tracking log of all warranty issues and Contractor's resolution.

3.7.3 The Contractor shall participate in an end-of-warranty Project review with the Owner, as scheduled by the Owner's Project Manager, at a time prior to termination of the warranty period.

3.7.4 Per the UGC, unless directed otherwise in writing by the Owner, all warranties shall use the date of Substantial Completion as the start date for that particular warranty.

3.7.4.1 If any equipment and/or system is completed prior to the date of Substantial Completion, Contractor shall provide, at Contractor's own cost, for the necessary warranty extension required by the UGC.

3.7.4.2 Contractor shall deliver all equipment to the Owner in an "as-new" condition. If equipment is put into service for the convenience of the Contractor, the Contractor shall, at Contractor's own expense, maintain, service and refurbish the equipment to "as-new" condition prior to delivery to the Owner.

3.7.5 Provisions described herein shall also apply to those items having warranties greater than one-year.

END OF SECTION 01 31 00

☐Yes ☐No

THE UNIVERSITY OF TEXAS
M.D. ANDERSON CANCER CENTER

APPLICATION FOR PAYMENT - CONSTRUCTION MANAGER AT RISK

APPLICATION FOR PARTIAL PAYMENT No. {ENTER No.} PROJECT No. {ENTER No.}

FOR THE PERIOD: {ENTER BEGINNING DATE} TO: {ENTER ENDING DATE} INCLUSIVE.

NAME OF PROJECT: {ENTER PROJECT NAME}

CM-R NAME & ADDRESS: {ENTER CM-R NAME & ADDRESS}

TO BE COMPLETED BY THE CONSTRUCTION MANAGER AT RISK

		PRE-CONSTRUCTION SERVICES	+	CONSTRUCTION SERVICES (GMP)	=	TOTAL CONTRACT AMOUNT
1	Original Contract Amount:	$ 0		$ 0		$ 0
2	Approved Change Order Extras:	$ 0		$ 0		$ 0
3	Accepted Change Order Deductions:	$ 0		$ 0		$ 0
4	Current Contract Amount:	$ 0		$ 0		$ 0
5	Total Completed To Date:	$ 0		$ 0		$ 0
6	Less Total Retainage Held To Date:	N/A		$ 0		$ 0
7	Total Net Earned Amount:	$ 0		$ 0		$ 0
8	Less Previous Payments:	$ 0		$ 0		$ 0
9	***Current Payment Due For Each Part:***	$ *0*		$ *0*		$ *0*
10	Balance To Finish, Including Retainage: *(line 4 less line 7)*	$ 0		$ 0		$ 0

AFFIDAVIT

Insurance: I, agent for the Construction Manager-at-Risk, do hereby certify that all insurances as required by law, and by the specifications, are in full force and effect as of this date.

Claims & Liability: I, agent for the Construction Manager-at-Risk, do furthermore certify that all current invoices and obligations have been paid in full, and there are no claims or liabilities against this contract.

_____
Signature of CMR

CONSTRUCTION MANAGER AT RISK'S NOTARIZED SIGNATURE

STATE OF TEXAS
COUNTY OF _____
(STAMP SEAL BELOW)

Personally before me, the undersigned authority, this day appeared ..... {PRINTED NAME OF CM-R AGENT} who being by me duly sworn, on his oath says that the account hereto attached, in the amount of ..... {ENTER AMOUNT} ..... in favor of {PRINTED NAME OF CONTRACTOR/FIRM} against The Board of Regents of the University of Texas System and M.D. Anderson Cancer Center. is, within the knowledge of affiant, just true, and correct: that it is due and that all just and lawful offsets, payments, and credits have been allowed.

Sworn to and subscribed before me, ... {CONTRACTOR SIGNATURE} ..... this _____ day of _____, 20 _____.
Signature of CONTRACTOR

Notary Public {NOTARY SIGNATURE} {ENTER NAME OF COUNTY} County, Texas
Signature of Notary

CONSTRUCTION SERVICES CERTIFICATE: TO BE COMPLETED BY THE PROJECT ARCHITECT/ENGINEER

TO THE BOARD OF REGENTS OF THE UNIVERSITY OF TEXAS SYSTEM, AUSTIN, TEXAS and the M.D. Anderson Cancer Center, Houston Texas

This is to certify that _____, Construction Manager-at-Risk

for the Project ..... _____ ..... is entitled to payment

for Construction Services of this Certificate in the amount of ..... $ _____

Architect/Engineer ..... _____

Reviewed and Approved on ..... _____ By: _____
Date *Signature of A/E*

PRE-CONSTRUCTION SERVICES : TO BE COMPLETED BY THE UTMDACC PROJECT MANAGER

Current Payment For Pre-Construction Services ..... $ _____

Reviewed and Approved on ..... _____ By: _____
Date *Signature of PM*

CONSTRUCTION SERVICES : TO BE COMPLETED BY THE UTMDACC PROJECT MANAGER

CM-at-Risk has submitted an updated Project Schedule: CM-at-Risk has updated the Record Drawings:

This Pay Application includes a current Release of Retainage: if "Yes", CM-at-Risk has included a "Consent of Surety":

Current Payment For Construction Services ..... $ _____

Reviewed and Approved on ..... _____ By: _____
Date *Signature of PM*

Attachment No. 2 – Schedule of Values Example

(Obtain an Electronic Version of This Form From Owner's Project Manager)

The U.T.M.D.A.C.C. Schedule of Values - Contractor's Estimate Continuation Sheet (8 1/2" x 11" Sheet ONLY)

Project No.:	Project Address:
Project Name:	Application For Payment Number:
Costruction Manager Name:	Application Period: From To

A	B	C		D	E	F	G	H	I	J	K	L	M	N
Spec. Section / Bid Package	Description of Work / Subcontractor / Supplier / Vendor / Specification Section	Initial Proposed Line Item Values	Additional Services / GMP Change Order Values	Actual Subcontract Amount at Buyout	Delta (Proposed to Actual)	Subcontract, Purchase Order or Vendor No.	Detailed Breakdown of Contract Line Items	Total Amount Previously Requested & Percent		Current Application: Total Amount This Period & Percent		Current Application: Total Amount Completed To Date & Percent		Retainage (5%)
Column Equations				C'	C - D		D'	L'	H / G	L - H	J / G	H + J	L / G	L x 5%
Pre-Construction Services														
Programming (20% If Applicable)		$ -	$ -	$ -	$ -	N/A	$ -	$ -	0%	$ -	0%	$ -	0%	N/A
Schematic Design (20%)		$ -	$ -	$ -	$ -		$ -	$ -	0%	$ -	0%	$ -	0%	
Design Development (20%)		$ -	$ -	$ -	$ -		$ -	$ -	0%	$ -	0%	$ -	0%	
GMP Development (10%)		$ -	$ -	$ -	$ -		$ -	$ -	0%	$ -	0%	$ -	0%	
Construction Documents (20%)		$ -	$ -	$ -	$ -		$ -	$ -	0%	$ -	0%	$ -	0%	
Bidding/Proposals (10%)		$ -	$ -	$ -	$ -		$ -	$ -	0%	$ -	0%	$ -	0%	
Additional Services		$ -	$ -	$ -	$ -		$ -	$ -	0%	$ -	0%	$ -	0%	
Pre-Construction Services Subtotal		$ -	$ -	$ -	$ -		$ -	$ -	0%	$ -	0%	$ -	0%	
Construction Services														
General Conditions														
On-Site Project Management Staff														
Project Scheduler		$ -	$ -	$ -	$ -	N/A	$ -	$ -	0%	$ -	0%	$ -	0%	$ -
Project Executive		$ -	$ -	$ -	$ -	N/A	$ -	$ -	0%	$ -	0%	$ -	0%	$ -
Superintendent(s)		$ -	$ -	$ -	$ -	N/A	$ -	$ -	0%	$ -	0%	$ -	0%	$ -
Office Engineer(s)		$ -	$ -	$ -	$ -	N/A	$ -	$ -	0%	$ -	0%	$ -	0%	$ -
Project Manager(s)		$ -	$ -	$ -	$ -	N/A	$ -	$ -	0%	$ -	0%	$ -	0%	$ -
Project Expeditor(s)		$ -	$ -	$ -	$ -	N/A	$ -	$ -	0%	$ -	0%	$ -	0%	$ -
Project Support Staff		$ -	$ -	$ -	$ -	N/A	$ -	$ -	0%	$ -	0%	$ -	0%	$ -
Assistant Superintendent(s)		$ -	$ -	$ -	$ -	N/A	$ -	$ -	0%	$ -	0%	$ -	0%	$ -
Safety Coordinator/Assistant(s)		$ -	$ -	$ -	$ -	N/A	$ -	$ -	0%	$ -	0%	$ -	0%	$ -
Out-of-State Project Specific Travel*		$ -	$ -	$ -	$ -	N/A	$ -	$ -	0%	$ -	0%	$ -	0%	$ -
Bonds and Insurance														
Builder's Risk Insurance		$ -	$ -	$ -	$ -	N/A	$ -	$ -	0%	$ -	0%	$ -	0%	$ -
General Liability Insurance		$ -	$ -	$ -	$ -	N/A	$ -	$ -	0%	$ -	0%	$ -	0%	$ -
Payment and Performance Bonds		$ -	$ -	$ -	$ -	N/A	$ -	$ -	0%	$ -	0%	$ -	0%	$ -
Other Project Insurance as Required by Contract		$ -	$ -	$ -	$ -	N/A	$ -	$ -	0%	$ -	0%	$ -	0%	$ -
Temporary Project Utilities														
Dumpsters		$ -	$ -	$ -	$ -	N/A	$ -	$ -	0%	$ -	0%	$ -	0%	$ -
Project Water		$ -	$ -	$ -	$ -	N/A	$ -	$ -	0%	$ -	0%	$ -	0%	$ -
Project Electricity		$ -	$ -	$ -	$ -	N/A	$ -	$ -	0%	$ -	0%	$ -	0%	$ -
Temporary Toilets		$ -	$ -	$ -	$ -	N/A	$ -	$ -	0%	$ -	0%	$ -	0%	$ -
Monthly Telephone / Internet Service		$ -	$ -	$ -	$ -	N/A	$ -	$ -	0%	$ -	0%	$ -	0%	$ -
Temporary Fire Protection		$ -	$ -	$ -	$ -	N/A	$ -	$ -	0%	$ -	0%	$ -	0%	$ -
Street Rental and Barricades		$ -	$ -	$ -	$ -	N/A	$ -	$ -	0%	$ -	0%	$ -	0%	$ -
Telephone / Internet System Installation		$ -	$ -	$ -	$ -	N/A	$ -	$ -	0%	$ -	0%	$ -	0%	$ -
Fencing and Covered Walkways		$ -	$ -	$ -	$ -	N/A	$ -	$ -	0%	$ -	0%	$ -	0%	$ -
Temporary Water Distribution and Meters		$ -	$ -	$ -	$ -	N/A	$ -	$ -	0%	$ -	0%	$ -	0%	$ -
Temporary Electrical Distribution and Meters		$ -	$ -	$ -	$ -	N/A	$ -	$ -	0%	$ -	0%	$ -	0%	$ -
Site Erosion Control (BMP) and Project Entrance(s)		$ -	$ -	$ -	$ -	N/A	$ -	$ -	0%	$ -	0%	$ -	0%	$ -
Field Offices & Office Supplies														
Partnering Costs		$ -	$ -	$ -	$ -	N/A	$ -	$ -	0%	$ -	0%	$ -	0%	$ -
First Aid Supplies		$ -	$ -	$ -	$ -	N/A	$ -	$ -	0%	$ -	0%	$ -	0%	$ -
Job Photos/Videos		$ -	$ -	$ -	$ -	N/A	$ -	$ -	0%	$ -	0%	$ -	0%	$ -
Reproduction Services		$ -	$ -	$ -	$ -	N/A	$ -	$ -	0%	$ -	0%	$ -	0%	$ -

SECTION 01 32 00 - PROJECT PLANNING AND SCHEDULING

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

1.1.1. The Contractor's attention is specifically directed, but not limited, to the Uniform General and Supplementary General Conditions for University of Texas System Building Construction Contracts (UGC) for other requirements.

1.2. SUMMARY

1.2.1 **Time is an essential part of this Contract. Therefore the timely and successful completion of the Work requires careful planning and scheduling of all activities inherent in the completion of the Project.**

1.2.2 Contractor must develop the Project Schedule to allow for a minimum amount of Float for the Project during Pre-Construction and/or Construction Services. Contractor must format the Project Schedule in a manner that facilitates reporting of progress and trends, identification of all critical paths, identification of each activity's predecessor(s) and successor(s), risks and opportunities, projection of upcoming activities, and forecasting of Project milestones.

1.2.3 The Owner must be able to reasonably rely on the Contractor's Project Schedule for projected activity dates in order to make accurate commitments to design professionals, contractors, vendors, user group(s), campus administration, and other parties as necessary.

1.2.4 **Owner's acceptance of the Project Schedule and any subsequent update of the Project Schedule are acceptance of the format and extent of detail of the Project Schedule only. Owner's acceptance does not indicate approval of the Contractor's means or methods, or of any change to the contract terms including, without limitation, any required contract Milestone Activities.**

1.2.5 This Specification applies to all Project delivery methods, regardless of contract type, whether the contracting firm, referred to as the Contractor, is a General Contractor, Construction Manager-at-Risk (CM-R), or Design/Build (DB) Contractor.

1.2.5.1 All references to Pre-Construction Services in this Specification shall apply to requirements for CM-R and DB contract types <u>only</u>.

1.3. DEFINITIONS

1.3.1. The term "Project Schedule", as used throughout the Contract Documents, shall refer to the schedule for the Project as developed, monitored, and maintained, by the Contractor's Project Scheduler, and as used by the Project Team during Pre-Construction and/or Construction Services.

1.3.2. The term "Project Team", as used throughout the Contract Documents, shall refer to the Owner, Architect, Design Consultants, Engineer, User, Contractor, Owner's Service Providers, and Subcontractors (as applicable) that are contracted and/or specifically assigned to the Project.

1.3.3. The term "Owner's Planning and Scheduling Specialist", as used throughout the Contract Documents, shall refer to the Owner's scheduling specialist representative, with all correspondence to be addressed to:

1.3.3.1. M.D. Anderson Cancer Center
Capital Planning and Management, Mail Box 703
1515 Holcombe Boulevard, Suite 1010

Houston, Texas 77030

1.3.4. The term “Data Date”, as used throughout the Contract Documents, shall refer to the date of the Project Schedule update.

1.3.5. The term “Total Float” (Float), as used throughout the Contract Documents, shall refer to the number of calendar days an activity on the Longest Path can be delayed without delaying the Substantial Completion date.

1.3.5.1. Negative Float indicates that the Project is late, while Positive Float is the property of the Project and does not belong to any one party (Refer to the UGC).

1.3.6. The term “Longest Path”, as used throughout the Contract Documents, shall refer to the sequence of activities that determines the longest duration for the Project when the Float is greater than zero.

1.3.6.1. The term “Critical Path”, as used throughout the Contract Documents, shall refer to the sequence of activities that determines the longest duration for the Project when the Float is equal to or less than zero.

1.4. CONTRACTOR RESPONSIBILITY

1.4.1. The Contractor is responsible for planning, management, coordination, and scheduling of all activities from a Notice to Proceed for Pre-Construction and Construction to Final Completion of the Project within the time allotted by the Agreement.

1.4.2. The Contractor is responsible for keeping the Owner and the Project Team fully informed of schedule status and upcoming activities throughout the Project via the Project Schedule.

1.4.3. The Contractor is solely responsible for the schedule and status of all activities related to Pre-Construction, procurement of materials and subcontractors, construction, testing, inspection, commissioning, and Project turnover to the Owner. The Contractor shall integrate the schedule and status of Owner furnished services such as test, adjust, and balance. Contractor shall schedule completion of activities and proactively submit for Owner’s review and approval, all documentation related to commissioning, including, but not limited to, the following. (Refer to Section 01 91 00 – Project Commissioning and Section 01 77 00 – Project Closeout Procedures for additional requirements.)

1.4.3.1. Commissioning Plan.

1.4.3.2. Equipment List/Matrix.

1.4.3.3. Submittal Schedule.

1.4.3.4 Format, content, and tab structure for Operating and Maintenance Manuals and submittal of binders.

1.4.3.5. Request for Start-Up/Functional Performance Test Form.

1.4.3.6. Prefunctional Checklists.

1.4.3.7. Functional Performance Test Procedures.

1.4.3.8. Integrated System Test Procedures.

1.4.3.9 Additional Commissioning and Closeout Manual documentation.

1.4.4. The Contractor shall provide adequate and reasonable Project planning in sufficient detail throughout all Project phases, as applicable for all aspects of Contractor's Work, to ensure completion of all activities within the Contract Time.

1.4.5. The Contractor's Pre-Construction and Construction project management personnel shall actively participate in the planning and development of the Project Schedule and shall be prepared to review such development and progress with the Owner, Architect/Engineer, and any other members of the Project Team so that the planned sequences and procedures are clearly understood by all parties.

1.4.6. The Contractor shall plan for appropriate activity durations to allow for thorough review, procurement, submittal, installation, inspection, testing, and commissioning, of all Work and/or systems in order to confirm Contract compliance, including Work relying on Owner participation or coordination.

PART 2 – PRODUCTS

2.1 QUALIFICATIONS OF THE PROJECT SCHEDULER

2.1.1 The Contractor shall assign a Project Scheduler who shall be responsible for the Project Schedule throughout Pre-Construction and Construction Services.

2.1.2 The Contractor's Project Scheduler shall have at least an undergraduate degree in a construction related field, and continuous experience on similar size and type of project(s) within the past five (5) years, including at least two (2) years with the specified scheduling software.

2.1.2.1 In lieu of a degree, the Contractor's Project Scheduler may have at least five (5) years continuous experience on similar size and type of project(s) with the specified scheduling software.

2.1.3 The Contractor's Project Scheduler shall be an integral part of the Project Team during Pre-Construction Services and shall be on-site full-time for Construction Services until at least Substantial Completion of the Work.

2.1.3.1 The Contractor's Project Scheduler may have additional responsibilities such as Senior Project Manager, Project Manager, Superintendent, Assistant Project Manager, Assistant Superintendent, Project Engineer, etc.

2.1.3.2 If the Contractor's Project Scheduler is outsourced, the Contractor shall assign an on-site contact for all Project Schedule related issues.

2.1.4 All Contractor personnel involved in the preparation, updating, and reporting of the Project Schedule shall possess adequate construction scheduling knowledge related to the Project, Critical Path Method (CPM) knowledge, and a general understanding of the specified software.

2.2 REQUIRED SCHEDULING SOFTWARE

2.2.1 Regardless of Project size or type, Contractor shall develop and maintain the Project Schedule using the latest version of Microsoft Project available as of the effective date of the Contract.

2.3 NAMING THE PROJECT SCHEDULE

2.3.1 The Contractor shall title the initial Owner approved Project Schedule, the Baseline Project Schedule: BPS1. Contractor may not "reset" the Baseline Project Schedule unless the Owner approves the reset.

2.3.1.1 If the Owner approves the Contractor's request to "reset" the Baseline Project Schedule, the new Baseline Project Schedule shall be titled sequentially (i.e. BPS1, BPS2, BPS3, etc.).

2.3.2 Subsequent updates to the Baseline Project Schedule shall be named by the last two (2) digits of the year and the month (Example: a March 2004 Baseline Project Schedule title would be "BPS2-0403").

2.4 PROJECT SCHEDULE DEVELOPMENT REQUIREMENTS

2.4.1 The Contractor shall assign a standard "Activity Code" using a custom field, to every activity or task; organized by at least the Project phase, stage, location, building, floor, area, elevation, or system, etc., (i.e. work breakdown structure) including the following primary Activity Codes:

Activity Code & Description	
CP	Contract Procurement
PP	Programming/Pre-Project Planning
SD	Schematic Design
DD	Design Development
CD	Construction Documents
BOR	U.T. System Board of Regents
GMP	Guaranteed Maximum Price
TH	THECB Approval
SP	Subcontractor Bidding / Procurement

Activity Code & Description	
C	Construction
GC	General Conditions
SU	Submittals
FD	Fabricate and Delivery
CI	Contractor Inspections
OI	Owner Inspections
Cx	Commissioning
TAB	Test, Adjust, and Balance
OP	Owner Provided - Contractor Installed

2.4.2 The Contractor shall assign a standard "Resource Code" to every Contractor, Subcontractor, Supplier, Fabricator, Installer, Design Consultant, Owner, and any other party responsible for the accomplishment of an activity, including, but not limited to, the following primary Resource Codes (as applicable):

Resource Code & Description	
AE	Architect / Engineer
Carp	Carpet
Casf	Casework Fabricator
Casi	Casework Installer
Cocw	Concrete Formwork
Conf	Concrete Finishing
Ctil	Ceiling / Acoustical Tile
Door	Doors & Frames
Dryw	Drywall / Light Gauge Stud Installer
Elec	Electrical
Elev	Elevator
Falm	Fire Alarm Systems
Fire	Fire Protection Systems
Ftil	Floor Tile
Furn	Furnishings

Resource Code & Description	
Omat	Owner's Material Testing Firm
Otab	Owner's Air Testing & Balance Firm
Ownr	Owner
Pain	Paint & Wall Coverings
Pier	Piers / Piles / Caissons
Plas	Plaster / EIFS
Plum	Plum
Rebf	Reinforcing Steel Fabricator
Rebi	Reinforcing Steel Installer
Roof	Roofing
Sign	Signs
Site	Sitework
Stee	Steel Erector
Stef	Steel Fabricator
Mstf	Miscellaneous Steel Fabricator

Resource Code & Description	
Glas	Glass / Glazing
Hard	Hardware
Hvac	HVAC
Insu	Insulator
Irri	Irrigation & Landscaping
Labc	Laboratory Casework Fabricator
Labi	Laboratory Casework Installer
Lbeq	Laboratory Equipment
Masn	Masonry

Resource Code & Description	
Msti	Miscellaneous Steel Installer
Stut	Site Utilities
Tele	Telephone / Communication Systems
Terz	Terrazzo
Toia	Toilet Accessories
Toip	Toilet Partitions
Watp	Waterproofing / Damp proofing
Wodf	Wood Framer
Wods	Wood Framing Supplier

2.4.2.1 The Contractor shall use additional Owner approved Resource Codes, as applicable.

2.4.3 The Contractor shall use additional Secondary Task and Resource Codes, as necessary, to monitor, provide status, and report the Project Schedule.

2.4.4 The Contractor shall assign a unique ”Work Breakdown Structure” (WBS Code) and ”Task Name” to <u>every</u> activity. The WBS Code and Task Name must be meaningful, easily understandable by the Project Team, similar to like activities at differing locations, and as shown on the Contractor’s Schedule of Values.

2.4.4.1 A Task Name shall start with a verb to indicate what is to be done and shall end with a location (Example: Install metal studs - 3rd floor Bldg B).

2.4.4.2 A “Milestone” Task shall refer to any major event or phase, or any other important point in the Project, including the following Tasks:

Milestone Task & Description	Milestone Task & Description
• NTP for Pre-Construction Services	• Authorize Architect/Engineer Start
• Authorize Architect/Engineer Start	• Submit for Owner Review(s)
• Submit for Owner Review	• Joint Review(s) for Owner Comments
• Joint Review for Owner Comments	• Approve Construction Documents
• Approve Schematic Design	• NTP for Construction Services
• Authorize Architect/Engineer Start	• Partnering/Preconstruction Meeting
• Submit for Owner Review	• Establish Site Controls /Mobilize
• Joint Review for Owner Comments	• Complete Primary Foundations
• Approve Design Development	• Structural Top-Out
• FPCC Meeting Deadline	• Building Dry-In
• BOR Approval	• Systems Commissioning
• Submit Construction Application	• Substantial Completion
• Approve Construction Application	• Final Completion
• Submit GMP	• Operational Occupancy
• Approve GMP	

2.4.4.3 A “Detailed” Task shall refer to a single Work event in the Project. The following table contains examples of Detailed Tasks for scheduling:

Detailed Task - Example	Detailed Task - Example
• Site Mobilization **Material Approval/Procurement** • Door Frames Shop Drawings • Contractor/AE review • Fabrication • Door Frame Delivery • Light Fixtures Submittal • Contractor/Architect/Engineer Review • Fabrication • Light Fixture Delivery • Sprinkler Shop Drawings/Calculations • Contractor/Architect/Engineer Review • Fabrication • Initial Equipment Delivery • Millwork Shop Drawings/Laminate Samples • Contractor/Architect/Engineer Review • Fabrication • Initial Millwork Delivery **Construction** • Layout/Top Track • MEP/Sprinkler Overhead Rough-In • Door Frames/Wall Framing • MEP In-Wall Rough-In • In-Wall Inspection • Corrections • Cover Walls • Tape and Float • Frame Ceilings • Furr-Downs/Recessed Light Coves • Furr Down/Ceiling Drywall Cover • Ceramic Tile • Plumbing Fixtures - Toilet Rooms • Prime/One-Coat Paint	• Toilet Partitions • Ceiling Grid • Curtaintrack Blocking • Light Fixtures/Grilles/Sprinkler Drops/Smoke Detectors • Overhead Inspections • Overhead Corrections • Ceiling Cover • Light Coves • Sheet Vinyl Flooring • Millwork • Cast Plastic • Toilet Accessories • Dark Room Equipment • Plumbing Fixtures - Millwork • Doors • Hardware • Glass & Glazing/Blinds • Curtaintrack • Biosafety Cabinets/Fume Hoods • Darkroom Equipment • Lockers • Final Paint Coat/Wallcovering • MEP Trim • Film Illuminators • TV Support Brackets • Appliances • Carpet Flooring • Resilient Base • Wall Protection • Final Clean • Pre-Final Inspections • TAB • Start-up and Testing • Corrections

2.4.4.4 A “Summary” Task (i.e. Hammock) shall refer to a grouping (or a summary) of Milestone and/or Detailed Tasks in the Project Schedule.

2.5 PROJECT SCHEDULING METHOD REQUIREMENTS

2.5.1 “Retained Logic” is the required mode of Project Schedule processing.

2.5.2 The estimated Activity Duration of an activity shall be expressed in calendar days.

2.5.2.1 During Pre-Construction Services and Construction Services, the Project Team shall determine the maximum duration for any activity.

2.5.2.2 During Construction, the minimum duration for any Owner milestone inspection activity (i.e. concealed space, above ceiling, substantial and final completion) shall be at least three (3) work days per inspection and re-inspection, or as approved by the Project Team.

2.5.2.3 Estimated remaining Activity Durations shall be stated in work days, as of the Data Date of every Project Schedule update.

2.5.3 Except for the Notice to Proceed for Construction (Preconstruction for CM-R and DB contracts) and the Final Completion Date Milestone, activities shall not have “open ends”.

2.6 PROJECT SCHEDULE ANALYSIS REQUIREMENTS

2.6.1 The Contractor shall use the CPM technique to determine the overall Project duration through the analysis of the durations of each of the activities, their schedule dependencies, and their resultant Float.

2.6.2 For CM-R and DB contracts, the Project Schedule shall include at least **20%** Float from the Notice To Proceed for Pre-Construction Services to the Substantial Completion date.

2.6.3 The Project Schedule shall include at least **10%** Float from the Notice To Proceed for Construction Services to the Substantial Completion date as identified by the Owner in the Notice To Proceed.

2.6.4 Float shall be shown as an activity within the Project Schedule. It should be the last activity prior to the Substantial Completion date Milestone.

2.7 COORDINATION WITH OTHER DOCUMENTS AND WORK

2.7.1 The Contractor shall coordinate the Project Schedule with the Contractor’s Submittal Schedule and Schedule of Values, as required by the UGC and Section 01 31 00 - Project Administration (i.e. the Work breakdown structure shall be arranged, numbered, and described consistently across the various documents).

2.7.1.1 Cost and/or resource loading of the Project Schedule are allowed.

2.7.1.1.1 If the Contractor elects to cost-load the Project Schedule, the Contractor shall provide a separate Schedule of Values in the format required by the Owner in Section 01 31 00 - Project Administration.

PART 3 – EXECUTION

3.1 PLANNING AND SCHEDULING WORKSHOP

3.1.1 Within thirty (30) calendar days after a Notice To Proceed, the Contractor shall schedule and conduct a Planning and Scheduling Workshop with at least the Contractor’s Project Scheduler, Project Manager, Superintendent, the Owner’s Project Manager and Owner’s

Planning and Scheduling Specialist (if applicable), the Architect/Engineer, Owner's representatives, and any available Subcontractors prior to submitting the Project Schedule to the Owner.

3.1.1.1 The Contractor shall schedule and coordinate the workshop with the Owner at least ten (10) calendar days prior to the Planning and Scheduling Workshop. The Contractor shall submit a complete draft Project Schedule to the Owner at least five (5) calendar days prior to the Planning and Scheduling Workshop.

3.1.1.2 The Contractor shall review the draft Project Schedule with the Project Team, including a verbal description of the logic and sequencing of activities, method for determining estimated Activity Durations and corresponding resources required, and any activities involving Owner participation and/or approval.

3.1.2 For CM-R and DB projects, Contractor shall schedule and conduct at least two (2) Planning and Scheduling Workshops. The first shall be within thirty (30) calendar days after a Notice to Proceed with Pre-Construction Services and the second shall be within thirty (30) calendar days after a Notice to Proceed with Construction Services for each "major" Guaranteed Maximum Price (GMP) Proposal executed.

3.1.3 Contractor's attendance at the Planning and Scheduling Workshop(s) and Owner's acceptance of the Baseline Project Schedule is a condition precedent to the Contractor submitting initial and any subsequent progress payments.

3.2 BASELINE PROJECT SCHEDULE SUBMITTAL

3.2.1 The Baseline Project Schedule shall be submitted to the Owner <u>with the required Float</u> within sixty (60) calendar days from the effective date of the Notice To Proceed for Pre-Construction and/or Construction Services (or as approved by the Owner in the Project Planning Scheduling Workshop).

3.2.1.1 A Baseline Project Schedule that does not have at least the minimum amount of Float at submission will result in the Contractor forfeiting all claims to Project Schedule extensions and/or delays as a result of Contract changes and/or excusable delays as described in the UGC.

3.2.1.1.1 If conditions arise prior to submission of the Baseline Project Schedule that are <u>beyond the Contractor's control</u>, the Contractor shall include an Executive Summary with the Baseline Project Schedule to justify the reduction in Float.

3.2.1.2 For CM-R and DB projects, the Baseline Project Schedule shall include identified Milestone and/or Summary Tasks for the remaining Work that has not been approved in an executed GMP Proposal for Construction Services.

3.2.1.2.1 When the Owner has approved the "full" scope of the Project (i.e. the last GMP Change Order has been executed), the Contractor shall coordinate with the Owner to "reset" the Baseline Project Schedule.

3.2.2 The Contractor shall submit one (1) electronic copy of the entire Baseline Project Schedule and one (1) paper copy of the following Baseline Project Schedule reports to the Owner within ten (10) calendar days when the "full" scope of the Project as been approved:

3.2.2.1 <u>Graphic Time-Scaled Report or Gantt Chart</u>: A graphic time-scaled view including all activities, early start and finish dates, estimated durations and Float sorted by Activity Code.

3.2.2.2 <u>Milestone Activity Report</u>: A listing of every Milestone Task and critical path sorted by early start date.

3.2.2.3 Detailed Activity Report: A listing of every Detailed Task sorted by early start date including a fully completed predecessor and successor column.

3.2.3 When the Owner has approved the initial Project Schedule, it shall be referred to as the Baseline Project Schedule, and shall be used for all future Project Schedule updates and reports as "BPS1."

3.2.3.1 For CM-R and DB projects, the Project Schedule shall include Milestone and Summary Tasks until thirty (30) calendar days prior to the submittal of a GMP Proposal for Construction Services. The Project Schedule shall also include Detailed Tasks for at least the first ninety (90) calendar days of Construction Services when submitted with the GMP Proposal.

3.3 UPDATING THE PROJECT SCHEDULE

3.3.1 When the Owner has approved the Baseline Project Schedule, the Contractor shall update the Project Schedule for Pre-Construction and Construction Services at least once per calendar month and submit reports at least seven (7) calendar days prior to the Owner's monthly Project Progress Meeting.

3.3.1.1 Project Schedule updates shall be based on actual Work progress, current logic, and remaining durations.

3.3.1.2 The Owner will determine which meeting will be designated as the Owner's monthly Project Progress Meeting.

3.4 MONTHLY PROJECT SCHEDULE REPORTS

3.4.1 The Data Date for all Project Schedule Update Reports shall be current within five (5) calendar days of submission to the Owner.

3.4.2 Contractor shall submit a Total Float usage log with Contractor's monthly Project Schedule Update Reports that identifies the number of days lost or gained each month.

3.4.3 Owner retains the authority, which shall not be unreasonably withheld, to approve or reject Contractor's utilization of Total Float. If Contractor desires to utilize a portion or all of the Total Float, Contractor must submit a written request with its monthly Total Float usage log to the Owner seeking Owner's written approval of utilization of Total Float.

3.5 SUBMITTING MONTHLY PROJECT SCHEDULE REPORTS

3.5.1 The Contractor shall submit one (1) electronic schedule back-up in ".mpp" format and one (1) paper copy of the Project Schedule to the Owner.

3.6 FORMATING PROJECT SCHEDULE REPORTS

3.6.1 Electronic copies shall be submitted on compact discs and as attachments to electronic mail.

3.6.1.1 All electronic Project Schedule submittals shall be "backups" created in the specified software and included on the website if required, within one (1) calendar day of required completion.

3.7 PROJECT SCHEDULE SLIPPAGE

3.7.1 If the Project Schedule indicates schedule slippage for two (2) consecutive calendar months or if the Owner notifies the Contractor of a determination that the Work is behind schedule,

the Contractor shall develop a “Recovery Plan” to make immediate revisions to the work force, work-hours, shifts, material deliveries, or any other aspects of the Work.

3.7.2 The Contractor shall submit the “Recovery Plan” to the Owner, as required in the UGC, clearly describing all changes in the Project Schedule or work enacted and/or planned in order to ensure completion by the Contract Substantial Completion date.

3.7.2.1 The Owner has the right to review and comment on any “Recovery Plan” activities that include Owner participation or affect any Owner consultants or outside contractors.

3.7.3 When the Owner approves the “Recovery Plan”, the Contractor shall incorporate the proposed revision into the Baseline Project Schedule.

3.8 PROJECT SCHEDULE CHANGES

3.8.1 If the Owner or Architect/Engineer issues a Change Proposal, the Contractor shall submit a proposed revision for all proposed Contract changes that affect the Substantial Completion date or remaining Float with the Change in Work Cost Analysis Form.

3.8.1.1 Proposed revisions shall be accompanied by a narrative listing of the affected activities including a statement of the expected overall impact of the change proposed.

3.9 EXCUSABLE DELAYS AND TIME EXTENSIONS

3.9.1 Excusable delays shall be administered per the UGC.

3.9.2 If an excusable delay extends the Contract Substantial Completion date, the Owner may extend the Contract time by the number of excusable calendar days lost on the Project Schedule or take other actions as appropriate under terms of the Agreement.

3.9.2.1 Change Proposal pricing that does not impact the Substantial Completion date or does not include a proposed revision prior to approval by the Owner shall not include a time extension.

3.9.3 Once the Owner accepts a time extension and authorizes the Contractor to proceed with the Contract change, the proposed revision shall be incorporated into the Baseline Project Schedule.

END OF SECTION 01 32 00

SECTION 01 35 16 – ALTERATION PROJECT PROCEDURES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 SUMMARY

A. Basic and supplemental requirements for Work that alters existing facility components, systems or equipment.

1.03 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the Contract Documents.

1.04 DEFINITIONS

A. Cutting: Removal of in-place construction necessary to permit installation or performance of other Work.

B. Patching: Fitting and repair work required to restore surfaces to original conditions after installation of other Work.

C. Demolish: Completely remove and legally dispose of off-site.

D. Remove: Detach items from existing construction and legally dispose of them off-site, unless indicated to be removed and salvaged or removed and reinstalled.

E. Remove and Salvage: Detach items from existing construction and deliver them to Owner [ready for reuse].

F. Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.

G. Salvage: Carefully detach from existing construction, in a manner to prevent damage, and deliver to Owner [ready for reuse]. Include fasteners or brackets needed for reattachment elsewhere.

H. Recycle: Recovery of demolition waste for subsequent processing in preparation for reuse.

I. Existing to Remain: Existing functional items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

J. Sensitive Area: The following areas are considered “Sensitive” by MD Anderson Cancer Center:

1. Sensitive Areas listed apply to human and animal occupancies.

2. Additional areas may also be considered Sensitive as determined by MD Anderson Cancer Center for a particular project. The Contractor shall coordinate with the Owner’s Project Manager prior to any installation Work to identify Sensitive Areas not listed.

a. Operating Rooms

b. Invasive Procedure Rooms

c. Bone Marrow Transplant / Protective Environment Areas

d. Intravenous Procedure Rooms (Chemotherapy)

e. Intensive Care

f. Inpatient Recovery Rooms

g. Sterile Supply Storage

h. Sterile Processing

i. Pharmacy I V Admixture

j. Pharmacy Drug Preparation

k. Pharmacy Drug Storage

l. Food Preparation, Storage, Serving

m. Data Centers

n. Electrical Equipment Rooms

o. Telecommunication Rooms

p. Potable Water Storage Tanks

q. Any Room Containing Imaging Equipment that May be Damaged Due to Water Leakage (MRI, Cat Scan, Etc.)

r. Animal Holding Rooms

s. Animal Procedure Rooms

t. Laboratory Clean Rooms

1.05 QUALITY ASSURANCE

A. Perform remodeling, alteration, demolition, cutting, patching, removal, refinishing, relocation, and disposal work in accordance with Federal, State, and local health and safety standards, codes, ordinances, and the University of Texas MD Anderson Cancer Center Institutional Safety Policies. Where conflicts occur, comply with the more restrictive requirements.

B. Perform remodeling, alteration, demolition, cutting, patching, removal, refinishing, and relocation work in such a manner as to preserve the aesthetic and structural integrity of materials and construction.

C. When the Contractor determines that it is unavoidable to locate new fan coil units, drainage piping, or waste piping above a Sensitive Area, the Contractor shall notify the Owner's Project Manager in writing and obtain a clear direction to proceed prior to any installation of Work.

D. When the Contractor determines that an existing penetration cannot be sealed due to accessibility, constructability or any other condition, the Contractor shall notify the Owner's Project Manager in writing and obtain a clear direction to proceed prior to any installation of Work.

E. When the Contractor determines that an existing fan coil unit cannot be relocated beyond the perimeter of a Sensitive Area, the Contractor shall notify the Owner's Project Manager in writing and obtain a clear direction to proceed prior to any installation of Work.

F. Portions of the existing remaining medical vacuum and gas systems affected by Work within this Project shall be re-certified in strict accordance with NFPA 99.

1.06 SUBMITTALS

A. Submit schedule for all proposed shut-downs prior to start of Work. The Contractor shall notify the Owner's Construction Inspector and the Owner's Project Manager, in writing, of any planned utility outages in accordance with Owner's Special Conditions.

B. Work with noise-producing equipment is subject, at all times, to Owner's approval of entire procedure. Submit a schedule of all such operations to the Owner's Project Manager at least two weeks in advance of need and secure approval of the Owner before proceeding.

1.07 NEW AND EXISTING PENETRATIONS

A. All new and existing penetrations through rated partitions and floor slabs within the Project boundary shall be sealed to provide a fire/smoke rating equal to or greater than the rating of the floor slab.

B. All new and existing penetrations through floor slabs within the Project boundary shall be sealed watertight.

1.08 EXISTING COMPONENTS ABOVE SENSITIVE AREAS

A. All existing sanitary waste, sanitary vent and storm drainage piping located within the ceiling or exposed above a Sensitive Area shall be provided with heavy-duty joint connections having a minimum 15 psi pressure rating and meeting the performance criteria of Factory Mutual 1680.3.

B. All existing piping located within the ceilings or exposed above a Sensitive Area receiving cooling coil condensate, ice machine drainage or conveying contents having temperatures below 55 degrees F shall be insulated and vapor sealed to prevent condensation.

C. Existing fan coil units located within the ceiling or exposed above a Sensitive Area shall be relocated to a position beyond the Sensitive Area.

1.09 JOB CONDITIONS

A. Visit the Project Site to determine by inspection all existing conditions, including access to the Site, the nature of structures, objects, and materials to be encountered, and all other facts concerning or affecting the Work. Information on the Drawings showing existing conditions does not constitute a guarantee that other items may not be found or encountered.

B. Obvious existing conditions, installations, and obstructions affecting work of this Section shall be taken into consideration as necessary work and included as part of work of this Section, the same as though completely shown or described.

C. Seal off areas in which work is in progress from the occupied portions of the building to prevent entry of dust and noise into occupied portions of the building. Take all necessary measures to limit the amount of dust and dirt rising and scattering in the air to the lowest practical level.

1. Where Work occurs immediately adjacent to occupied portions of the building, construct dust-proof partitions of nominal 3-5/8 inch metal studs with 5/8-inch Type X drywall, full height on both sides. Tape joints on the occupied side at non-fire rated partitions. Tape both sides full height at fire rated partitions. Fill partition cavity with sound-deadening insulation.

2. Equip partitions with dustproof doors and security locks.

D. If temporary closures block required exits, provide closures with acceptable openings equipped with gasketed, self-closing doors that open in the direction of exit as approved by authorities having jurisdiction.

E. Provide temporary barricades and other forms of protection to protect Owner's personnel and general public from injury due to remodeling work.

1. Provide protective measures as required to provide free and safe passage of Owner's personnel and general public to occupied portions of building.

2. Erect temporary covered passageways as required by authorities having jurisdiction.

3. Provide interior and exterior shoring, bracing, or support to prevent movement, settlement, or collapse of structure or element to be demolished and adjacent facilities or work to remain.

4. Protect from damage existing finish work that is to remain in place and becomes exposed during remodeling operations.

5. Protect floors with suitable coverings when necessary.

6. Cover and protect furniture, equipment, and fixtures from soilage or damage when demolition work is performed in areas where such items have not been removed.

7. Provide temporary weather protection during interval between demolition and removal of existing construction on exterior surfaces and installation of new construction to ensure that no water leakage or damage occurs to structure or interior areas of existing building.

8. Remove protections at completion of work.

F. Furnish and maintain temporary types of protection as necessary to adequately protect and prevent accidental injury to the public, Owner's personnel and personnel employed at the work. Take all necessary precautions to keep trespassers out of work areas. Properly secure work areas from entry when work is not in progress.

G. Conduct demolition and removal operations and the removal of debris to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities. Do not close or obstruct streets, walks, or other occupied or used facilities without permission from authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.

1.10 TEMPORARY ELEVATOR USE

A. Designated existing elevators may be used by construction personnel and for materials. Coordinate use with Owner. Provide protective coverings for finish surfaces of cars and entrances.

1.11 EXISTING UTILITIES AND CONDITIONS

A. The location and description of utilities and conditions shown on Drawings are indicated from information available and are approximate only. Verify existing utilities and conditions.

B. Protect existing utilities and conditions from damage. Repairs to utilities and conditions damaged during the Work shall be the responsibility of the Contractor and shall be made promptly at no additional cost to the Owner.

C. Maintain existing utilities in operation at all times except where specific permission is given by Owner's Project Manager. Support and protect all exposed piping and utilities during demolition and utility rough-in.

D. All outages of utilities, sidewalks, parking areas, driveways or facility access shall be scheduled in advance with Owner in accordance with Owner's Planned Utility Outage Procedure as specified within Section 00 25 00 – Owner's Special Conditions.

E. Notify the Owner's Project Manager and all concerned parties prior to disconnecting and terminating abandoned utilities.

1.12 REMOVAL OF EXISTING CONSTRUCTION

A. Where permanently disconnecting domestic water, medical vacuum, medical gas, natural gas, treated water, drainage, vent, or other piping serving removed fixtures, inlets, outlets or equipment, remove all associated piping back to remaining active mains.

B. All existing floor drains that will not remain in service after Project completion shall be isolated from the remaining active building drainage and vent system. Floor drain bodies remaining within slabs shall be sealed watertight. Slab shall be finished to allow specified application of flooring or to match surface of the adjacent finished area. Completed patching of the slab shall prevent the passage of water and provide a structural integrity and fire rating equal to or greater than the existing slab. Remove all associated piping serving decommissioned floor drains located in suspended slabs back to remaining active mains.

C. All existing wall penetrations that will be unused due to removal of piping shall be permanently sealed to maintain the fire rating of the wall or floor.

D. All existing floor penetrations that will be unused due to removal of piping shall be permanently sealed to maintain the fire rating of the floor and to provide a watertight seal.

E. All existing supports serving removed piping, duct, conduit and equipment shall be removed.

F. Carefully remove and store all items indicated or required to be reused.

G. Perform demolition and removal work completely and remove debris from the Site. Use such methods as required to complete the Work within the limitations of governing regulations.

1. Proceed with demolition and removal work in a systematic manner, from the top to the bottom in areas indicated.

2. Remove debris in covered carts to limit air pollution.

3. Locate demolition equipment throughout the structure and remove materials so as to not impose excessive loads to supporting walls, floors, or framing.

4. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.

H. Cutting:

1. Structural Elements: If not specifically shown, but removal or alteration is required, perform such removal or alteration only upon written approval of the Architect/Structural Engineer. Do not damage or alter any structural element of the existing building. Where drilling or fastening to post-tensioned reinforced concrete construction is required, X-ray existing structure to determine tendon locations and potential for tendon tension release before proceeding. Notify Architect/Structural Engineer in each instance when conflict occurs. Architect/Structural Engineer will determine corrective action required. Do not proceed until corrective action has been received.

2. Concrete: Saw cut where exposed to view. Jack hammering with electric or pneumatic equipment is acceptable only with scheduled approval of Owner.

3. Masonry: Cut back masonry to joint lines and remove old mortar allowing space for repairs.

4. Ceramic, Structural Clay Tile, and Quarry Tile: Saw cut to natural joint lines; remove so that repairs or continuations of new work will be relatively imperceptible.

5. Resilient Tiles: Remove in whole units to natural breaking points and/or straight joint lines with no damaged or defective existing tiles remaining where joining new construction.

6. Plaster: Cut back to sound plaster on straight lines, and back bevel edges of remaining plaster. Trim and prepare existing lath for tying of new lath.

7. Woodwork: Cut back to a joint or panel line.

8. Existing Doors, Frames, and Sash: Remove in such manner as to facilitate filling in of openings or installation of new work, as required by the Drawings.

9. Cutting for Access to Mechanical and Electrical Systems: Removal of existing ceilings and the removal, cutting, and patching and replacement of existing walls and floors as may be necessary for access to valves, piping, conduit, and tubing by mechanical and electrical trades shall be included and performed as an obligation of, and as directed by the Contractor and accepted by the Owner.

I. Patching, Repairing, and Finishing Existing Work:

1. Perform in compliance with the applicable requirements of the Specification technical Section covering the work to be performed and the requirements of this Section.

   a. All holes and damaged areas exposed to view in ceilings, walls, and floors of all finished spaces shall be repaired. Repaired construction shall match existing adjacent construction and finish, unless otherwise indicated or specified.

   b. Minor surface abrasions, small nail holes, cracks, aged checked natural wood finish and other similar deterioration not visible, when viewed under finished lighting conditions, from a distance of 6 inches will not be required to be repaired if the base material is sound and suitable to receive the scheduled finishes, if any.

   c. Interior penetration holes in walls and ceilings of unfinished spaces and spaces not exposed to view shall be grouted and sealed with accepted materials to equal the sound seal and fire resistance rating of original construction.

   d. Penetration holes through exterior walls above grade shall be grouted and sealed as required to produce a weather tight seal.

   e. Penetration holes through exterior walls below grade shall be grouted and sealed to produce a watertight seal.

2. Concrete: Edges of existing concrete shall be kept damp for 24 hours and scrubbed with neat portland cement grout just before new concrete is placed; in lieu thereof, an accepted epoxy concrete adhesive may be used. Finish shall match existing adjoining work. Unless otherwise specified, all concrete for patching shall be 3,000 psi concrete. Reinforcing bars and dowels shall be provided where required. Where installation of concrete is impracticable, the openings shall be filled with dry packed non-shrink grout as directed.

3. Masonry: Patch with sound whole units to match existing. Joints shall match adjoining surfaces.

4. Lath: Lath areas to be patched as required, install as required for new lath, and wire-tie to existing lath at edges at 6 inch (15.2 cm) intervals. Lap lath 3 inch (7.6 cm) minimum.

5. Plaster: Dampen edges of existing plaster. Plaster patching shall be 3 coat work of type, thickness, and finish to match the existing work.

6. Damages: Promptly repair damages to adjacent facilities caused by demolition and removal operations at no additional cost to the Owner.

7. Painting and Finishing:

   a. Preparation: Prepare patched areas as required for new work. Wash areas to be repainted with neutral soap or detergent, thoroughly rinse, and sand when dry. Feather remaining paint edges smooth with sandpaper.

   b. Painting and Finishing: Conform to the applicable provisions of Painting Section. Prepare and build up bare areas and patches in existing painted surfaces with proper primer and intermediate coats, sand smooth and flush with adjoining surfaces. Paint all areas scheduled to be painted and/or repainted as specified in Painting Section of the Specifications, except the first or primer coat may be omitted on existing painted surfaces.

J. Disposal of Debris: Clean up all material, debris, and rubbish resulting from remodeling work, remove from the building and Site, and legally dispose of. Leave all areas of work in “broom clean” condition.

   1. All debris shall be transported out of the building in covered carts with no materials extending above the cart rim.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

B. Matching Existing Work: Except where otherwise specifically indicated or specified as a definite change, the finish materials and appearance of the new work shall match the existing contiguous materials and finishes in all respects. Repairs and/or continuations of existing work shall be relatively imperceptible in the finished work when viewed under finished lighting conditions from a distance of 6 feet (1.8 meters).

PART 3 - EXECUTION

3.01 SEQUENCING AND SCHEDULING

A. Schedule Work so as to impose a minimum of hardship on the present operation of the facilities and the performance of the work of other trades.

B. Maintain existing utilities indicated to remain; keep in service and protect against damage during demolition and removal operations.

C. Do not interrupt existing utilities serving occupied or used facilities, except when authorized in writing by Owner. Provide temporary services during interruptions to existing utilities, as acceptable to the governing authorities.

3.02 POST DEMOLITION CONFERENCE

A. Coordinate, schedule and conduct post demolition meetings prior to installation of new Work.

1. Purpose: Communicate existing conditions revealed by demolition that are not identified on Contract Drawings. Determine scope, cost and schedule impacts and obtain a clear direction to proceed.

2. Attendees: Contractor, Owner's Project Manager, Architect/Engineer.

3.03 INSTALLATION

A. Check Drawings carefully and thoroughly investigate existing building construction.

B. Protect work to remain from damage. Use barricades, tarpaulins, temporary walls, plywood, planking, masking, and other suitable means and methods as accepted.

1. Restore accidental or careless damage to work to remain in place to a condition as good as or better than existed before work was commenced and at no additional cost to the Owner.

C. Provide all shoring and bracing necessary to positively protect existing elements of the building. Use material adequate to support anticipated loads with a properly calculated margin of safety. Provide for transfer of stresses to successively lower construction.

D. All work must be staged and performed so that disruption to occupied areas is minimized and so that these areas are available and suitable for their intended use during normal hours of operation. Any work that would incur excessive noise, dust, or disruption must be scheduled in advance with the Owner's Project Manager.

E. Carefully remove and replace items of existing construction indicated to remain upon completion of the Contract, but which require removal to complete the work. Match condition of construction prior to the start of the Work unless otherwise required. Carefully remove items indicated for relocations in new Work, or to be retained by Owner, to avoid damage, thoroughly clean, and reinstall as indicated or store as directed.

F. Items of salvable value to the Contractor may be removed from the structure as the work progresses. Salvaged items must be transported from the Project Site as they are removed. Storage or sale of removed items on the Project Site will not be permitted.

1. Remove and dispose of all demolition materials, equipment and debris off premises, unless identified for salvage on the drawings. Deliver salvaged items to a location within a 5 mile radius of UTMDACC as directed by the Owner's Project Manager. Protect and store all items identified for reuse. Contractor assumes no salvage value for items removed and not reused in the Project.

END OF SECTION 01 35 16

SECTION 01 35 23 – PROJECT SAFETY (OCIP)

PART 1 – GENERAL

1.1 OVERVIEW

The Owner's objective is an injury and incident-free Project, with a focus on safety that shall not be compromised to achieve any other business objective. The Contractor shall structure an effective and systematic safety management approach that emphasizes continuous improvement.

1.2 GENERAL REQUIREMENTS

The Owner recognizes that the Contractor and Subcontractors may have existing safety management programs with established safety policies, processes, procedures, and work practices. The Owner will support these where they prove to be effective and meet the intent and purpose of this Section. Upon request by the Owner, the Contractor and/or Subcontractors (of any tier) shall promptly produce and provide copies of any required documents related to Project safety. Where opportunities for improvement are identified, Contractor and Subcontractors shall work collaboratively with MD Anderson toward making appropriate revisions to progress toward an injury and incident free workplace.

1.3 DEFINITIONS

1.3.1 The term "Owner's Safety Representative" (OSR) or "Owner's Designated Representative" as used throughout the Contract documents shall refer to any construction safety professional who is acting on behalf of the Owner. This will include, but may not be limited to the MD Anderson OCIP Manager, MD Anderson Safety Inspector, and all Risk Control Consultants associated with Owner Controlled Insurance for the Project. In general for OCIP and safety related issues the OSR or ODR will be the MD Anderson OCIP Manager.

1.3.2 The term "Project Safety Coordinator" (PSC) as used throughout the Contract documents shall refer to the Contractor's construction safety professional who is acting on behalf of the Contractor and who shall be responsible for safety training, inspections, incident investigations, record keeping, reporting, incident response, and claims management, and shall serve as the technical advisor to the Contractor's project staff for all safety issues.

1.3.3 The term "Project Safety Assistant(s)" (PSA) as used throughout the Contract documents shall refer to any Contractor's construction safety professional who is acting on behalf of the Contractor and who shall perform safety related tasks as delegated by the PSC.

1.3.4 The term "Subcontractor's Safety Representative" (SSR) as used throughout the Contract documents shall refer to a person employed by the Subcontractor of any tier who is designated to be the "qualified" safety representative and possesses the proper credentials for the position. Subcontractors shall provide at least one SSR per shift.

1.3.5 The term "qualified" as used throughout this Section shall match the definition within the OSHA construction safety standards (Title 29 CFR, Part 1926). *Qualified means one who, by possession of a recognized degree, certificate, or professional standing, or who by extensive knowledge, training, and experience, has successfully demonstrated his ability to solve or resolve problems relating to the subject matter, the work, or the Project.*

1.3.6 The term "competent" as used throughout this Section shall match the definition within the OSHA construction safety standards (Title 29 CFR, Part 1926). *Competent person means one who is capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.*

1.3.7 The term “Construction Area” as used throughout this Section shall refer to the portion of the Owner’s property that is released to the Contractor’s control and is designated by the Contractor as the space where actual construction efforts will be undertaken to execute the Work.

1.3.8 The term “Administration Area” as used throughout this Section shall refer to the portion of the Owner’s property that is released to the Contractor’s control and is designated by the Contractor as the space where support efforts will be undertaken to provide administrative needs for the Work. If the Project has Project office trailers within the confines of the Owner’s property, that space and the parking area around it may be designated as an Administration Area.

1.3.9 The term “worker” as used throughout this Section shall refer to any person who has successfully completed the Project safety orientation.

1.3.10 The term “visitor” as used throughout this Section shall refer to any person who has not successfully completed the Project safety orientation. Visitors shall not be allowed access to the “construction areas” unless they are escorted by a member of the Contractor’s Project management staff or MD Anderson.

1.4 PURPOSE

1.4.1 The Contractor shall bear overall responsibility for all aspects of safety at the Project.

1.4.2 The Contractor shall, at all times, provide adequate resources, equipment, training, and documentation to:

1.4.2.1 Assure compliance with the requirements of this Section and all Federal, State, and local statutes, standards, and regulations.

1.4.2.2 Assure a safe work environment at the Project.

1.4.2.3 Instill a culture for safe behavior in all supervisors and workers.

1.4.2.4 Ensure a universal understanding that safety and health issues take precedence over all other considerations at the Project.

1.4.3 In any circumstance where this Section differs from, or conflicts with any statutory requirement, the more stringent requirement shall apply.

1.4.4 The Owner reserves the right to have any manager, supervisor or worker removed from the Project for disregarding Project safety requirements. Removal of Project Superintendent, PSC, PSA or SSR may result in work stoppage that will remain in effect pending approval of a suitable replacement.

1.4.5 The Owner reserves the right to deduct from the Contract any safety related expenses that the Owner incurs as a result of the Contractor’s, or any Subcontractor’s, failure to comply with the requirements of this Section.

1.4.6 The Owner will deny requests for time extensions and/or monetary considerations whenever the Owner intercedes on behalf of safety compliance as a result of Contractor failure to act as required by Contract.

1.5 RELATED DOCUMENTS

In addition to specific references indicated herein, the Contractor's attention is also directed, but not limited, to the following Publications and documents:

1.5.1 Current edition of Uniform General and Supplementary Conditions for The University of Texas System Building Construction Contracts (UGC);

1.5.2 Owner's Special Conditions;

1.5.3 Current edition of OSHA Safety Standards for the Construction Industry, CFR Title 29, Part 1926.

PART 2 – PRODUCT

2.1 PROJECT SAFETY COORDINATOR (PSC)

2.1.1 One (1) PSC shall be provided by the Contractor and shall be assigned full time and dedicated to the Project until Final Completion. The PSC and or PSA must be at the Project during the hours when workers are present unless otherwise agreed upon by the MD Anderson OCIP Manager or ODR.

2.1.2 Overall career experience must include at least five (7) years in construction safety management on projects similar in size and scope to the project in question.

2.1.3 Primary responsibilities of the proposed PSC during the previous five (5) years of work history must have been fully dedicated to management of construction safety in a safety management position equivalent to a PSC, or the candidate will not be accepted.

2.1.4 The PSC shall possess a certificate of completion for the OSHA 500 (or the 502 refresher "Train the Trainer") instructor outreach training for Safety in the Construction Industry. The certificate must be dated within four (4) years of the executed Contract. Formal submittal of proof must be completed before any portion of the Work will be allowed to commence.

2.2 PROJECT SAFETY ASSISTANT (PSA)

2.2.1 Each PSA shall be assigned full time and dedicated to the Project and shall have no additional duties other than safety.

2.2.2 The initial one (1) PSA shall be provided by the Contractor and shall be assigned full time and dedicated to the Project for the entire duration of the Work. PSA and or PSC must be at the Project during the hours when workers are present.

2.2.3 A second PSA shall be provided by the Contractor when the average daily population at the Project rises to more than one hundred (100) persons. Additional PSAs shall be provided by the Contractor when the average daily population increases by another increment of one hundred (100) persons. All of the additional PSAs shall remain assigned to the Project until the average daily population decreases to a number that is below the figure that caused them to be placed on the Project. Final decision on the release of any PSA must be approved by the MD Anderson OCIP Manager.

2.2.4 Primary responsibilities of any proposed PSA, during the previous five (5) years of work history must include at least three (3) years in a safety management position equivalent to a PSA on a project of similar size and scope to the project in question, otherwise the candidate will not be accepted.

2.2.5 The ultimate number of PSA at the Project shall be dictated by the value for construction services (Construction Cost Limit) as follows:

2.2.5.1 For up to and including Twenty - five Million Dollars ($25,000,000), only the one (1) initial PSA shall be required.

2.2.5.2 For projects over Twenty-five Million Dollars ($25,000,000) up to Seventy-five Million Dollars ($75,000,000), one (1) additional PSA shall be required. Additional PSAs shall be added on Seventy - five Million Dollar ($75,000,000) increments. The MD Anderson OCIP Manager reserves the right to increase or decrease the requirements for the number of PSA's on a particular project if the increase or decrease is determined to be necessary due to the scope of the work or other factors that may not be known at the start of a particular project. The GC will be consulted and proper notice will be provided, particularly if an increase in the number of PSA's is deemed to be necessary.

2.2.5.3 For Contracts that involve multiple Phases and Stages, the value for construction services shall accumulate as additional packages of Work are added to the overall Contract. If there are significant population gaps between the head count at the start of a new GMP and the declining count of the previous one, the MD Anderson OCIP Manager will decide if the new GMP shall relax the demand for additional PSAs.

2.2.6 The PSA shall possess a certificate of completion for the OSHA 510 class (30-hour outreach training for Safety in the Construction Industry). The certificate must be dated within four (4) years of the executed Contract. Formal submittal of proof must be completed before the PSA will be accepted by the ODR.

2.3 PSC AND PSA (PSC/A)

2.3.1 The qualifications and previous work experience of the initial PSC/A shall be submitted with the RFP. Any PSC/A additions or changes after the RFP receipt date must be formally submitted for consideration to the ODR. Work shall not be allowed to commence prior to written acceptance by the ODR. Any cost related to the Contractor's failure to meet this requirement will not be reimbursed by Owner and additional time extension of the Project schedule will not be allowed. The final decision on acceptance of a prospective PSC or PSA rests solely with the MD Anderson OCIP Manager.

2.3.2 For two (2) years of military service that cites safety training or an Associate's Degree in a field of study that contains significant safety training, one (1) year of required experience will be subtracted from the requirements listed above. For four (4) years of military service that cites safety training or a Bachelor's (Undergraduate) Degree in a field of study that contains significant safety training, two (2) years of required experience will be subtracted from the requirements listed above.

2.3.3 PSC/A shall possess certifications for CPR and AED that are current to within two (2) years.

2.4 SUBCONTRACTOR'S SAFETY REPRESENTATIVE (SSR)

2.4.1 Each first-tier Subcontractor shall declare one (1) or more employees to be its designated SSR. The SSR shall be dedicated to the Project for on-site safety services. Any exceptions shall be at the discretion of the ODR.

2.4.2 The SSR may have collateral duties, but must be on the Project site when any part of the applicable Subcontractor's Work is being performed. The Contractor shall formally approve each SSR.

2.4.3 Each SSR shall possess a certificate of completion for the OSHA 510 class (30-hour outreach training for Safety in the Construction Industry). The certificate must be dated within four (4) years of the executed Subcontract.

2.5 CONTRACTOR PROJECT SAFETY MANAGEMENT PLAN (PSMP)

2.5.1 The Contractor shall develop, implement, and furnish adequate resources for the PSMP.

2.5.2 The objectives and intent of the PSMP shall include, but not be limited to:

2.5.2.1 Anticipating, plan, control and coordinate Work to eliminate hazards, minimize risks, and aggressively manage losses involving injuries or property damages;

2.5.2.2 Ensuring education and training for best safety practices by all workers and holding supervisors accountable for safety performance;

2.5.2.3 Documenting and recording preventative measures; establishing inspection, notification, and investigation requirements; and measuring results of performance;

2.5.2.4 Providing protection for adjacent property and safety for the public.

2.5.3 The Contractor shall submit a complete draft of the PSMP to Owner for review and written acceptance prior to the issuance of NTP for construction services. The Contractor shall incorporate Owner comments into a final draft and shall resubmit the amended version to the ODR within thirty (30) calendar days following the return date of Owner comments to the initial draft.

2.5.4 The Contractor shall formally evaluate and update the PSMP and its supporting documentation at least semi-annually to assure effectiveness and continuous improvement. The Contractor shall facilitate a meeting with the ODR to present results of the PSMP evaluation. Contractor shall inform ODR of date no later than fifteen (15) calendar days prior to presentation.

2.5.5 The PSMP shall address the inclusion of the OFPC SafetyNet (DBO^2) Program for electronic collection of safety observations. The terms of this Owner directed Program shall not be replaced by any existing process including any existing version of the SafetyNet Program used by the Contractor. Within fifteen (15) calendar days of the issue of the NTP, the Contractor shall purchase two (2) each hand-held (PDA) devices and PC docking stations to allow the field-recorded observations to be downloaded to the Program server through specified computers at the Project. Training for the Contractor staff will be conducted by the Owner immediately following arrival of the hand-held devices.

2.5.6 The Contractor shall provide documentation to assure the Owner that a structured review of the PSMP has been performed to confirm that all Contractor and Subcontractor safety deliverables have been developed and are in place prior to commencement of the Work.

2.6 PERSONAL PROTECTIVE EQUIPMENT (PPE)

2.6.1 PPE shall be required for all workers in construction areas. The following items shall be furnished, inspected, and maintained by the employer.

2.6.2 Hard Hats (Safety Helmets) shall be ANSI stamped (Z89.1-1997, Type I, Class E, G and C).

2.6.3 Eye Protection (Safety Glasses) shall be ANSI stamped Z87. If a worker wears prescription glasses (plastic lens only) that are not marked Z87, the employer shall furnish goggles or safety glasses that are designed to fit over another pair of glasses.

2.6.4 Vests shall be reflective traffic vests and shall be worn outside of all upper body clothing.

2.6.5 Contractor shall purchase and maintain an appropriate inventory of types and sizes to be able to furnish the three (3) items listed above for up to ten (10) Owner representatives who may visit the Project.

2.6.6 Hand Protection, Hearing Protection, Respiratory Protection, Fall Arrest Equipment, and other PPE shall all be furnished as required to comply with this Section and OSHA Standards.

2.7 MEDICAL EQUIPMENT

2.7.1 The Contractor shall purchase and maintain at least one (1) First Aid Kit on the Project site as per ANSI Z308.1 and it must be accessible whenever work is ongoing.

2.7.2 The Contractor shall purchase and maintain at least one Automatic External Defibrillator (AED) unit on the project site. The unit shall be located in Contractor project site office with appropriate signage.

2.7.3 A minimum of two (2) Contractor employees, with current certifications for CPR/Emergency First Aid and for use of the AED, shall be at the Project whenever Work is being performed.

2.8 CERTIFICATIONS

Prior to commencement of the Work, employers shall submit lists to the PSC that identify Supervisors, Competent Persons, Equipment Operators, Crane Operators, Riggers and Emergency Responders. In addition to lists, employers shall include copies of all training certificates or formal documentation to support the declared positions and qualifications. Operations that require one of the abovementioned classifications may not commence until said documentation is at the project site.

2.8.1 For the overall authority at the Project and for all operations that require a Competent Person, the PSC shall maintain in a Project file from each employer, a transmittal that names each person declared to be competent for each operation. For operations that require independent certification, copies of the certificates shall be attached.

2.8.2 For every brand and model of crane and motor driven equipment (earth moving, lift platforms, suspended stages, material handling, etc.) brought onto the Project, the using company shall transmit to the PSC a list of employees who are trained and authorized to operate the equipment. Copies of all available training and/or certification documents shall be attached. Industrial Trucks (forklifts) and Cranes shall only be operated by persons who possess documentation of certification from a training program that carries nationally recognized accreditation. Individuals who possess required credentials shall demonstrate capability for witness by the PSC/A. The PSC/A shall issue cards and insignia as detailed herein to authorize on-site operations of all specified equipment.

2.8.3 For every position that is required to assist crane and motor driven equipment operations (flaggers, signal persons, riggers, spotters, etc.), the using company shall transmit to the PSC a list of employees who are trained and authorized to perform these functions. Rigging shall only be performed by persons who possess documentation of completion from a training program that carries recognized accreditation. Individuals who possess required qualifications shall demonstrate capability for witness by the PSC/A.

2.9 PROJECT SAFETY SIGNS AND POSTERS

2.9.1 The Contractor shall post a pair of safety regulation signs at every point of entry to the Project: one in English and one in Spanish. Font shall be black in color and sized in each language to completely fill the surface of a white-coated four foot (4') vertical by eight foot (8') horizontal sheet of 3/4 inch plywood and shall contain only the following text:

ALL VISITORS, DELIVERY PERSONS, AND NEW WORKERS MUST REPORT TO THE PROJECT OFFICE <u>BEFORE</u> ENTERING ANY CONSTRUCTION AREAS.

ALL PERSONS ENTERING ANY CONSTRUCTION AREA MUST WEAR STURDY WORK SHOES, PROPER CLOTHING, A HARD HAT AND SAFETY GLASSES AT ALL TIMES – NO EXCEPTIONS ARE ALLOWED DURING WORK HOURS.

POSSESSION OF WEAPONS, ALCOHOLIC BEVERAGES, CONTROLLED SUBSTANCES, OR DRUG PARAPHERNALIA WILL RESULT IN IMMEDIATE REMOVAL FROM THIS PROPERTY.

EXCEPT WHERE DESIGNATED (BY POSTED SIGNS AND AVAILABLE RECEPTACLES), USE OF ANY TOBACCO PRODUCTS ARE PROHIBITED ON THIS PROJECT

THE MAXIMUM SPEED LIMIT FOR <u>ALL VEHICLES</u> ON THE PROJECT SITE IS NINE (9) MPH – LOWER SPEED MAY BE REQUIRED BY POSTED SIGNS IN SOME AREAS. ONLY AUTHORIZED VEHICLES ARE ALLOWED ENTRY INTO CONSTRUCTION AREAS.

2.9.2 The Contractor shall post a notice sign at the Project office in English and Spanish. Font shall be black in color on a white coated board and size of letters shall be at least three inches (3") in height, and shall contain at least the following text:

VISITORS, DELIVERY PERSONS AND NEW WORKERS MUST CHECK-IN HERE FIRST.

COPIES OF MATERIAL SAFETY DATA SHEETS (MSDS) FOR MATERIALS THAT WILL BE USED OR STORED ON SITE MUST BE DELIVERED BY ALL SUBCONTRACTORS TO THIS LOCATION AND SHALL BE AVAILABLE TO ANY REQUESTOR.

2.9.3 The Contractor shall also post the following in locations that may easily be viewed by workers:

2.9.3.1 Color Codes for Quarterly Equipment Safety Inspections:

2.9.3.1.1 1st Quarter = White (January 01– March 31)
2.9.3.1.2 2nd Quarter = Green (April 01 – June 30)
2.9.3.1.3 3rd Quarter = Red (July 01– September 30)
2.9.3.1.4 4th Quarter = Orange (October 01 – December 31)

2.9.3.2 Emergency contacts list, including phone numbers

2.9.3.3 Hazard Rating Guide (HMIS and/or NFPA)

2.9.3.4 Project Insurance Provider for Worker's Compensation Coverage

2.9.3.5 Others as required by Federal and/or State regulation

2.10 PROJECT SAFETY FILE DOCUMENTS

Contractor shall create and maintain files for Owner review. The following files shall be established in one location on the Project and shall be made accessible to Owner agents during working hours. Additional files shall be created as directed by ODR.

2.10.1 Project Safety Management Plan (PSMP)
2.10.2 Project Safety Management Plan Semi-Annual Evaluations
2.10.3 Project Safety Orientation Checklists
2.10.4 Project Access Log
2.10.5 Project First Aid Log

2.10.6 Project Incident Notification, Investigation, and Evaluation reports
2.10.7 All Qualified Person Certifications and/or Training Documentation
2.10.8 Project Competent Persons lists
2.10.9 Project Equipment and Crane Operators lists
2.10.10 Job Safety/ Job Hazard Analyses (from each Subcontractor per operation)
2.10.11 Project Daily Safe Task Assignment (STA) Briefings
2.10.12 Project Weekly Safety ("Tool Box") Briefings
2.10.13 Project Weekly Safety Representative Meeting Minutes
2.10.14 Project (Monthly) Safety Summary Observation (SafetyNet) reports
2.10.15 Contractor Monthly Safety Report
2.10.16 Project Quarterly (Portable) Equipment Inspection reports
2.10.17 Project Annual (Large) Equipment Inspection reports
2.10.18 Project Permits (for specialty operations)
2.10.19 Project Safety Infraction records

PART 3 – EXECUTION

3.1 POSITIONS, ROLES AND REQUIREMENTS FOR PROJECT SAFETY

3.1.1 Contractor's Project Superintendent
Project Superintendent shall have overall responsibility for all aspects of Project safety and shall support the PSC/A when actions are required to maintain a safe work environment at the Project.

3.1.2 Project Safety Coordinator (PSC)

3.1.2.1 Work history (resume) shall cite previous positions held, time spent at each position, primary work activities performed, education, continued safety related training, and a list of projects that were similar in size and complexity to this Project. Knowledge of experience with and certifications held for fall protection, scaffolds, excavations, crane operations, energy release and incident analysis shall be included in submittal of credentials. All references and work history will be verified by the MD Anderson OCIP Manager.

3.1.2.2 PSC shall report directly to an executive officer of the Contractor and shall not report through the Contractor's Project management team.

3.1.2.3 If removal of the PSC is initiated by the Contractor, the existing PSC shall remain in position until a replacement candidate has been proposed to and accepted by the ODR in writing and is assigned to the Project. If the PSC leaves before the proposal and acceptance procedure is concluded, the Contractor shall temporarily install either a Safety Director (Regional or Corporate) or a professional construction safety consultant as the PSC until a suitable replacement is accepted in writing by the ODR. Any temporary replacement must meet the qualification levels, perform the duties, and be present full time on the Project as required of the PSC in order for Work to proceed. A permanent replacement shall be accomplished within thirty (30) calendar days.

3.1.3 Project Safety Assistant (PSA)

3.1.3.1 Work history (resume) must cite previous positions held, time spent at each position, primary work activities performed, education, continued safety related training, and a list of projects where various roles were experienced. Description of size and complexity of previous projects shall be included. Specifics on safety management related work experience must be clearly established and included. References and work history will be verified by the MD Anderson OCIP Manager.

3.1.3.2 PSA shall each have credentials for an OSHA 510 course that is current to within three (3) years.

3.1.3.3 PSA shall report to PSC.

3.1.3.4 If PSA leaves the Project, acceptable replacement shall be accomplished as soon as possible but in no case longer than 30 calendar days. MD Anderson reserves the right to require a temporary qualified replacement for a PSA. To cover until a permanent replacement is in place.

3.1.4 Both PSC and PSA (PSC/A)

3.1.4.1 The PSC/A shall show evidence of specialized training for Emergency First Aid, Cardio Pulmonary Resuscitation (CPR) and Automatic External Defibrillator (AED) current to within two (2) years.

3.1.4.2 The PSC/A shall have the authority to direct Contractor and Subcontractor personnel to correct any safety violations.

3.1.4.3 The PSC/A shall have the authority to stop operations that involve any level of risk.

3.1.4.4 The PSC/A shall be fluent in English and shall have immediate access to the necessary resources to communicate verbally with all workers at the Project.

3.1.4.5 The PSC shall be on-site, full time from the commencement of construction until Final Completion.

3.1.5 Subcontractor Safety Representative (SSR)

3.1.5.1 SSR name, emergency contact information, and documentation of qualifications shall be submitted to and accepted by the Contractor prior to the commencement of any work activities by the Subcontractor. The SSR shall have the authority to direct actions, stop work and enforce discipline for safety issues.

3.1.5.2 The SSR shall submit an initial written Job Hazard ***/***Safety Analysis (JH/SA) and revisions as work conditions change for each of the risk exposures associated with the employer's portion of the Work. Each submittal shall be reviewed and accepted by the Contractor prior to commencement of the work operation that will create the exposure. Documentation of attendees and subject material covered must be provided by the SSR. Refer to EXHIBIT B.

3.1.5.3 The SSR shall attend the Project Weekly Safety Representatives Meeting when the company is actively (or within one week of) performing work at the Project.

3.1.5.4 The SSR should accompany injured workers that require medical attention at facilities outside the Project. The SSR shall be responsible for notification to the PSC of any incident including near-misses, and shall complete all the documents required to manage any insurance claims. The SSR shall participate in incident investigations that involve the employer's portion of the Work.

3.1.5 5 Each SSR shall accompany the PSC/A during portions of each Project safety inspection that involves the Subcontractor's part of the Work.

3.1.5.6 The SSR shall either conduct and/or make arrangements for all training, equipment and materials that workers need to perform their duties safely.

3.1.6 Work Crew Supervisor, Equipment Operator, Competent Person, Qualified Person Medical Responder

3.1.6.1 Supervisors, Operators, Competent Persons, and Medical Responders for each of the positions held, shall be recognized by the employer through formal submittal to the Contractor. Documentation shall be maintained in the Project safety file.

3.1.6.2 Designations of certifications and qualifications for special roles shall be clearly displayed on hard hats per EXHIBIT F.

3.1.7 Tradesman, Worker, and Laborer

3.1.7.1 All persons assigned to perform any portion of the Work at the Project shall attend a Project safety orientation to acquaint them with potential hazards, and the general safety rules that must be observed. No person shall be allowed to perform any Work at the Project until Contractor declares a successful completion of the Project safety orientation and issues a photo identification badge.

3.1.7.2 A signed copy of the Project safety orientation checklist shall indicate attendance. Contractor shall attach to the checklist a written test taken by each worker that documents at least an eighty (80%) percent correct understanding of the presented material.

3.2 PROJECT SAFETY MANAGEMENT PLAN (PSMP)

3.2.1 Safety Mission and Policy Statement. Contractor's safety Mission Statement shall include commitment to create and maintain a work environment that will eliminate or minimize all risk exposures for all workers at the Project. The Safety Policy Statement shall include acknowledgement that the Contractor is accountable for providing and controlling a safe environment for all workers and members of the public. An original signature and date to endorse and assure commitment by a Corporate Executive or Business Owner shall be affixed to this element of the PSMP. The PLAN shall include the following as a minimum:

3.2.2 Safety Roles and Responsibilities. This element shall outline and describe roles, responsibilities, and authority of each member of the Project staff for involvement in site safety, security, incident command, and incident claims management. The Contractor's Project organization chart shall indicate the reporting line for the PSC. The PSC role shall include authority to direct actions of Subcontractors and to stop work operation whenever any worker is exposed to a risk that can be reduced or eliminated.

3.2.3 Safety Enforcement. This element shall include Contractor's disciplinary procedure for its own employees and for those of all Subcontractors. It shall include a description of the levels of severity and frequency (repetition) that will result in Contractor intervention and provide details of the retraining and/or disciplinary steps that will ensue from the possible combinations of unsafe behaviors. It shall also include discipline for supervisors who tolerate risk.

3.2.4 Safety Recognition and Incentive. This element shall include a description of how those workers who demonstrate exemplary safety behavior and those supervisors who manage, enforce, educate and promote safety will be recognized and commended. Any celebration that will occur as part of this element shall not be minimized with achievement of Project milestones that are associated with production, schedule, quality or budget.

3.2.5 Safety Hazards. This element shall include a narrative that recognizes existing site conditions, foreseeable changes to existing conditions, local climate, Owner and public interface, environmental impact and remediation issues, skill and experience levels of available work

force, utility interruptions, water supply sources, power supply sources, Owner facility provisions, sanitation requirements, parking, material storage areas, and proximity to students and public walkways and roadways. It shall contain a completed copy of the Anticipated Project Hazards Checklist (EXHIBIT A). It shall also be expanded throughout the duration of Work to include Subcontractor plans for elimination or minimization of risk. These plans shall be described by use of Job Hazard/Safety Analysis forms (EXHIBIT B). Each JH/SA shall identify the work steps required to complete an activity, assess the hazards associated with each step, and offer a plan to eliminate or minimize the identified risks for each step. A copy of each accepted JH/SA shall be posted into this element as an explanatory amendment. JH/SA forms shall be reviewed by supervisors with the work crew at least daily and immediately prior to performance of the work that the form addresses. All portions of this element shall be in accord and cooperation with existing procedures for the campus Environmental Safety and Health department, the campus Security department, and local municipal Fire and Rescue.

3.2.5.1 Hazard Communication ("HazCom"). Insert the elements required by OSHA. The PSC/A shall maintain a Hazardous Materials Inventory List with individual MSDS for each and every hazardous substance brought onto the Project site. In addition to the product label of contents, all containers with at least five (5) gallons of fluid capacity or twenty (20) pounds of chemical content shall include either HMIS or NFPA hazards warning labels (except drinking water and fire extinguishers). All products with HMIS/NFPA number ratings greater than zero or one in any of the three categories (health, flammability, or reactivity) shall be considered as hazardous.

3.2.5.2 Environmental (Sensory) Hazards. Insert actions to measure worker exposures and to control hazards that exist beyond OSHA permissible exposure limits (i.e. dust, fumes, noise, chemicals, and extreme temperatures). Also include control and remediation plans for incidents that result in a spill or discharge of a potentially hazardous or toxic substance (fluid or gas).

3.2.5.3 Roadway and Traffic Hazards. Insert actions to be taken at times when public roadways or sidewalks are affected by construction activities. Signs, devices, and procedures shall be identified where public passage is to be closed or altered. Procedures and training for flaggers shall be required and shall be in compliance with all applicable Texas Department of Transportation regulations for road safety; specifically the Texas Manual on Uniform Traffic Control Devices (TMUTCD) shall be referenced.

3.2.6 Fire Prevention and Control

3.2.6.1 Insert arrangements and equipment necessary to provide adequate protection during all phases of construction. All portions of this element shall be developed to be in accord and cooperation with existing procedures for the campus Environmental Safety and Health department, the campus Security department, and local municipal Fire and Rescue.

3.2.6.2 Burning, Welding, Flame Operations. Insert the process for issuance of a "Hot-Work" permit (EXHIBIT C). Permits forms shall be issued by PSC, unless campus Environmental Health and Safety department desires to be involved. Permit form shall be completed by SSR and returned to PSC for acceptance prior to start of operation. Static operations in open spaces (i.e. on-site fabrication) may be authorized by week-long permits. All others shall require permits that expire at the end of the shift. Permits shall identify fire watcher(s) and require pre-operation and post-operation inspections.

3.2.7 Emergency Response. Describe each type and level of emergency that may reasonably be expected to occur on the Project. Insert response or rescue plan for each kind of potential emergency. The portion of this element that addresses occupational illness and injury shall incorporate the essence of the Illness/Injury Management Matrix (EXHIBIT D). This element shall address first aid, off-site medical care, property damage, rescue, project alarm signals,

wind, flood, lightning, and evacuation, threat of violence, protests or deliberately disruptive events. NOTE: Campus Spokesperson shall be the only person authorized to communicate with the media. This element shall include a drawing or sketch of the site (maintained for "as built" conditions) to indicate gates, emergency vehicle roadways, lay down areas, crane set up positions, exterior hoists, etc. All portions of this element shall be developed to be in accord and cooperation with existing procedures for the campus Environmental Safety and Health department, the campus Security department, and local municipal Fire and Rescue.

3.2.7.1 Incident Notification. Insert the list of personnel with phone, email, position and company information who may be contacted. The ODR shall be included by receipt of a copy of the Contractor Incident Notification Report form (EXHIBIT E). Indicate specific positions within the campus staff that may be contacted and/or involved in the notification and control process; i.e. site control and utility management. Campus Public Relations officer shall be the only person authorized to release live or pre-recorded video or written statements to the media. Contractor shall cooperate with campus PR officer and coordinate media arrangements as directed.

3.2.7.2 Site Security. Insert actions and control measures to prevent intrusion during work and non-work hours. Describe intended controls for perimeter security, gate security, pedestrian crosswalks, protection at public paths through and alongside construction areas, warning signage, etc. Identify special work that may not be performed during regular hours, and will require special precautions. Include descriptive detail for some method of gathering names and probable locations of workers who have not been cleared for safe departure during any type of emergency. Identify the position(s) of all who will possess this information and be prepared to convey critical details quickly to any outside emergency response command that might arrive at the Project.

3.2.8 Project Trenching, Tunneling and Excavation. Insert soil boring reports, soil classification analysis, site sketch and any other information that may support, explain or clarify the intent of this element. In addition to UGC, this element must be stamped and sealed by a Registered Professional Engineer recognized in the State of Texas in the field of Civil or Soils Engineering.

3.2.9 Drug and Alcohol Impairment. The Contractor, for itself and all Subcontractors, shall have a robust drug and alcohol screening and intervention plan. Insert details of Contractor policy for screening both direct employees and Subcontractor employees for the presence of controlled substances, prescription pharmaceuticals, and alcohol. Describe all of the types of testing and confirmation that the Contractor requires and the tolerance thresholds for each substance. This element shall include, as a minimum, a detailed explanation of the following situations and mandatory testing events:

3.2.9.1 Pre-employment – Test results conducted within two weeks preceding issuance of badge for Project access.

3.2.9.2 Post-incident (required per the OCIP for all injuries on a OCIP project)

3.2.9.3 Random selection

3.2.9.4 For cause

3.2.10 Concrete (for slip-form, crane bucket, pump truck, cast-in-place)

3.2.11 Confined Space Entry (Permit Required and Restricted Entry)

3.2.12 Crane Operations (for set-up/use requirements and limitations)

3.2.13 Demolition (Mechanical and/or Explosive Blasting)

3.2.14 Electrical Power Service (address power supply and use during construction)

3.2.15 Fall Prevention and Protection (from elevations and at same level)

3.2.16 Hand and Power Tools

3.2.17 High Voltage ("Proximity Work")

3.2.18 Ladders and Stairs

3.2.19 Lock-out, Tag-out (Energy Isolation for sudden release of any kind of energy)

3.2.20 Respiratory Protection

3.2.21 Safety Inspection

3.3 PERSONAL PROTECTIVE EQUIPMENT (PPE)

The following PPE requirements shall apply to all workers in construction areas. Contractor may declare specific lunch break areas within construction areas to be exempt from PPE requirements. Markings for these spaces shall be clearly defined and signage shall be legible and prominently posted in language that all workers can read.

3.3.1 Hard Hats (Safety Helmets) shall be worn 100% of the time in construction areas, with the brim forward (or as allowed by the manufacturer). "Cowboy" style hard hats shall not be allowed (even if ANSI stamped). Hard hats with noticeable wear or damage shall be replaced. Each hard hat shall be examined by the PSC/A during the Project Safety Orientation to confirm acceptable condition. The PSC shall place decals on the right side to indicate orientation/badge number and worker trade and status as a safety responder (EXHIBIT F). The PSC shall also place decals on the left side to indicate authorizations for equipment operations (EXHIBIT F).

3.3.2 Eye Protection (Safety Glasses) shall be worn 100% of the time in construction areas. Additional eye and face protection shall be provided by employers for any employee when work operations create an exposure to airborne particles, chips, sparks, radiation, etc.

3.3.3 Vests shall be worn 100% of the time in construction areas.

3.3.4 Hearing Conservation and Protection shall meet or exceed OSHA requirements. Except for suppression of sound level energy, no devices or equipment that may hinder ability to hear an alarm shall be placed in or over the ears. Portable radios and other electronic devices used for any reason except emergency assistance are prohibited in construction areas.

3.3.5 Hand Protection that is designed to counter the exposure shall be furnished to all workers who must handle materials or equipment with sharp edges, slick surfaces, chemically reactive components or extreme temperatures.

3.3.6 Respiratory Protection shall meet or exceed OSHA requirements.

3.3.7 Foot Protection (Work Shoes) must have soles with a resistance to punctures, uppers that cover the entire foot and ankle and offer resistance to scrapes and cuts. Sandals, open-toed shoes, dress loafers, high-heels, and all athletic style shoes (including those with ANSI markings) are prohibited. Additional protection shall be provided when work operations create impact exposures.

3.3.8 Other OSHA required PPE shall be furnished as appropriate for specific tasks.

3.3.9 Other clothing:

3.3.9.1 Shirts shall not have noticeable holes and shall be free of profane, inflammatory, sexually explicit or discriminatory messages. Sleeve length shall cover the ball of the shoulder and shirt length shall reach waist of pants.

3.3.9.2 Pants shall be full length. Holes must not be large enough to catch on snag points or offer measurable amounts of exposed skin.

3.4 PROJECT SAFETY MEETINGS AND TRAINING

3.4.1 Project Initial (Safety Kick-Off) Meeting

3.4.1.1 At any time after the date of intent to award Contract, but not more than fifteen (15) calendar days after the issue of the Notice to Proceed with Construction Services, the Contractor shall arrange suitable accommodations for the meeting. The MD Anderson OCIP Manager will chair the meeting. Minimum attendance shall include the Construction Inspector(s), OSR, Contractor's PM, Superintendent, and PSC/A. The Contractor's safety director, additional representatives for the Owner, the Institution, the A/E, the Contractor and local regulatory entities may also attend. Any Subcontractors that have been awarded part of the Work are encouraged to attend.

3.4.1.2 The Contractor shall confirm the schedule availability for all required attendees at least fourteen (14) calendar days prior to the meeting date.

3.4.2 Initial Meeting with Subcontractors for acknowledgment of Safety Requirements

3.4.2.1 At any time after the date of intent to award each first tier Subcontract, but prior to commencement of any Work, the Contractor shall arrange and chair a meeting with Subcontractor to explain safety requirements. Minimum attendance shall include the OFPC Construction Inspector(s), Contractor's PM, Superintendent, PSC/A, and SSR. Other interested parties for OFPC, campus and Contractor may also attend. Any lower-tier Subcontractors that have been awarded part of the Work are encouraged to attend.

3.4.2.2 In addition to all of the pertinent safety regulations that apply to the portion of the Work that the Subcontractor will perform, the Contractor shall clearly state the expectation that safety management of its workers and Sub-tier workers shall be the Subcontractor's responsibility and that failure to adequately manage safety could result in a demand for the removal and replacement of supervisors. The roster of attendees shall indicate distribution to the ODR and the Subcontractor.

3.4.3 Project Safety Orientation Training

3.4.3.1 The PSC/A shall present training to every person who is to be allowed into the construction area(s) without an escort. This duty shall not be delegated. Unless the PSC/A is bi-lingual, a translator shall be present when there are workers in attendance who do not speak English. Workers and their immediate supervisors shall be required to attend a repetition of the orientation whenever observed behavior indicates a lack of understanding or repeated non-compliance.

3.4.3.2 The PSC shall review the Safety Orientation Checklist (EXHIBIT G) and incorporate each applicable topic within the training presentation**.** At the conclusion of the presentation, the PSC shall issue a twenty (20) question multiple choice test to each attendee. PSC shall create the questions from the body of the Orientation Checklist to be a comprehensive

representation of its entire content. All questions and answers will be reviewed with the participants at the conclusion of the exam. Any attendee missing five or more questions will be immediately re-tested after this review. Those who do not pass a second time will be individually evaluated by the PSC for understanding and retention of information. Any attendee who cannot read English will receive the questions orally and responses will be recorded into a blank copy of the test. Questions for the test shall be changed at least each quarter. Orientation Checklist and successful test shall be stapled together and filed as a single document in the Project safety file.

3.4.3.3 In addition to the decals placed on the hard hat, the PSC shall also furnish to each person who satisfactorily completes the Project Safety Orientation a photo-identification badge. The badge will indicate the worker's name, company, job title, project name, and OFPC project number. The badge must be visible at all times that the worker is on the Project and be located above the waist using clip or arm band. Lanyards are prohibited. Alternately, a printed adhesive backed photo badge can be used for identification. Printed adhesive backed hard hat stickers are the preferred badge for employee identification. Failure to maintain the badge will be grounds for removal from the Project.

3.4.3.4 The PSC shall confirm employer insurance requirements prior to start of orientation. PSC shall confirm document credentials for operators and SSR prior to start of orientation. The PSC shall maintain a site access log to document each successful orientation and any reorientations. The log shall include the person's identity and Project critical information (name, employer, badge number, equipment operator, medical responder and/or supervisor status). Prior to issue of hard hat stickers for equipment operations, PSC shall visually observe operator capabilities.

3.4.4 Daily Crew Pre-start (Safe Task Assignment) Briefing

3.4.4.1 Prior to start of Work for each shift, the immediate supervisor shall conduct a brief meeting with all members of the work crew to explain how the work steps for the shift are to be accomplished. Explanation shall include a discussion of all the work activities that will be performed in the vicinity as well as the work that the crew is expected to accomplish. Explanation shall also address all of the recognized risks associated with the task and the measures to be installed or actions to be taken to eliminate or minimize the exposures.

3.4.4.2 A sign in sheet shall be produced to document the training. It shall contain names and initials of all attendees, name of supervisor, statement of task(s), reference to the JH/SA that covers this task, and any special safety measures or actions that are required to assure elimination or minimization of risk. A copy of the sign in sheet shall be given to the PSC at the end of the shift and copies of any completed permits shall be clipped to the document. If any near-miss or lessons learned events occur during the shift, they should also be attached in written form and discussed with the PSC. The supervisor's signature on the sign in sheet shall be understood to also mean a thorough examination of the work space has been concluded and that no housekeeping issues or safety measures have been left in a compromised state.

3.4.4.3 All Project Management team members (OFPC, Contractor and Subcontractor) are encouraged to attend these pre-start meetings as frequently as possible to reinforce the Project safety culture.

3.4.5 Project Weekly Safety Representatives Meeting

3.4.5.1 The PSC shall chair a weekly meeting with all SSR(s) to ensure that all are aware of the existing hazards and exposures that should be addressed with each crew. A written agenda (EXHIBIT H), attendance roster, and meeting minutes shall be prepared and

maintained at the Project site by the PSC. A copy of these documents shall be submitted to the ODR.

3.4.5.2 This meeting shall be exclusively reserved for safety and loss control issues. Attendance shall be required of all SSR(s) when the employer is actively (or within one week of) conducting work operations at the Project. All Project Management team members (OFPC, Contractor and Subcontractor) are encouraged to attend these weekly meetings as frequently as possible to reinforce the Project safety culture.

3.4.6 Project Weekly Site Safety ("Tool Box Talk") Briefing

3.4.6.1 All workers on the project site, including site Project Management team members, shall attend a weekly safety Tool Box Talk, which shall be presented in English and all other languages that are natively spoken at the Project. The PSC/A may deliver each talk to the entire Project population or each SSR may deliver individual briefings to a specific trade and/or group. The PSC/A shall collect and maintain copies of all sign-in sheets for every briefing.

3.4.6.2 Briefings shall address appropriate topics for the near-future work operations and current site conditions. In addition, the PSC/A shall select at least one (1) of the elements within the PSMP to be a mandatory topic each week, and shall select every element at least once during the course of the Project.

3.4.7 Safety Lessons Learned and Best Practices Workshops

Contractor and Subcontractors shall work with OFPC to use Lessons Learned Workshops to capture work site high-impact safety experiences and best practices over the course of the work. Contractor will work with OFPC to facilitate a Worksite Lessons Learned Workshop every six (6) months and will work with Subcontractors to actively participate in Work Site Lessons Learned Workshops. Contractor will disseminate high-impact lessons learned to OFPC and Subcontractors as they are captured.

3.5 SAFETY INSPECTIONS

3.5.1 Daily (SafetyNet) Inspections

3.5.1.1 Site safety inspections shall be entered into SafetyNet. OSR(s), MD Anderson EH&S Safety Inspectors PM, CI, Contractor Superintendent, PSC/A, and SSR(s) shall all be recognized users of the Owner's SafetyNet Program. Other persons may also be added to the user list.

3.5.1.2 User participation shall include recording of all observations of safe and unsafe behaviors and conditions at the Project (via the Program's menu-driven checklist). Additionally, the Contractor shall review on-line reports and respond prudently.

3.5.1.3 Each unsafe observation shall be corrected or controlled immediately. The PSC shall be responsible for reviewing and ensuring proper closure of all unresolved ("open issues") unsafe observations. ODR shall be notified prior to closure in the on-line record of any "A" or "B" violation.

3.5.1.4 MD Anderson will conduct initial training for Contractor understanding and use of the SafetyNet Program. All subsequent training for follow-on Subcontractors shall be accomplished by the Contractor.

3.5.1.5 A daily SafetyNet inspection may only record a group of observations within a single work operation, but the accumulated inspections conducted by the Contractor throughout each work week shall reflect a comprehensive report of all operations at the Project. At least one Safety/Net set of observations must be completed every work day (including Saturday,

Sunday and holidays) by the PSC/A. The formal safety inspection that is required to be done by the GC once a week will be in addition to the aforementioned daily inspections and it will also be done in the Safety/Net application.

3.5.1.6 When the OSR conducts an inspection, the PSC/A shall be available to join in during the walk around. Other users may also require the PSC/A to join in during inspections.

3.5.1.7 When the PSC/A conducts an inspection, at least one SSR shall join in for the portion of the inspection that addresses the Subcontractor's portion of the Work.

3.5.2 Quarterly (documented) Inspection of all tools, rigging, and portable equipment

3.5.2.1 The PSC shall facilitate a documented safety inspection each quarter. Each employer shall produce and submit a document (EXHIBIT I) that addresses all tools, rigging, and portable equipment within the company's inventory on the Project site. Documents shall be maintained by the PSC.

3.5.2.2 This inspection shall include, but not be limited to, the following: Fall Arrest Equipment, Rigging, Manufactured Ladders, Power Tools, Cords, Welding Leads, Hoses, First Aid Kit, AED, Air and Sound Meters, and Ground Fault Circuit Interrupter devices. Personally owned hand tools are exempt from this inspection procedure, but daily examinations of all portable items prior to start of work shift as prescribed by OSHA standards are not relaxed.

3.5.2.3 For every item that "passes" the quarterly inspection, remove the previous quarter's color coding and affix the current quarter's color coding. Every item removed from service shall be destroyed or clearly tagged as "unsafe" until it is transported off the Project. The inspection report shall reflect such actions. Inspection reports shall be completed and submitted to the PSC prior to use of any new equipment on the Project site and re-inspections before the 1st calendar day of the beginning of each quarter of the year. Quarterly re-inspections may begin and color coding may be changed anytime during the final two-week period of the previous quarter.

3.5.3 Initial and Annual Inspection of all Cranes and Motor Driven Equipment

3.5.3.1 The Contractor shall facilitate safety inspections and written certifications for all hoists, cranes, mobile equipment, motorized scissors and aerial lift platforms, motorized stage platforms, generators, and compressors on the Project.

3.5.3.2 The Contractor shall ensure that all equipment inspections are consistent with the manufacturer's requirements. An initial inspection and certification of proper condition shall be transmitted to PSC before a piece of equipment is allowed to commence operations at the Project.

3.5.3.3 The Contractor shall select the month that occurs approximately six (6) months after the commencement of construction, and announce this as the month for annual re-inspections and re-certifications of all motor driven units of equipment and cranes that remain in use at the Project. Any equipment that leaves the Project will require re-certification before it shall be allowed to resume operation at the Project.

3.5.4 Inspections by Regulatory Agencies

The PSC/A shall notify the ODR immediately of the arrival at the Project site by an representative of a Regulatory Agency (OSHA Compliance Officer, TCEQ representative, Law Enforcement Officer, etc.), and provide the Owner with a copy of any published findings or

citations (OSHA Safety Orders, EPA Site Deficiencies, etc.) issued to any employer and shall ensure that statutory posting requirements are met.

3.6 CONTRACTOR RECORDS, INVESTIGATIONS AND REPORTS

3.6.1 Mobile Equipment and Crane Operator Records

Each employer shall submit to the PSC/A, for each operator, a record of training that identifies the trainer and the details that were addressed and successfully demonstrated during training. The minimum amount of detail shall include the following assurances:

3.6.1.1 Pre-start up inspection, travel path issues, and location/set up procedure;

3.6.1.2 Start up, operation, intended use, and shut down (normal and emergency);

3.6.1.3 Equipment Operations Manual, Limit Chart(s), Motor Plate information, equipment capacities and limitations, alarm features, safety stops, seat belts, roll over protection and preventive maintenance;

3.6.1.4 PPE, fall protection, environmental, and any other related risks or exposures.

3.6.2 Contractor Monthly Safety Report

3.6.2.1 The PSC/A shall prepare a monthly report (EXHIBIT J) and shall submit copies, as directed, to the MD Anderson OCIP Manager. Report shall be due by the 10th day of the of the month following the recorded information.

3.6.2.2 This information is vital to the Owner's safety benchmarking efforts. Failure to submit the information in a timely manner may result in ODR withholding a portion of the Contractor application for payment, and shall disqualify the Contractor from consideration for safety award for the month of failure to submit.

3.6.3 Incident Notification, Investigation and Reporting Procedure

3.6.3.1 During the orientation, the PSC shall instruct all workers to immediately report to their supervisor every incident, even if there is no obvious injury or property damage. Supervisors shall immediately notify the PSC/A. PSC shall immediately notify the MD Anderson OCIP Manager of any incident. . All incidents shall be thoroughly investigated. Contractor and involved Subcontractors shall discover all obtainable and measurable information and reach conclusions that cite both the contributing factors and the root cause(s). Contractor shall lead the efforts and follow a structured incident investigation program (TapRoot or equivalent). Contractor and involved Subcontractors shall tailor the magnitude and depth of the investigation effort to correspond to the potential, rather than the actual, outcome of the incident and shall include qualified senior management, line management, and safety consultants as the circumstances warrant. The ODR reserves the right to participate in incident investigations. Contractor shall prepare and submit reports that will allow the MD Anderson OCIP Manager and Subcontractors to understand findings and planned changes to the PSMP. At the time of any injury incident, workers and supervisors shall be provided a copy of Exhibits K & L that explain the rights, duties, and expectations for those who are involved in the incident.

3.6.3.2 There is a mandatory requirement that all Contractors provide restricted duty, transitional, "light" duty Return to Work (RTW) for all injuries. There are no exceptions to this requirement. This is mandatory and non-negotiable and will be enforced explicitly by the MD Anderson OCIP Manager. The MD Anderson OCIP Manager will be the only authority that can authorize any deviation from this requirement.

3.6.3.2 Incident Responsibilities for Workers and Supervisors

3.6.3.2.1 Contractor shall cover the information in the Worker Responsibilities (EXHIBIT K) document during the orientation and keep copies to hand out to any worker who appears to have sustained an occupational injury.

3.6.3.2.2 Contractor shall cover the information in the Supervisor Responsibilities (EXHIBIT L) document during the orientation and keep copies to hand out to any supervisor who informs PSC/A that an worker injury has occurred.

3.6.3.3 Incident Notification Report

Contractor shall submit an incident notification report as soon as the situation is deemed to be under control. The intent of this report is to make the ODR aware of the event and to provide a general idea about severity (close call, first aid, medical only, restricted duty, removal from work, etc.) Use EXHIBIT E for this notification in addition to entering data into SafetyNet. For all injuries, regardless of the severity, the MD Anderson OCIP Manager must be notified immediately by the PSC. The MD Anderson OCIP Manager reserves the right to relax this requirement as he/she deems appropriate.

3.6.3.4 Incident Investigation Report

3.6.3.4.1 Contractor shall prepare a two-stage written investigation report for each incident that involves any questions about facts, details or causes.

3.6.3.4.2 The first stage of the report shall provide all of the collected facts and corroborated statements that have a bearing on the understanding of all that happened before, during and after the event. This piece of the report shall be submitted to the ODR as soon as possible, but not less than two days following the event.

3.6.3.4.3 The second stage of the report shall provide three parts. The first part shall include a time line that contains all of the linked components in the chain of events that set up the incident. The second part shall include a description of all the apparent surface causes and underlying root causes that enabled the incident to occur. The third part shall describe all of the apparent weakness(s) in the PSMP, modification(s) that might have prevented or reduced the severity of the risk, and a commitment to adopt and engage the modification(s) as a new best practice. This piece of the report shall be submitted to the ODR as soon as possible, but not less than two (2) weeks following the event. If forensic studies or consultant reports will not be available within two (2) weeks, those factors shall be attached as addenda at a later date and the modification(s) to the PSMP may then be further adjusted.

3.6.4 Contractor Final Safety Report

3.6.4.1 Contractor shall work with Subcontractors to prepare a Final Safety Report and shall forward to OFPC no later than thirty (30) calendar days after Substantial Completion.

3.6.4.2 Report shall include at least the following items:

3.6.4.2.1 Summary of the PSMP with description of improvement initiatives undertaken during the course of the Project

3.6.4.2.2 Evaluation of the effectiveness of the PSMP, including summary results of assessments performed

3.6.4.2.3 Project safety performance results (leading and trailing indicator measures)

3.6.4.2.4 Project safety lessons learned and best practices

3.6.4.2.5 Summary of Project incidents

3.6.4.2.6 Evaluation of Contractor and all Subcontractor overall safety performance

3.6.5 Contractor shall provide Ad Hoc reports as requested by the ODR. This may include work force histograms, training documents, safety trending reports, etc.

3.6.6 If the Project conditions ever present a situation that will not allow compliance with this Section, the Contractor shall submit a Variance Request letter (EXHIBIT M) to the ODR. Until the variance is signed and approved by the ODR, compliance with this Section shall be maintained. If Work must be halted because the Variance Request was not submitted in a timely manner or was not deemed to be necessary, the Owner will disallow any request for compensation.

3.7 CONSTRUCTION OPERATIONS

The following requirements are either in addition to or in the absence of Federal and State regulations. Where conflicts exist, the most stringent directives shall apply.

3.7.1 CRANES

3.7.1.1 Tower cranes (including affiliated transformers and power supply equipment) shall be surrounded by at least a sixteen-foot (16') high, 5/8-inch plywood enclosure with a lock-controlled entrance.

3.7.1.2 Operators of cranes shall possess certification from a nationally accredited training organization.

3.7.1.3 Every crane and piece of hoisting equipment shall be equipped with an anti-two blocking sensor above each lifting block.

3.7.1.4 Unless the crane is equipped with sensors that inform the operator of the weight of the load on the hook and the current wind speed, these measurements shall be determined by other means before commencement of each pick.

3.7.1.5 When outriggers are used on cranes, they shall be fully extended. Float pads shall be landed onto leveled and properly designed and sized slabs or cribbing. Where steel plate is used for cribbing, welded or bolted cleats shall be attached to upper surface to prevent float pads from moving horizontally.

For cranes of up to and including 35-ton capacities, wooden cribbing shall be a minimum of four inches (4") in thickness. For cranes over 35-ton capacities and up to 150-ton capacities, cribbing shall be a minimum of eight inches (8") in thickness. For all cranes up to 150-ton capacity, the minimum size of the surface ("footprint") of the cribbing assembly shall be determined by the following formula: the capacity of the crane (in tons) divided by 5 equals the minimum square footage required. Properly sized circular crib pads are acceptable. Side dimensions for rectangular crib pads shall be equal to each other or differ by no more than one foot. For cranes larger than 150-ton capacities, a qualified person shall design the cribbing. "Sandwich" units of cribbing are allowed as long as the plywood on bottom and on top is at least one inch in thickness.

3.7.1.6 For "Pick and Move" operations, the pick shall be made directly in front of the crane with the boom as near vertical as possible. Move at walking speed with a "spotter" in front of the load and another behind the crane. Guy wire cables that secure the load to the body

(to prevent lateral force loading of the boom) of the crane shall be required if the grade slope is more than three (3) degrees or the terrain is uneven. Only rubber-tired cranes shall be allowed to perform this operation without a “critical lift” plan and the load must be under fifty percent (50%) of the “on rubber” chart limit.

3.7.1.7 Critical Lifts shall include, but not be limited to: (1) Tandem Lifts, (2) Lifts greater than seventy-five (75%) percent of Load Chart, (3) Crane Suspended Personnel Hoists, (4) Non-Conventional Outrigger placements and (5) “Blind” picks and/or placements. All of these events shall require submittal of custom designed plans by qualified persons.

3.7.1.8 Multiple lift operations (“Christmas Treeing”) shall not be permitted.

3.7.1.9 All crane operators on rigs rated for more than five (5) tons of capacity shall submit to a physical examination prior to conducting any work on the Project and**,** if still on the Project, at least every twenty-four (24) months thereafter. The physician’s written declaration of fitness shall be submitted to and maintained by the PSC/A in Project files.

3.7.1.10 Only the designated rigger and/or signal persons shall issue lift instructions to the operator. The only exception shall be an emergency stop signal, which may be delivered by anyone on the Project who knows how to alert the operator.

3.7.1.11 All loads raised more than six feet (6’) above ground elevation shall have a tag line attached that is long enough to allow control of load spin without placing any part of the body directly below the load. When “shake out” hooks are used, the load must never be elevated above five feet (5’) over the surrounding surface and workers must stay at least five feet (5’) horizontally away from the suspended load.

3.7.1.12 For any load that may be elevated and moved directly above workers, a means for worker notification must be in place. The crane operator may perform this notification by horn if the load can be seen at all times. If the crane operator will lose sight of the load at any time, notification must be made by a designated individual who can maintain sight of the load. Notification must be accomplished by some means that attracts the attention of all workers.

3.7.2 DEMOLITION

3.7.2.1 Maintain clearly marked and well-illuminated egress paths at all times.

3.7.2.2 Maintain barricades and signage that isolates impacted areas to prevent entry by other trades and members of the public.

3.7.2.3 Removal of materials and trash from elevated locations must be controlled. Refer to FALL PROTECTION article below for details.

3.7.2.4 Unless the Contract documents clearly call for it, the use of explosives for demolition is prohibited.

3.7.3 ELECTRICAL POWER

3.7.3.1 Ground Fault Circuit Interruption (GFCI) shall be the primary protection from exposure to electrical current for all workers on the Project. Only exit lighting and medium-high (greater than 240) voltage service will not be GFCI protected. Welding equipment that also serves as a generator shall not be used for both purposes at the same time.

3.7.3.2 All strings of temporary lights shall be fully lamped and guarded regardless of height, and shall be continuously maintained. Adequate and consistent levels of illumination for the work operations in each area must be maintained at all times

3.7.3.3 All receptacles and switches shall have trim plates installed before they are energized.

3.7.3.4 All power distribution panels shall have full covers installed before primary power is brought into the panel. When energized panels are located in open areas, covers shall be locked except when an electrician is present. When panels are located inside separate rooms or closets, automatic closers and automatically locking hardware shall be installed on doors as soon as equipment is energized, and only authorized persons shall be provided a key. Doors shall not be wedged to stay open. Warning signs shall be placed in conspicuous locations.

3.7.4 EXCAVATIONS

3.7.4.1 In addition to UGC requirements, every excavation shall require a preliminary meeting with the ODR to determine historical knowledge of existing utilities. Where applicable, a phone call for utility "locates" shall be completed seventy-two (72) hours in advance. “Potholing” and/or hand excavation shall be required within three (3) horizontal feet of “located” centerlines, and in areas where knowledge is lacking.

3.7.4.2 The “toe” of spoil piles that are less than four feet (4’) in height shall be at least two feet (2’) from the edge of any excavation; spoil piles greater than four feet (4’) in height shall add one foot (1’) of distance from the excavation for every additional foot in height. Spoils shall be managed to prevent airborne dust.

3.7.4.3 Trench excavations should be backfilled at the end of each shift.

3.7.4.3.1 When an excavation cannot be backfilled in the same day as it is created, a highly visible barricade shall be erected at a minimum distance of six feet (6’) from all approachable edges. All portable means of access shall be removed at the end of each workday.

3.7.4.3.2 Earth ramps that are to be used for walking access shall not exceed twenty percent (20%) (eighteen degrees [18°]) in grade slope. Steeper slopes shall be gate controlled for equipment only, and alternate access shall be added for pedestrian traffic.

3.7.5 FALL PROTECTION AND PREVENTION

3.7.5.1 Any walking/working surface that is equal to or greater than six feet (6’) above surrounding areas shall present an unacceptable fall exposure unless it has all edges (side and ends) protected by an attached guardrail system, fall arrest netting, or is blocked off by an adjacent wall. An adjacent wall shall be continuous, structurally sound, and at least thirty-nine (39) vertical inches above the walking/working surface, and within eight (8) horizontal inches from the open edge.

3.7.5.2 Any employer that will create a fall exposure equal to or greater than six feet (6’) shall submit a detailed plan and/or set of drawings in advance of the operation to indicate how the exposure shall be addressed. This will be referred to as the Contractor’s Fall Protection Plan. All Contractors that have a fall protection exposure must have a Fall Protection Plan. The Contractor shall require the plan to contain either “engineered” or conventional fall protection measures for each and every exposure that involves vertical distances equal to or greater than six feet (6’). Any precautionary measure that would allow greater risk than that afforded by a guardrail system, fall restraint equipment, fall arrest equipment, or fall capture netting shall be prohibited. The recognized exemptions/exceptions are as follows:

3.7.5.2.1 Allow work from portable step ladders as long as a “three point” contact is maintained, the ladder is secured from movement, the height of the worker’s feet is limited to eight feet (8’), and the worker’s center of gravity remains between the rails and in front of the feet.

3.7.5.2.2 Allow work from an extension or straight ladder if the ladder is secured at the top and bottom, a “three point” contact is maintained, and the worker’s center of gravity remains between the rails and in front of the feet.

3.7.5.2.3 When the competent person determines that no feasible anchor points are possible, allow erection or dismantling of welded frame or tube and couple scaffolding to a height of twenty-one feet (21’) with no fall capture equipment. This determination shall be supported by the PSC and detailed to the satisfaction of the ODR. For heights above twenty-one feet (21’), scaffold frames shall be attached to adjacent structure, and the framework shall be designed to act as anchorage for a fall arrest system if no better anchorage exists.

3.7.5.2.4 Allow an exposure for the amount of time required to install anchor points and/or fall capture arrangements when the competent person determines that no protection is feasible prior to the installation. These determinations shall be supported by the PSC and detailed to the satisfaction of the ODR.

3.7.5.2.5 Allow an exposure for the amount of time required to climb upon a load in order to engage or disengage a hook when the competent person determines that no feasible anchor points are possible. These determinations shall be supported by the PSC and detailed to the satisfaction of the ODR.

3.7.5.2.6 Work may be performed without any fall prevention measures while standing on an elevated walking/working surface at a distance of at least six (6) horizontal feet from an unprotected edge. The unprotected edge shall be clearly identified by posted signage and a warning line erected continuously at a six-foot (6’) setback distance. When work is to be performed from a ladder placed near the warning line and the ladder can fall toward the leading edge, the safe distance from an unprotected edge shall increase one foot (1’) horizontally for each vertical foot that a worker climbs above the surrounding surface. This requirement shall also apply to a ladder that is being placed beside a protected edge. Any leading edge (“controlled access”) zone work shall require fall capture arrangements prior to entry.

3.7.5.3 Covers placed over pier holes, and roof or floor openings shall be physically secured and clearly marked with warning message "HOLE COVER - DO NOT REMOVE.” Any cover that is too small for legible wording shall be bright orange or red.

3.7.5.4 Job built ramps and bridges shall be surfaced with an abrasive (non-skid) material. Ramps shall comply with ADA slope requirements.

3.7.5.5 Materials, scraps or waste shall never be allowed to free-fall from a height greater than ten feet (10’). Items that may be caught by wind and carried horizontally shall never be allowed to drop freely for any distance. When items are allowed to be dropped freely, a person shall be stationed at the landing elevation at a safe distance to warn others away from the operation, and the landing area shall be surrounded by warning tape placed at least six feet (6’) outside of the expected landing area. Wall openings that may be located vertically between the material drop point and the expected landing area shall be securely covered and marked from inside. Anything that is to move downward at a distance greater than ten feet (10’) or is capable of sailing horizontally shall be contained within a chute or controlled by hoist.

3.7.5.6 Equipment and work operations of any description shall not be permitted to be performed directly above a worker unless adequate overhead protection is provided prior to commencement of the operation.

3.7.6 FIRE PROTECTION

3.7.6.1 All floors that have combustible materials present shall be accessible from ground level by a usable stair system (temporary or permanent). For structures greater than three (3) stories in height, fire sprinkler standpipes shall be completed and charged to within two (2) stories, or thirty (30) vertical feet of all floors containing combustible materials. Siamese connection shall be installed at every level to provide access for fire hoses. All fire extinguishers that are not task-specific shall be adequate in number and description to comply with OSHA declared limits for egress points, floor area and travel distances. They shall be situated in highly visible locations mounted at heights that place the gauges at eye level to facilitate ease of inspection and retrieval for use.

3.7.6.2 All fire extinguishers that are task specific shall be inspected and furnished in advance by the employer that will be conducting the work that requires such fire fighting provisions. The fire extinguisher shall be situated within sight of and less than twenty-five feet (25') from the perimeter of the task operation. All work that includes burning or welding of any type shall be defined as "hot work" and shall require the presence of a fire extinguisher, at least one fire watcher, and a Hot Work Permit. Refer to WELDING AND BURNING for additional detail.

3.7.7 HOUSEKEEPING

The PSC/A shall ensure that the Contractor and all Subcontractors "effectively" clean the Project site continuously throughout each workday. "Effective clean-up" shall adequately address all of the following housekeeping issues:

3.7.7.1 All construction waste, trash, and debris shall be placed in designated receptacles. Glass bottles shall not be permitted on the Project site.

3.7.7.2 Stack (or restack) all whole and scrap materials in locations that shall not obstruct a clear pathway nor create a risk for toppling onto a person passing through the area.

3.7.7.3 Place all hoses, cords, cables and wires in locations that prevent them from being damaged by tires, sharp edges or pinch points and from creating tripping hazards.

3.7.7.4 Secure and effectively cover all materials on roofs or elevated levels that may be displaced by wind.

3.7.7.5 Restore all signs, barricades, fire extinguishers, guardrails, gates, etc. to proper locations and sound condition.

3.7.7.6 Properly store and secure all flammable and combustible liquids and gases.

3.7.7.7 Collect and place all cut-off or waste pieces of rolling stock, as they are created, into waste or scrap containers.

3.7.7.8 Live rounds that have been ejected from powder-actuated tools shall be immediately placed in designated containers and periodically returned to a tool dealer or a law enforcement agency for proper disposal.

3.7.7.9 All puncture and impalement exposures shall be covered or eliminated as soon as they are created. As per ANSI specification, effective covers shall be designed to prevent impalement of a 250-pound body being dropped from a fall of four feet (4').

3.7.8 LADDERS

3.7.8.1 Every elevated platform (slab, deck or work surface) shall have at least two (2) remote means of access/egress when the platform is populated by more than three (3) persons. As the population rises above twenty-five (25), additional means of access/egress shall be required. A double-cleated ladder may only serve as two (2) separate means of access/egress when another means is available at a remote location.

3.7.8.2 At the end of each workday, ground access to elevated levels shall be eliminated. This shall be accomplished by removal and storage of all portable and job-built ladders, or installation of a lockable shield that prevents use of the lower rungs.

3.7.8.3 Portable aluminum ladders shall be prohibited.

3.7.8.4 Extension ladders, straight ladders and job-built ladders shall be secured from movement at the top and the bottom.

3.7.8.5 Physical barricade offsets that force at least one change in walking path direction shall be constructed within a six-foot (6') radius around the upper access points for any ladder's step off landing area.

3.7.8.6 All elevated landings shall include a rope hoist (manual or motorized) near the ladder's upper-most access point.

3.7.8.7 Manufactured portable (step and extension) ladders shall display ANSI heavy-duty rating (Class I-A) and be inspected daily for condition and set up.

3.7.9 MEDICAL ASSISTANCE AND SCREENING

3.7.9.1 The PSC/A shall maintain a First Aid Log for all treatment administered on the Project (including any that might later escalate). Each SSR shall report and record details daily.

3.7.9.2 PSC/A shall transport or accompany any injured worker to off-site medical services.

3.7.9.3 Drug and Alcohol Screening shall be mandatory for every supervisor and/or worker who sustains or contributes to any incident that involves injury beyond first aid or property damage. If impairment or poor judgment appears to be involved in a first aid event, PSC shall direct injured employee to be screened for probable cause.

3.7.9.4 Minimum requirements for chemical screening shall at least match the threshold limits for a NIDA 5-panel protocol and for alcohol screening shall at least match the Texas DOT vehicle operator's limit for blood alcohol content. Only negative results are acceptable for employment on the Project.

3.7.9.5 Screening shall be initiated as soon as possible, but not later than two (2) hours after the incident occurrence. Any worker's refusal to submit to screening shall be treated in the same manner as a "positive" finding Any worker who withholds notification of an incident for longer than one (1) hour after the alleged event shall be evaluated by the PSC/A and if declared to be negligent shall be permanently removed from the Project.

3.7.10 PETROLEUM-BASED FUEL OPERATED EQUIPMENT

3.7.10.1 Where possible, equipment operator cabs shall be locked during non-working hours. Only equipment operators and direct supervisors shall have access to keys.

3.7.10.2 Any combustion engine equipment with less than ninety-eight (98) percent clean air exhaust shall not be operated in enclosed spaces unless the exhaust is piped to outside air, and “fresh” air is brought into the space to replace the amount being consumed. The PSC shall be responsible for monitoring air quality at the Project. This includes generators and compressors as well as mobile equipment.

3.7.10.3 For hose and termination fittings on air compressors, "whip checks" shall be used at all connection points. Emergency automatic shut off valves shall be installed on every discharge fitting of all air compressors that are capable of producing air pressure greater than thirty (30) pounds per square inch.

3.7.11 PUBLIC PROTECTION

3.7.11.1 The project boundary perimeter shall be secured from public intrusion by fencing and locked gates.

3.7.11.2 "Attractive nuisance" items such as tower cranes, tall ladders, fire escapes, large excavations, etc. shall require additional and separate security measures.

3.7.11.3 Contractor shall challenge any visitor or member of the public who attempts to enter a construction area without an authorized escort.

3.7.11.3.1 Contractor shall be authorized to contact campus police to remove anyone who refuses to abide by Contractor directive to leave the construction area. The ODR shall be notified immediately should this occur.

3.7.12 SANITARY FACILITIES

3.7.12.1 The Contractor shall provide at least one (1) toilet facility per twelve (12) workers (separate count per gender) at the Project site; and shall pump, clean and re-supply at least once per week to maintain sanitary conditions. When average temperatures during daylight hours exceed 85 degrees, pump outs shall occur at least twice per week. When female workers are present at the site, toilets designed and designated for their exclusive use shall be clearly marked. Toilets located in Project management office trailers and used by office support staff shall not be considered to meet this requirement unless by written consent of the ODR.

3.7.12.2 On all projects that are four (4) stories in height or greater, sanitary facilities shall be furnished on ground level and every third level (maximum 45 vertical feet).

3.7.12.3 The use of any Owner facility is strictly prohibited unless by written consent of the ODR.

3.7.13 SCAFFOLDING

3.7.13.1 Each ground-supported scaffold shall bear a shift inspection tag (initialed by the competent person for each company that requires use of the scaffold) to indicate the status of the scaffold (i.e. completely safe, specific precautions required, or not safe/do not use). For suspended scaffold, inspection tags shall also be placed on the outrigger as well as the work platform. The PSC/A shall purchase and control a universal system to be used by all employers at the Project site. Training and documentation shall be required for all workers on the Project who will climb onto any kind of scaffolding. Contractor shall furnish tags, and train all competent persons for procedure. This requirement shall apply to all rolling and baker-type scaffolds as well as welded frame and tube and couple system scaffolds.

3.7.13.2 Mudsills and surrounding areas at the base of ground-supported scaffolds shall be maintained in a well-dressed and level condition. Scaffold foot plates (or casters) shall be

installed on the legs of all ground level frame sections and shall be visible for inspection at all times. Diagonal braces shall be included in every scaffold section as is practically possible. Every work level shall be fully planked and kick-off protection shall be included along open sides and ends. Overhead protection shall be constructed where walk-though passages are allowed. Mudsills shall be at least 2”x12” in one-foot lengths with foot place centered and nailed in two corners.

3.7.13.3 Brakes on rolling scaffolds shall be secure at all times, except when the scaffold is being moved. Workers shall not be allowed on the platform when a scaffold is being moved.

3.7.14 STAIRS

3.7.14.1 Properly designed and built stair and landing units shall be placed at access doors for every Project office and storage trailer prior to use. Per ANSI requirements, the landing outside each door of any office trailer shall be no greater than one quarter inch (1/4”) below the threshold and the unobstructed (standing) area outside the swing radius shall be no less than twenty-two inches (22”). Fire & Life safety code (NFPA) and ADA requirements shall also be satisfied as they apply. Ramps or connecting decks may be installed to satisfy this requirement.

3.7.14.2 For incomplete permanent stair sections, at least the bottom four (4) risers and upper entry points for each floor shall be physically blocked and marked "INCOMPLETE – DO NOT USE.” Until a complete section is made acceptable for general use, the barricades and signs for that section shall be maintained.

3.7.15 PROJECT SERVICE WATER

3.7.15.1 Potable Water: Potable water shall comply with city and community health requirements.

3.7.15.2 Non-potable Water: Water storage containers, hose bibs and faucets shall be posted in English and Spanish “DANGER – DO NOT DRINK.”

3.7.16 WELDING AND BURNING

3.7.16.1 Splices, taps, welds and/or burning operations that may produce sparks, slag or hot scraps shall require “Hot-Work” or “Burn” Permits (one per shift). “Burn Permit” forms shall be furnished by the Contractor and issued by the PSC. The SSR shall submit completed permit form in advance of the Work to the PSC for acceptance. One copy of the accepted permit form shall be posted by the SSR in the vicinity of the operation. At the conclusion of the work and successful completion of the smolder/re-kindle watch, a copy of the expended permit shall be signed off and returned to and filed by the PSC. If the campus Environmental Health and Safety group wishes to be involved in the process (provision of permit and/or pre-inspection of the permit space), Contractor shall arrange to accommodate these wishes. No matter who furnishes the permit form, all Hot Work shall provide at least a fire watcher(s), fire extinguisher(s), and smolder watch. If the work produces intense light, permit shall also contain requirement for screens to protect others from flash burns. For open space operations that will not be moved, (on-site fabrication shops), a permit may be issued for a week.

3.7.16.2 Oxygen and fuel gas cylinders shall not be stored together, including on bottle carts. At the end of any cutting operation and/or any shift, bottles must be removed from carts and taken to OSHA prescribed storage arrangements. Hoses and gauges shall be removed and caps restored onto cylinders.

3.7.16.3 Anti-flashback arrestors shall be installed at the pressure regulator gauges of all Oxy-Acetylene cutting rigs, even if the torch is equipped with a built-in arrestor.

3.7.16.4 Fire watchers shall be posted at every operation that produces sparks, flames or sufficient heat to create an ignition or to fall onto another person. Watchers shall be trained in the use of extinguishers, shall keep other people from entering exposure areas, and shall not be assigned other duties until the rekindling possibility ("smolder watch") is over. When sparks, slag, or fire may fall to a different level, a separate watcher shall monitor each level directly below the work (including exterior locations).

3.7.16.5 Heater boxes for welding electrodes shall have a manufacturer's label that certifies the purpose of the unit. Job-built heaters shall be prohibited.

3.7.16.6 The unused stubs of welding electrodes ("rod butts") shall be collected and placed in proper disposal containers (i.e. metal bucket with sand or water) as soon as each one is expended. Whenever operation is idle, electrode shall be removed from stinger.

3.7.16.7 Welding operations shall not be allowed to present an opportunity for flash burn exposures to the eyes of any workers in the vicinity. All welding operations shall provide appropriate screening measures, erected in advance to contain the high energy light.

EXHIBITS:

- EXHIBIT A (Anticipated Construction Project Hazards – Checklist submittal)
- EXHIBIT B (Job Hazard/Safety Analysis – Subcontractor submittal)
- EXHIBIT C (Hot Work Burning/Welding Permit – Project file document)
- EXHIBIT D (Occupational Injury/Illness Incident Management – Decision matrix)
- EXHIBIT E (Incident Notification Report – Contractor submittal)
- EXHIBIT F (Safety Identification for Orientation & Equipment Operator - Guide)
- EXHIBIT G (Project Safety Orientation - Checklist)
- EXHIBIT H (Safety Representatives Weekly Meeting Agenda - Template)
- EXHIBIT I (Quarterly Equipment Inspection Report – Project file document)
- EXHIBIT J (Contractor's Monthly Safety Report – Contractor submittal)
- EXHIBIT K (Worker Guide for Reporting Injury - Handout)
- EXHIBIT L (Supervisor Guide for Management of Worker Injury - Handout)
- EXHIBIT M (Request for Safety Variance – Contractor submittal)

END OF SECTION 01 35 23

EXHIBIT A	CONTRACTOR SUBMITTAL TO OWNER – CHECKLIST

The University of Texas System – Construction Project Safety

ANTICIPATED CONSTRUCTION PROJECT HAZARDS

CIP (Owner's Project) #	Project Name	Date

No	Yes	Issue	Timing for appearances & ID for Subcontractor JH/SA's
		General Health Exposures	
		Noise, Illumination, Lasers and X-ray	
		Dusts, Mists, Vapors, Gases	
		Chemical exposures	
		Proximity to public and/or traffic	
		Existing geography/ extreme weather	
		Electrical Exposures	
		Overhead power lines in area	
		High Voltage (> 600 volts)	
		Hot taps and/or Double fed circuits	
		Excavations	
		Tunnels and/or Jack and Bore	
		Maximum estimated trench depth	
		Maximum estimated pier sizes	
		Existing underground services	
		Proximity to streets or buildings	

Elevated Fall Exposures			
		Excavations and piers	
		Structural erection (steel/precast)	
		Building exterior	
		Stairwell/ Chase/Elevator Shaft	
		Roof (note steep or low slope)	

Cranes/ Hoists/ Derricks			
		Pier Drilling/ Pile Driving	
		Exterior Hoists (Elevators)	
		Mobile Cranes (track and rubber tire)	
		Tower Cranes	
		Critical lifts	
Tools and Equipment			
		Powder Actuated	
		Pneumatics or High Torque power tools	
		Generators and Compressors	
Motor-Driven Equipment			
		Earth moving equipment	
		Lift Platforms (articulating and/or scissor)	
		Industrial trucks (fork lifts)	
		Bulk fuel storage area	
Demolition			
		Structural, Explosive or Mechanical	
		Jackhammers and power cutting	
Scaffolding			
		Ground supported (static and/or motorized)	
		Suspended	

Welding and Burning			
		Types and Locations	
Confined Space			
		Permit required and/or not required	

EXHIBIT B	SUBCONTRACTOR SUBMITTAL to CONTRACTOR - PLAN

The University of Texas System – Construction Project Safety

JOB HAZARD/JOB SAFETY ANALYSIS

(insert Company name)		Original author name:	
Job Task Name:		Original issue date:	
Job Task Description:		Latest revision author:	
		Latest revision date:	
		Approved by:	

Step # 1 in sequence of steps required to accomplish task	
Description of actions of participants	
List associated hazards	
Define required safety measures	
Step # 2 in sequence of steps required to accomplish task	
Description of actions of participants	
List associated hazards	
Define required safety measures	

Step # 3 in sequence of steps required to accomplish task	
Description of actions of participants	
List associated hazards	
Define required safety measures	

Step # 4 in sequence of steps required to accomplish task	
Description of actions of participants	
List associated hazards	
Define required safety measures	

Step # 5 in sequence of steps required to accomplish task	
Description of actions of participants	
List associated hazards	
Define required safety measures	

Step # 6 in sequence of steps required to accomplish task	
Description of actions of participants	
List associated hazards	
Define required safety measures	

EXHIBIT C	CONTRACTOR DECISION MATRIX – GUIDELINE

The University of Texas System – Construction Project Safety

HOT WORK (BURNING/WELDING) PERMIT
(ONE COPY MUST BE POSTED IN THE VICINITY OF THE WORK)

CIP NUMBER		Request date:	
UT CAMPUS/INSTITUTION			
PROJECT NAME			
REQUESTING COMPANY			
RESPONSIBLE SUPERVISOR			
WORK LOCATION and GENERAL DESCRIPTION of WORK TASK			
DATE(S) REQUIRED		to	

Permit Duration (check one):		**One Week (Static Operation)**		**One Shift (Transitory Operation)**

ISSUES AND/OR PREVENTION MEASURES	**DESCRIPTION**
Dedicated Fire Extinguisher(s)	
Special Suppression Equipment	
Fire Blankets/ Equipment Shielding	
Flash Burn (Eye Safety) Screening	
Fire Watch Position(s)	
Existing Sprinklers Disabled	
OTHER CONSIDERATIONS:	

NOTES:

1. STATIC OPERATIONS (i.e. fabrication shop areas) may use a weekly permit. **All others must be daily**.

2. Unless a specific task requires a **LONGER** time period, fire watch positions must also conduct a smolder-rekindle watch for at least THIRTY (30) MINUTES after the burning/welding operation is completed.
3. If the work moves from one area to another during a single shift, the permit must accompany the move and all task areas must be identified on the permit.
4. After the work is completed, the permit must be initialed by the RESPONSIBLE SUPERVISOR (below) and a copy must then be forwarded to the Prime (Controlling) Contractor within one (1) work day.

If unexpected events during the work led to modified plan, place initials in appropriate box: ☐ **NO** ☐ **YES**

If **YES**, describe the unexpected events and the subsequent actions.

EXHIBIT D	CONTRACTOR DECISION MATRIX – GUIDELINE

The University of Texas System – Construction Project Safety

OCCUPATIONAL INJURY/ILLNESS INCIDENT & CRISIS MANAGEMENT

Page 1 of 3

Eleven (11) steps that shall be completed when an occupational injury occurs

1	Render immediate "first" aid (using all available resources on the Project)
2	Immediately notify emergency services (if required) and then Owner representative
3	Secure and preserve the scene of the incident, evidence and attached surroundings
4	Start the evidence gathering and incident recovery control process
5	Complete insurance (first report) claims forms and record incident
Steps #1 through #5 SHALL be completed on the date of the incident	
6	Facilitate opportunity for return to work (full or modified duty)
7	Confirm all medical findings and physical restrictions
8	Complete investigations and develop recovery/prevention plans
9	Issue a "bona fide" offer of employment to workers with medical restrictions
10	Bring insurance claim to closure
Steps #6 through 10 SHALL be completed as soon as possible	
11	Instruct all persons on the Project to perform their roles during a crisis.
Step #11 starts as soon as an incident escalates beyond a first aid event (see page 3 of 3)	

The matrix (table) on the next page indicates the step-by-step responsibilities associated with each level of severity. There are three (3) distinct levels. Level 2 is subdivided to capture the modification of control when patient handling and recovery moves beyond prepared arrangements.

NOTES to assist the reader

- Term CC is used to denote the (Controlling) Contractor.
- Texas Department of Insurance (previously Texas Workers Compensation Commission).
- Where Drug Test is indicated, Alcohol Test shall also be required.

OCCUPATIONAL INJURY/ILLNESS INCIDENT & CRISIS MANAGEMENT

Level One	**Level 2**		**Level 3**
First Aid	Occupational Clinic	Single Hospital Case	Catastrophe
Qualified persons (with CPR and Emergency First Aid training)	Qualified persons (with CPR and Emergency First Aid training)		Qualified persons (with CPR and Emergency First Aid training)
Injured worker's Employer to notify CC immediately following treatment.	• Injured worker's Employer to notify CC immediately. • CC to notify OFPC RCM immediately		• Injured worker's Employer to notify CC immediately. • CC to notify OFPC RCM and UT Police immediately. • Injured worker's Employer to notify OSHA within 8 hours.
N/A	CC physically secures the area until investigation has all information.		CC physically secures the area until OSHA, UT Police, and OFPC release
CC records incident in the project First Aid Log within one day.	• Employer completes TDI form ("First Report of Injury"). • CC confirms insurance carrier notification within one day. • Employer and CC record the incident in OSHA 300 log within 6 days		• Employer completes TDI form ("First Report of Injury"). • CC confirms insurance carrier notification within one day. • Employer and CC record the incident in OSHA 300 log within 6 days.
N/A	• CC issues treatment authorization form to supervisor of injured worker. • Supervisor transports worker and treatment form to clinic. • CC contacts clinic to apprise them of status.	• CC contacts the claims adjuster for the insurance carrier as soon as the names of the injured worker and hospital are known. • CC shares the information with OFPC RCM.	• CC contacts the claims adjuster for the insurance carrier as soon as the names of the injured worker and hospital are known. • CC shares the information with OFPC RCM.
N/A	Supervisor of injured worker informs medical provider that the Employer will furnish a position to match medical restrictions.	Adjuster contacts the emergency room to announce "doctor of record" for all follow-up care.	Adjuster contacts the emergency room to announce "doctor of record" for all follow-up care.

N/A	• Doctor diagnosis and announces restrictions. • Drug test is completed.	• Emergency room completes care. • Doctor of record makes arrangements for drug test and announces restrictions.	• Emergency room completes care. • Doctor of record makes arrangements for drug test and announces restrictions.
Employing Contractor conducts investigation and reports findings to CC.	Employing Contractor and CC conduct investigation and report findings to Safety Team and OFPC RCM.		• Employing Contractor and CC conduct investigation and report findings to Safety Team and OFPC RCM. • OSHA will conduct a separate investigation, starting within 24 hours of notice. • Police investigation is also possible.
N/A	Employer issues a “bona fide” offer letter to inform injured worker that employment is available to match medical restrictions.		Employer issues a “bona fide” offer letter to inform injured worker that employment is available to match medical restrictions.
N/A	Doctor issues a return to work notice when all medical treatment is concluded. Permanent restrictions are possible.		Doctor issues a return to work notice when all medical treatment is concluded. Permanent restrictions are possible.

Step # 11 **(CRISIS MANAGEMENT AND MEDIA RESPONSE GUIDELINE)**

-------For non-command persons on the Project – general items of understanding

A. Do not approach an incident scene until the entire situation and vicinity has been evaluated and all possible hazards have been identified and neutralized. **Do not become an additional casualty for the emergency response team**.

B. Know the name and face of the person who is the incident commander for the Project. Know the name of the campus media relations person who is the only official spokesperson for the Project.

C. Confirm that someone has contacted the appropriate emergency services and public safety agencies.

D. Stay back from the scene if you have no assistance skills to offer. Be prepared to take directions from those who are in charge of the response. Offer any logical suggestions that seem to be appropriate for the situation.

E. Try to observe and remember as much detail as possible. Witness statements concerning times, names, physical details, weather conditions, adjoining work operations, etc. may add a critical bit of information to develop an effective recovery and future prevention plan.

-------For Contractor – action items to be managed (and coordinated with ODR and campus)

SPECIAL NOTE: Media reporters will broadcast and publish the most sensational story that can be reported. One tactic is to question as many people as possible and look for evidence of confusion and conflict among the gathered statements.

A. Designate one employee to be the liaison with both the Corporate and UT Campus spokespersons. If the spokespersons are not at the Project, the liaison should be capable of reaching them to decide the preliminary information that may be shared with the media. Normally this duty will fall to the Project Manager for the Contractor.

B. Designate one employee to be the incident commander during the emergency. This has to be a person who is assigned to the Project and must be on call 24/7. Normally this duty will fall to the Project Superintendent.

C. Shut down all unnecessary operations at the Project. Do not allow the appearance that the Owner is more concerned with production than with people's safety and health, and allow nothing to impede emergency response professionals.

D. Instruct all workers to avoid contact with members of the media, and to understand that the Project spokesperson will deliver the entire story when the details are fully understood. Provide an easy avenue for internal expression of their feelings about what they hear from others and see in publication.

E. Promise to give the media all of the pertinent facts (in stages if necessary). **Speculation must not be offered**.

F. Have a preplanned area designated for media assembly. For events that draw only one or two reporters, direct them to an office or small conference room until the spokesperson is ready to deliver comments. For larger groups, contain the reporters outside the gate, or collectively in a remote area, and keep them informed with bits of factual information that may be aired.

G. Do not divulge the names of any injured persons until law enforcement or corporate representatives issue assurance that the families have been contacted. Be honest with estimates of times when information will be shared.

H. Keep the media away from all areas where the emergency response professionals will be congregating during moments of rest. You do not want to see their unguarded remarks or blood stained clothing in print or on television.

I. A “sensitive” professional should be delivering messages to family members, and in communication with the Project.

J. Be prepared to furnish counseling for anyone (workers, responders, and family members) that may need such help.

K. Send representatives to all area hospitals involved in treatment of injured workers. Assure the injured persons and their families that their problems will be given the best attention and that the medical expenses will not be their problem.

EXHIBIT E	CONTRACTOR INCIDENT NOTIFICATION - REPORT

Report is to be completed and submitted to Owner within two hours following control of incident. If initial report is submitted electronically, one hard copy with an original signature must also be submitted to ODR within 24 hours.

MD Anderson Project # _____

Place an "x" in the appropriate box/boxes below that best classify the incident.

Safety/Health

- ☐ Occupational Injury
- ☐ Occupational Illness
- ☐ Near Miss (Safety)

Loss/Damage

- ☐ Workers Compensation
- ☐ 3rd Party Injury/Property Damage
- ☐ Builder's Risk
- ☐ Other (describe)

Environmental

- ☐ Material Spill/Gas Discharge
- ☐ Fire/Explosion
- ☐ Near Miss (Environmental)

Section 1: Background Information (for any kind of incident with a worker involved)		
Worker Name:	**Employer/Company:**	**Work Trade & Job Title:**
Supervisor's Name:	**When supervisor reported incident:** _____ @ _____ **AM/PM**	**When worker said it happened:** _____ @ _____ **AM/PM**

Section 2: General Incident Details (for any kind of incident, even if no loss occurred)
Describe where on the Project the incident occurred (according to current best information).
Describe how the incident occurred (according to current best information).
What job task(s) was/were being performed at the time of the incident?
Has the condition(s) that might have contributed to the incident been corrected or made safe? _____Yes _____No If "Yes," how?
Were there any witnesses to the incident? _____Yes _____No

Section 3: Injury (If incident involves injury or illness, complete this section)
Describe the injury and body part affected (1" scratch to right forearm, etc.): Describe the initial treatment (antiseptic and band-aid applied, etc.): Will injury probably be Recordable per OSHA guidelines? _____Yes _____No

Section 4: Spill/Discharge (If incident involves environment, complete this section)
Type of material spilled/discharged: _____ Estimated Volume of material lost: _____ Estimated Volume recovered: _____

Was remediation required? _____Yes _____No If "Yes," how?

PSC completing report: _____ _____ _____ _____

(Print Name) **(Signature)** **(Date)**

Distribution:	MD Anderson Project Manager	MD Anderson OCIP Manager	Contractor's Project Safety File

The University of Texas System – Construction Project Safety

SAFETY IDENTIFICATION FOR ORIENTATION & EQUIPMENT OPERATOR

Procedure

1. The Contractor shall purchase and control the issue of wallet cards (see upper portion of page 3) and hard hat stickers (see lower half of page 3) to mirror the Categories and Levels (color codes for categories and flag numbers for levels) that are printed on the wallet card.

   To allow the visual elements to be effective, operators shall begin employment at the Project with a relatively unmarked hard hat to allow the subsequent added graphic information to stand out.
2. Wallet Cards and Stickers shall only be issued by the Contractor after **witnessing** either of the following events:
   a. The employing Contractor shall conduct an examination of each proposed operator in the presence of an authorized representative of the Contractor (see page 2).
   b. The employing Contractor shall arrange on-site training to be conducted by a qualified person for a specific manufacturer and training shall be attended by the Contractor.
3. Employing Contractor's SSR or 3rd party trainer shall sign-off (initial & date) authorization on wallet card for each level of operator competency.
4. Operator observed without Sticker and/or Wallet card shall be ejected from Project. Employing Contractor shall then furnish a valid operator and the Contractor shall issue to the crew supervisor and/or SSR a disciplinary warning for first event (eject for second event).
5. Operator observed with Sticker, but not in safe control of equipment shall have Sticker removed. Employing Contractor shall furnish new operator and the Contractor shall issue to the crew supervisor and/or SSR a disciplinary warning for first event (eject for second event).
6. The Contractor shall maintain documentation of all safety enforcement actions.
7. Locations of hard hat Stickers shall be as follows:
   a. Right side, front = Project Safety Orientation sticker (see page 4)
   b. Right side, rear = Personnel Handling equipment (Green – see page 3)
   c. Left side, front = Material Handling equipment (Blue – see page 3)
   d. Left side, rear = Earth Work equipment (Red/Brown – see page 3)
   e. Front and/or Back = Worker's Name, Company Name & Logo (all optional)

SAFETY IDENTIFICATION FOR ORIENTATION & EQUIPMENT OPERATOR

Demonstration Directives

Employing Contractor shall facilitate and Contractor **SHALL** witness each of these demonstrations of competence prior to release of wallet Cards and hard hat Stickers

1. Show operations manual.
2. Show where the capacity limits for the equipment can be read (must be legible).
3. Describe how far away other workers must be before the equipment is allowed to move, turn, swing or change position.
4. What personal protective equipment is needed and/or required when operating this equipment?
5. Describe limits for surface evenness and structural (ground, roadway, or slab) support that must exist for equipment's safe set up and/or travel.
6. Show alarms for the equipment, what causes them to sound, and what will happen when alarm sounds?
7. Declare the name of the SSR for employing Contractor.
8. Show the emergency shutdown ("kill" or "deadman") switch and steps that bring the equipment to a safe and rapid stop.
9. Show or describe the preparations required to set up the work zone before the equipment goes into operation.
10. Start equipment and demonstrate each of the controls. Activate each alarm that does not require a true emergency to cause it to function.
11. Confirm understanding that unsafe and/or unauthorized use of equipment shall result in ejection from Project.

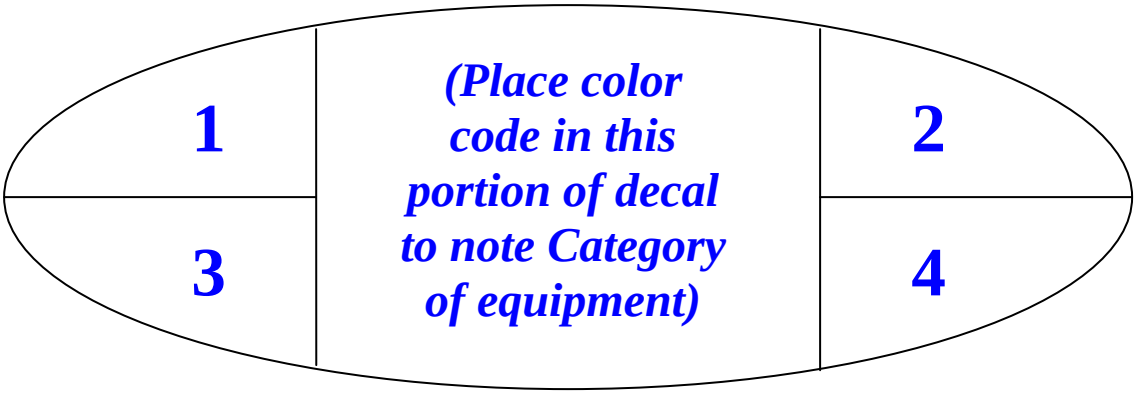
SAFETY IDENTIFICATION FOR ORIENTATION & EQUIPMENT OPERATOR

Wallet Card for Equipment Operators

(print CLEARLY)	**This instrument is valid for Calendar Year:**	**2*xxx***	
The University of Texas System		Project #	
Employing Contractor			
Operator Name			
Type of equipment		Witness Initials and Date	Category	Level
Elevator, Material Hoist			**Personnel Handling (green)**	**1**
Bos'ns Chair, Float Scaffold				**2**
Aerial Lift, Scissor Lift, Knuckle Boom Lift				**3**
Suspended Scaffold, Swing Stage				**4**
Sm. Crane, All Terrain, Draught (mob.)	**≤5 Ton**		**Material Handling (blue)**	**1**
Industrial Lift Truck***** (i.e. Lull, Sky Track, Fork Lift)				**2**
Med. Crane***** (mobile)	**>5 Ton & ≤150 Ton**			**3**
Lg. Crane*****, Crawler or Truck Mounted, Tower Crane				**4**
Bobcat, Small excavator			**Earth Work (red/brown)**	**1**
Sheepsfoot Roller, Steam Roller, Vib. Compactor				**2**
Backhoe, Front end Loader, Dozer				**3**
Track hoe, Large excavator, Skid Pan				**4**

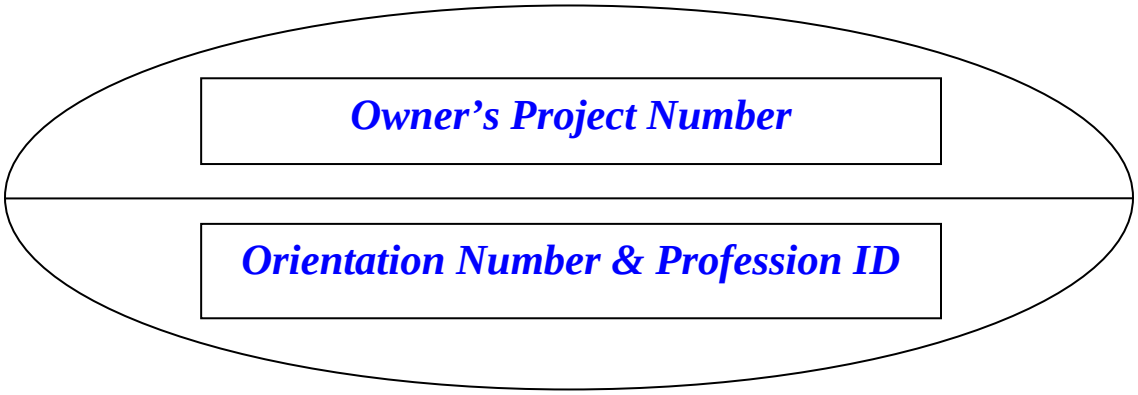
*******For this Level, in addition to this Wallet Card, the employing Contractor shall submit to the Contractor a copy of a Certificate for the item of equipment (in accord with OSHA requirements) to be placed in Project file.*

Hard Hat Sticker for Equipment Operators



SAFETY IDENTIFICATION FOR ORIENTATION & EQUIPMENT OPERATOR

Hard Hat Sticker for Project Safety Orientation



Procedure:

- Each person who successfully completes the Project Safety Orientation will be issued a unique 4-digit number in chronological order of attendance starting with 0001. This number shall be placed on the hard hat and the Project photo-badge.
- In addition to the number, each person's profession or trade will be identified with an Alphabetic Character taken from the chart below.
- Anyone with Emergency First Aid training should also have a Red Cross sticker added.
- Anyone assigned to the Project Emergency Response team and all SSR(s) should also have a Green Cross sticker added.
- Site Access Log shall include at least attendee name, employer, and orientation number.

Prefix	Trade/Profession
A	Agent of the Owner, A/E, Campus
B	Builder, Contractor, GC
C	Concrete, Formwork, Flatwork, Pkg.
D	Dirt, Excavation, Earth Work, Fence
E	Electrical, Lightning Protection
F	Fire Sprinkler, Suppression Equip.
G	Glazing, Curtain Wall, Caulk
H	HVAC, Mech. System and Ductwork
I	Instrumentation, Data Cable
J	Drywall, Acoustic Ceiling
K	Coatings, Painting
L	Landscape, Plantings, Sod
M	Masonry, Brick, CMU

Prefix	Trade/Profession
N	Elevators, Hoists
O	Ornamental Metal, Misc. Steel
P	Plumbing, Drains, Pumps
Q	Doors, Frames, Hardware, OH Doors
R	Roofing
S	Structr. Steel, Decking and Pre-cast
T	Tile, Floor Cover, Carpet, Terrazzo
U	Lab Cabinets, Millwork
V	Accessories – Bath, Partitions, A/V
W	Waterproofing and Fireproofing
X	*USE AS NEEDED*
Y	Sand blast, Demolition
Z	Environmental – Lead, Asbestos

EXHIBIT G	CONTRACTOR CHECKLIST – TRAINING DOCUMENT

The University of Texas System – Construction Project Safety

PROJECT SAFETY ORIENTATION	
Owner's Project #	Date of Safety Orientation Training:
Project Name	
Trainer's Name:	
Contractor/Employer's Company Name:	

***INSTRUCTIONS**: Place a ☑ mark in the box to the right of each topic as it is discussed.*

1-	Review General Purpose of Rules		
	a.	Do NOT work alone – stay in contact	
2-	Personal Protective Equipment (PPE)		
	Purpose, use, storage and care of:		
	a	Safety Helmets (Hard Hats)	
	b	Basic Eye Protection	
	c	Additional Eye/Face Protection	
	d	Feet/Hands/Clothing Protection	
	e	Respiratory Protection	
	f	Hearing Protection	
	g	Fall Protection	
	h	Special Protection issues	
3-	Hazard Communication (aka Right to Know)		
	a	General Plan	
	b	Major Chemical hazards on-site:	
NAME			
NAME			
NAME			
NAME			
	c	Hazard Labels	
	d	Material Safety Data Sheet (MSDS)	
	e	Location of MSDS	
	f	Safe Task Training requirements	
4-	Emergency Equipment (location and use)		
	a	First Aid Station and AED	
	b	Fire Extinguisher	
	c	Eye Wash/Shower Stations	

7-	Daily Issues		
	a	Housekeeping	
ITEM		Slippery surfaces and Trip hazards	
ITEM		Visual obstructions to emergency equipment	
ITEM		Blocked Exit paths	
ITEM		Emergency Roadways	
ITEM		Trash = Vermin/Fire hazards	
ITEM		Puncture/Impalement hazards	
ITEM		Unstable Stacks of materials	
	b	Manual Lifting	
	c	Ladders and Stairs	
	d	Scaffolding (frame and suspended)	
	e	Tools and Portable equipment	
	f	GFCI/Electrical power	
	g	Surface and ground conditions	
	h	Overhead exposures	
8-	Motorized Equipment Operations		
	a	Mobile equipment (uses and alarms)	
	b	Crane and Rigging Operations	
	c	Lift platform equipment	
	d	Hoists/ Exterior Elevators	
	e	Company/ Personal Vehicles	
9-	Special Operations (with and w/out permit)		
	a	Excavations	
	b	Concrete pour and place	
	c	Steel and Precast erection	
	d	Decking and roofing	

5-	Emergency Procedures				e	Lock/Tag out of Energized Systems	
	a	Medical/ Injury incident			f	Hot work and Burn Permits	
	b	Fire incident			g	Scaffold erection/dismantle and use	
	c	Weather/ Evacuate			h	Critical shutdown	
	d	Violence, Protest, Spill, Explosion		10-	Miscellaneous Issues		
6-	Incident Notification/Reporting				a	Parking, Smoking, Harassment	
	a	Tell Supervisor Immediately			b	Signs, Barricades, Handrails	
	b	Help –OR- stay out of the way			c	Traffic, Pedestrians, Neighbors	
	c	Give a statement of facts			d	Drugs and Alcohol	
	d	Assist investigation			e	Meetings, Badges, Incentives	
	e	Report Unsafe acts and conditions			f	Enforcement	

I understand that this training is designed to help me make safe decisions and act to reduce risks.

Employee Name (print)

Employee Signature

The University of Texas System – Construction Project Safety

SAFETY REPRESENTATIVES WEEKLY MEETING AGENDA

- Sign in and introduction of any new Subcontractor Safety Representatives
- Read minutes from last meeting and vote final adjustments before filing into record

Past (Old Business):

1. Discuss investigations (findings and conclusions) from recent past incidents.

2. If the Project has a safety committee, have someone from the committee report the safety conditions and behaviors noted in the past week.

3. Review safety issues/conditions identified during Project Safety Coordinator's weekly safety inspection or third party inspection.

4. Discuss any pending claims (worker injury or general liability). Review claims handling procedures.

5. Discuss trends identified regarding claims or safety performance.

Present (Current and New Business):

6. Review the activities for the week ahead. Identify particular safety concerns and issues. Develop actions to control identified hazards.

7. Review any MSDS for potential exposure warnings that pertain to upcoming operations.

8. Review specific PSMP elements and/or requirements.

9. Safety suggestions

10. Open forum for general Q and A

11. Announcements

    - Subcontracts that are concluding – need final look at their areas
    - Upcoming safety recognition events
    - Upcoming training opportunities
    - Upcoming professional safety seminars or workshops
    - Names of workers who are not permitted to return to Project
    - Time and date of next meeting
    - Next week's mandatory topic for the Weekly Tool Box talk

EXHIBIT I	SUBCONTRACTOR SUBMITTAL – FILE DOCUMENT

The University of Texas System – Construction Project Safety

QUARTERLY EQUIPMENT INSPECTION REPORT

Quarterly Color Codes:	(1st) White	(2nd) Green	(3rd) Red	(4th) Orange
Project Number		Date of Report		
Project Name				
Contractor				
Employer Name				
Inspector's Name				

INSTRUCTIONS:

1. Use one line to identify each type of portable equipment on Project.
2. Use a "check" mark to indicate pertinent categories for each line item.
3. Use an "N/A" mark to indicate non-applicable categories for each line item.
4. Use "Qty" column to indicate total number for each item inspected.
5. Use "Comments" area to describe items removed for repair and/or discarded.
6. Complete this process within final fourteen (14) days of each quarter.
7. Items that enter or return to Project during quarter must first be re-inspected.

Portable Equipment Items	Qty	Insulation intact and cords undamaged	Clean, no electrical shorts, good polarity	Labels in place and legible	All parts present and undamaged	No excessive wear or corrosion	No deformity or sign of excessive strain	Safety feature(s) intact and working	Warning alarms operating properly

Comments:

I certify that all of the portable items on this Project at the beginning of this quarter have been inspected and certified or removed from service.

Signature of Inspector

Date of Report

Distribution: Employer's Project file ☐ Contractor's Project file ☐

EXHIBIT J	CONTRACTOR SUBMITTAL TO OWNER - REPORT

The University of Texas System – Construction Project Safety

CONTRACTOR'S MONTHLY PROJECT SAFETY REPORT

Project Name:	
Owner's Project #:	Report Date:
This safety report documents events for the month and year of:	
Name of Contractor:	
Name of Preparer:	
Position/Title of Preparer:	

INFORMATION FOR the MONTH BEING REPORTED

	Number of hours worked during the month (include all project assigned personnel):	
	Average daily number of workers on project site (average of first and last Wednesday's population headcounts):	
	Current number of Subcontractors (& confirmed certificates of insurance) active on the project site:	
	Total number of close call ("near miss") incidents reported during the month:	
	Number of incidents on the Project that were "first aid" only:	
A	Number of (OSHA Recordable) injured/ill workers who were treated and released without restrictions:	
B	Number of (OSHA Recordable) injured/ill workers who were treated and released with restrictions:	
C	Number of (OSHA Recordable) injured/ill workers who received medical orders to not return to work next day:	
	Number of all OSHA Recordable incidents (total A + B + C above):	
	Number of occupational deaths:	
Did PSC/A transport or accompany each patient who was required to leave Project for medical attention?		
Were Drug & Alcohol tests completed for each injury (except first aid and deaths)?		
Were any unsafe behaviors or conditions reported to Contractor during the month (if yes, describe on reverse side)?		
Did responsible Subcontractor(s) investigate and take appropriate actions (if no, describe on reverse side)?		
Number of incidents with Builder's Risk or General Liability damage only (no occupational injury or illness to workers):		
Were all incidents (with damage or injury) investigated and are reports of findings on file?		

CUMULATIVE INFORMATION for ALL MONTHS COMPLETED TO DATE	
Total number of hours worked through month being reported:	
Total number of months since Notice To Proceed with Construction Services:	
Total number of all OSHA Recordable Lost Workday Cases through month being reported:	
Total number of all OSHA Recordable Incidents through month being reported:	
Number of workdays completed since most recent Lost Workday incident:	
Largest number of workdays completed between Lost Workday incidents:	
Total number of Construction Industry occupational deaths:	

By my signature, I certify that the information above is true and accurate to the best of my knowledge.	
I understand that any details identified on this report may require discussion and/or incident review meeting with the Owner.	
I also understand that failure to submit this form as required by Contract may result in Owner withholding funds.	
Signature:	

Distribution:		One copy with original signature to OFPC RCM no later than submittal for following month's payment application
	e-mail copy **MD Anderson OCIP Manager** by the end of the month following the occurrence of information	
	e-mail copy to tod.hollis@marsh.com by the end of the month following the occurrence of information (for **OCIP Five Projects only**)	

The University of Texas System – Construction Project Safety

WORKER GUIDE FOR REPORTING INJURY

- **WORKERS MUST IMMEDIATELY REPORT** all injuries (no matter how minor) to a supervisor.
- The supervisor will report the incident to the Contractor and take care of all paperwork.
- The Contractor will drive the injured employee to the clinic to guarantee safe transport and to secure swift and complete medical attention.
- The doctor may prescribe written "orders" for medical restrictions. The supervisor must then assign temporary duties that fit the restrictions ("Light Duty"). This guarantees the worker a full paycheck while the injury heals. For any injury that requires restricted work activity a Bona Fide Offer of Employment must be executed by the Contractor involved.
- The Contractor will drive the injured worker back to the Project and make arrangements with the employer to get the worker and personal vehicle home by a safe method.
- Injured employees must follow the doctor's "orders" and comply with work restrictions – **at home and at work**. Employers must allow reasonable times for visits to the doctor and to therapy sessions. Normally, sessions can be scheduled during non-work hours.
- The insurance company may contact the injured employee to discover how the doctor and the employer are planning to treat the injury and the recovery. Injured workers should share any personal details that might help the agent understand the situation. If anything needs to be changed in order to help the recovery process, the agent will contact the proper people to make it happen.
- The insurance company will pay the medical bills for injuries on this Project. Workers should never pay any medical bills for an injury that is related to work. If there are any questions, talk to a supervisor and/or the Project Safety Coordinator for the Contractor.

SPECIAL WARNING TO USERS AND ABUSERS (of alcohol and other controlled substances):
No matter where a worker receives medical care, the treatment will include a drug and alcohol test. Workers who are injured as a result of impairment from alcohol or non-prescribed drugs will lose the guarantee that all medical treatment will be covered by insurance. Also, they will not be allowed to return to work on any UT System Project.

EXHIBIT L	CONTRACTOR INFORMATION – SUPERVISOR HANDOUT

The University of Texas System – Construction Project Safety

SUPERVISOR GUIDE FOR MANAGEMENT OF WORKER INJURY

1. Workers must **IMMEDIATELY REPORT** all injuries (no matter how minor they appear at the time of the incident) to a supervisor (foreman, general foreman, superintendent, etc.).

2. The supervisor must **IMMEDIATELY REPORT** any injury to the Contractor's Project Superintendent or Safety Coordinator. Improper and/or late reporting of injuries will result in Owner directed recovery charges as described in the Contract.

3. The supervisor must then escort the injured employee to the Contractor's Project office (**except when the injury requires an ambulance or emergency response**).

4. The Contractor's Safety Coordinator shall retrieve 5 documents from the Project Safety Files as follows:
   a. The form (Authorization for Medical Treatment) that guarantees quickest medical response at the clinic
   b. A map that shows the best route to the clinic
   c. A copy of the OCIP Return to Work Policy from the employer of the injured worker
   d. A "First Report of Injury" form to furnish the insurance company with the necessary information to start a claim and pay medical bills
   e. A "Bona Fide Offer of Employment" form to guarantee suitable employment for medically restricted workers

5. The Contractor will drive the injured employee to the clinic to guarantee safe transport and present the "Authorization to Treat" form to obtain swift response. This form will also notify the clinic that a test for drugs and alcohol is required. If the injured worker is transported elsewhere, the Contractor shall also notify the insurer. The supervisor shall also be at the clinic to respond to questions from the physician.

6. After the doctor has completed the examination and all required medical care, the Contractor and the worker shall meet with the doctor to accomplish three objectives:
   a. Review the injury and discover the need for any additional medical assistance.
   b. Discuss suitable Return to Work positions to accommodate any medical restrictions.
   c. Present the worker with a "Bona Fide Offer of Employment" form to guarantee continuing employment and to guarantee work tasks that will not exceed prescribed medical restrictions.

7. The Contractor shall then drive the worker back to the Project and the supervisor shall make suitable arrangements to get the worker and personal vehicle home at the end of the day. If the doctor has written a prescription that contains orders for medical restrictions, the worker must be assigned to ("Light Duty") tasks that meet the restrictions. This presents a "win-win" for all involved as follows:
   a. The injured worker will continue to draw his/her full paycheck.
   b. The employer will be able to keep its insurance rating as competitive as possible.
   c. The insurance provider will be able to keep the costs of medical claims as low as possible.

8. The supervisor must promote three issues to quickly and completely restore health:
   a. Maintain awareness of medical restrictions, and assign work tasks that do not violate the restrictions.
   b. When contacted by the insurance agent, be candid and share any information that may expedite the physical recovery of the injured worker.
   c. Allow reasonable times for physical therapy (or other medical treatment) and maintain contact with worker.

9. **Zurich** is the insurance company that will pay the medical bills. The Contractor's Project Safety Coordinator will have the contact information to file the required insurance claim.

SPECIAL NOTE: No matter where the worker receives medical treatment, a drug and alcohol test MUST occur at the Project assigned clinic. Employers must not allow workers with confirmed drug or alcohol impairment to return to employment on any UT System Project unless the drug is prescribed by a physician and the work assignment can be safely performed.

EXHIBIT M	CONTRACTOR SUBMITTAL TO OWNER - TEMPLATE

The University of Texas System – Construction Project Safety

REQUEST FOR VARIANCE

Date of Request:

From: *(insert name of Contractor and name of person signing on behalf of company)*

To: The University of Texas MD Anderson Cancer Center – *(insert name of MD Anderson OCIP Manager)*

Project Name: _____

Project Number: _____

We respectfully request a variance from the Contract, Section # 01 35 23 (Project Safety Requirements). We understand that no alteration of safety procedures is to be allowed until formal acceptance is executed by MD Anderson.

We believe that the following regulation(s) is/are either not practicable or not the best practice for the Project at this time.

(Insert verbiage that describes the specified regulation.)

(Insert description of how and why the existing conditions make the existing regulation less than the safest method for accomplishing the work – convenience is not an acceptable reason.)

(Insert the proposed method in sufficient detail to allow a reader to visualize the better plan.)

Very truly yours,

_____ _____

Signature *Position*

On behalf of the Board of Regents of The University of Texas System, Contractor's request is:

ACCEPTED ☐ DENIED ☐

_____ _____

Print name *Signature*

Request reviewed by MD Anderson OCIP Manager and no objections to the request are made at this time.

_____

Printed Name *Signature*

MD Anderson Project Manager

REVISION LOG

The following is provided for convenience to the Owner, Architect/Engineer and Contractor to track changes between annual document issuances and is not to be considered by any party to be contractual or 100% complete.

Date	Paragraph Revised
02/01/08	Correct numbering in section 3.8
06/01/08	Include SafetyNet Program in section 2.4
04/20/09	Reissue date of substantially revised document.
[04/20/09 Revision Posted on MD Anderson Website 03/09/10]	
09/30/10	2.1.2 change "five (5)" to seven (7) 2.1.3 after "construction safety" add "in a safety management position equivalent to a PSC" 2.2.4 change three (3) to five (5) and later in the sentence change the one (1) to three (3) years in a safety management position equivalent to a PSA.

SECTION 01 35 25 – OWNER SAFETY REQUIREMENTS TABLE OF CONTENTS

SECTION 01 35 25 – OWNER SAFETY REQUIREMENTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

C. For projects enrolled under the Owner Controlled Insurance Program (OCIP), this Section supplements Section 01 35 23 Project Safety Requirements, with additional Owner requirements for work within existing facilities or for work in areas controlled by the Owner.

1.02 SUMMARY

A. The control of Project Safety by the Contractor is an essential element of performing work at The University of Texas MD Anderson Cancer Center (MD Anderson). The Contractor shall, at all times, provide adequate resources, equipment, training, and documentation to assure a safe work environment at the Project site and to instill a culture for safety in the behavior of all supervisors and workers. Every worker shall understand that safety and health issues always take precedence over all other considerations, and that identifying, reporting, and correcting unsafe acts and conditions are the responsibility of everyone at the Project site.

B. MD Anderson is dedicated to providing a safe healing and work environment for all patients, visitors, staff, students, guests, and Contractors.

C. The details of this document should be considered as supplemental requirements. The Contractor shall develop, implement, maintain, and submit to the Owner a written Project Safety Program that meets or exceeds all Federal, State, and Local standards and regulations pertaining to construction activities. The Contractor and every Subcontractor shall comply with the rules and guidelines outlined in this guideline. In any circumstances where this section differs with or conflicts with any standard or statutory requirement, the more stringent requirement shall apply. Contractors may use a company-wide safety program in lieu of the Project specific safety program as long as it meets or exceeds the requirements listed in these guidelines.

D. The Owner reserves the right to have any manager, supervisor or worker employed by the Contractor or Subcontractor removed from the Project for disregard of Project Safety requirements.

E. The Owner reserves the right to deduct from the Contract any safety related expenses that the Owner incurs, as a result of the Contractor's, or any Subcontractor's, disregard for Project safety.

1.03 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

1.04 DEFINITIONS

A. The term “Owner’s Designated Representative” or “MD Anderson Representative”, as used throughout the document, shall refer any of the Owner’s Project management team, insurance carrier representative(s), Owner’s designated agent, or campus representative(s).

B. The term “Contractor” as used throughout the Contract Documents shall refer to the party having a direct contractual agreement with the Owner to provide services. This term is to apply whether Contractor is known as a Prime Contractor, General Contractor, Construction Manager, or Design/Build Contractor.

C. The term “Subcontractor” as used throughout the Contract Documents shall refer to any on-site Subcontractor, regardless of tier.

1.05 EMERGENCY / IMPORTANT CONTACT INFORMATION

A. Consult with your MD Anderson Representative regarding the correct emergency contact information for the facility in which you are working. Each facility may have a different emergency call procedure.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

PART 3 - EXECUTION

3.01 ASBESTOS CONTAINING MATERIAL

A. Environmental Health and Safety must review <u>all</u> Job sites prior to the start of a Project to determine the presence of Asbestos Containing Material (ACM).

B. All suspect materials shall be considered asbestos-containing material until identified otherwise by an EPA approved method of analysis for identifying asbestos-containing material.

C. Any Contractor personnel needing to disturb any suspected asbestos containing building materials shall first contact their MD Anderson Representative. It is then the responsibility of the MD Anderson Representative to contact Environmental Health and Safety to determine if there is any Asbestos Containing Materials present.

D. Contract personnel coming into contact with known or suspected asbestos containing materials (ACM) will:

1. Avoid any physical contact or other actions that may damage or otherwise disturb the material.

2. Submit all requests for sampling suspected asbestos containing materials through your MD Anderson Representative. If the material has not been previously identified as containing asbestos, Environmental Health & Safety personnel will sample the materials, obtain analysis, and report results to the requester.

3.02 BLOODBORNE PATHOGENS

A. Contractors shall instruct their employees in the concept of Standard Precautions and document training in accordance with OHSA 29 CFR Section 1910.1030.

B. The Contractor must take every effort to prevent exposure to blood and/or body fluids while in the hospital.

C. Patient care and research areas are considered to have the potential for exposure and special instructions may be given by the nursing or research staff on how to avoid potential contamination. Contact your MD Anderson Representative to determine if an exposure potential exists for all areas in which you will be working.

D. Contractors shall not handle bags or containers identified as containing potentially infectious materials. Contractors may contact Environmental Health and Safety at 713-792-2888 for additional questions.

E. For Smithville / Bastrop, Contractors may contact Environmental Health and Safety with additional questions at:

1. Smithville Office Phone: 512-237-9522, 9536

2. Bastrop Office Phone: 512-332-5232

3.03 CELLULAR PHONE AND RADIO USE

A. The use of the following devices in PMA locations should be used with caution (beyond six feet of physiological monitoring systems):

1. Cellular Phones

2. Computers with wireless capabilities

3. Two-way pagers

4. Wireless handheld devices

B. Definitions:

1. Cellular Phone – Telephone that uses a frequency range of 800 - 1910 MHz to transmit voice and data to a remote cell and up to 625mW of power.

2. Close Proximity - within twenty (20) feet for two-way radios and within three (3) feet for cell phones and others of a physiological monitoring system.

3. Non PMA Area - an area of M.D. Anderson facility outside of the defined PMA Areas.

4. Physiological monitoring area (PMA)- An area of M.D. Anderson facility where patients are likely to require the use of a physiological monitoring (e.g., Electrocardiograph, electroencephoalographs, pulse oximetry, cardiac output, invasive pressure, etc) for care or treatment.

5. PMA Locations: Bone Marrow Unit (G11), Cardiac Unit (P12), Cardio-Pulmonary Clinic (R8), Diagnostic Imaging (G3, R3, B3, ACB4-ACB7), Emergency Center (R1, P1, P2), Endoscopy Clinic (R5), Intensive Care Unit (G7), Operating Rooms (G5, ACB4), Pediatric Unit (G9, R7), Post Anesthesia Care Unit (G3, G5, ACB4, P3 Pod B), Rehab and Patient Therapy (P8), and the Telemetry Unit (P7).

6. Wireless Communication Devices - Cellular telephones and two way radios are the only devices currently defined as having caused interference to medical devices.

7. Two Way Radios – “Walkie-talkies" which use a frequency range of 29 - 1000 MHz to transmit voice between two locations up to 5 watts of power.

8. Wireless Handheld Devices – Commonly known as PDA (Personal Digital Assistant). Devices that provide a range of personal information management, voice communication, data communication, and computing capabilities, that relies on wireless technology to transfer or retrieve data. May include Palm Pilot, Pocket PC, Blackberry, Smartphone, or similar devices with operating frequency of 800 to 1900 MHz.

C. If allowed to be turned on, the volume of radios and cellular telephones must be turned down to minimize disruption to patients and operations.

3.04 CONDUCT

A. The use or consumption of alcoholic beverages or controlled substances is strictly forbidden on any Institution owned or controlled property.

B. Contractor shall not permit any person to operate a motor vehicle or heavy equipment while taking prescription or non-prescription medication that may impair their ability to operate safely.

C. MD Anderson is a NO SMOKING Institution. No smoking or use of tobacco products is allowed on any Institutional property. There are no designated smoking areas. Anyone found smoking will be immediately removed from the jobsite.

D. Contractor personnel shall be courteous to all tenants, business invitees, patients, visitors, and employees.

E. Unacceptable behavior on the part of the workers anywhere on campus, including parking lots, the project site, the accessible route(s) through the site or through the campus may lead to the identifiable Contractors being removed from the project.

F. Personal grooming, personal hygiene and language by Contractors must be constructed in a professional manner at all times. Use of foul and off-color language will not be tolerated and can result in Contractor removal from jobsite.

G. Shirts must have sleeves of at least 3 inches, measured from the armpit seam. All buttoned shirts must be buttoned to at least the third button from the top. T-shirt styles may be approved if they are part of a company uniform or contain no political or offensive language or images. For additional guidance, see Section 3.26 Personal Protective Equipment.

H. Pants that are excessively loose, torn, ragged or with dragging cuffs will not be permitted. Shorts are not allowed.

I. No clothing, accessories, or hardhat stickers that display offensive, derogatory or inflammatory wording or graphics shall be worn on the worksite.

J. All clothing must be in good repair and free of any large holes or major damage. All clothing must be clean and sanitary at the start of each work shift and periodically cleaned to prevent tracking dust and debris out of the construction area.

K. Workers clothing must be clean of visible dusts and dirt when outside of the Project site.

L. No radios or music shall be allowed on the Project including headphone systems. Personnel must be able to hear alarms and warnings in the immediate area. (This does not pertain to the use of two-way hand held communication equipment or phones).

M. No tools or equipment will be loaned by Owner to Contractors to assist them in completing Projects.

N. Contractor personnel shall not tape back lock/latch mechanisms nor prop open any exterior door, security door, stairwell door, or fire / smoke door. Personnel may not disconnect any electronic security device or defeat lock systems.

3.05 CONFINED SPACES

A. MD Anderson does not provide any confined space entry support such as sampling, entry permits, rescue personnel, rescue equipment, etc., for contractor personnel.

B. Contractors are responsible for ensuring all of their employees are trained on the recognition and significance of confined space entry procedures in accordance with 29 CFR 1910.146.

C. It will be the responsibility of the Contractor performing the work inside the confined space to provide the necessary equipment to assess the hazards within the space and prepare the space for entry and to meet the precautions of the entry permit.

D. Contractor shall provide all emergency rescue equipment and personnel as required by 29 CFR 1910.146, as applicable.

E. The Contractor conducting the work inside a permit-required confined space shall follow, at a minimum, all applicable OSHA requirements.

3.06 CONSTRUCTION SAFETY SITE INSPECTIONS

A. All construction sites will be subject to periodic inspections by Environmental Health and Safety representatives. The inspector(s) will be looking for life safety, environmental, construction safety, and indoor air quality deficiencies. Once noted, the inspector will notify the MD Anderson Representative responsible for the site. The inspector may also notify the Contractor Representative on site.

B. All noted deficiencies shall be immediately corrected.

C. The inspector will be enforcing IAQ measures found in the “Maintaining Indoor Air Quality During Construction and Renovation” policy / procedures and other requirements set forth in the MD Anderson construction specifications for that Project. (See Attachment A).

D. A job or activity will be suspended if an imminent danger to patients, animals, visitors, employees, Contractor personnel or facilities is observed.

3.07 CONTRACTOR DAILY SIGN-IN AND WORK NOTIFICATION - HOUSTON

A. Contractors must follow any specific check-in procedures for the facilities in which they will be working. Your MD Anderson representative will inform you of these procedures.

B. All Contractors/vendors must wear an MD Anderson-issued ID badge at all times while on property owned or under the control of the Institution. Badge must be worn and be visible at all times. Contact your MD Anderson Representative for assistance in obtaining an ID badge.

3.08 CONTRACTOR DAILY SIGN-IN AND WORK NOTIFICATION – SMITHVILLE / BASTROP

A. Contractors/Vendors hired by the Facilities Management Division must register their activities with Facilities Management before commencing work.

B. Contractors coordinate with Project Managers for access to the campus. Contractors must submit a Construction Schedule to Physical Plant Management.

C. Physical Plant informs Facilities Management of contractors schedule as well as the badge numbers issued to that contractor. Facilities Management will issue badges to contractor for their use while on the property. Contractors are responsible for distributing the badges as needed.

D. Contractor/vendor registration is performed in the Physical Plant Building.

E. All Contractors/vendors must wear an MD Anderson-issued ID badge at all times while on property owned or under the control of the Institution.

F. Contractors/vendors who fail to register with Physical Plant Management are subject to removal from the property by the UT Police.

3.09 CONTRACTOR INJURIES AND INCIDENTS

A. Contractors shall make prior provisions for the treatment of minor injures.

B. Contractor is responsible for cleaning up all blood and body fluids and debris from accidents.

C. Contractor employees requiring immediate medical treatment should be taken to the emergency room of a local hospital. MD Anderson does not provide medical treatment to Contractors engaged in projects.

D. If an injured worker cannot be moved and assistance is needed, contact the Houston or local Fire Department (911) for an ambulance.

E. An injury requiring treatment beyond minor Job Site First Aid, shall be reported immediately to your MD Anderson Representative or Designee and Monitoring Services 713-792-2888 (All Houston Locations) and UTPD Smithville/Bastrop at 512-332-5371 or 512-237-9411

F. A copy of the incident / accident report must be provided in a timely manner to your MD Anderson Representative. A preliminary report must be made within 24 hours of the end of the next working day.

G. All incidents that result in property damage must be reported to your MD Anderson Representative.

3.10 CONTRACTOR SAFETY ORIENTATION

A. All Contractor personnel are required to complete the MD Anderson Construction Safety and Infection Control Orientation Training given by the Environmental Health and Safety Office before beginning work at the Institution. This training may be in the form of videos or an in-class presentation. Videos can be requested through the EH&S department or your MD Anderson Representative and are available in both English and Spanish.

B. Completion of orientation is required to obtain an MD Anderson hardhat sticker and emergency contact card.

C. The Contractor may be required to attend orientation again for refresher, and review any changes if deemed necessary by the Owner.

D. The Contractor's MD Anderson Representative must contact the Environmental Health and Safety Office to make arrangements for the orientation session.

E. It is the responsibility of the Contractor to ensure that the information given in the orientation session is understood by all workers (i.e., Spanish or other language translation).

3.11 ELECTRICAL SAFETY

A. Refer to Section 3.24 on Lock Out / Tag Out requirements.

B. All electrical power tools, equipment and extension cords shall be inspected daily before use. Defective items shall be immediately removed from service for repair or replacement.

C. NOTICE: RED OUTLETS are for power requirements provided by the Emergency Generator System and shall NOT be used by Contractor personnel.

D. Ground Fault Circuit Interrupters (GFI's) shall be in use between any permanent receptacle and any Contractor equipment.

E. Temporary power panels shall have GFI protected circuits built into the panel.

F. The GFI shall be tested for function before plugging in any Contractor equipment.

G. Electrical power tools shall be grounded, or double insulated, or battery powered. The cord on the tool must be free of defects.

H. Battery powered portable hand tool battery charging stations are not to be plugged into hallway or exit stairs outlets or other areas so as not to create a trip hazard.

I. Extension cord sets shall be the “heavy duty” three-wire grounded type (14 gauge or larger), and must be rated for the particular application in which it is to be used.

J. Three-wire flat type extension cords are NOT permitted.

K. Defective cord ends must be replaced with a UL rated repair end; Contractor must follow the manufacturer instructions for repair installation.

L. Damage to the cord jacket shall not be taped over and must be repaired per manufacturer’s recommendations.

M. Extension cords shall be routed overhead whenever possible or otherwise protected against damage or tripping hazard by being securely taped to the floor or secured by other acceptable means and approved by the MD Anderson Representative.

N. Running/hanging extension cords through ceiling spaces is not permitted. Special permission from Environmental Health and Safety is required for any variation from this requirement.

O. Extension cords must be used as designed by the manufacturer. Avoid using extension cords in a manner to cause damage to the electrical system or cause personal injury.

P. All electrical shutdowns and electrical “taps” must be coordinated through the Project Manager or MD Anderson Representative for that Project.

Q. Contractors are absolutely not allowed to turn on/off any electrical source breakers or switches without permission from the respective MD Anderson Facilities Management representative for that building/space. This should be accomplished through a Utility Shutdown Request submitted by the Project Manager or MD Anderson Representative.

R. Existing and new electrical equipment must be protected at all times from humidity, liquid material splashes, activities inducing to vapor formation and condensation.

S. No liquid materials shall be handled in electrical rooms, electrical equipment areas or areas adjacent to electrical equipment locations.

T. In the event that the Contractor must handle liquid materials in the vicinity of electrical equipment locations, the Contractor must inform the Owner and seek written approval, prior to bringing those liquid materials to the above-mentioned locations.

3.12 EXCAVATIONS

A. All excavation shall have the following prerequisites:

1. Discussion with the appropriate MD Anderson Representative or site owner/property manager of as-built locations of all underground utilities in the vicinity;

2. Where applicable, a phone call for utility “locates” shall be completed seventy-two (72) hours in advance. “Potholing” and hand excavation shall be required within three horizontal feet of “located” centerlines.

3. All excavations must follow the applicable OSHA guidelines and requirements as related to design and protection of excavations.

4. All trench excavations should be backfilled or plated at the end of each shift.

5. When an excavation cannot be backfilled or plated in the same day it is created, a highly visible hard and sturdy barricade such as a wooden fence or wooden railings shall be erected. Excavation protections in areas of traffic must comply with local, state, or federal safety standards.

6. Means of access into excavations shall be removed or physically barricaded at the end of each workday.

7. Excavations in areas of public access shall be secured with a temporary “hard” barricade such as solid fencing or wooden railings to prevent entry. These excavations and protection plans must be approved by the Environmental Health and Safety Office.

B. Where applicable, all required engineer stamped excavation plans must be readily available at all excavations for review by MD Anderson Representative(s). Certificates of soil testing shall also be made available.

3.13 FALL PROTECTION AND PREVENTION

A. Work in areas not protected by a standard guardrail system OR present a fall hazard greater than six (6) feet shall require compliance with all current applicable OSHA Fall Protection requirements and/or ANSI/WCA I-14.1 Window Cleaning Safety Standard.

B. The Contractor shall ensure that all workers exposed to fall hazards have been properly trained and equipped by their employer.

C. No worker or equipment shall be allowed to perform work directly above another worker unless adequate overhead protection is provided.

D. Covers or fencing of sufficient design shall be placed over holes, roof and floor openings or drop offs to prevent personnel or equipment from penetrating the opening.

E. Covers or fencing shall be physically secured and clearly marked with warning message, such as “Danger”, “Hole”, or “Cover! Do Not Remove”.

F. If a cover is too small for a warning message, it shall be painted bright orange or red.

G. All puncture and impalement exposures shall be covered or eliminated as soon as they are created. Exposed ends of rebar are to be covered with material that is designed to prevent impalement of a 250-pound body from a fall of four (4) feet.

3.14 FIRE PREVENTION

A. All combustible materials shall only be stored in approved areas as designated by the MD Anderson Representative.

B. MD Anderson is a NO SMOKING facility. No smoking or use of tobacco products is allowed on any Institutional property. There are no designated smoking areas. Anyone found smoking will be immediately removed from the jobsite.

C. Contractor shall coordinate the covering and uncovering of smoke/heat detectors with Owner’s Environmental Health and Safety Department (713-792-2888) prior to starting work or upon discovery of such devices as work progresses. Covering smoke detectors with tape, rubber gloves, or any other method that can agitate or damage a detector is prohibited.

D. Contractor is subject to fines by the Cities of Houston, Bastrop/Smithville Fire Marshal or Fire Department Inspector if they are found to negligently activate fire alarm devices.

E. For large or high dust generating Projects, the Contractor shall coordinate with their Project Manager or MD Anderson Representative to arrange for the replacement of smoke detectors with heat detectors. Environmental Health and Safety must approve all changes to any fire alarm or suppression systems.

F. Combustible scrap, trash, and debris shall be removed from the Project site on a daily basis, or, more frequently as required.

G. Contractor shall not tape back door lock/latch mechanisms nor prop open any exterior door, security door, stairwell door, or fire / smoke door. Lock cores shall not be removed. Coordinate changing lock cores to the designated construction core lock with your MD Anderson Representative.

H. Flammable products shall be limited to one days supply inside the building. Flammable products shall be stored outside the building or in approved UL Rated flammable storage cabinets. Flammable liquids shall be in approved safety cans or cans designed for their use.

I. No internal combustion engines or portable propane heating devices are allowed in any Institutional buildings unless approved by the Owner. Coordination of how gasoline will be transported through buildings and stairwells must be coordinated with your MD Anderson Representative.

J. Absolutely no gasoline will be allowed inside MD Anderson owned buildings. For temporary use outdoors, only approved metal safety cans will be permitted.

K. Compressed flammable gas cylinders (i.e acetylene) shall not remain inside the building overnight and must be removed from the premises at the conclusion of each workday. Oxygen cylinders must also be removed from the premises at the end of each workday. Gas bottles are not allowed to be stored in areas that are used as Contractor offices.

L. The Contractor shall also have the Material Safety Data Sheets (MSDS) for each gas used available within 15 minutes when requested. .

M. Compressed flammable gas cylinders, while on the project site, shall be secured by chain or other suitable method to prevent tipping or falling over. All safety caps shall be securely installed when tanks are not in use.

N. When working in the ceiling space or on rated fire/smoke rated walls and structures, all holes and penetrations for wires, conduits, piping, etc. shall be sleeved and sealed with a UL approved fire caulking / sealing compound at the end of each workday. Any holes that must remain overnight must be sealed with an equivalent temporary fire proofing material as approved by the MD Anderson Representative.

O. Work on fire sprinkler and detection systems shall continue until the system operation is fully restored. No impairments will be allowed to extend beyond approved periods of time or during times when the site is unattended.

P. Shutdown of any fire suppression or detection systems/devices shall be coordinated through the Owner's Designated Representative. Unauthorized shutdown or disabling of life safety systems shall be grounds for immediate removal from the jobsite.

Q. All Contractors are required to supply and maintain a minimum of one currently tagged ABC fire extinguisher, 10 pound (Class 2-A) or greater. The use of a M. D. Anderson owned fire extinguisher will not be permitted. Requirements are as follows:

   1. Indoors - Within 100 feet of any Class-A hazard, within 25 feet of any hot work and one for every 3000 square feet of floor space.

   2. Outdoors – between 25 - 50 feet of any hot work.

R. All Contractor employees shall be trained on the proper use and handing of fire extinguishers.

S. If a Project involves multiple locations on a single floor or on multiple floors, additional multi-purpose fire extinguishers are required.

T. The Owner may require additional extinguishers as dictated by the risk of each project or project area.

3.15 FIRE REPORTING AND EVACUATION PLAN

A. Contractor shall establish a designated emergency evacuation assembly area for all Projects prior to starting work. Contractor shall train all employees on assembly area locations and how to get to each area.

B. For areas that do not allow a clear view of egress route, the Contractor must post easy to understand maps, that are clearly visible to all workers and visitors, of the proper exit paths as required by OSHA and NFPA.

C. In the event of a fire alarm, all work is to stop, all sources of ignition or hazardous work shall be immediately halted and all personnel are to proceed to the door of the construction site and wait for further instructions.

D. In the event of a smoke, fire, or emergency incident the following procedures should be followed:

1. RACE – Rescue, Alarm, Confine, Evacuate/Extinguish

a. Rescue: rescue Patients, Visitors, Employees

b. Alarm: a fire alarm pull station should be activated as quickly as possible or call 911.

c. Confine: confine the fire or smoke by closing all doors to the area.

d. Evacuate/Extinguish: extinguish the fire after you have performed the above operations but only if you can do it safely.

E. When reporting a fire by phone:

1. The caller should provide their name, the location of the fire, and a brief description of the incident. The caller should not hang up until emergency services personnel instruct them to do so.

2. The caller should be prepared to guide the Fire Alarm Response Team and Emergency Responders to the fire location.

F. All Contractor personnel shall report to their designated assembly area immediately. Contractor must coordinate the Designated Assembly Area with their MD Anderson Representative prior to the beginning of the project.

3.16 GENERAL SITE CONDITIONS – LIFE SAFETY

A. Contractors will comply with all OSHA and NFPA life safety requirements as related to emergency exiting and lighting for construction areas.

B. For areas that do not allow a clear view of egress route, the Contractor must post easy to understand maps, that are clearly visible to all workers and visitors, of the proper exit paths as required by OSHA and NFPA. Contractor should coordinate the creation of these maps with their MD Anderson Representative.

C. Contractors are required to maintain any required temporary signs directing to exit routes. These signs shall be externally or internally illuminated by lighting that is either on emergency power or of the luminescent “glow-in-the dark” type.

D. All temporary lighting and bulb protective devices shall be maintained and in good working condition. Wiring for temporary lighting shall be removed at the conclusion of the Project scope.

E. All emergency exit doors must be maintained and in good working order. Paths to exits must remain clear at all times.

F. Depending on the size of the project site and number of Contractors working in the site, a Contractor may be required to maintain at least two clearly marked exits per NFPA 101 and 241 requirements.

G. All exits must be clearly marked with the words “EXIT” or “EMERGENCY EXIT”. Doors that the Contractor does not want to use for daily access may be marked with the words “EMERGENCY EXIT ONLY”.

H. Lock all entry doors/gates to the project site. Due to life safety requirements, chains and/or pad locks will not be permitted on any door. Contact your M.D. Anderson Representative for the proper lock cores and keys.

I. If a combination key pad is installed on a jobsite, the door must also be equipped with a construction core to ensure emergency personnel maintain access to the site. Key pads without a construction core will not be permitted. Contractor must also ensure that the combination to the key pad is not posted on the wall or door of the site. If this occurs, the combination must be changed immediately.

3.17 HAZARD COMMUNICATION (HAZCOM)

A. The Contractor shall provide training and maintain documentation that their personnel and Subcontractors have received proper training in Hazard Communications under the provisions of OSHA’s requirements in 29 CFR 1910.1200 and/or 1926.59.

B. A printed, legible copy of the Material Safety Data Sheet (MSDS) shall be made available within 15 minutes of a request for each chemical used on the job site.

3.18 HAZARDOUS WASTE AND WORK IN HAZARDOUS LOCATIONS

A. Owner chemical, biological or radioactive materials (hazardous substances and equipment) must be moved or secured prior to beginning work in any area. Contractor shall coordinate the removal of these items with their MD Anderson Representative.

B. The Contractor’s MD Anderson Representative will coordinate any pre-site assessments with Environmental Health and Safety, the laboratory principle investigator, clinic representative or laboratory manager to prevent disturbing experiments/animals or creating accidents.

C. All Contractors must have permission from their MD Anderson Representative and the laboratory manager or clinic representative before entering laboratory or hospital clinical work areas.

D. Disposal of all hazardous wastes generated by Contractor activities is the responsibility of the Contractor. All wastes must be removed from the premises.

E. Absolutely no chemicals, trash, paint, paint brush rinse, shop vacuum contents, excess materials, sand, dirt, etc. may be disposed of in storm sewers/drains or sanitary drains.

F. Contractor must prevent dirt from entering exterior storm drains by adding appropriate silt protection screen material to all exterior drains that may be impacted by the project.

G. Contractor must follow all requirements set forth in the Storm Water Pollution Prevention Plan (SWPPP) as indicated in the appropriate Project Specification (Section 01 57 23). Consult the Environmental Health and Safety Office (713-792-2888) for questions regarding environmental permitting and plans.

H. All hazardous waste, fuel, oils, and chemicals stored outdoors must have adequate secondary containment to prevent discharge onto the ground or in storm or sanitary sewer drains. All containers must be stored to prevent theft or unauthorized access. All containers outdoors must also be protected from weather elements and secured from public access.

I. Contractor shall ensure that adequate spill protection equipment and supplies are readily available during all equipment refueling activities.

3.19 HOT WORK PERMITS

A. A valid and signed Hot Work Permit must be obtained anytime all work being implemented involves the use of any incendiary or heating devices such as:

1. Electric Arc Welding

2. Oxygen Acetylene Welding

3. Tig/Mig Welding

4. Cutting/Soldering

5. Propane Torch

6. High Heat Producing Sources

7. Spark Producing Activities

8. Gasoline or Propane Powered Equipment used Indoors

B. All Smithville/Bastrop hot work applicants must go to Physical Plant Management and fill out a blank Hot Work Permit. Instructions on how to properly fill out the permit are available.

C. Permits to work on ANY medical gas systems must be obtained from the Facilities Department responsible for that area prior to work.

D. Hot Work Permits shall be completed by the Contractor 24 hours in advanced and once approved, posted in the vicinity of any burning or welding operations that are to be completed inside or near a building or enclosure. Permits may be issued for up to three (3) days duration only when the work operation is to be continuous in a single area and so approved by the Owner.

E. Hot work applicants must contact the designated Facilities Building Manager or your MD Anderson Representative for specific hot work permitting requirements for the facility in which they are working.

F. Responsibilities of the Contractor:

1. It is the responsibility of the contractor, vendor, and/or UTMDACC personnel to read, understand, and acknowledge sections I, II, and III of the Hot Work Permit.

2. It is the responsibility of the contractor, vendor, and/or UTMDACC personnel to acknowledge and abide by all precautions stated in section III of the Hot Work Permit.

3. It is the responsibility of the contractor, vendor, and/or UTMDACC personnel to complete and sign the appropriate sections of the Hot Work Permit 24 hours prior to the start date of the work to be performed.

4. Projects that are to begin on Saturday, Sunday, or Monday must have Hot Work Permit request form completed by the preceding Friday.

5. Contractors are responsible for ensuring all of their authorized and affected employees are trained on the significance of Welding, Cutting, and Brazing procedures in accordance with OSHA regulations 29 CFR 1910.252 - 1910.255.

6. At the end of any cutting operation or at the end of the day, all fuel gas cylinders must be removed from the facility. Fuel gas cylinders WILL NOT be allowed to remain in the facility overnight.

7. Anti-flashback arrestors shall be installed at the base of all Oxy-Acetylene cutting torches or at the pressure regulator gauges where the hoses are attached, unless the torch is equipped with a built-in arrestor. Only friction strikers shall be used to light and re-light Oxy-Acetylene torches.

8. Fire Watchers shall be posted at every operation that produces sparks, flames or sufficient heat to create an ignition. Watchers shall be trained in the use of extinguishers, shall keep other people from entering exposure areas, and shall not be assigned other duties until the rekindling ("smolder watch") possibility is over. Additional fire watch personnel shall be posted in all areas in which hot work sparks, slag, heat, etc. go beyond the sight of the primary fire watch.

9. Except in a fabrication shop or in front of a properly guarded grinding wheel, the person performing the work may not act as a watcher. When sparks, slag, or fire may fall to a different level, a separate watcher shall monitor each level directly below the work (including exterior locations).

10. Heaters for welding electrodes shall have a manufacturer's label that certifies the purpose of the unit. Job-built heaters shall be prohibited.

11. The remains of welding electrodes shall be picked up and disposed of as soon as each electrode is expended. No welding electrode shall be permitted to fall and remain in the work area.

12. All temporary fabrication areas shall be approved by the Facility Manager prior to starting work.

3.20 HURRICANE / SEVERE WEATHER PLANS FOR CONSTRUCTION SITES

A. Construction sites may be required to have a Hurricane/Severe Weather Plan special to that site. Consult with your MD Anderson Representative for applicability, as some departments may require this Plan for small projects.

B. A copy of the Hurricane/Severe Weather Plan must be submitted to your respective MD Anderson Representative prior to starting work.

C. The Texas Medical Center (TMC) Emergency Preparedness Office or Campus Director (Smithville/Bastrop) will issue warning levels in the event of possible flooding or hurricanes. Contractors are urged to learn more about the TMC warning system by contacting their MD Anderson Representatives.

3.21 IDENTIFICATION (ID) BADGES

A. It is the policy of The University of Texas MD Anderson Cancer Center to issue an identification (ID) badge to each employee and to all Temporary Agency and Contractor personnel.

B. All badge requests must be processed by the MD Anderson department (i.e., PCF, REF, CPM, AFCO, etc.) that is issuing the contract for work.

C. ID badges must be worn at all times in a highly visible manner while on property owned or under the control of the Institution.

D. Contractors are responsible for returning any badges for personnel that will no longer be providing services to the Institution within one week after termination or conclusion of Project.

E. The badge must be clearly visible to someone facing the wearer.

F. A fee may be required to replace a lost Contractor badge. Lost identification badges that have programmed electronic access must be reported to the contracting department representative (i.e. Project Manager) immediately.

G. Personnel not wearing proper identification may be subject to immediate removal from the jobsite.

3.22 INTERIM LIFE SAFETY MEASURES (ILSM) GUIDELINE

A. Interim Life Safety Measures (ILSM) – Is a series of administrative actions required to temporarily compensate for significant hazards posed by existing National Fire Protection Association 101, 2009 Life Safety Code (LSC) deficiencies or construction activities.

B. All Contractors are required to abide by any ILSM requirements that may be implemented by the Owner due to a temporary deficiency/hazardous condition and must be continuously enforced through Project completion or until the deficiency is corrected. Each Contractor shall be responsible for ensuring all personnel on site are aware of the Interim Life Safety Measures implemented.

C. Contractors may be required to keep daily logs of the condition of their jobsites.

3.23 LADDER SAFETY

A. Ladders must be inspected prior to each use. Defective ladders shall be immediately removed from service and removed from the job site.

B. Ladders shall be used only in accordance with the manufacturer's labeled instructions.

C. Stepladders shall be used only in the fully open position with spreaders locked in place. Using a folded stepladder leaned against a support is prohibited.

D. Employees shall not stand on the top platform, the step below the top platform or the back stretchers.

E. Do not sit on, or straddle the top platform.

F. Stepladders shall not be used for access to platforms or other elevated areas – an extension ladder is required.

G. Extension ladders must be properly positioned and locked in place.

H. Extension ladders used for access to elevated areas shall extend at least three feet beyond the supporting structure.

I. Extension ladders must be secured to the supporting structure or be held at the base by another employee.

J. Job built ladders shall conform to applicable ANSI Standards AND shall be limited to use in excavations or concrete form work only. These types of ladders must be inspected daily.

K. At the end of each workday, remove and store, or secure from use all portable and job-built ladders that provide ground access to any elevated platform or structure so as to prevent unauthorized access.

L. Chaining ladders to equipment or mechanical, electrical, or plumbing fixtures or piping is prohibited. Ladders must be stored in a manner to prevent blocked fire exits or escape routes. Ladders must not block access to equipment or facilities.

M. Portable stepladders and extension ladders shall be rated class I-A.

N. Ladders that have multiple sections that can be manipulated to form multiple surfaces and angles are not allowed.

O. Aluminum ladders are prohibited.

P. All exceptions to these requirements must be approved by MD Anderson Environmental Health and Safety.

3.24 LOCK OUT / TAG OUT

A. It is the policy of The University of Texas MD Anderson Cancer Center that its employees and Contractors are protected from all energy sources during maintenance and repair activities.

B. Each facility has a Lock Out/Tag Out program. Contractors whose work will involve the Lock Out/Tag Out process shall comply with the provisions of the respective Facilities Management program and procedures. If there is a difference between the Contractor's program and the Institution's program, the more stringent procedure shall prevail.

C. Lock Out/Tag Out procedures may be specific to each type of equipment or device. Consult with the Facility Maintenance Department for specific procedures.

D. Contractors are responsible for ensuring all of their authorized and affected employees are trained on the significance of Lock Out/Tag Out procedures in accordance with 29 CFR 1910.147 and must follow these requirements.

E. Only the authorized employee or Contractor who applied a device is allowed to remove his/her lock out or tag out device from each energy-isolating device so energy can be restored to the equipment. MD Anderson personnel may add locks or tags to tagged-out devices – Contractors are not allowed to remove these locks or tags.

F. Never remove another person's tag/lock. Unauthorized removal of tags/locks will be grounds for immediate and permanent removal from the jobsite.

G. If tags/locks remain on equipment, contact the appropriate personnel or department for resolution to the removal process.

3.25 MAINTAINING INDOOR AIR QUALITY (IAQ) DURING CONSTRUCTION AND RENOVATION ACTIVITIES

A. It is critical to our patient's health that proper controls are in place to ensure indoor air quality is maintained during construction and renovation activities. These activities disturb existing dust and/or create new dust, which causes the release of Aspergillus and other mold spores into the air. These spores can result in serious complications, and potentially death, for immuno-compromised individuals.

B. The guideline covers all Contractors involved in building maintenance, construction, renovation and/or repair and applies to all areas of the Institution.

C. An Indoor Air Quality (IAQ) Permit may be required for every Project, no matter the duration. The permit explains the requirements needed to maintain the best possible air quality outside the work site.

D. This permit shall be posted at the site and shall remain posted until the completion of the Project.

E. EH&S will perform periodic inspections, verify that the proper controls are in place and will periodically monitor sites with instruments used to measure applicable indoor air quality (IAQ) parameters.

F. Contractor must follow the requirements of the Indoor Air Quality Permit and the Maintaining Indoor Air Quality During Construction and Renovation Policy.

G. See Attachment A for the “Maintaining Indoor Air Quality During Construction and Renovation Policy” for the requirements that must be followed for each Project. This policy is a guide to the minimum protective measures that are to be in place prior to start of all Projects.

3.26 PERSONAL PROTECTIVE EQUIPMENT (PPE)

A. The minimum OSHA requirements for Personal Protective Equipment (PPE) shall be required of ALL persons on the Project site. Each Contractor/Subcontractor shall provide their workers with all required PPE. The Contractor is responsible to ensure that PPE is inspected and maintained in proper condition.

B. Safety Hard Hats: When required, every person in the Project shall wear a hard hat that meets the minimum OSHA requirements.

C. When required, hardhats are to be worn and maintained in accordance with the manufacturer’s recommendations. “Cowboy” style hard hats shall not be allowed, including ANSI approved hats. Hard hats that display noticeable wear or damage shall be replaced or repaired per manufacturer’s specifications.

D. Eye Protection: When required, every person on the Project shall wear eye protection. Additional face protection may be required when work operations create airborne particles, chips, or sparks. Eye protection and face protection shall meet the minimum OSHA requirements. .

E. Shoes: When required, every worker on the Project shall wear shoes that have soles with a resistance to punctures, leather or leather equivalent uppers that cover the entire foot and ankle and offer resistance to scrapes and cuts. Sandals, open-toed shoes, dress loafers, high-heels, fabric shoes and all athletic style shoes (including those with ANSI markings) are prohibited.

F. When required, exterior toe and metatarsal cover shall be used when activities involve impact exposures to the feet (ie; jackhammering, water blasting, concrete demolition etc), unless the shoe has this protection built into the footwear.

G. Clothing: When required, sleeve length shall cover the ball of the shoulder. Shirts shall not have noticeable holes, be long enough to be tucked into pants and be free of profanity, objectionable, or obscene messages. Pants shall be full length and without excessive holes.

H. Hearing Protection: When required, employees shall be provided with hearing protection against the effects of noise exposures from machines, equipment or surrounding operations generating sound levels that exceed OSHA hearing protection requirements. Employees required to use hearing protection shall be tested and trained in the use and limitations of such protection.

I. Hand Protection: When required, employees handling materials or equipment with potential hand injury hazards shall be provided with appropriate hand protection.

J. Harnesses, Lifelines, and Lanyards: When required, employees working in areas where there is an exposure to falls of heights greater than six (6) feet, regardless of work activities (i.e. steel erection, leading edge work, scaffold use, and brick masonry) shall be protected by measures that are equal to or better than fall restraint/arrest systems.

K. Respiratory Protection: When required, employees shall be provided with respirators when it is necessary to protect them from inhalation of toxic or harmful gases, vapors, mists, fumes, and dust.

L. When required, employees required to use respiratory protective equipment shall be medically qualified and thoroughly trained in the use and limitations of such equipment. Employer must demonstrate compliance with OSHA 29 CFR 1910.134.

M. Other PPE: When required, employees working in areas where there is a possible danger to other parts of the body not listed above shall be protected by the appropriate PPE for that body part.

3.27 ROOF WORK

A. All roof work must be approved by the Administrative Facilities Campus Operations (AFCO) - Chief Engineer at the campus you are working at prior to project start.

B. All roof access to T. Boone Pickens Tower must be approved prior to access. This area contains multiple radio transmitters and receivers that emit harmful radio and microwaves. All personnel accessing this area must have attended the required training. Contact the building owner for training requirements.

C. Contractor is responsible for ensuring that they are able to immediately contact emergency forces during an emergency event by providing cell phones, radios, or access to working phones within MD Anderson facilities. Contractor shall ensure personnel working on the jobsite know the address of the building.

D. Any roof repairs that are performed around fresh air intakes shall be scheduled with Facilities Operations Group (713-563-9977) prior to any planned work. Contractor is required to provide fume control devices when performing roof repair, replacement, or installation to prevent odors from being transmitted inside the facility.

E. Some areas of roofs may be restricted due to potentially hazardous exhaust from laboratories or processes. Contractor must obtain approval from their MD Anderson Representative before proceeding with entering any roof areas.

F. Contractors are required to comply with all applicable OSHA Fall Protection requirements.

G. Contact Facilities Operations Group Campus Operations (713-563-9977or 713-563-1143) regarding proper davit use and tie-off areas.

H. All roof work involving heated materials or open flames must have a valid hot work permit.

I. The Contractor shall have a 20 pound ABC Fire Extinguisher on the roof and immediately available for use. Institutional fire extinguishers will not be loaned. Additional extinguishers must be provided as needed.

J. All fire extinguishers must have current annual certification tags and in working order.

K. All open flames must be continuously supervised.

L. A 1-hour fire watch must be provided after any heated materials or open flames have been used during roof work. Fire watch personnel must perform a “touch test” to determine any residual hot spots. A laser thermometer is recommended. Fire watches could be up to two hours in duration.

M. All propane bottles must be removed from the premises daily. Do not store propane cylinders in mechanical or roof spaces.

N. All roofing materials shall be secured at the end of each workday to prevent disruption by wind and rain.

3.28 SANITATION AND HOUSEKEEPING

A. Contractors and Subcontractors are responsible for ensuring that Project sites are effectively cleaned.

B. "Effectively Cleaned" shall address all of the following issues:

1. Place all construction waste, trash, and debris in a designated receptacle. Glass bottles shall not be permitted in the Project site. Trash must be removed on a daily basis as to prevent accumulation and attraction for pests. Contractor must have an approved method for removing trash from the jobsite (i.e., dumpsters, trucks, etc.) before starting work.

2. Eating is not allowed on the jobsite. Limited amounts of soft drinks and water will be allowed but must be removed on a daily basis as to prevent attraction of insects or rodents.

3. Contractor may only use PUBLIC restroom facilities assigned by their MD Anderson Representative. Contractors may not use staff restrooms.

4. Any waste, trash, and/or debris created by the Contractor shall be cleaned (ie; sweeping, vacuuming, dust mopping, large debris removal etc.) at the end of the day to prevent accumulation of dirt and combustibles on the jobsite.

5. Contractors are NOT allowed to use sinks or drains to clean materials or paint brushes.

6. All holes and penetrations to the outside of the building must be sealed with an appropriate material as to prevent water, insects and rodents from entering the building.

7. All windows must remain closed unless permission is granted by Environmental Health and Safety. All windows or penetrations used for ventilation purposes shall be protected from water, insect/rodent, and dust intrusion by use of protective covers and screen wire materials.

8. Stack (or restack) all whole and scrap materials in locations that do not obstruct a clear pathway nor create a risk for toppling onto a person passing by the area.

9. Place all hoses, cords, cables, and wires in locations that prevent them from damage and do not create tripping hazards.

10. Restore all signs, barricades, fire extinguishers, guardrails, gates, etc. to proper locations and condition.

11. Properly store and secure all flammable and combustible liquids and gases in proper containment or flammable storage cabinets.

12. Collect and place all cut-off or waste pieces of rolling stock, as they are created, into waste or scrap containers. No rolling stock shall be permitted to fall and remain in the work area.

13. Used shot strips from powder-actuated tools shall be properly maintained and disposed of in accordance with manufacturer's recommendations.

14. All puncture and impalement exposures shall be covered or eliminated as soon as they are created. Exposed ends of rebar are to be covered with material that is designed to prevent impalement of a 250-pound body from a fall of four (4) feet.

15. All work surfaces shall be maintained in level and smooth condition as to prevent rolling carts from catching and possibly falling over while in transit. Appropriate temporary fill materials shall be installed as warranted.

16. All wheeled equipment shall have non-marking wheels or tape shall be used over wheels when moving through non-project areas to prevent marking and damage to floor surfaces. Tape should be removed if adequate traction is required to perform a task. Tape can be removed once in job-site area.

17. Contractors shall only use their trash dumpsters or dumpsters designated by their MD Anderson Representative.

3.29 SITE POSTINGS

A. Contractor shall securely post the required warning signs (as required by the Owner and OSHA) for the Project area(s).

B. All signs must be approved by your MD Anderson Representative. Consult your MD Anderson representative regarding facility specific informational signs.

1. Signs that warn of impending danger (i.e., CONSTRUCTION AREA – DO NOT ENTER)

2. Signs that communicate the level of personal protective equipment that is required (i.e., HARD HATS AND SAFETY GLASSES REQUIRED)

3. All necessary permits (i.e., Hot Work Permits, Indoor Air Quality Permit, ILSM and/or other State/Local Regulatory Agency Permits as required by law).

C. These postings must consist of the required color, size, and character size lettering and/or symbols as required by OSHA and/or Sate/Local regulations.

D. Signs must be made from a sturdy material that resists tearing and fading. Laminated signs are acceptable for indoor postings.

E. All exterior Projects must contain the above noted required postings in all locations that warrant these warning signs and postings.

F. A single location such as a plywood Project board is acceptable for posting required permits and project information signage. Any required permits should be protected from the elements by covering them in a laminate or waterproof material.

G. Contractor shall install and maintain any additional signs, barricades, warning devices, and traffic warnings.

3.30 SCAFFOLDING

A. All scaffold systems (any temporary elevated platform (supported or suspended) and its supporting structure (including its point of anchorage), used for supporting employees or materials or both) - shall follow the manufacturer instructions and adhere to all applicable OSHA requirements per each type of scaffolding device.

B. Contractor shall be required to receive permission from MD Anderson Facility – Administrative Facilities and Campus Operations before erecting any suspension or stationary scaffolding system on roofs or attaching lines to roof davits. Consult with the MD Anderson Representative for approval before beginning any work.

C. All ground-supported scaffolds shall bear a safety tag that indicates the safety status of the scaffold. The Contractor shall designate a universal Project system for tagging scaffolding that is to be used by any or all personnel.

D. Training and documentation shall be required for all workers on the Project who will erect, maintain, dismantle, or use the scaffolding. A designated competent person must ensure scaffold use requirements are maintained and inspected at the beginning of each work shift as per OSHA requirements. Contractor shall maintain documentation to support this requirement.

E. Contractor will ensure proper fall protection for employees is required and followed per OSHA requirements when using scaffolding and aerial lift.

F. Mudsills and surrounding areas at the base of ground-supported scaffolds shall be maintained in a well-dressed and level condition. Scaffold feet shall be installed on all legs and the maximum number of diagonal braces shall be included in every scaffold section.

G. Every work level shall be fully planked and toe board shall be included along open sides. Overhead protection shall be constructed where walk-through passages are allowed.

H. Brakes shall be secure at all times on rolling scaffolds, except when being moved. Workers shall not be allowed on the platform when the scaffold is being moved.

I. Rolling scaffolds shall not be used on uneven or unstable surfaces. Wheels shall be non-marking or temporarily covered with tape to prevent damage to floor surfaces when being moved through non-project areas.

ATTACHMENTS

"A" - Maintaining Indoor Air Quality During Construction and Maintenance Activities Policy

END OF SECTION 01 35 25

ATTACHMENT "A"
MAINTAINING INDOOR AIR QUALITY DURING CONSTRUCTION AND MAINTENANCE ACTIVITIES POLICY

Volume IV

Book F Environmental Health and Safety

Chapter 4 Construction Safety

Policy Number IV.F.4.02 Last Revised by EH&S: 04/18/07

PURPOSE	The purpose of this policy is to provide guidance for maintaining indoor air quality during activities such as construction, renovation, modernization, and structural repairs - particularly, to prevent Aspergillus and other mold spores from being generated or released into the air. These spores can result in serious complications, and potentially death, for immuno-compromised individuals.	
POLICY STATEMENT	It is the policy of The University of Texas MD Anderson Cancer Center (MD Anderson) to manage all construction, renovation, modernization, and structural repairs in a manner designed to minimize the potential for the spread of infections due to degraded air quality or environmental contamination.	
SCOPE	This policy covers all employees and contractors involved in construction, renovation, modernization, structural repairs and/or repair. This policy applies to all areas of the Institution.	
DEFINITIONS	**Bioaerosols:** Microscopic live particulates such as spores, pollen, bacteria, and viruses. **Construction, Renovation, Modernization, and Structural Repair Activities:** Activities that disturb existing building features, which can cause or create the release of potentially harmful dusts or bioaerosols. **Designee:** Person(s) appropriately trained and able to demonstrate competency in assessing and determining appropriate infection control requirements. **HEPA Filter:** High-Efficiency Particulate Air (HEPA) filter. **Infection Control Risk Assessment (ICRA):** Using a risk assessment tool to determine the minimum level of controls used during a project to control potentially harmful dusts and bioaerosols. **Pre-Construction Risk Assessment (PCRA):** A comprehensive risk assessment tool that must be completed before a project starts. Major areas of review are Infection Control, Interim Life Safety Measures (ILSM), Utility Disruptions, Noise and Vibration.	
RESPONSIBILITY	1.1	It is the responsibility of all MD Anderson personnel, contractors, and vendors to abide by the requirements of this policy to ensure a safe patient care, research, and work environment. Corrective actions shall be taken immediately when deficiencies are discovered.
	1.2.	The Environmental Health and Safety Department (EH&S), Infection Control, or designee may perform periodic inspections of the work site to monitor compliance with this policy.

EXCEPTIONS	2.1	Any exception to this established policy is at the discretion of the Institutional Safety Committee. Procedural exceptions may be granted through Environmental Health and Safety or Infection Control (IC).
PERFORMANCE REQUIREMENTS	3.1	Activities that disturb existing building features, possibly causing or creating the release of potentially harmful dusts or bioaerosols, must be conducted in accordance with the required precautions listed in the implementation section of this policy.
	3.2	Prior to commencing Construction, Renovation, Modernization, and Structural Repair Activities, a Pre-Construction Risk Assessment (PCRA) must be obtained from the Environmental Health and Safety department or designee.
	3.3.	Project management shall provide personnel and equipment at all times while working on site for the purpose of containment and clean-up of dust and particulates in and around the work area. Equipment may include dust mops, wet mops, adhesive walk-off ("tacky") mats, buckets, HEPA-filtered vacuums, and clean rags for removing fine dust inside and outside the site and from equipment.
IMPLEMENTATION – (SEE MATRIX)	4.1	Use the infection control risk assessment (ICRA) matrix to determine the appropriate precautions that must be used.
	4.2	See matrix.

REFERENCES:

Joint Commission for Accreditation of Health Care Organizations, Environment of Care Standard EC.8.30

AIA, Guidelines for Design and Construction of Hospital and Health Care Facilities

Centers for Disease Control and Prevention, Guidelines for Environmental Infection Control in Health Care Facilities.

Approved by (Name):	Title:	Date:
Joseph Savala	Associate Vice President, Facilities Administration	04/18/2007
Matthew Berkheiser	Director, Environmental Health and Safety	04/18/2007
Jim Mathis	Program Director, Safety	04/18/2007
Bryan Galloy	Program Manager, Safety	04/18/2007

ATTACHMENT "A"
MAINTAINING INDOOR AIR QUALITY DURING CONSTRUCTION AND MAINTENANCE ACTIVITIES POLICY

INFECTION CONTROL RISK ASSESSMENT

Instructions on how to determine the appropriate indoor air quality measures for your project/activity	
Step 1	Determine the Risk Area using the Risk Areas Defined table (TABLE A)
Step 2	Determine the Activity Type on the left side of the Matrix table (ie, small, medium, large; TABLE B), then compare the project activity type to the risk area to determine the Class of Indoor Air Quality controls that are to be implemented
Step 3	Then select the appropriate Class of controls to be used on the project (LIST C)

TABLE -A-			
Risk Areas Defined			
RISK AREA 1 LOW RISK	**RISK AREA 2** MEDIUM RISK	**RISK AREA 3** HIGH RISK	
Office areas not adjacent to high risk areas	Cancer Prevention Center	Admissions areas	BMT Patient Unit
Dock and Service Corridors	Place of Wellness	Inpatient units	Operating rooms
Physical Plant spaces	Kitchen(s)	Emergency Center	Sterile Processing
Boiler room		Mays Clinic – (Ambulatory Care Building)	ensive Care units CU, PACU & MICU)
		Cafeteria	Pharmacy
		Laboratory Medicine	Pharmacy mixing areas
		Physical Therapy	Research labs
		Occupational Therapy	Laboratories involved with production of products for patient infusion
		All outpatient clinics	Waiting rooms
		Office areas adjacent to high risk areas	Proton Therapy Center
		Radiation Oncology	
		Sterile animal areas	
		Animal ORs	

Note: The current nature, adjacency to other areas, and use of a space may change the risk group determination and should be reviewed prior to start of planning and work.

ATTACHMENT "A"

MAINTAINING INDOOR AIR QUALITY DURING CONSTRUCTION AND MAINTENANCE ACTIVITIES POLICY

INFECTION CONTROL RISK ASSESSMENT

TABLE -B-			
Matrix			
Project Activity Types:	**RISK AREA I** **Low Risk Areas** *See risk area definition*	**RISK AREA II** **Medium Risk Areas** *See risk area definition*	**RISK AREA III** **High/Extreme Risk Areas** *See risk area definition*
Small/Minor: Inspections above ceiling that create minimal to no dust, minor repair, painting, (no patching), minor electrical work, plumbing, similar work with little or no drilling, cutting, or other dust-raising activity, opening into chases and concealed spaces. Normal maintenance activity.	**Class I Precautions** ☐	**Class I Precautions** ☐	**Class I Precautions** ☐
Medium Scale Projects: Installation of electrical and computer cabling, working in chases and concealed spaces, working above ceiling, replacing finishes, carpet removal, wall covering removal, cutting plaster and drywall, sanding and other dust making activity within a room or other controlled area, opening ceiling tiles (more than 16 square feet consecutive). Usually one to three shifts.	**Class I Precautions** ☐	**Class II Precautions** ☐	**Class III Precautions** ☐
Large/Major Scale Projects: Removing floor coverings, sanding plaster walls, wall demolition and construction, duct work, major ceiling work, major demolition of areas, particularly those open to patient care areas, work on HVAC systems that release dust. Usually more than three days work.	**Class II Precautions** ☐	**Class III Precautions** ☐	**Class III Precautions** ☐

ATTACHMENT "A"
MAINTAINING INDOOR AIR QUALITY DURING CONSTRUCTION AND MAINTENANCE ACTIVITIES POLICY

INFECTION CONTROL RISK ASSESSMENT

LIST -C-
Recommended Infection Control Precautions, by Class

Class I Precautions

Indoor air quality permit posted at jobsite entrance, when required.
Control of Debris: use covered container to remove debris through internal hospital paths. Cover must be dust tight and secured to container, not just laid on top.
Protect patient care areas from activity, or enclose work area (close doors). Replace ceiling tiles promptly.
Minimize dust and dirt, clean or have area cleaned when work is complete and when dust or dirt builds up. Vacuum with HEPA filter type vacuum, and/or damp mop areas when work is complete.
Direct questions about work to Environmental Health and Safety.
Other precautions as assigned.

Class II Precautions

Indoor air quality permit required and posted at jobsite entrance
Protect patient care areas from activity by closing doors, or enclosing area with approved (6 mil minimum) fire retardant polyethylene plastic or equivalent. Replace ceiling tiles prior to removal of enclosures.
Use water spray mist to minimize dust when applicable (ie, cutting sheetrock).
Close off HVAC system openings (exhaust and supply) with plastic or equivalent. If exhaust must be maintained, use a "clean air" machine (HEPA-filter equipped), or powered HEPA filters in exhaust path, or exhaust directly to outside.
Use dust mats or tacky mats at entrances inside site (not to be used in public access hallways because of trip hazard). Wet mops areas during and after construction to remove and control dust and dirt with suitable cleaning agents.
Control of Debris: use covered container to remove debris through internal hospital paths. Cover must be dust tight and secured to container, not just laid on top.
Temporary barriers or containment vestibule— stationary (6 mil fire retardant polyethylene or drywall) or mobile containment (control cube).
Direct questions about work to Environmental Health and Safety.
Debris and supply routing pre-determined through PCRA evaluation.
Other precautions as assigned.

Class II Precautions: At Job Completion

Replace all ceiling tiles, or re-close ceiling.
Wipe down all horizontal surfaces (except floor and ceiling). Wet mop or extract floor with hospital approved disinfectant. If appropriate, vacuum all areas with HEPA filters on vacuum.
Clean the HVAC system diffusers as the enclosure is being removed, and operate system for 24 hours prior to final cleaning of job site.
Maintain all enclosures as practical until post-job cleaning complete. Use vacuum with HEPA filters during removal of barriers, as practical.
Schedule final cleaning of area by MD Anderson Housekeeping.
Other precautions as assigned.

INFECTION CONTROL RISK ASSESSMENT

LIST -C-
Recommended Infection Control Precautions, by Class

Class III Precautions

Indoor air quality permit required and posted at jobsite entrance
Isolate the HVAC systems to minimize a route for dust movement. If exhaust is used to maintain the area negative in pressure to outside areas, the exhaust must go to the outside when possible. If existing exhaust systems are to be used, they must be non-recirculating exhausts. A pressure negative to the air in the patient care units must be maintained during construction activity, when feasible.
Use a "clean air" machine (HEPA-filter equipped), both to re-circulate air in the job site to reduce airborne dust, and to exhaust air from the job site, to maintain a pressure negative to the air outside the job site, so leakage will be into the job site. The same machine may be used for both purposes, if it has suitable capacity.
Provide construction separations that are fire resistive, and dust tight, constructed of sheet rock or limited combustion plywood. Enclose work areas prior to any demolition work or opening any walls or ceilings. If work is being done in public areas, use control unit technology (similar to units developed to remove asbestos in areas that could not be closed down) and "clean air" machines to maintain a pressure in the enclosure negative to the air outside the enclosure, with the exhaust going through a HEPA filter prior to releasing into the air in the patient care area.
Debris must be removed in tightly closed containers, with solid lid, or plastic taped into place. The debris removal containers should be vacuumed or wet-wiped prior to removal from the site, to remove all surface dust and dirt.
Create a construction ante-room where all clothing, tools, equipment, and other materials being removed are vacuumed or wet-wiped prior to being taken off site through the hospital patient care areas. The ante-room should be as clean as a patient care area. Cart wheels should also be cleaned, and run over a tacky mat, or similar method to assure no dust is tracked out via wheels. All persons must walk across the tacky mats to clean their feet. Any person who has dust, dirt, or materials on their clothing must vacuum it prior to leaving the ante-room areas. Tacky mats will be maintained to keep the surface tacky, and to replace or remove layers when they become dirty. The ante-room will be wet mopped frequently (several times a day in usual construction activity), or similar methods will be used to satisfy Environmental Health and Safety or Infection Control staff.
Seal all holes, penetrations, and openings in the construction barriers and walls which are part of the construction separation with appropriate materials. Sealed holes in fire rated separations must be equivalent in fire rating. Other holes must be sealed with tape and plastic, or similar materials which are strong enough to withstand the pressure differential without leakage.
When required, personnel working in the area must either change clothing prior to leaving the job site, or use shoe covers and cover clothing prior to leaving the area.
Direct questions about work to Environmental Health and Safety.
Debris and supply routing predetermined through the PCRA Evaluation.
Containment vestibule – stationary or mobile – (for work outside site).
Other precautions as assigned.

INFECTION CONTROL RISK ASSESSMENT

LIST -C-
Recommended Infection Control Precautions, by Class

Class III Precautions: At Job Completion

Maintain barriers and "clean air" machines (HEPA-filter equipped), in place as much as practical until final cleaning is complete. Removal of barrier materials should be accompanied by vacuuming using a vacuum with HEPA filters.
Clean HVAC system diffusers as closure being removed, and operate system for 24 hours prior to final cleaning of job and removal of barriers (to the extent practical based on the system). If necessary, allow the HVAC to blow into the site with the "clean air" machine catching the output of the supply, and the machine feeding the air to the returns.
Site must be thoroughly cleaned by damp-wiping all horizontal surfaces with a hospital approved disinfectant.
Schedule final cleaning of area by MD Anderson Housekeeping.
Other precautions as assigned.

END OF ATTACHMENT "A"

SECTION 01 45 00 - PROJECT QUALITY CONTROL

PART 1- GENERAL

1.1. RELATED DOCUMENTS

1.1.1. The Contractor's attention is specifically directed, but not limited, to the Uniform General and Supplementary General Conditions for University of Texas System Building Construction Contracts (UGC) for other requirements.

1.2. SUMMARY

1.2.1. This Section provides administrative and procedural requirements for Contractor quality control on the Project.

1.2.2. Specific quality-control requirements for individual construction activities are specified in the Sections that govern those activities. Requirements in those Sections may also cover production of manufactured products.

1.2.3. Specified tests, inspections, and related actions do not limit Contractor's quality-control procedures to fully comply with the Contract Document requirements in all regards.

1.2.4. Provisions of this Section do not limit the requirements for the Contractor to provide quality-control services required by the Contract Documents or the Authority Having Jurisdiction.

1.2.5. The following quality issues are addressed in detail in this Section:

1.2.5.1. (1.3) Quality Control

1.2.5.2. (1.4) Quality Assurance

1.2.5.3. (1.5) Contractor Employed Testing Agency

1.2.5.4. (1.6) Testing

1.2.5.5. (1.7) Inspections

1.2.5.6. (1.8) Preinstallation Meetings

1.2.5.7. (1.9) Mock-ups

1.3. QUALITY CONTROL

1.3.1. Quality Control shall be the sole responsibility of the Contractor, unless specifically noted otherwise. The Contractor shall be responsible for all testing, coordination, start-up, operational checkout, and commissioning of all items of Work included in the Project, unless specifically noted otherwise. All costs for these services shall be included in the Contractor's cost of work.

1.3.2. The Contractor shall assign one employee to be responsible for Quality Control. This individual may have other responsibilities, but may not be the Contractor's Project superintendent or the Contractor's Project manager.

1.4. QUALITY ASSURANCE

1.4.1. The Owner or Owner's designated representative(s) will perform quality assurance. Owner's quality assurance procedures may include observations, inspections, testing, verification,

monitoring and any other procedures deemed necessary by the Owner to verify compliance with the Contract Documents.

1.4.1.1. The Owner's quality assurance testing and inspection program is separate from Owner's commissioning program, as defined in Section 01 91 00 –General Commissioning Requirements.

1.4.2. The Contractor shall cooperate with and provide assistance to the Owner related to Owner's quality assurance procedures. Contractor shall provide to Owner ladders, lifts, scaffolds, lighting, protection, safety equipment and any other devices and/or equipment (including operators if required) deemed necessary by the Owner to access the Work for observation/inspection.

1.4.3. Owner may employ independent testing agencies to perform certain specified testing, as Owner deems necessary. The Contractor shall integrate Owner's independent testing services within the Baseline Project Schedule and with other Project activities.

1.4.4. Owner's employment of an independent testing agency does not relieve the Contractor of the Contractor's obligation to perform the Work in strict accordance with requirements of the Contract Documents.

1.5. TESTING AGENCY

1.5.1. The Contractor shall employ and pay for services of an independent testing agency to perform all specified testing requiring an independent agency, unless specifically noted otherwise.

1.5.2. Contractor's employment of an independent testing agency does not relieve the Contractor of the Contractor's obligation to perform the Work in strict accordance with requirements of the Contract Documents.

1.5.3. The Contractor Employed Testing Agency:

1.5.3.1. The testing agency must have the experience and capability to conduct testing and inspecting indicated by ASTM standards and that specializes in the types of tests and inspections to be performed.

1.5.3.2. The testing agency shall comply with requirements of ASTM E 329, ASTM E 543, ASTM E 548, ASTM C 1021, ASTM C 1077, ASTM C 1093, and other relevant ASTM standards.

1.5.3.3. The testing agency's laboratory must maintain a fulltime engineer on staff to oversee and review the services. The engineer must be licensed in the State of Texas.

1.5.3.4. The testing agency must calibrate all testing equipment at reasonable intervals (minimum yearly) with accuracy traceable to either National Bureau of Standards or accepted values of natural physical constants.

1.5.4. The Contractor shall not employ the same testing entity engaged by the Owner for the Project, without the Owner's written approval.

1.6. TESTING

1.6.1. Where specific testing is specified in a technical section of the Specifications or indicated in the Contract Documents, the Contractor shall bear all costs of such tests unless the Owner has expressly agreed in writing to pay for the tests.

1.6.2. Testing specifically identified to be conducted by Owner, will be performed by an independent entity and will be arranged and paid for by the Owner unless otherwise indicated in the Contract Documents. Should the test return unacceptable results, the Contractor shall bear all costs of retesting and reinspection as well as the cost of all material consumed by testing, and replacement of unsatisfactory material and/or workmanship.

1.6.3. The Owner's Construction Inspector will schedule the Owner's testing services. The Contractor must assist the Owner's Construction Inspector to facilitate timeliness of such testing services.

1.6.4. The Owner may engage additional consultants for testing, air balancing, commissioning, or other special services. The activities of any such Owner consultants are in addition to Contractor testing of materials or systems necessary to prove that performance is in compliance with Contract requirements. The Contractor must cooperate with persons and firms engaged in these activities.

1.6.4.1. The Contractor shall self-perform various tests to verify performance and/or operation of various systems. Test reports that document the tests shall be consecutively numbered and defined by scope and extent of the test. Copies of the test report forms can be obtained from the Owner. The following Owner test report forms are examples of forms that shall be used for this purpose and shall not be altered in any manner:

1.6.4.1.1. Pipe Test Report.

1.6.4.1.2. Duct Test Report.

1.6.4.1.3. Equipment or System Start-up/Request for Inspection.

1.6.4.1.4. Contractor's Request for Utility Shutdown.

1.6.4.1.5. Domestic Water Sterilization and Flushing Report.

1.7. INSPECTIONS

1.7.1. All of the Work is subject to inspection and verification of correct operation prior to 100% payment of the line item(s) pertaining to that aspect of the Work.

1.7.2. The Contractor shall incorporate adequate time for performance of all inspections and correction of noted deficiencies into the Work Progress Schedule for the Project.

1.7.3. During the course of construction, the Owner, Architect/Engineer, and/or other Owner representatives may visit the Site for observation of the Work in place. The Contractor shall provide all necessary personnel and/or equipment for safe access to the Work to be inspected or observed, regardless of frequency. This requirement shall extend to all Owner personnel and their representatives. Some of these inspections will be informal and some will require formal notification by the Contractor.

1.7.4. The Contractor shall provide a system of tracking all field reports, describing items noted, and resolution of each item. The Owner will review this printed report on a monthly basis, or as necessary.

1.7.5. The following are typical Project inspections:

1.7.5.1. <u>Informal Daily Reviews</u> of Project conditions by the Owner's Construction Inspector and/or members of the Project Team. When considered appropriate, results of these reviews will be documented via Observation Reports or Memorandum.

1.7.5.2. Concealed Space Inspections shall be formally scheduled in advance by the Contractor through the Owner's Construction Inspector by submitting written notification at least five (5) calendar days prior to the inspection. Subject areas include partitions, structural walls, chases, crawl spaces, ceiling spaces, and any other Work, which will be difficult or impossible to examine once concealed in the final construction.

1.7.5.2.1. Contractor shall not enclose partitions, structural walls, chases, crawl spaces, ceiling spaces, and any other Work which will be difficult or impossible to examine once concealed in the final construction until Contractor has received written approval from Owner's Construction Inspector.

1.7.5.3. Progress Inspections for piping, ductwork, and other systems shall be scheduled by the Contractor through the Owner's Construction Inspector as appropriate portions, or sections, of the Work are completed. This is in addition to "system-wide" performance verification and tests. The Contractor shall schedule and document the tests using the standard Owner Pipe Test and Duct Test report forms. The Contractor shall conduct the tests and the Owner's Construction Inspector will witness and approve the results.

1.7.5.3.1. The Contractor shall coordinate their intended "apportioning" of systems tests with the Owner's Construction Inspector immediately following formal submission of their Work Progress Schedule so that all parties are aware of the intended Work and inspection sequence.

1.7.5.4. Overhead and Above Ceiling Inspections are similar in nature and requirements to the Concealed Space Inspections. Ceilings that are fixed in place, such as gypsum board or plaster, constitute a Concealed Space Inspection. Ceilings that are of "lay-in" type or where no finish ceiling is scheduled are considered an "overhead" inspection. Contractor shall include Overhead and Above Ceiling Inspections on the Work Progress Schedule. Contractor shall provide written inspection request notice to the Owner's Construction Inspector and Architect/Engineer at least five (5) calendar days in advance.

1.7.5.4.1. No finish ceiling material shall be installed until all overhead punchlist items have been resolved to the satisfaction of the Owner.

1.7.5.4.2. Completed Work in place necessary for an Overhead Inspection shall include all required infrastructure and appurtenances, inclusive of, but not limited to the following.

1.7.5.4.2.1. Installation of ceiling grid or framework.

1.7.5.4.2.2. Installation and operation of all above ceiling electrical Work, including light fixtures.

1.7.5.4.2.3. Installation of all HVAC and plumbing Work above ceiling with installation and connection of terminal units and air devices.

1.7.5.4.2.4. Installation of fire sprinkler heads.

1.7.5.4.2.5. Completion and Owner approval of all required tests for above ceiling Work.

1.7.5.5. Inspections of Building Systems and Equipment are intended to confirm acceptable operation. Contractor shall formally schedule inspections through the Owner's Construction Inspector and Architect/Engineer utilizing Owner's Inspection Request Form. Refer to Section 01 91 00 –General Commissioning Requirements and to

Technical Specifications for additional requirements pertaining to system start-up, commissioning, operation, demonstration, and acceptance.

1.7.6. The Contractor shall perform a thorough checkout of operations with the manufacturer's representatives prior to requesting the formal inspection by the Owner. Contractor must notify the Owner's Construction Inspector, in advance, as to when the manufacturer's representative is scheduled to arrive at the Site.

1.7.7. Inspection and documented approval of individual equipment and/or system(s) must be accomplished prior to requesting Substantial Completion Inspection for any area affected by said equipment and/or system.

1.7.8. For "building-wide" and/or life safety systems, such as emergency lighting, emergency power, uninterruptible power supply systems, fire alarm, fire sprinkler systems, smoke evacuation systems, toxic gas monitoring, captured exhaust systems, etc., the formal start-up inspection shall be completed prior to requesting Substantial Completion Inspection for any area of the Project.

1.7.8.1. The manufacturer's representatives and the installing contractor shall demonstrate both operation and compliance to the Owner's agents and consultants. If coordinated and scheduled appropriately by the Contractor, these equipment and/or systems inspections may also serve to provide the required Owner training, if approved in advance by the Owner.

1.7.8.2. The Contractor is responsible for requesting that the Owner's Construction Inspector and Architect/Engineer arrange for the inspection of materials, equipment, and Work prior to assembly or enclosure that would make the materials, equipment, or Work inaccessible for inspection and at other times as may be required.

1.7.9. For any requested inspection, the Contractor shall complete prior inspections to ensure that items are ready for inspection and acceptance by the Owner and/or Architect/Engineer. The Contractor shall be responsible for any and all costs incurred by Owner and/or Owner representatives, including consultants, resulting from a review or inspection that was scheduled prematurely.

1.7.10. The Contractor shall coordinate the Work and schedule the inspections in advance so as not to delay the Work. All major inspections shall be indicated on the Work Progress Schedule for advance planning. Contractor shall allow a minimum of five (5) calendar days to confirm schedule of requested inspections with Owner and Owner's representatives.

1.8. PREINSTALLATION MEETINGS

1.8.1. The Contractor shall coordinate and conduct meetings to review the installation of major systems/equipment on the Project. As a minimum, Contractor shall schedule and conduct the Preinstallation Meeting(s) for the Work of each major building system. The Preinstallation Meeting(s) shall be convened following approval of system submittals and prior to commencement of system installation Work.

1.8.2. The purpose of the Preinstallation Meeting(s) is for the Contractor and all applicable subcontractors and/or suppliers and/or factory representatives to discuss all aspects of the installation of the particular system. Contractor shall direct special attention to the scheduled order of Work and any impact on or by any other building systems. Contractor shall develop a strategy acceptable to the Owner for start-up, inspection and acceptance, based on Contractor's Prefunctional Checklists, so that all parties are aware of what is expected and/or acceptable.

1.8.3. The Contractor shall ensure attendance of the installing subcontractor, manufacturer and/or supplier (if appropriate), supporting subcontractors involved in the installation, and any other parties involved in the phase of Work to be reviewed. Contractor shall notify the Owner and Architect/Engineer in writing at least five (5) calendar days in advance of the Preinstallation Meeting(s).

1.8.4. Each party shall be prepared to discuss in detail the staging, installation procedure, quality control, testing/inspection, safety and any other pertinent items relating to the Work being reviewed. Submittal approval shall be a prerequisite of the Preinstallation Meeting(s). At this meeting(s), Contractor shall review and discuss the Commissioning Plan, test procedures, scheduling, and logistics. Contractor shall bring the following to the Preinstallation Meeting(s), as a minimum, for review and discussion:

1.8.4.1. Portion of the Initial Equipment List/Matrix applicable to the system under discussion.

1.8.4.2. Draft of the Prefunctional Checklists.

1.8.4.3. Current work schedule data pertaining to the beginning, start-up, inspection, and turnover phases anticipated for the particular system.

1.8.4.4. Copy of all approved submittals for the system.

1.8.5. The Contractor shall take minutes of the Preinstallation Meeting(s) and distribute to all attending parties.

1.8.6. Whether required in the Technical Specifications or not, a Preinstallation Meeting(s) shall be conducted for the following Work, if included in the Project:

1.8.6.1. Concrete.

1.8.6.2. Masonry.

1.8.6.3. Large Steel Fabrications.

1.8.6.4. Waterproofing.

1.8.6.5. Roofing.

1.8.6.6. Exterior Glazing (including storefront and curtain wall).

1.8.6.7. Door Hardware.

1.8.6.8. Audio / Visual Equipment.

1.8.6.9. Air Handling Units.

1.8.6.10. Medical Gas Systems.

1.8.6.11. All Other Mechanical and Electrical Systems.

1.9. MOCK-UPS

1.9.1. Before installing portions of the Work requiring mock-ups, Contractor shall build mock-ups for each form of construction and finish required, using materials indicated for the completed Work.

1.9.2. Build mock-ups in location and of size indicated or, if not indicated, as directed by Architect/Engineer. The mock-up may be work in place that is intended to remain, unless otherwise directed by the Owner.

1.9.3. Notify Architect/Engineer and Owner five (5) calendar days in advance of dates, times, and locations of when and where mock-ups will be constructed.

1.9.4. Demonstrate the proposed range of aesthetic effects and workmanship. Demonstrate anticipated repairs in the mock-up, such as for stone veneer.

1.9.5. Obtain Architect/Engineer's and Owner's approval of mock-ups before starting work, fabrication, or construction.

1.9.6. Maintain mock-ups during construction in an undisturbed condition as a standard for judging the completed Work.

1.9.7. Demolish and remove mock-ups when directed by Owner, unless otherwise indicated.

1.9.8. As a minimum, Contractor shall prepare a mock-up for the following Work, if applicable to the Project. Owner may define additional mock-ups at the Pre-bid or Preconstruction Meeting.

1.9.8.1. Exterior wall system to include: substructure, masonry/stone veneer, plaster, architectural concrete and windows.

1.9.8.2. Roof system.

1.9.8.3. Interior laboratory room; utilities serving laboratory casework.

1.9.8.4. Interior patient care and prevention room.

1.9.8.5. Interior wall finishes.

1.9.8.6. Ceramic tile.

1.9.8.7. Finished flooring.

1.9.8.8. Plumbing battery for multiple-use toilet rooms.

1.9.8.9. Medical gas headwalls.

PART 2- PRODUCTS (NOT USED)

PART 3- EXECUTION (NOT USED)

END OF SECTION 01 45 00

SECTION 01 77 00 - PROJECT CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

1.1.1. The Contractor's attention is specifically directed, but not limited, to the Uniform General and Supplementary General Conditions for University of Texas System Building Construction Contracts (UGC) for other requirements.

1.2. SUMMARY

1.2.1. The following Project closeout procedures are addressed in this Section:

1.2.1.1. (1.4) General Description of Closeout Requirements

1.2.1.2. (1.5) Requirements for Substantial Completion

1.2.1.3. (1.6) Provisions for Release of Retainage

1.2.1.4. (1.7) Requirements for Final Acceptance

1.2.1.5. (1.8) Required Project Record Documents

1.2.1.6. (3.1 & 3.2) Project Cleaning

1.3. DEFINITIONS

1.3.1. The term “Project Closeout” is hereby defined to include requirements near the end of the Contract Time, in preparation for Substantial Completion acceptance, occupancy by Owner, release of retainage, final acceptance, final payment, and similar actions evidencing completion of the Work. Specific additional requirements for individual units of work are specified in the Technical Specifications.

1.3.2. The term “Time” of closeout is directly related to completion and acceptance, and therefore may be either a single time period for the entire Project, or a series of time periods for individual portions or phases of the Project that have been certified as substantially complete at different dates.

1.4. GENERAL DESCRIPTION OF CLOSEOUT REQUIREMENTS

1.4.1. This Section is based on completion and acceptance of the entire Project during a single time period.

1.4.1.1. If the Project is to be accepted in phases, whether by originally specified Project scope or by subsequent agreement between the parties, then Project Closeout requirements shall pertain to each separately accepted portion or phase of the Project; unless by written notice the Owner allows for these requirements to be done singularly upon anticipated acceptance of the final phase.

1.4.2. RECORD DOCUMENTS for Project Closeout include, but are not necessarily limited to the following documents, which are required at Substantial Completion:

1.4.2.1. As-Built Record Drawings.

1.4.2.2. As-Built Record Specifications.

1.4.2.3. Operating and Maintenance Manuals.

1.4.2.4. Record Approved Submittals and Samples.

1.4.2.5. Certification of No Asbestos Products Incorporated in Project.

1.4.2.6. Completed Punch Lists.

1.4.3. REQUIRED DOCUMENTS for final payment to be released include final versions of all of the above and the following:

1.4.3.1. Final Release of Claims & Liens.

1.4.3.2. Affidavit of payment of Debt and Claims.

1.4.3.3. Consent(s) of Surety.

1.4.3.4. Completed SWPPP documents and Notice of Termination.

1.4.3.5. Final Historically Underutilized Business Plan.

1.4.3.6. Completed Commissioning and Closeout Manual.

1.5. REQUIREMENTS FOR SUBSTANTIAL COMPLETION

1.5.1. Prior to requesting Architect/Engineer and Owner to schedule a Substantial Completion inspection (for either the entire Work or portions thereof as agreed to by the Owner and Contractor), Contractor shall complete the following and list known exceptions in the request.

1.5.1.1. For the progress payment request coincident with the period of time anticipated for Substantial Completion, Contractor's payment request should reflect a minimum of 95% completion for all applicable Work.

1.5.1.2. Contractor must submit to Architect/Engineer and Owner a complete copy of the Contractor's most current punch list covering the portion(s) of the Project claimed as substantially complete.

1.5.1.2.1. Such punch list shall indicate dates of Contractor re-checks and schedule for completion of work items remaining.

1.5.1.2.2. All items remaining outstanding on the Contractor's punch list shall include a projected date of completion and/or correction with an explanation of why such item is not presently completed.

1.5.1.3. Contractor must submit to Architect/Engineer and Owner for review the full set of marked-up as-built record drawings and marked-up as-built record specifications as described later in this Section.

1.5.1.4. Contractor must submit to Architect/Engineer and Owner for review the preliminary copies of Owner's Operating and Maintenance Manuals as described later in this Section.

1.5.1.5. Contractor must provide access to Contractor’s copy of the Commissioning and Closeout Manual for review by Owner and Architect/Engineer. The Commissioning and Closeout Manual must be up-to-date before the Contractor requests the Substantial Completion inspection.

1.5.1.6. Contractor must submit the certification statement that no asbestos containing materials have been used or incorporated into the Project. Contractor must use Owner's sample letter format.

1.5.1.7. Contractor must obtain and submit releases enabling Owner's full and unrestricted use of the Project and access to services and utilities, including (where applicable) operating certificates, and similar releases.

1.5.1.8. Contractor must deliver tools, spare parts, extra stocks of materials, and similar physical items to Owner.

1.5.2. If Owner intends to occupy Project upon Substantial Completion acceptance, Contractor shall make provisions for final changeover of locks with the Owner's personnel. Upon written directive from Owner and for the convenience of the Contractor in completing punch list activity, Owner may waive the final changeover of locks until final acceptance.

1.5.3. Contractor must complete instructing and training Owner's personnel for all systems and equipment serving the areas claimed as substantially complete, for which Owner training was not completed in association with system demonstrations and inspections. Refer also to Section 01 91 00 – General Commissioning Requirements.

1.5.4. Contractor must complete the initial clean up requirements as described later in this Section for the entire portion of the Project claimed as substantially complete. Contractor must touch up and otherwise repair and restore marred exposed finishes.

1.5.5. SUBSTANTIAL COMPLETION INSPECTION PROCEDURE

1.5.5.1. Refer to the UGC and Section 01 45 00 – Project Quality Control.

1.5.5.2. The Contractor shall ensure the Work is ready for inspection and/or reinspection. If the Work is found not to be as stated in the Contractor's punchlist or the items have not been substantially corrected/completed, the inspection will be terminated. All costs incurred by the Owner and Architect/Engineer for scheduling and attending the terminated inspection(s) shall be the responsibility of the Contractor and excluded from the Cost of Work.

1.6. PROVISIONS FOR RELEASE OF RETAINAGE

1.6.1. Refer to the UGC.

1.6.2. Release of any retainage, or reduction in amount of retainage withheld, is strictly at the discretion of the Owner, regardless of Contractor compliance with requirements. <u>All of the requirements noted for Substantial Completion acceptance must be completed prior to application for final release of Contract retainage</u>. In addition, Contractor shall meet the following requirements:

1.6.2.1. Contractor must submit affidavits of final release of claim and lien from each subcontractor and supplier who provided materials and/or labor to the Project.

1.6.2.2. Contractor must submit affidavit that all bills for the Project have been paid, or will be paid within thirty (30) calendar days of Contractor's receipt of payment.

1.6.2.3. Contractor must submit Consent of Surety to Release of Retainage.

1.7. REQUIREMENTS FOR FINAL ACCEPTANCE

1.7.1. Prior to requesting Architect/Engineer and Owner to schedule Final Inspection for the Project, Contractor shall complete the following:

1.7.1.1. Contractor must submit a draft payment request showing 100% completion for each line item on the Schedule of Values. Contractor must submit with this draft the final releases and supporting documentation not previously submitted and accepted. Contractor must include Certificates of Insurance when applicable. The Final Payment, including final release of retainage, will not be released until all Work (including punch list items) has been completed, all requirements met, a Project closeout audit performed (if deemed necessary) and a Final Change Order has been processed if required to resolve final cost or closeout audit issues, including deletion of any remaining Contract allowances.

1.7.1.2. Contractor must submit a copy of Architect/Engineer's Substantial Completion punch list including evidence that each item has been completed or otherwise resolved.

1.7.1.3. Contractor must submit final meter readings for utilities, and similar data as of time of Substantial Completion or when Owner took possession of and responsibility for corresponding elements of the Work.

1.7.1.4. Contractor must submit final record as-built drawings and specifications and two (2) copies of all approved submittals and Operating and Maintenance Manuals as described later in this Section. This includes specific warranties, maintenance agreements, product certifications and similar documents. The Architect/Engineer and Owner must approve record closeout documentation in writing prior to issuance of final payment.

1.7.1.5. Contractor must transmit the completed Commissioning and Closeout Manual to the Owner. The Commissioning and Closeout Manual shall be complete, acknowledging receipt of all attic stock, spare parts, training/demonstration, test reports and any other requirements of the Contract Documents.

1.7.1.6. Contractor must complete final cleaning requirements including touch-up of marred surfaces.

1.7.1.7. Contractor must submit the final payment request including the following documentation:

1.7.1.7.1. Release of Liens and Claims.

1.7.1.7.2. Affidavit of payment of Debts and Claims.

1.7.1.7.3. Consent of Surety.

1.7.1.7.4. Completed SWPPP documents and Notice of Termination.

1.7.1.7.5. Final Historically Underutilized Business Plan.

1.7.1.7.6. Completed and signed Notice of Termination.

1.7.1.8. Contractor must revise and submit evidence of final and continuing insurance coverage complying with applicable insurance requirements.

1.7.2. FINAL ACCEPTANCE INSPECTION PROCEDURE

1.7.2.1. When the Contractor has completed the Work required in the Substantial Completion punch list and has complied with the close-out requirements in this Section and elsewhere in the Contract Documents, then the Contractor must provide written notice to the Architect/Engineer and Owner that the Project is ready for Final Inspection. Refer to the UGC for additional requirements.

1.7.2.2. All Owner and Architect/Engineer costs for travel and time for additional inspections at either Substantial Completion or Final Acceptance which are required either by failure of the Contractor to complete the noted punch list items, or by erroneous notices that the Work is ready for such inspections, shall be the responsibility of the Contractor. Owner may issue a unilateral deductive Change Order for these costs.

1.8. REQUIRED PROJECT RECORD DOCUMENTS

1.8.1. AS-BUILT RECORD DOCUMENTS

1.8.1.1. Contractor may not use record documents for construction purposes. Contractor must protect record documents from deterioration and loss in a secure location. Contractor must provide access to record documents for Owner and/or Architect/Engineer's reference or review during normal working hours.

1.8.1.2. Contractor must furnish as-built record drawings made from the Architect/Engineer's Contract Drawings, or subsequent updates thereof, annotated as noted below with actual as-built conditions.

1.8.1.2.1. As-built drawing information must be professionally drafted.

1.8.1.2.2. As-built drawings must show all changes in the Work relative to the original Contract Documents; and must show additional information of value to Owner's records but not indicated in the original Contract Documents.

1.8.1.3. As-built record documents must include marked-up copies of Contract Drawings and Specifications, including newly prepared drawings if applicable or necessary to achieve the Owner’s intended result, and shop drawings including all changed conditions issued through addenda and/or change orders.

1.8.1.3.1. Contractor must include marked-up product data submittals, field records for variable and concealed conditions such as excavations and foundations, and miscellaneous record information on Work that was schematically recorded only schematically or not recorded at all.

1.8.1.4. Certain individual sections of the Technical Specifications indicate specific requirements, which may clarify requirements of this Section. When a conflict may be perceived to exist, the more restrictive (i.e.: more expensive) requirement will prevail. There is no intent, however, to require more sets of as-built drawings than is indicated herein.

1.8.1.5. The Contractor shall bear all costs associated with obtaining the Architect/Engineer's original Contract Documents, and subsequent updated plots thereof, drafting as-built information, reproduction, or other related work.

1.8.1.5.1. Contractor shall ensure that all as-built changes are of good drafting quality, performed by a person skilled in drafting and knowledgeable of the conventions of the trades involved.

1.8.1.5.2. Contractor may utilize Contractor's staff or seek outside assistance, including the Architect/Engineer, for this drafting work provided the contractual requirements pertaining to quality, format, and content are met.

1.8.1.6. MAINTENANCE OF AS-BUILT DRAWINGS DURING CONSTRUCTION

1.8.1.6.1. During progress of the Work, Contractor shall maintain a blueline set of Contract Drawings along with the specifications and the shop drawings in the construction office. Contractor must update these drawings weekly, at a minimum, with mark-ups of actual installations that vary from the work as originally shown. Contractor shall include all drawings issued as addenda, clarifications, and/or change orders.

1.8.1.6.1.1. Contractor must mark-up whatever drawing is most compatible for showing actual physical condition, fully and accurately and must reference all other appearances of this work to the updated sheet. Contractor must include cross-references to the official change number on the updated sheet and all additional sheets where the work is shown.

1.8.1.6.1.2. Contractor must mark-up with erasable colored pencil in a legible and professional manner, using separate colors where feasible to distinguish between changes for different categories of work at the same general location.

1.8.1.6.1.3. Contractor must mark-up important additional information, which was either shown schematically only or omitted from the original drawings. Contractor must give particular attention to information on concealed work that would be difficult to identify or measure and record at a later date.

1.8.1.6.1.4. Contractor must record alternative numbers, change order numbers and similar identification for any change.

1.8.1.6.1.5. Contractor must require each person preparing mark-ups to initial and date the mark-ups and indicate the name of their firm.

1.8.1.6.2. The Contractor shall maintain and have available for review in conjunction with the regular Project Progress Meetings, a current set of the marked-up as-built blueline drawings and specifications marked with "as-constructed" information. Availability for review and acceptability of both the format and the content, is a prerequisite condition for certification of the monthly pay requests by the Owner and Architect/Engineer.

1.8.2. SUPPLEMENTAL DRAWINGS

1.8.2.1. The use of shop drawings as supplements to the As-Built Record Drawings is required for all items in which the larger scale employed on the shop drawings is needed to show the work in sufficient detail for Owner's future use. When marked-up shop drawings are included in the As-Built Record documents, Contractor must mark-up and cross-reference on the Contract Drawings at the corresponding location.

1.8.2.1.1. Use of such shop drawings is particularly applicable to ductwork and electrical shop drawing layouts. Use of shop drawing supplements is acceptable provided the following conditions are met:

1.8.2.1.1.1. The applicable supplemental sheet must be placed in the set directly behind the Contract Drawing, which it supplements, with appropriate reference notes on both the applicable Contract Drawing and all other affected drawings.

1.8.2.1.1.2. Contractor must retain a copy for inclusion with the record product submittals.

1.8.2.1.1.3. The supplemental document must be identified as a "Supplementary Record As-Built Drawing" and must be numbered with an extension to the Contract Drawing it supplements in a manner acceptable to the Owner.

1.8.3. PREPARATION OF FINAL AS-BUILT RECORD DRAWINGS

1.8.3.1. In association with Contractor's request for Substantial Completion inspection, Contractor must submit the marked-up site copy of the as-built drawings to the Architect/Engineer and Owner for review.

1.8.3.1.1. Following the Architect/Engineer's review of the marked-up as-built drawings and supplemental drawings, and upon the Architect/Engineer's acceptance that the marked-up information is accurate and complete, the Contractor shall proceed with preparation of a full set of professionally drafted As-Built Record Drawings in electronic format made from Architect/Engineer's Contract Drawing files.

1.8.3.1.2. Contractor shall submit final as-built record drawings to Owner in Owner's designated version of AutoCAD.

1.8.3.2. All drawings shall bear the official Project name and number. Further, each drawing, including supplemental drawings, shall also bear a stamp to the effect of "Record As-Built" along with the Contractor's certification that such is an accurate reflection of actual as-built conditions. Contractor shall sign and date each certification in a format that is acceptable to the Owner.

1.8.3.2.1. All drawings shall be the same size as the original Contract Documents.

1.8.3.2.2. Once the final As-Built Record Drawings are complete, the Contractor shall transmit them to the Owner within sixty (60) calendar days after Final Completion.

1.8.3.2.3. Contractor shall ensure that all drawings issued as addenda, clarifications and/or change orders are incorporated into the as-built record drawing set and fully shown on the applicable Contract Drawing. If supplemental sheets are used, Contractor must follow the requirements outlined above for supplemental shop drawing sheets.

1.8.4. AS-BUILT RECORD SPECIFICATIONS

1.8.4.1. During progress of the Work, Contractor must maintain and update one record copy of specifications at the jobsite, including addenda, change orders and similar modifications issued during construction, indicating all significant variations between the actual Work and the text of original specifications.

1.8.4.1.1. Contractor must give particular attention to substitutions, selection of options, and similar information on work where the exact products used are not clearly identified or readily discernable in the original specifications. When applicable, Contractor must cross-reference related record drawing information and product data.

1.8.4.1.2. It is not necessary to re-type an entire section if modified, but it is mandatory that all changes to specified materials, installation, warranty, etc. be clearly and fully marked within the applicable specification section in a manner acceptable to the Architect/Engineer and the Owner. Contractor should review with the Owner and document an acceptable procedure early in the construction phase.

1.8.4.1.3. Contractor must neatly transcribe and post all as-built marked-up information to a "clean" copy of the Project Specifications, ensuring that similar types of information are annotated in like fashion throughout the Project Specifications.

1.8.4.2. In association with Contractor's request for Substantial Completion inspection, Contractor must submit the marked-up site copy of the specifications to the Architect/Engineer and Owner for review.

1.8.4.3. Once the marked-up specifications are found acceptable by the Architect/Engineer, based on the Architect/Engineer's belief that the marked-up information is accurate and complete, the Architect/Engineer will proceed with preparation of As-Built Record Specifications.

1.8.4.3.1. The Architect/Engineer will prepare the As-Built Record Specifications based upon the Contractor's mark-up specifications using Owner's designated version of Microsoft Word with changes tracked in red-lined format.

1.8.4.4. After the Architect/Engineer has completed the As-Built Record Specifications, the Architect/Engineer will submit both the marked-up site copy of the specifications and the As-Built Record Specifications to the Owner in both electronic (doc and pdf) and paper format.

1.8.5. OPERATING AND MAINTENANCE MANUALS

1.8.5.1. Contractor shall organize maintenance-and-operating manual information into suitable sets of manageable size, and bind into individual binders properly tabbed and indexed. Contractor shall provide equipment data electronically in a spreadsheet or database format provided by Owner.

1.8.5.2. Within thirty (30) calendar days of the Notice to Proceed with Construction, Contractor shall submit to Owner the proposed format, content and tab structure for all Operating and Maintenance Manuals for the Owner's review and approval. The tab structure for Operating and Maintenance Manuals shall follow specification division format as accepted by the Construction Specification Institute. After the Owner approves the proposed format, content, and tab structure for the Operating and Maintenance Manuals, Contractor shall create and deliver to Owner tabbed binders within twenty-one (21) calendar days. Contractor shall transmit to Owner the content of the Operating and Maintenance Manuals in a timely manner as the Work progresses.

1.8.5.3. Contractor shall make revisions and corrections to format and content as reasonably requested by Owner. Contractor shall submit to Owner each individual

Operating and Maintenance Manual document within fifteen (15) calendar days of the document's availability to facilitate inspections and testing by Contractor and Owner.

1.8.5.3.1. Operating and Maintenance Manual documents must include, but are not limited to, approved submittals, manufacturer's operating and maintenance instructions, brochures, shop drawings, performance curves and data sheets annotated to indicate equipment actually furnished (e.g. identifying impeller size, model, horsepower, etc), procedures, wiring and control diagrams, records of factory and field tests and device/controller settings and calibration, program lists or data compact discs, maintenance and warranty terms and contact information, spare parts listings, inspection procedures, emergency instructions, and other Operating and Maintenance documentation that may be useful to Owner.

1.8.5.3.2. The material and equipment data required by this Section must include all data necessary for the proper installation, removal, normal operation, emergency operation, startup, shutdown, maintenance, cleaning, adjustment, calibration, lubrication, assembly, disassembly, repair, inspection, trouble-shooting, and warranty service of the equipment or materials.

1.8.5.4. Contractor must bind the Operating and Maintenance Manual documents in heavy-duty, 3-ring vinyl-covered binders including pocket folders for folded sheet information. Contractor must mark binder identification on both the front and spine of each binder.

1.8.5.4.1. Contractor must submit the Operating and Maintenance documents on bindable 8-1/2" x 11" sheets or on sheets that are bindable and foldable multiples of 8-1/2" x 11". The bindable edge shall be the left 11" edge.

1.8.5.4.2. Contractor may request waivers to the size requirement for specific instances. Contractor's waiver request must be in writing to the Architect/Engineer and Owner. Contractor's waiver request must include a justification for seeking the waiver.

1.8.5.5. Contractor must provide two (2) complete paper copies of each bound Operating and Maintenance Manual to the Owner.

1.8.5.6. Contractor must provide an electronic version of the complete and final Operating and Maintenance Manuals to Owner in original electronic file format on compact disc or DVD. Contractor must also provide one electronic pdf file of each bound Operating and Maintenance Manual that represents each Manual's content. The electronic pdf file must match the Operating and Maintenance Manual content and organizational structure.

1.8.5.7. The requirements of this Section are separate, distinct and <u>in addition</u> to product submittal requirements that may be established by other Sections of the Specifications. Owner's manuals, manufacturer's printed instructions, parts lists, and other submittals required by other Sections of the Specifications may be included in the Operating and Maintenance Manuals provided that they are approved and are formatted in a manner consistent with the requirements of this Section.

1.8.5.7.1. Test data and Commissioning data included in the Operating and Maintenance Manuals need not be duplicated in the Commissioning and

Closeout Manual and vice versa. Test data not pertaining to a particular device or piece of equipment (such as domestic water pipe pressure test reports) must be inserted in the Commissioning and Closeout Manual.

1.8.5.8. Equipment is defined as any mechanism, mechanical, electrical or electronic device, or any combination thereof, which is made up of two (2) or more working parts to perform a particular function.

1.8.5.9. When an item of equipment is a packaged unit furnished by one manufacturer and the package as furnished contains proprietary items of equipment obtained from other sources, Contractor must include copies of equipment data for each item of such equipment as if each item of equipment had been separately furnished.

1.8.5.10. For general guidance only, the following are examples of equipment, material, and systems for which operating and maintenance data is required:

Architectural	**Mechanical**	**Electrical**
Doors and Windows	Piping, Valves, and Fittings	Cable, Wire, and Connectors, 600 volt
Overhead Coiling Doors and Grilles	Motors	Wiring Devices
Automatic Door Openers	Fire Protection Systems	Motor Control Centers
Door Hardware	Plumbing Equipment	Distribution Panelboards
Finish Materials	Plumbing Specialties	Branch Circuit Panelboards
Loading Dock Equipment	Liquid Nitrogen System	Electronic Grade Panelboards
Laboratory Casework and Furnishings	Gas Systems	Packaged Electric Generating Plant
Fume Hoods	Fuel Oil Systems	Automatic Transfer Switches
Access Flooring	Reverse Osmosis System	Standby Power Generator Switchgear
Environmental Rooms	Hydronic Specialties	Switchboards
Biological Safety Cabinets	Steam and Steam Condensate Specialties	Switchgear
Sterilizers, Washers and Dryers	HVAC Pumps	Power Factor Correction Capacitors
Audio-Visual Equipment	Chemical Treatment Systems	Transformers
Window Treatment	Chillers	Busway – 600 Volt and Below
Radiation Protection	Boilers	Surge Protective Devices
Conveying Systems	DX Air-Conditioning Systems	Lighting Fixtures
Irrigation Systems	Heat Exchangers	Lighting Control Systems
	Humidifiers	Fire Alarm System
	Terminal Heat Transfer Units	Power Status and Monitoring System
	Modular Air Handling Units	Paging System
	Custom Air Handling Units	Security System
	Fans	
	Filters	
	Ductwork	
	Air Terminal Units	

Architectural	Mechanical	Electrical
	Air Outlets and Inlets	
	Variable Speed Drives	
	Building Automation System	

1.8.5.11. The UGC requires that a preliminary copy of all Operating and Maintenance Manuals, in addition to as-built record documents, be furnished prior to the Substantial Completion inspection. The Contractor shall accumulate and package the documentation and submit the preliminary copy to the Architect/Engineer for review.

1.8.5.12. The Contractor's submission of a preliminary copy of all Operating and Maintenance Manuals to the Architect/Engineer for review is a precondition for scheduling of a Substantial Completion inspection. The Contractor's final submission of these Operating and Maintenance Manuals in an acceptable format (based on review of preliminary copies by the Architect/Engineer) is a precondition for scheduling of a Final Acceptance inspection, release of remaining contract retainage, and application for Final Payment.

1.8.5.13. Equipment Data to be Included in Operating and Maintenance Manuals

1.8.5.13.1. Description of Equipment. Refer also to the equipment list requirements of Section 01 91 00 – General Commissioning Requirements. Contractor shall prepare a form for each item of equipment on 8-1/2" x 11" paper using the Owner's format or using a format approved by the Owner. Contractor must include the description of the equipment and following additional information in the Operating and Maintenance Manuals.

1.8.5.13.1.1. A complete description of each equipment item in the following order: basic descriptive terminology first, followed by modifying words describing the model, size and weight, flow rate, amperage, voltage, material, etc., as applicable, plan designation, if any, and package serial number.

1.8.5.13.1.2. Part Number. Manufacturer's and supplier's part number.

1.8.5.13.1.3. Quantity. Total quantity of this equipment item installed under this Contract.

1.8.5.13.1.4. Specification Paragraph Reference. State the specification section, paragraph, and page number under which the item of equipment was procured.

1.8.5.13.1.5. Source. Manufacturer's name and address and supplier's name and address.

1.8.5.13.1.6. Serial Number. Complete manufacturer's serial number(s) or other identity symbol(s) as applicable.

1.8.5.13.1.7. Location. State the name of the system and/or sub-system in which each like item of equipment is installed and state the physical location of each like item of equipment by identifying the columnar grid intersections, as shown on the Drawings,

near which the item is located and also state the room or space title as applicable. The location of item must correspond to Owner's wayfinding codes listing in Owner's space management database, consisting of building identification code (or color zone), floor level, and room number.

1.8.5.13.2. Parts Lists. Contractor must clearly identify every part in the item of equipment with the proper manufacturer's name, part nomenclature and number, local source, and list price.

1.8.5.13.3. Recommended Spare Parts. Contractor must furnish a list of recommended spare parts for each equipment item that Owner will likely need within a 12-month period to support and operate that item of equipment. The quantities of spare parts recommended must be based upon the quantity of like equipment items installed under the Contract Documents. Contractor must prepare the recommended spare parts list for each equipment item on 8-1/2" x 11" paper and must include the following information for each part in columns.

1.8.5.13.3.1. Part Description. Complete descriptive nomenclature plus manufacturer's complete model and part number, and list price cost for each part.

1.8.5.13.3.2. Quantity Per Assembly. Quantity of listed part that occurs in the item of equipment.

1.8.5.13.3.3. Quantity of Equipment Items. Quantity of like equipment items installed under this Contract.

1.8.5.13.3.4. Shelf Life. Storage life of part, in months, if the part has limited life.

1.8.5.13.3.5. Recommended Quantity. Quantity of parts that Owner will need to support the installed quantity of equipment in which the part appears for a period of twelve (12) months.

1.8.5.13.3.6. Source for Part. Name, address, website address, and phone number of the nearest supplier for the part.

1.8.5.13.4. Contractor's Purchase Order. Contractor must furnish a copy of Contractor's purchase order for the equipment. The furnished copy need only show the quantity ordered, part number, equipment description and name and address of the vendor who supplied the item

1.8.5.13.5. Normal Operating Instructions. Contractor must furnish normal operating instructions with sufficient detailed information to permit a journeyman mechanic to adjust, start-up, operate and shut down the equipment. Special start-up precautions must be noted as well as other action items required before the equipment is put into service.

1.8.5.13.6. Emergency Operating Procedures. Contractor must furnish a detailed description of the sequence of action to be taken in the event of a malfunction of the unit, either to permit a short period of continued operation or emergency shutdown to prevent further damage to the unit and to the system in which it is installed.

1.8.5.13.7. Preventive Maintenance. Contractor must furnish detailed information to cover routine and special inspection requirements, including but not limited to, field adjustments, inspections for wear, adjustment changes, packing wear, lubrication points, frequency and specific lubrication type required, cleaning of the unit and type solvent to use, and such other measures as are applicable to preventive maintenance program.

1.8.5.13.8. Calibration. Contractor must furnish detailed data on what to calibrate, how to calibrate, when to calibrate and procedures to enable checking the equipment for reliability or indications as well as data for test equipment, special tools and the location of test points.

1.8.5.13.9. Scale and Corrosion Control. Contractor must furnish detailed information covering the prevention of and removal of scale and corrosion.

1.8.5.13.10. Trouble Shooting Procedures. Contractor must furnish detailed information and procedures for detecting and isolating malfunctions and detailed information concerning probable causes and applicable remedies.

1.8.5.13.11. Removal and Installation Instructions. Contractor must furnish detailed information concerning the logical sequence of steps required to remove and install the item including instructions for the use of special tools and equipment.

1.8.5.13.12. Disassembly and Assembly Instructions. Contractor must furnish detailed illustrations and text to show the logical procedure and provide the instructions necessary to disassemble and assemble the unit properly. The text shall include all checks and special precautions as well as the use of special tools and equipment required to perform the assembly or disassembly.

1.8.5.13.13. Repair Instructions. Contractor must furnish detailed repair procedures to bring the equipment up to the required operating standard including instruction for examining equipment and parts for needed repairs and adjustments, and tests or inspections required to determine whether old parts may be reused or must be replaced.

1.8.5.13.14. System Drawings. Contractor must furnish detailed drawings, where applicable, that clearly show wiring diagrams, utility service diagrams, control diagrams, system schematics, pneumatic and fluid flow diagrams, etc., which pertain to the unit function. System drawings must show major pieces of equipment, such as chillers, boilers, heat exchangers, pumps, air handlers, tanks, switchgear, etc., as meaningful to the Project. Fluid flow and direction and valves with their valve tag identification numbers must be clearly noted on drawings. Drawings must show modifications to another manufacturer's standard unit when it is incorporated into the assembly or package unit.

1.8.5.13.14.1. System diagrams must be provided on multiples of 8-1/2" x 11" format, folded to fit within the Operating and Maintenance Manuals. The outer (exposed) face of the folded drawing must include identification of the system and the specification section that governs its installation and operation.

1.8.5.13.14.2. The requirements of this paragraph are separate, distinct, and in addition to similar requirements that may be established by other Sections. Where such system diagrams are required for submittal by other specification sections, the same diagrams will be acceptable for inclusion herein, so long as the diagrams used were approved during the submittal phase and are reproduced for clarity and to fit the size format of the Operating and Maintenance Manuals.

1.8.5.13.14.3. The Contractor must provide diagrammatic drawings for each installed system that indicate placement of the system in relation to the building, and the physical location of each item or equipment installed within the system. Each installed item of equipment shown on the drawing must be identified by the equipment item model and/or serial/part number.

1.8.5.13.14.4. System drawings may, for purpose of clarity, be prepared upon a major subsystem basis.

1.8.5.13.14.5. The drawings may be prepared upon several drawings having referenced match lines.

1.8.5.13.15. Special Tools and Test Equipment: Contractor must furnish a detailed list of the special tools and test equipment needed to perform repair and maintenance for each equipment item. The list must contain the special tool and test equipment part number, size, quantity, price, manufacturer's name and address, and local supplier's name and address.

1.8.5.13.16. Warranties and Guarantees: Contractor must bind, within the tabbed section for each system, equipment item, or material, an executed copy of the specified warranty/guarantee with warranty effective dates covering that particular system, equipment item, or material.

1.8.5.13.16.1. Contractor must include both the manufacturer's warranty as specified and the installing contractor's guarantee for workmanship and system operation.

1.8.5.13.16.2. This copy of the particular warranty/guarantee is in addition to original signature copies of all Project warranties and guarantees bound together separately. Contractor shall transmit this binder to the Owner when complete.

1.8.5.13.16.3. Contractor must provide in a separate tabbed section of the Operating and Maintenance Manuals a grouping of all Project warranties and guarantees as required by various specification sections and other conditions of the Contract. Contractor must include all specific warranties on manufactured items and installed systems as noted above, in addition to Contractor's Project warranty and applicable guarantees from all subcontractors and suppliers covering defects in workmanship or manufacture.

1.8.5.13.16.4. As clarification, it is intended that the Contractor provide the Owner with a separate binder containing all original Project warranties and guarantees. Contractor must also provide a copy of the appropriate warranty in the same section as the equipment (or system) data furnished in individual tabbed

sections of the Operating and Maintenance Manuals for convenient reference.

1.8.5.13.17. Training of Owner Personnel: Contractor must furnish documentation of Owner's personnel training regarding operation of particular systems within the tabbed section for that particular system. Contractor must include identification of parties receiving training and date(s) of such training.

1.8.6. RECORD PRODUCT SUBMITTALS

1.8.6.1. During progress of the Work, Contractor must maintain approved copies of each product data submittal and shop drawing. Contactor must mark up significant variations in the actual Work in comparison with submitted information. Contractor must include both variations in product as delivered to the Site and variations from manufacturer's instructions and recommendations for installation.

1.8.6.1.1. Contractor must maintain during the course of the Project, a separate binder with one copy of all MSDS sheets for any and all products incorporated into the Project. Contractor must include this binder in the record submittal documents.

1.8.6.2. Contractor must give particular attention to concealed products and portions of the Work that are not clearly identified in the original submittal or cannot otherwise be readily discerned at a later date by direct observation. Contractor must cross reference to change orders and mark-up of record drawings and specifications.

1.8.6.3. Upon completion of as-built revisions, Contractor must submit two (2) complete sets of all approved submittals to Architect/Engineer for review and subsequent transmittal to Owner. Contractor must organize and group files in sturdy file boxes with tabbed dividers for each separate specification division. Contractor must include a complete table of contents. In addition, Contractor must submit all Record Product Submittals to Owner in its original electronic file format on compact disc or DVD. Contractor may scan material into electronic file format when necessary.

1.8.6.4. These record submittal requirements are in addition to inclusion of similar material as supplementary as-built drawings or technical data for the Operating and Maintenance Manuals.

1.8.7. RECORD SAMPLE SUBMITTAL

1.8.7.1. Immediately prior to date(s) of Substantial Completion, Contractor must arrange for Architect/Engineer and Owner's representative to meet with Contractor at the Site to determine which (if any) of the submitted samples or mock-ups maintained by Contractor during progress of the Work are to be transmitted to Owner for record purposes.

1.8.7.2. Contractor must comply with Architect/Engineer's and/or Owner’s instructions for packaging, identification marking, and delivery to Owner's designated location at the Site or other location as directed by Owner.

1.8.7.3. Contractor must dispose of other samples in the manner specified for disposal of surplus and waste materials, unless otherwise indicated or directed by Architect/Engineer and/or Owner.

1.8.8. COMMISSIONING AND CLOSEOUT MANUAL

1.8.8.1. The Contractor shall incorporate all Commissioning and closeout documentation and/or verification documents not included in the Operating and Maintenance Manuals, into a separate Commissioning and Closeout Manual for transmittal to the Owner at the conclusion of the Project. The Commissioning and Closeout Manual is intended to be a consolidation of documentation/verification for the Project commissioning and closeout process. By updating the Commissioning and Closeout Manual throughout the Project, the documentation process can be expedited and monitored.

1.8.8.2. The Commissioning and Closeout Manual shall include, but is not limited to, the following.

1.8.8.2.1. Commissioning documentation as described in Section 01 91 00 General Commissioning Requirements.

1.8.8.2.2. Closeout Documentation Matrix. A spreadsheet listing of system/equipment documentation that Contractor must submit to Owner as required by the Technical Specification requirements and containing columns for submittal dates, approval (if required) dates, and Owner's signature or initials for acknowledgement. The Closeout Documentation Matrix is subject to Owner's approval.

1.8.8.2.3. Paint/Finish Schedule.

1.8.8.2.3.1. Contractor must include a schedule of all paints, flooring, finishes, etc. used on the Project.

1.8.8.2.3.2. Contractor must provide manufacturer, model number, color formula, location on Project, purchase source and any other information helpful to the Owner's maintenance personnel.

1.8.8.2.4. Spare Parts, Attic Stock and Keys Checklists.

1.8.8.2.5. Elevator Checklist.

1.8.8.2.6. Electrical Test Reports (including factory tests and settings).

1.8.8.2.7. Miscellaneous Equipment Test Reports (including factory tests and settings).

1.8.8.2.8. HVAC Calibration Reports (including duct testing reports).

1.8.8.2.9. Fire Alarm Test Reports.

1.8.8.2.10. Piping Test Reports.

1.8.8.2.11. Sewer Video Log.

1.8.8.2.12. Demonstration / Training Reports.

1.8.8.2.13. Millwright's Alignment Report: Contractor must include a report of the coupled mechanical equipment after the equipment has been set and installed.

1.8.8.2.14. Code-required Certifications as described within Technical Specifications.

1.8.8.2.15. Miscellaneous Record Documents. Contractor must provide categories of requirements resulting in miscellaneous work records including, but not be limited to, the following.

1.8.8.2.15.1. Required field records on excavations, foundations, underground construction, wells and similar work.

1.8.8.2.15.2. Accurate survey showing locations and elevations of underground lines, including invert elevations of drainage piping.

1.8.8.2.15.3. Surveys establishing lines and levels of building.

1.8.8.2.15.4. Plant treatment records (wood, soil, etc).

1.8.8.2.15.5. Certifications received in lieu of labels on products and similar record documentation.

1.8.8.2.15.6. Batch mixing and bulk delivery records.

1.8.8.2.15.7. Testing and qualification of tradesmen.

1.8.8.2.15.8. Documented qualification of installation firms.

1.8.8.2.15.9. Load/performance testing.

1.8.8.2.15.10. Final inspection and deficiency corrections.

1.8.8.3. The Owner may provide a preliminary handbook with sample forms and matrix for use by the Contractor in development of the Commissioning and Closeout Manual. Each Project may require the Contractor to revise and/or create forms for Project specific equipment. The Contractor must review each form for approval with the Owner before using the Contractor's form.

1.8.8.4. The Contractor shall maintain and provide two (2) copies of the Commissioning and Closeout Manual. Contractor shall transmit one copy to the Owner's Construction Inspector for use during the Project. The Contractor shall keep the other copy and shall update both copies as the Work progresses. The Owner's Construction Inspector will initial the Closeout Documentation Matrix to acknowledge receipt of various documentation, spare parts, attic stock, etc.

1.8.8.4.1. Contractor must insert the accumulated documentation into the Commissioning and Closeout Manual in tabbed formatting according to the table of contents for each Project.

1.8.8.4.2. Contractor must bind the documentation in heavy-duty 3-ring vinyl-covered binders including pocket folders for folded sheet information. Contractor must mark identification on both the front and spine of each binder.

1.8.8.4.3. Contractor must provide an electronic version of the completed Commissioning and Closeout Manual to Owner in original electronic file format on compact disc or DVD. In addition, Contractor must provide one electronic pdf file for each bound Commissioning and Closeout Manual that includes each Manual's content. Contractor must organize data to match the Commissioning and Closeout Manual tab structure.

1.8.8.5. The Contractor shall prepare the initial Closeout Documentation Matrix early in the Project to ensure tracking of this process throughout the Project.

1.8.8.6. The Commissioning and Closeout Manual is not intended to impose duplication of closeout documentation. Those items and/or data that are incorporated into the Operating and Maintenance Manuals need not be included in the Commissioning and Closeout Manual.

1.8.9. Equipment and system submittals as required elsewhere in the Contract Documents.

PART 2- PRODUCTS (NOT USED)

PART 3- EXECUTION

3.1. PROJECT CLEANING AT SUBSTANTIAL COMPLETION

3.1.1. The Contractor must maintain the Project and the Site in a clean and orderly condition throughout the course of construction. In addition to continuous Project cleaning, the following requirements are related to Project closeout.

3.1.2. Special cleaning for specific units of Work may also be specified in other Sections of Project Specifications.

3.1.3. Contractor must perform an initial cleaning of the Work consisting of cleaning each surface or unit of Work to normal "clean" condition expected for a first-class building cleaning and maintenance program.

3.1.4. Contractor must comply with manufacturer's instructions for cleaning of all system components, equipment, and materials incorporated into the Project.

3.1.5. Contractor must perform the following "initial" final cleaning immediately prior to the time the Contractor requests Substantial Completion inspection.

3.1.5.1. Contractor must remove labels that are not required as permanent labels.

3.1.5.2. Contractor must clean exposed hard-surfaced finishes, including glass, metals, stone, concrete, painted surfaces, plastics, tile, wood, special coatings, and similar surfaces, to a dirt-free condition, free of dust, stains, films and similar noticeable distracting substances. Contractor must restore reflective surfaces to original condition.

3.1.5.3. Contractor must remove debris and surface dust from limited-access spaces including plenums, shafts, and similar spaces.

3.1.5.4. Contractor must clean concrete floors in non-occupied spaces, wet-mop and broom clean.

3.1.5.5. Contractor must clean fixtures of all dust and debris. Contractor must replace lamps in accordance with Technical Specifications after final Project cleaning.

3.1.5.6. Contractor must remove crates, cartons and other flammable waste materials or trash from the Site. Contractor must provide Owner with a finished Project that is free of concealed garbage, trash and rodent infestation. If concealed garbage, trash and rodent infestation are revealed, or odors from them occur, Contractor shall remove and correct at the Contractor's expense. Contractor must restore property to its original condition where no improvements are shown.

3.1.5.7. Contractor must clean leave free from rubbish, loose plaster, mortar drippings, extraneous construction materials, dirt and dust spaces which are generally unfurnished such as elevator shafts, electrical closets, pipe and duct shafts, chases, furred spaces, and similar spaces.

3.1.5.8. Contractor must remove rubbish by way of chutes, taken down on hoists, or lowered in receptacles. Contractor shall not remove rubbish or waste by dropping or throwing from one level to another within or outside the building(s).

3.1.5.9. Contractor must ensure that Contractor does not mark, soil or otherwise deface finished surfaces. If Contractor marks, soils, or otherwise defaces finished surfaces, Contractor shall bear all costs for cleaning and restoring such surfaces to their originally intended condition.

3.2. PROJECT CLEANING AT FINAL ACCEPTANCE

3.2.1. The following "final" cleaning is to be accomplished immediately prior to the time the Contractor requests Final Acceptance inspection:

3.2.1.1. Contractor must clean transparent materials, including mirrors and window/door glass, to a polished condition, removing substances that are noticeable as vision-obscuring materials.

3.2.1.2. Contractor must turn the work over in immaculate condition inside and outside including the premises.

3.2.1.3. Contractor must clean all work on the premises including walks, drives, curbs, paving, fences, grounds and walls. Contractor must provide a clean shine on slick surfaces. Contractor must removal of smudges, marks, stains, fingerprints, soil, dirt, paint, dust, lint, labels, discolorations and other foreign materials.

3.2.1.4. Contractor must clean all finished surfaces on interior and exterior of Project (again) including floors, walls, ceilings, windows, glass, doors, fixtures, hardware and equipment. Contractor must final wax and polish all natural finish metal on interior or exterior surfaces. Contractor must clean and apply finish (including wax) to all floors as recommended by the manufacturer.

3.2.1.5. In addition to the cleaning specified above and the more specific cleaning required in various Sections of the Specifications, Contractor must prepare the building(s) for occupancy by a thorough cleaning throughout, including washing (or cleaning by approved methods) surfaces on which dirt or dust has collected, and by washing glass on both sides. Contractor must wash exterior glass using a window-cleaning contractor specializing in such work.

3.2.1.6. Contractor must remove temporary buildings and structures, fences, scaffolding, surplus materials and rubbish of every kind from the site of the work. Contractor must repair these areas to be compatible with the surrounding construction finished condition.

END OF SECTION 01 77 00

SECTION 01 91 00 –GENERAL COMMISSIONING REQUIREMENTS

PART 1 – GENERAL

1.1. RELATED DOCUMENTS

1.1.1. The Contractor's attention is specifically directed, but not limited to, the Uniform General and Supplementary General Conditions for University of Texas System Building Construction Contracts (UGC) for other requirements.

1.1.2. Specifications throughout all Divisions of the Project Manual, which pertain to operable and non-operable equipment and/or building systems, are directly applicable to this Section, and this Section is directly applicable to them.

1.2. SUMMARY

1.2.1. This Section establishes general and administrative requirements pertaining to commissioning of equipment, devices, and building systems installed on renovation and new construction projects delivered under various contracting methodologies. Technical requirements for commissioning of particular systems and components are established in the Contract Documents.

1.2.2. It is of primary concern that all operable systems installed in the Project perform in accordance with the Contract Documents and the specified Owner's operational needs. During Commissioning, the Contractor systematically demonstrates to the Owner that the operable systems are properly performing in strict accordance with the Contract Documents.

1.2.3. Commissioning requires cooperation and involvement of all parties throughout the construction process. The Contractor shall deliver a successful Commissioning process. Successful Commissioning requires that installation of all building systems complies with Contract Document requirements and that full operational check-out and necessary adjustments are performed prior to Substantial Completion, with the exception of deferred tests approved in advance by Owner.

1.2.4. Commissioning will encompass and coordinate traditionally separate functions of system documentation, installation checkout, Prefunctional Checklists and start-up, control system calibration and point-to-point checkout, testing, adjusting, and balancing, Functional Performance Tests, and Integrated System Tests, Contractor demonstration to the Owner, and training of Owner. Commissioning is intended to achieve the following specific objectives of the Contract Documents.

1.2.4.1. Verify and document proper installation and intended performance of equipment, systems, and integrated systems.

1.2.4.2. Ensure that operating and maintenance and Commissioning documentation requirements are complete.

1.2.4.3. Provide Owner with functional buildings and systems that meet the Contract Document requirements at Substantial Completion.

1.3. DEFINITIONS

1.3.1. Building Automation System: System and components associated with the Building Automation System.

1.3.2. Commissioning: A systematic process confirming that building systems have been installed, properly started, and consistently operated in strict accordance with the Contract Documents,

that all systems are complete and functioning in accordance with the Contract Documents at Substantial Completion, and that Contractor has provided Owner adequate system documentation and training. Commissioning includes deferred and/or seasonal tests as approved by Owner.

1.3.3. Commissioning Consultant: Owner or Owner's consultant who performs technical reviews of Contract Documents, observes completion of construction, verifies equipment and system start-up by Contractor or Subcontractor, observes Prefunctional Checklists and Functional Performance Tests of systems, and Integrated System tests for compliance with the Contract Documents, tracks deficiencies, and recommends solutions. Commissioning Consultant does not have authority to alter design or installation procedures without the written approval of Owner.

1.3.4. Commissioning Plan: Document prepared by Contractor and approved by Owner that provides the structure, schedule, and coordination plan for the Commissioning process from the construction phase through the warranty period. The Commissioning Plan must satisfy the Owner's Test Requirements.

1.3.5. Commissioning Team: Working group made up of representative(s) from the Architect/Engineer, Contractor, Test, Adjust, and Balance Firm, Building Automation System vendor, specialty manufacturers and suppliers, and Owner. Contractor will provide ad-hoc representation of subcontractors on the Commissioning Team as required for implementation of the Commissioning Plan.

1.3.6. Datalogging: Monitoring flows, current, status, pressures, etc. of equipment using stand-alone dataloggers or the Building Automation System as acceptable to Owner.

1.3.7. Deferred Tests: Functional Performance or Integrated System Tests performed after Substantial Completion due to partial occupancy, partial equipment acceptance, seasonal requirements, design, or other Site conditions that prohibit the test from being performed prior to Substantial Completion.

1.3.8. Deficiency: Condition of a component, piece of equipment, or system that is not in compliance with the Contract Documents.

1.3.9. Factory Testing: Testing of equipment at the factory, by factory personnel with an Owner's representative present, if deemed necessary by Owner.

1.3.10. Functional Performance Test: Test of dynamic function and operation of equipment and systems executed by Contractor. Systems are tested under various modes, such as during low cooling or heating loads, high loads, component failures, unoccupied, varying outside air temperatures, life safety conditions, power failure, etc. Systems are run through all specified sequences of operation. Components are verified to be responding in accordance with Contract Documents. Functional Performance Tests are executed after start-ups and Prefunctional Checklists are complete.

1.3.11. Functional Performance Test Procedures: Commissioning protocols and detailed test procedures and instructions in tabular and script-type format that fully describe system configuration and steps required to determine if the system is performing and functioning properly. Contractor prepares these procedures to document Functional Performance Tests.

1.3.12. Integrated System Test: Test of dynamic function and operation of multiple systems. Integrated System Tests are tested under various modes, such as fire alarm and emergency situations, life safety conditions, power failure, etc. Systems are integrally operated through all specified sequences of operation. Components are verified to be responding in accordance with Contract Documents. Integrated System Tests are executed after Functional Performance Tests are complete and prior to Substantial Completion. Integrated

System Tests provide verification that the integrated systems will properly function according to the Contract Documents.

1.3.13. Integrated System Test Procedures: Commissioning protocols and detailed test procedures and instructions in tabular and script-type format that fully describe system configurations and steps required to determine if the interacting systems are performing and functioning properly. Contractor prepares these procedures to document Integrated System Tests.

1.3.14. Indirect Indicators: Indicators of a response or condition without direct physical linkage, such as a reading on a control system display reporting a damper to be 100 percent closed.

1.3.15. Manual Test: Use of hand-held instruments, immediate control system readouts or direct observation to verify performance (contrasted to analyzing trend data to make the "observation").

1.3.16. Overwritten Value: Writing over a sensor value in control system to see response of a system (e.g., changing outside air temperature value from 52°F to 72°F to verify economizer operation). See also "Simulated Signal".

1.3.17. Prefunctional Checklist: A list of static inspections and material or component tests that verify proper installation of equipment (e.g., belt tension, oil levels, labels affixed, gages in place, sensors calibrated, etc.). The word Prefunctional refers to before Functional tests. Prefunctional Checklists must include the manufacturer's start-up checklist(s). Contractor shall sign Prefunctional Checklists as complete and submit with the Request for Start-Up/Functional Performance Test Form.

1.3.18. Simulated Condition: Condition created to test component(s) and system(s) responses. (e.g., applying heat to space temperature sensor to monitor response of a terminal unit).

1.3.19. Simulated Signal: Disconnecting a sensor and using a signal generator to send voltage, amperage, resistance or pressure to transducer and/or direct digital control system to simulate a value to the Building Automation System to test the system and component response.

1.3.20. Start-up: The activities where equipment is initially energized, tested and operated. Start-up is completed prior to Functional Performance Tests.

1.3.21. Test, Adjust, and Balance Firm: The Owner may engage a Test, Adjust, and Balance Firm directly. Test, Adjust, and Balance responsibilities are contained in Technical Specifications and in the Test, Adjust, and Balance Firm's contract.

1.3.22. Test Requirements: Requirements specifying what systems, modes and functions, etc. must be tested. Test requirements are not detailed test procedures. Test requirements and acceptance criteria are specified in the Contract Documents.

1.3.23. Trending: Data collection of monitoring points using the Building Automation System or dataloggers.

1.4. COORDINATION

1.4.1. Commissioning Team:

1.4.1.1. Members appointed by Owner:

1.4.1.1.1. Owner's Project Manager and any other designated representatives of Owner's staff.

1.4.1.1.2. Commissioning Consultant (if hired by Owner).

1.4.1.1.3. Architect/Engineer.

1.4.1.1.4. Test, Adjust, and Balance Firm.

1.4.1.2. Members appointed by Contractor:

1.4.1.2.1. Individuals, each having authority to act on behalf of the entity they represent, explicitly organized to implement the Commissioning process through coordinated actions.

1.4.1.2.2. Representatives of Contractor, including but not limited to, Project Manager and Commissioning coordinator, subcontractors, installers, and equipment suppliers. Owner must approve Contractor's Commissioning coordinator.

1.4.2. Scheduling:

1.4.2.1. Contractor shall integrate all Commissioning activities into the Project Schedule. All parties will address scheduling problems and make necessary notifications in a timely manner to expedite the Commissioning process.

1.4.2.2. Contractor shall provide the initial schedule of primary Commissioning activities at the Pre-Commissioning Meeting. Prior to the first Start-up or Prefunctional Checklist test occurring, Contractor shall have incorporated and integrated all Commissioning activities into the Project Schedule with appropriately linked predecessors and successors.

1.5. ROLES AND RESPONSIBILITIES

1.5.1. Roles and responsibilities of Commissioning Team members are provided in this Section to clarify the Commissioning process.

1.5.2. Owner's Role and Responsibilities:

1.5.2.1. Review Architect/Engineer's Technical Specifications containing Commissioning requirements.

1.5.2.2. Provide Owner's Test Requirements to Contractor.

1.5.2.3. Approve Contractor's Commissioning Plan and Contractor's schedule of Commissioning activities.

1.5.2.4. Assign Owner's representatives and schedule them to participate in Commissioning activities, including the following:

1.5.2.4.1. Commissioning Team meetings.

1.5.2.4.2. Review and approve Commissioning Plan, Prefunctional Checklists, Functional Performance Test Procedures, Functional Performance Tests, Integrated System Test Procedures, Integrated System Tests, Deferred Tests, Trending, and other Commissioning documents.

1.5.2.4.3. Attend Contractor's training sessions in operation and maintenance of systems and equipment.

1.5.2.4.4. Observe Contractor's demonstration of system and equipment operation.

1.5.3. Architect/Engineer's Role and Responsibilities:

1.5.3.1. Specify control sequences of operation within the Contract Documents.

1.5.3.2. Attend Commissioning Team meetings.

1.5.3.3. Review Commissioning Plan, Prefunctional Checklist, Functional Performance Test Procedures, Functional Performance Test, Integrated System Test Procedures, Integrated System Tests, Deferred Tests, Trending, and other Commissioning documents.

1.5.3.4. Review Commissioning training plan.

1.5.3.5. Review Test, Adjust, and Balance plan.

1.5.3.6. Coordinate resolution of Deficiencies and approve technical requirements for correction of deficiencies identified during Commissioning, Deferred Tests, and during the warranty period.

1.5.3.7. Review Operating and Maintenance Manuals.

1.5.4 Contractor's Role and Responsibilities:

1.5.4.1 Produce for Owner's approval the Commissioning Plan, Prefunctional Checklist, Functional Performance Test Procedures, Integrated System Test Procedures, Request for Start-Up/Functional Performance Test Form, Equipment List/Matrix of all devices, systems and equipment supplied, and other Commissioning documents. Contractor must incorporate Owner's Test Requirements within the Commissioning Plan.

1.5.4.2 As the Project progresses, add specific checklists, test procedures, schedules, recorded results, action lists, signoff sheets and other documents for the Commissioning and Closeout Manual. Administer updates to the Commissioning and Closeout Manual with the intent that all Commissioning Team members will have up-to-date documentation as the Commissioning progresses.

1.5.4.3 Provide a qualified individual, subject to Owner's approval, experienced in construction and Commissioning of building systems to organize, schedule, conduct, and document the Commissioning Plan and the Commissioning process. The Contractor shall assign this individual to act as the Contractor's Commissioning Coordinator. The Contractor's Commissioning Coordinator may have additional duties such as MEP Coordinator, but not as Project Manager or Superintendent. In the event that Contractor chooses to subcontract its Commissioning obligations, then Contractor must submit the subcontractor's qualifications and personnel to Owner for Owner's approval.

1.5.4.4 Furnish and install systems that meet all requirements of the Contract Documents. Perform construction inspections, Start-ups, Prefunctional Checklists, Functional Performance Tests, and Integrated System Tests in accordance with the Contract Documents and Commissioning Plan. Correct any deficiencies identified during these processes.

1.5.4.5 Ensure that Commissioning activities are incorporated into the Project Schedule.

1.5.4.6 Submit inspection and Start-up documentation to Owner in accordance with this Section – 01 99 00 General Commissioning Requirements, Section 01 45 00 – Project Quality Control, Section 01 77 00 – Project Closeout Procedures, Technical Specifications, and the Commissioning Plan.

1.5.4.7 Cooperate with Owner's representative(s), provide access to Work and provide adequate labor, resources, and time for Commissioning.

1.5.4.8 Furnish copies of all shop drawings and submittals, manufacturers' literature, maintenance information, and any other information required for the Commissioning process. Contractor must submit to Owner installation and checkout materials actually shipped inside equipment and actual field checkout sheet forms used by factory or field technicians. Cross-reference Section 01 31 00 – Project Administration and Section 01 77 00 – Project Closeout Procedures (Operating and Maintenance Manuals) for additional required documentation.

1.5.4.9 Schedule and conduct pre-installation meetings and pre-commissioning meetings with subcontractors and equipment suppliers related to Commissioning. Contractor must invite Architect/Engineer and Owner to attend the pre-installation meetings and pre-commissioning meetings.

1.5.4.10 Provide qualified personnel, including subcontractors as required, to fully perform the testing and operational demonstrations required by the Contract Documents and the Commissioning Plan, including any deferred tests or re-testing related to warranty work.

1.5.4.11 Correct deficiencies identified during any stage of the Commissioning process.

1.5.4.12 Provide training to Owner. Coordinate subcontractor/vendor participation in training sessions.

1.5.4.13 Perform Deferred Tests and make necessary amendments to Operating and Maintenance Manuals and as-built drawings for applicable issues identified during the Deferred Tests.

1.5.4.14 Contractor shall be responsible for the following activities, and may contract with a Building Automation System vendor for these activities.

1.5.4.14.1 Provide on-site technician skilled in software programming and hardware operation to exercise sequences of operation and to correct controls deficiencies identified during Commissioning. Contractor must provide final as-builts reflecting correction of controls deficiencies identified during Commissioning.

1.5.4.14.2 Provide instrumentation, computer, software and communication resources necessary to demonstrate compliance with the Contract Documents and the Commissioning Plan during the Prefunctional Checklist, Functional Performance Tests and Integrated System Tests of Building Automation System equipment.

1.5.4.14.3 Attend pre-commissioning meetings and Commissioning meetings including seasonal, post occupancy, or deferred Commissioning meetings and activities as deemed appropriate to the Owner. Prepare training plans with Commissioning Team and perform training as specified in Contract Documents and Commissioning Plan.

1.5.4.14.4 Maintain comprehensive system calibration and checkout records. Submit records to Commissioning Team.

1.5.4.14.5 Set up, capture, analyze, and report trend logs as requested by Owner to substantiate proper systems operation.

1.5.5 Test, Adjust, and Balance Firm's Role and Responsibilities:

1.5.5.1 Attend pre-commissioning meetings and Commissioning Team meetings including seasonal, post occupancy, or deferred Commissioning meetings and activities as deemed appropriate to the Owner.

1.5.5.2 Submit Test, Adjust, and Balance Plan and forms describing methodology for performance of Test, Adjust, and Balance procedures specific to this Project to Owner for review.

1.5.5.3 Cooperate with Contractor and Contractor's Building Automation System vendor, if any, during Commissioning.

1.5.5.4 Re-balance any Deficiency identified during Commissioning.

1.5.5.5 Provide Test, Adjust, and Balance report to Contractor before Contractor begins Functional Performance Tests.

1.6 EQUIPMENT DOCUMENTATION REQUIREMENTS

1.6.1 Equipment List / Matrix:

1.6.1.1 Contractor shall submit a complete listing of all equipment, devices, and systems, with certain information as herein noted, within twenty-one (21) calendar days of issuance of the Notice to Proceed with Construction and at least seven (7) calendar days prior to submission of the first application for payment. This listing shall be referred to as the Equipment List/Matrix. Refer to Attachment "A" for an example of the Equipment List/Matrix.

1.6.1.2 Contractor shall coordinate Contractor's response to this requirement with Contractor's preparation of the Project Schedule, Submittal Schedule, Schedule of Values, and list of all equipment. Refer to Section 01 32 00 – Project Planning and Scheduling and Section 01 31 00 – Project Administration.

1.6.1.2.1 To the extent practical, Contractor should minimize redundant efforts in favor of a single, organized approach to all documentation required for Project equipment, systems, and devices.

1.6.1.3 The Equipment List/Matrix shall be formatted as a computerized spreadsheet with capability for printing various selected data columns (ranges) to meet documentation requirements at various stages of construction, and for different purposes as required by various Technical Sections. The Equipment List/Matrix shall be updated as the Project progresses and submitted periodically as requested by Owner. Provide Owner with an electronic version (Microsoft Excel 2003 or later) of the final approved Equipment List/Matrix at or before project closeout.

1.6.1.3.1 Contractor may elect to combine the Submittal Schedule and Equipment List/Matrix into one computerized spreadsheet (with multiple tabbed sheets) that Contractor updates as the Project progresses.

1.6.1.4 The Equipment List/Matrix shall identify all operable devices and equipment grouped by the Construction Specification Institute (CSI) Master Format under the system they are primarily categorized under. When sorted by the column for system identification, the resulting printout must identify all system components, regardless of whether they are mechanical, electrical, or otherwise.

1.6.1.5 Contractor shall submit the Equipment List/Matrix in its entirety prior to the first pre-commissioning meeting. The Equipment List/Matrix shall include the following data, as a minimum, for each device, and shall provide for additional columns containing subsequent data requirements as follows.

1.6.1.5.1 Specification section.

1.6.1.5.2 Room Number: Owner's Wayfinding Codes from Owner's Space Management database referring to room number or building location.

1.6.1.5.3 Equipment Plan Designation: Equipment Naming Convention (equipment acronym and sequential number) from Contract Documents.

1.6.1.5.4 Owner's asset number from Owner's maintenance database.

1.6.1.5.5 Description: Further detail including more definitive description and identification of duplicate assets, if available.

Service: Building area or type or system that the equipment serves.

1.6.1.5.6 Product submittal reference number(s) and projected time of original submission of device or system.

1.6.1.5.7 Product submittal approval date.

1.6.1.5.8 Name of installing Subcontractor.

1.6.1.6 Contractor shall provide the <u>final</u> Equipment List/Matrix for each device or system as an attachment to the Contractor's submission of the Request for Start-Up/Functional Performance Test Form for requesting Start-up and Functional Performance Test of particular devices or systems. The final Equipment List/Matrix shall include all data noted above; including any necessary corrective updates to the data, and shall also provide the following new data in distinct columns:

1.6.1.6.1 Equipment manufacturer's representative (Vendor).

1.6.1.6.2 Equipment manufacturer's representative (Vendor) phone number.

1.6.1.6.3 Equipment manufacturer, model number, and serial number.

1.6.1.6.4 Vendor's P.O. number.

1.6.1.6.5 Date of initial equipment or device start-up by the Contractor.

1.6.1.6.6 Substantial Completion date.

1.6.1.6.7 Manufacturer's warranty start date.

1.6.1.6.8 Manufacturer's warranty duration period.

1.6.1.6.9 Functional Performance Test approval date.

1.6.1.6.10 Integrated Systems Test approval date.

1.6.2 Request for Start-Up/Functional Performance Test Form:

1.6.2.1 Contractor must use Owner's Request for Start-Up/Functional Performance Test Form to request: (1) to initially energize or operate equipment and systems; and (2) an inspection of any system or system component for readiness prior to Functional Performance Tests. Contractor must complete the appropriate section of Owner's Request for Start-Up/Functional Performance Test Form.

1.6.2.1.1 Request for Start-up. Contractor must certify that: (1) electrical and mechanical connections have been installed and are safe for initial Start-up; (2) Contractor has complied with Owner's outage notifications; and (3) Start-up will not harm Owner's daily routine operations.

1.6.2.1.2 Request for Functional Performance Test. Contractor must certify that the Contractor has verified that the installation, Start-up, Prefunctional Checklists, and initial operation of the system or component are in accordance with the Contract Documents and the Commissioning Plan including manufacturer's instructions, manufacturer's requirements for maintenance of warranty, and verification that the system is ready for Functional Performance Tests. Contractor must certify that the manufacturer's representative has verified that the installation, start-up, and initial operation of the system or component are in accordance with the manufacturer's published recommendations.

1.6.2.2 Contractor shall attach to the Request for Start-Up/Functional Performance Test Form the applicable Prefunctional Checklist(s) completed and signed by Contractor, evidencing Contractor's own thorough inspection of the system and completion of start-up activities required by the Contract Documents and the Commissioning Plan.

1.6.2.3 Contractor must obtain Owner's signature on the Request for Start-Up/Functional Performance Test Form prior to proceeding with the Start-up or Functional Performance Test.

1.8 PREFUNCTIONAL CHECKLIST

1.8.1 Contractor shall provide a Prefunctional Checklist for each system to Owner and Architect/Engineer for review.

1.8.1.1 The Prefunctional Checklist shall identify in columnar format each device, location, test method, control sequence of operation reference, device code reported, and other data as appropriate.

1.8.1.2 Contractor shall provide a draft version of each Prefunctional Checklist at a pre-installation meeting for the system. Based on discussions at a preinstallation meeting and subsequent as-built conditions, Contractor shall amend and revise each Prefunctional Checklist as appropriate prior to requesting system inspection from the Owner.

1.8.1.3 Contractor shall provide the final approved Prefunctional Checklist as an attachment to the Request for Start-Up/Functional Performance Test Form.

1.8.2 In addition to the Request for Start-Up/Functional Performance Test Form, Contractor shall review the installation and Contract Documents for each system and shall provide written confirmation of the following.

1.8.2.1 All required test reports and/or certifications have been submitted and accepted by Owner. If required, Contractor must provide certification of acceptance from manufacturer's representative.

1.8.2.2 Evidence that Architect/Engineer has approved all shop drawings and product data submittals for each component device.

1.8.2.3 All valve charts, wiring diagrams, control schematics, electrical panel directories, etc. have been submitted, approved, and installed in accordance with the Contract Documents.

1.8.2.4 All tabulated data has been submitted for each system and/or device.

1.8.2.5 Each component device has been installed in accordance with applicable codes, the Contract Documents, and manufacturer's written recommendations.

1.9 COMMISSIONING AND CLOSEOUT MANUAL

1.9.1 Contractor shall incorporate all Commissioning and closeout documentation and/or verification into a Commissioning and Closeout Manual for the Owner as specified in Section 01 77 00 – Project Closeout Procedures.

1.9.2 The Commissioning and Closeout Manual submitted to Owner must contain all documentation related to the Commissioning process, including but not limited to: Prefunctional Checklists, calibrations, all related correspondence, Functional Performance Test Procedures and results, Integrated Systems Test Procedures and results, Deficiency reports, data trends, punchlists, and signoffs.

PART 2 - PRODUCTS

2.1. TEST EQUIPMENT

2.1.1. Contractor shall provide all specialized tools, test equipment and instruments required to execute start-up, checkout, and testing of equipment.

2.1.2. All specialized tools, test equipment and instruments required to execute start-up, checkout, and testing of equipment shall be of sufficient quality and accuracy to test and/or measure system performance within specified tolerances. A testing laboratory must have calibrated test equipment within the previous twelve (12) months. Calibration shall be NIST traceable. Contractor must calibrate test equipment and instruments according to manufacturer's recommended intervals and whenever the test equipment is dropped or damaged. Calibration tags must be affixed to the test equipment or certificates readily available.

PART 3- EXECUTION

3.1. PRE-COMMISSIONING MEETING

3.1.1. Contractor shall submit the Commissioning Plan to Owner at least ninety (90) calendar days prior to initial installation of materials or equipment that will undergo Start-up and Functional Performance Tests, or as otherwise approved by Owner.

3.1.1.1. Contractor shall allow a minimum of twenty-one (21) calendar days after Owner's receipt of the Commissioning Plan for Owner to submit initial review comments to Contractor.

3.1.1.2. Contractor shall incorporate Owner's initial review comments and resubmit the revised Commissioning Plan to Owner within fourteen (14) calendar days of receipt of Owner's initial review comments.

3.1.1.3. Contractor shall allow in the Project Schedule an additional fourteen (14) calendar days for Owner's approval of the resubmitted Commissioning Plan that incorporates Owner's initial review comments.

3.1.2. Upon obtaining Owner's approval of the Commissioning Plan, Contractor shall schedule, plan, and conduct a Pre-Commissioning Meeting with all parties involved in the Commissioning process. This meeting should include the major subcontractors, specialty manufacturers/suppliers, Architect/Engineer, Test, Adjust, and Balance Firm, and Owner's representatives as participants.

3.1.3. Contractor shall prepare for the Pre-Commissioning Meeting by creating drafts of the following documents with input from the Owner.

3.1.3.1. Approved Commissioning Plan including the Equipment List/Matrix and the Closeout and Documentation Matrix and defined in Section 01 77 00 – Project Closeout Procedures.

3.1.3.2. Project Schedule incorporating Commissioning activities.

3.1.3.3. Prefunctional Checklists.

3.1.3.4. Functional Performance Test Procedures.

3.1.3.5. Integrated System Test Procedures.

3.1.4. Contractor shall conduct the Pre-Commissioning Meeting and review all aspects of the Commissioning Plan. All documentation will be discussed and all test procedures and forms reviewed for approval with the Owner. Contractor shall prepare an outline noting responsibilities of the various parties involved in the Commissioning process for review at this meeting.

3.1.5. The Commissioning Plan shall be reviewed with all attendees and the scope of work discussed. Contractor should be prepared to distribute copies of the pertinent sections to the various subcontractors involved in the Commissioning process.

3.1.6. Contractor shall present Commissioning target dates for the Project. These dates and durations shall be incorporated in the Project Schedule in accordance with Section 01 32 00 – Project Planning and Scheduling.

3.1.7. Contractor shall provide updates to the Project Team on the Commissioning process during all Project Progress Meetings.

3.2. REPORTING

3.2.1.1. Contractor shall provide status reports to Owner at frequencies directed by Owner.

3.2.1.2. Contractor shall communicate at least monthly with all members of the Commissioning Team, keeping them apprised of Commissioning progress and scheduling changes.

3.2.1.3. Contractor shall submit non-conformance and Deficiency reports to Owner within five (5) calendar days of the non-conformance or Deficiency occurrence.

3.2.1.4. Contractor shall provide final Commissioning documentation to Owner in accordance with Section 01 77 00 – Project Closeout Procedures, which will become part of the Commissioning and Closeout Manual.

3.3. INITIAL START-UP

3.3.1. Start-up of Independent Devices:

3.3.1.1. Prior to Start-up, Contractor shall not energize or activate, or allow to be energized or activated, any operable device until Contractor has verified to Contractor's own satisfaction that all Contract Document requirements for the operable device have been met, other than the requirements relating to operational checkout.

3.3.1.2. Contractor may energize and/or start-up independent devices for operational check-out and testing only after Contractor and manufacturer's representative and/or engineering technician (if required by the Contract Documents) have inspected and accepted the installation. The installation must not vary from provisions of the applicable Specifications and the manufacturer's written recommendations for Start-up.

3.3.1.3. When Start-up of equipment or systems have the potential to impact Owner's daily operations, Contractor must provide advance notice to Owner prior to Start-up. Contractor may not proceed with Start-up without the Owner's written approval.

3.3.2. Start-up of Building Systems:

3.3.2.1. Contractor shall not energize or activate any building system until the following conditions have been met:

3.3.2.1.1. Contractor has verified that all wiring and support components for equipment are complete and have been tested in accordance with the technical specifications and/or the manufacturer's written recommendations.

3.3.2.1.2. Contractor has verified that each component device has been checked for proper lubrication, vibration isolation, drive rotation, belt tension, control sequence, or other conditions that may cause damage.

3.3.2.1.3. Contractor has verified that all tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer and are in compliance with applicable Contract Documents.

3.3.2.1.4. Contractor has provided the Owner and Architect/Engineer with a written seven (7) calendar day notice of intent to start-up the system for operational check-out. The Request for Start-Up/Functional Performance Test Form <u>without attachments</u> shall be used for this notification.

3.3.2.2. Contractor shall perform Start-up under supervision of the responsible manufacturer's representative in accordance with manufacturer's instructions and specification requirements.

3.3.2.3. Contractor shall coordinate and schedule system(s) Start-up in a timely manner so that each component or system can operate for a period of time that is sufficient to evaluate and adjust performance as necessary. All building systems shall be operational and must have been successfully inspected by Owner's representatives, through attendance and concurrence with results of the Prefunctional Checklists or as otherwise approved by Owner, prior to the Contractor proceeding with Functional Performance Tests.

3.3.2.4. Contractor shall clearly list outstanding items or initial Start-up and Prefunctional Checklists not completed successfully. Contractor shall obtain from Subcontractor completed forms documenting any outstanding Deficiency within five (5) calendar days of completion of such test procedures.

3.3.2.5. Contractor shall review completed Deficiency forms to determine if outstanding items prevent the Functional Performance Tests.

3.3.2.6. Owner may backcharge Contractor for any incomplete Prefunctional Checklist or Deficiency that subsequently causes delays during Functional Performance Test.

3.4. FUNCTIONAL PERFORMANCE TESTS

3.4.1. Objective and Scope:

3.4.1.1. The objective of a Functional Performance Test is to demonstrate that each system operates according to the Contract Documents.

3.4.1.2. Contractor shall operate each system through all modes of operation (occupied, unoccupied, warm-up, cool-down, etc.) for specified system responses. Contractor is required to demonstrate to Owner's satisfaction each operational sequence.

3.4.2. Development of Functional Performance Test Procedures:

3.4.2.1. The purpose of a Functional Performance Test is to verify and document compliance with the stated criteria of acceptance. Contractor shall develop specific script-type test procedures and associated test forms to verify and document proper operation of each piece of equipment and system.

3.4.2.2. Contractor shall prepare Functional Performance Test Procedure forms as part of the Commissioning Plan.

3.4.2.3. Functional Performance Test Procedure forms must include the following.

3.4.2.3.1. System and equipment or component name(s).

3.4.2.3.2. Equipment location and identification number as identified in the Equipment List/Matrix.

3.4.2.3.3. Unique test identification number and reference to unique Prefunctional Checklist and Start-up documentation identification numbers for the equipment.

3.4.2.3.4. Date and time of test.

3.4.2.3.5. Project name.

3.4.2.3.6. Participating parties.

3.4.2.3.7. Specific sequence of operation or other specified parameters, including performance data being verified.

3.4.2.3.8. Instructions for setting up a Functional Performance Test.

3.4.2.3.9. Specific script-type, step-by-step procedures to perform a Functional Performance Test, in a clear, sequential and repeatable format that is customized for the system being tested.

3.4.2.3.10. A Yes/No checkbox (or data entry box as appropriate) for clearly indicating whether or not proper performance of each part of a Functional Performance Test was achieved and space for actual readings.

3.4.2.3.11. Section for comments.

3.4.2.3.12. Signatures and date block for participants and Owner approvals.

3.4.3. Contractor shall operate, or cause to be operated, each system, device, or equipment item, both intermittently and continuously, for a duration period as indicated in the Specification Section(s) for each item and/or in accordance with the manufacturer's written recommendations, the Contract Documents and the Commissioning Plan.

3.4.4. Contractor shall operate each component device and each building system to the full extent of its capability, from minimum to maximum, and under automatic control and manual control.

3.4.5. Contractor and manufacturer's representatives shall supervise and coordinate adjustments and balancing of all devices and systems for proper operation prior to requesting a Functional Performance Test(s).

3.4.5.1. Where final balancing of a system is to be performed by Owner or Owner's consultants, such as final air balancing, Contractor shall provide all services indicated in the applicable Technical Sections and under this Section including the following prior to Owner's final balancing.

3.4.5.1.1. Operational verification of all component devices and the total system, including automatic controls when applicable. Operational verification includes verification that all motors, fans, dampers, and other operable devices are performing in compliance with Specifications throughout their operable range and that all devices are controlled as described in the specified sequence of operation.

3.4.5.1.2. All tabulated data, motor amperage readings, valve tag verifications, and other data required by Technical Specifications.

3.4.5.2. Where final balancing of a system or particular components of a system are not specifically indicated to be performed by Owner or Owner's consultants, Contractor shall provide final balancing and adjustments for operation within specified tolerances prior to Functional Performance Test of such system.

3.4.6. Coordination and Scheduling.

3.4.6.1. Owner may observe Functional Performance Tests of equipment components and systems. Contractor shall provide written notice to Owner at least seven (7) calendar days prior to Functional Performance Tests of equipment components and systems. Contractor shall notify Owner in advance of any changes to the Functional Performance Test schedule. Owner may require Contractor to reschedule Functional Performance Tests to ensure availability of Owner's representative(s).

3.4.6.2. Contractor conducts Functional Performance Tests after system Start-up and Pre-functional Checklists are satisfactorily completed and approved by Owner. Air balancing and water balancing shall be completed before Functional Performance Tests.

3.4.6.3. Contractor conducts Integrated System Tests after Functional Performance Tests are satisfactorily completed and approved by Owner. Owner's representative(s) may observe Integrated System Tests.

3.5. INTEGRATED SYSTEM TESTS

3.5.1. Objective and Scope:

3.5.1.1. The objective of an Integrated System Test is to demonstrate that each system operates jointly and independently of other systems according to the Contract Documents.

3.5.1.2. Contractor shall operate each system, jointly and independently of other systems, through selected modes of operation (occupied, unoccupied, warm-up, cool-down, etc.) for specified system responses. Contractor is required to demonstrate to Owner's satisfaction each operational sequence.

3.5.2. Development of Integrated System Test Procedures:

3.5.2.1. The purpose of an Integrated System Test is to verify and document compliance with the stated criteria of acceptance. Contractor shall develop specific script-type test procedures and associated test forms to verify and document proper operation of each piece of equipment and system, jointly and independently of other systems.

3.5.2.2. Contractor shall prepare Integrated System Test Procedure forms as part of the Commissioning Plan.

3.5.2.3. Integrated System Test Procedure forms must include the following.

3.5.2.3.1. System and equipment or component name(s).

3.5.2.3.2. System and equipment location and identification number as identified in the Equipment List/Matrix.

3.5.2.3.3. Unique test identification number and reference to unique Prefunctional Checklist, Start-up documentation, and Functional Performance Test identification numbers for the system and equipment.

3.5.2.3.4. Date and time of test.

3.5.2.3.5. Project name.

3.5.2.3.6. Participating parties.

3.5.2.3.7. Specific sequence of operation or other specified parameters, including performance data being verified.

3.5.2.3.8. Instructions for setting up an Integrated System Test.

3.5.2.3.9. Specific script-type, step-by-step procedures to perform an Integrated System Test, in a clear, sequential and repeatable format that is customized for the system being tested.

3.5.2.3.10. A Yes/No checkbox (or data entry box as appropriate) for clearly indicating whether or not proper performance of each part of an Integrated System Test was achieved and space for actual readings.

3.5.2.3.11. Section for comments.

3.5.2.3.12. Signatures and date block for participants and Owner approvals.

3.5.3. Contractor shall operate, or cause to be operated, each system, device, or equipment item, both intermittently and continuously, for a duration period as indicated in the Specification Section(s) for each item and/or in accordance with the manufacturer's written recommendations, the Contract Documents and the Commissioning Plan.

3.5.4. Coordination and Scheduling.

3.5.4.1. Owner may observe Integrated System Tests of equipment components and systems. Contractor shall provide written notice to Owner at least fourteen (14) calendar days prior to Integrated System Tests of equipment components and systems. Contractor shall notify Owner in advance of any changes to the Integrated System Test schedule. Owner may require Contractor to reschedule Integrated System Tests to ensure availability of Owner's representative(s).

3.5.4.2. Contractor conducts Integrated System Tests after Functional Performance Tests are satisfactorily completed and approved by Owner. Owner's representative(s) may observe Integrated System Tests.

3.6. DOCUMENTATION AND NON-CONFORMANCE

3.6.1. Documentation:

3.6.1.1. Contractor shall witness and document the results of all Functional Performance Tests and Integrated Systems Tests using specific procedural forms developed for that purpose. Prior to testing, Contractor shall submit these forms to the Owner for review and approval. Contractor will include the completed, filled-out forms in the Commissioning and Closeout Manual.

3.6.2. Non-Conformance:

3.6.2.1. Contractor shall record results of Functional Performance Tests and Integrated System Tests. Contractor shall report all deficiencies and non-conformance issues to Owner on the Functional Performance Test form and the Integrated Systems Test form and in a Commissioning Deficiency report.

3.6.2.2. At the sole discretion of Owner, Owner may permit Contractor to make corrections of minor deficiencies observed during a Functional Performance Test or during an Integrated System Test. However, the Contractor must document the Deficiency and resolution on the appropriate report form.

3.6.2.3. Contractor shall make every effort to expedite testing and minimize unnecessary delays, while not compromising the integrity of a Functional Performance Test or an Integrated Systems Test.

3.6.2.4. Contractor and Owner will attempt to resolve deficiencies in the following manner.

3.6.2.4.1. When there is no dispute about a Deficiency and Contractor accepts responsibility for correction.

3.6.2.4.1.1. Contractor documents the Deficiency and the corrective actions, and then proceeds to another test or sequence. Contractor submits a Deficiency report to Owner. Contractor corrects the Deficiency, completes the statement of correction form certifying that the equipment or system is ready for retesting, and sends the certification to Owner.

3.6.2.4.1.2. Contractor reschedules test with Owner.

3.6.2.4.2. When there is a dispute about whether or not the test indicates a Deficiency, or the Contractor's responsibility for the correction of the apparent Deficiency.

3.6.2.4.2.1. Contractor documents the apparent Deficiency and proceeds to another test or sequence. Contractor submits a Deficiency report to Owner, including the apparent Deficiency.

3.6.2.4.2.2. Contractor facilitates resolution of Deficiency and provides recommendations to the Owner. Contractor and Owner may bring other parties into the discussions as needed. Final technical interpretive authority is with the Architect/Engineer. Final acceptance authority is with the Owner.

3.6.2.4.2.3. Contractor documents resolution process.

3.6.2.4.2.4. If Owner agrees with Contractor's interpretation and proposed resolution, Contractor forwards response to Owner. Contractor reschedules test with Owner. Contractor must repeat this process until satisfactory performance and Owner's approval is obtained.

3.7. DEMONSTRATION AND OWNER TRAINING

3.7.1. Contractor shall conduct classroom-style training session followed by on-site demonstrations of system operation. Refer to Technical Specification Sections and Contract Documents for training requirements. When equipment or a system requires both demonstration and training, Contractor may combine the demonstration and training provided that the Contractor obtains the Owner's approval at least ten (10) calendar days prior to the demonstration and training.

3.7.2. Contractor shall furnish to the Owner a professional quality video and audio recording of the training. Owner may select portions of the training to be recorded.

3.7.3. Contractor shall coordinate, schedule and complete the training related to all equipment specified in the Contract Documents. Contractor may utilize the installing subcontractor and/or manufacturers' representative or others approved in advance by Owner for specific portions of equipment or systems training. Contractor shall conduct multiple training sessions as required to adequately train Owner's staff.

3.7.4. Contractor shall submit a written training plan to the Owner and Architect/Engineer for review and approval. Contractor's training plan shall cover the following elements.

3.7.4.1. Equipment included in training.

3.7.4.2. Intended audience.

3.7.4.3. Location of training.

3.7.4.4. Objectives.

3.7.4.5. Subjects covered.

3.7.4.6. Duration of training on each subject.

3.7.4.7. Instructor for each subject.

3.7.4.8. Methods (classroom lecture, video, Site walk-through, actual operational demonstrations, written handouts, etc.).

3.7.4.9. Instructors and qualifications.

3.7.5. Contractor shall use Operating and Maintenance Manuals and the Equipment List/Matrix as a basis for instructing Owner's staff regarding system operation. Contractor shall review contents of Operating and Maintenance Manuals and review equipment data and performance verification to Owner as part of Owner training. This instruction and data review should be held in a classroom environment.

3.7.6. Contractor shall demonstrate in the field: start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of the system(s) and each component device.

3.7.7. Contractor shall demonstrate system performance at each stage of sequence of operation. Contractor shall promptly correct any deficiencies noted during the demonstration and document on a Deficiency report.

3.7.8. Contractor shall cooperate with Owner and Owner’s Test, Adjust, and Balance Firm for verification testing and final adjustments and balancing as may be indicated in the Contract Documents or as directed by Owner.

3.7.9. As a minimum, Contractor shall perform training on all systems including, but not limited to, the following (as applicable to the Project):

3.7.9.1. Heating, Ventilating, and Air Conditioning Airside and Waterside Systems.

3.7.9.2. Building Automation System.

3.7.9.3. Life Safety Systems (including Fire Alarm, Stairwell Pressurization, Fire Protection, and Smoke Containment, Control, and Response System).

3.7.9.4. Elevators/Escalators.

3.7.9.5. Refrigeration Systems.

3.7.9.6. Lighting Control Systems.

3.7.9.7. Communications Systems (including Network, Data, Nurse Call)

3.7.9.8. Emergency Power and Uninterruptible Power Supply (UPS) Systems.

3.7.9.9. Domestic and Process Water Systems.

3.7.9.10. Medical Gas and Vacuum Systems.

3.7.9.11. Laboratory Gas and Vacuum Systems.

3.7.9.12. Any other major system not identified above.

3.8. DEFERRED TESTS

3.8.1. Deferred Tests:

3.8.1.1. Contractor shall complete Deferred Tests as part of this Contract during the warranty period. Contractor shall schedule this activity with Owner. Contractor shall perform tests and document and correct deficiencies. Owner may observe the tests and review and approve test documentation and Deficiency corrections.

3.8.1.2. Contractor shall incorporate final updates to the Commissioning and Closeout Manual.

3.8.1.3. If any check or test cannot be completed prior to Substantial Completion due to the building structure, required occupancy condition, or other condition, performance of such test may be delayed to later in the warranty period, upon approval of the Owner. Contractor shall reschedule and conduct these unforeseen deferred tests in the same manner as Deferred Tests.

3.9. COMMISSIONING DOCUMENTATION

3.9.1. Contractor shall compile and organize the Commissioning and Closeout Manual, and deliver the Commissioning and Closeout Manual to Owner. The Commissioning and Closeout Manual must include the following:

3.9.1.1. The Commissioning Plan within the Commissioning and Closeout Manual must include an executive summary, list of participants and roles, brief building description, overview of commissioning and testing scope and general description of testing and verification methods. The Commissioning Plan shall address methodology for documentation of equipment and system operational performance in the following areas: 1) Conformance to Contract Documents, 2) Equipment Installation, and 3) Prefunctional Checklist, Functional Performance Tests, and Integrated System Tests.

3.9.1.2. Specifically list all outstanding non-compliance items. Recommendations for improvement to equipment or operations, future actions, etc. shall also be listed. Each non-compliance issue shall be referenced to the specific Functional Performance Test or Integrated System Test where the Deficiency is documented.

3.9.1.3. Project Commissioning schedules with Commissioning milestone activities and Equipment List/Matrix.

3.9.1.4. Request for Start-Up/Functional Performance Test Forms with all attachments.

3.9.1.5. Completed Prefunctional Checklists and Prefunctional test results, Functional Performance Tests, Integrated System Tests, and Owner Demonstration test records and results of each.

3.9.1.6. Owner training attendance.

3.9.1.7. Deficiency reports and solution results.

3.9.1.8. Recommendations on continuous Commissioning, best practices, and preventive maintenance.

3.9.2. Contractor shall submit the Commissioning and Closeout Manual to Owner on paper and in original electronic file format as described in Section 01 77 00 – Project Closeout Procedures.

ATTACHMENTS:

“A” - Equipment List/Matrix

END OF SECTION 01 91 00

ATTACHMENT "A"

Download an electronic version of this spreadsheet to use as a template for submittal purposes at:
HTTP://WWW2.MDANDERSON.ORG/DEPTS/CPM/STANDARDS/SUPP.HTML

MD Anderson Cancer Center Equipment List/Matrix

Project Name: **Issue Date:**

Specification Section	Location (MD Anderson Room Number)	Equipment Plan Designation	MD Anderson Asset Number	Description	Service	Product Submittal Reference Number	Product Submittal Approval Date	Installing Contractor	Manufacturer	Manufacturer's Representative (Vendor)	Vendor's Phone Number	Model Number	Serial Number	Vendor's P.O. Number	Start-Up Date	Substantial Completion Date	Manufacturer's Warranty Start Date	Manufacturer's Warranty Duration Period	Functional Performance Test Approved	Integrated Systems Test Approved
Level 1																				
Elevator/Escalator																				
14 21 00				High Rise Traction Elevator																
Fire Suppression System																				
21 31 13				Fire Pump																
21 31 13				Fire Jockey Pump																
Plumbing System																				
HVAC System																				
Electrical System																				
Level 2																				
Plumbing System																				
22 33 33				Electric Water Heater																
22 40 00				Electric Drinking Fountain																
HVAC System																				
23 82 19				Fan Coil Unit																
27 73 13				Air Handling Unit																
23 36 00				Fan Powered Terminal Unit																
23 36 00				VAV Terminal Unit																
23 36 00				Exhaust VAV Terminal Unit																
Electrical System																				
26 22 13				Dry Type Transformer																
Level 3																				
Plumbing System																				
22 33 33				Electric Water Heater																
22 40 00				Electric Drinking Fountain																
HVAC System																				
23 82 19				Fan Coil Unit																
27 73 13				Air Handling Unit																
23 36 00				Fan Powered Terminal Unit																
23 36 00				VAV Terminal Unit																
23 36 00				Exhaust VAV Terminal Unit																
Electrical System																				
26 22 13				Dry Type Transformer																
26 22 14				Harmonic Cancellation Transformer																
Penthouse																				
Plumbing System																				
22 10 30				Back Flow Preventer																
HVAC System																				
23 72 23				Energy Recovery Unit																
23 82 19				Fan Coil Unit																
23 34 13				Stair Pressurization Fan																
23 34 16				Exhaust Fan																
Electrical System																				
26 22 13				Dry Type Transformer																

SECTION 02 41 19 – SELECTIVE DEMOLITION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with all applicable requirements and standards.

1.03 SUBMITTALS

A. Record Documents:

1. Schedule indicating proposed sequence of operations for selective demolition Work to Owner's Representative for review prior to start of Work. Include coordination for shutoff, capping, and continuation of utility services as required, together with details for dust and noise control protection.

a. Provide detailed sequence of demolition and removal Work to ensure uninterrupted progress of Owner's on-site operations.

b. Coordinate with Owner's continuing occupation of portions of existing building and with Owner's partial occupancy of completed new addition.

2. Photographs of existing conditions of structure surfaces, equipment, and adjacent improvements that might be misconstrued as damage related to removal operations. File with Owner's Representative prior to start of Work.

1.04 PROJECT CONDITIONS

A. Owner will occupy portions of the building immediately adjacent to areas of selective demolition. Conduct selective demolition Work in manner that will minimize need for disruption of Owner's normal operations. Provide minimum of 72 hours advance notice to Owner of demolition activities that will affect Owner's normal operations.

B. Owner assumes no responsibility for actual condition of items or structures to be demolished.

1. Conditions existing at time of inspection for bidding purposes will be maintained by Owner insofar as practicable. However, minor variations within structure may occur by Owner's removal and salvage operations prior to start of selective demolition Work.

C. Promptly repair damages caused to adjacent facilities by demolition Work.

D. Conduct selective demolition operations and debris removal to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities.

1. Do not close, block, or otherwise obstruct streets, walks, or other occupied or used facilities without written permission from authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.

E. Do not use cutting torches for removal until Work area is cleared of flammable materials. At concealed spaces, such as interior of ducts and pipe spaces, verify condition of hidden space before starting flame cutting operations. Maintain portable fire suppression devices during flame cutting operations.

F. Maintain existing utilities indicated to remain in service and protect them against damage during demolition operations.

1. Do not interrupt utilities serving occupied or used facilities, except when authorized in writing by authorities having jurisdiction. Provide temporary services during interruptions to existing utilities, as acceptable to governing authorities.

2. Maintain fire protection services during selective demolition operations.

G. Use water sprinkling, temporary enclosures, and other methods to limit dust and dirt migration. Comply with governing regulations pertaining to environmental protection.

1. Do not use water when it may create hazardous or objectionable conditions such as ice, flooding, and pollution.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.02 MATERIAL OWNERSHIP

A. Except for items or materials indicated to be reused, salvaged, or otherwise indicated to remain the Owner's property, demolished materials shall be become the Contractor's property and shall be removed from the Site with further disposition of the Construction's option.

B. Historical items, relics, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, antiques, and other items of interest or value to the Owner, which may be encountered during demolition, remain the Owner's property. Carefully remove and salvage each item or object in a manner to prevent damage and deliver promptly to the Owner.

PART 3 - EXECUTION

3.01 PREPARATION

A. Provide interior and exterior shoring, bracing, or support to prevent movement, settlement, or collapse of areas to be demolished and adjacent facilities to remain.

1. Cease operations and notify Owner's Representative immediately if safety of structure appears to be endangered. Take precautions to support structure until determination is made for continuing operations.

2. Locate, identify, stub off, and disconnect utility services that are not indicated to remain.

a. Provide bypass connections as necessary to maintain continuity of service to occupied areas of building. Provide minimum of 72 hours advance notice to Owner if shutdown of service is necessary during changeover.

3.02 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. All installation shall be in accordance with manufacturer’s published recommendations.

3.03 DEMOLITION

A. Perform selective demolition Work in a systematic manner. Use such methods as required to complete Work indicated on Drawings in accordance with demolition schedule and governing regulations.

1. Demolish concrete and masonry in small sections. Cut concrete and masonry at junctures with construction to remain using power driven masonry saw or hand tools; do not use power driven impact tools.

2. Locate demolition equipment throughout structure and promptly remove debris to avoid imposing excessive loads on supporting walls, floors, or framing.

3. Provide services for effective air and water pollution controls as required by local authorities having jurisdiction.

4. Demolish foundation walls to a depth of not less than 12 inches below existing ground surface. Demolish and remove below grade wood or metal construction. Break up below grade concrete slabs.

5. For interior slabs on grade, use removal methods that will not crack or structurally disturb adjacent slabs or partitions. Use power saw where possible.

6. Completely fill below grade areas and voids resulting from demolition Work. Provide fill consisting of approved earth, gravel, or sand, free of trash and debris, stones over 6 inches in diameter, roots, or other organic matter.

B. Remove culvert or sewer pipe for reuse by careful excavation of all material on the top and sides so that the pipe will not be damaged. Removal of sewer appurtenances shall be included for removal with the pipe. Remove pipe which are unsatisfactory for reuse, and dispose of, off the Project Site.

C. Concrete parts of structures below the permanent ground-line shall be neatly squared off with reinforcement cut off close to the concrete.

D. Dismantle steel structures or steel portions of structures in sections determined by the Owner's Representative.

1. The sections shall be of such weight and dimensions which permit convenient handling, hauling and storing.

2. Rivet and bolts connecting steel rail members, steel beams or girder spans and steel stringers of truss spans will be removed by cutting the heads with a cold cut then punching or drilling by a method that will not injure the member for reuse.

3. The removal of rivets and bolts from connections will not be required unless specifically indicated.

4. Unless otherwise specified, the Contractor shall have the option of dismantling these members by flame cutting immediately adjacent to the connection.

5. Flame-cutting will not be permitted when Drawings call for the structural unit to be salvaged in such a manner as to permit re-erection. In such cases, all members shall be carefully dismantled without damage, match marked with paint, and all rivets and bolts removed from the connections.

E. Remove Concrete Masonry Unit structures by sledging the masonry into removal sizes.

F. If unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure both nature and extent of the conflict. Submit report to Owner's Representative in written, accurate detail. Pending receipt of directive from Owner's Representative, rearrange selective demolition schedule as necessary to continue overall job progress without undue delay.

3.04 EXCAVATION AND BACKFILL

A. Back-fill to the level of the original ground-line, all excavation made in, and all openings below, the natural ground-line caused by the removal of old structures or portions thereof.

B. That portion of the back-fill which will support any portion of the roadbed or paving shall be placed in layers of the same thickness as those required subgrade preparation.

1. Material in each layer shall be wetted uniformly, if required, and shall be compacted to the density required in the adjoining embankment. In places inaccessible to blading and rolling equipment, mechanical or handtampers shall be used to obtain the required compaction.

C. Place that portion of the back-fill which will not support any portion of the roadbed or paving in such a manner, and compact, to preclude settling.

3.05 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove from building Site debris, rubbish, and other materials resulting from demolition operations. Transport and legally dispose off Site.

1. If hazardous materials are encountered during demolition operations, comply with applicable regulations, laws, and ordinances concerning removal, handling, and protection against exposure or environmental pollution.

2. Burning of removed materials is not permitted on the Project Site.

3.06 CLEANUP AND REPAIR

A. Upon completion of demolition Work, remove tools, equipment, and demolished materials from the Project Site. Remove protections and leave interior areas broom clean.

1. Repair demolition performed in excess of that required. Return elements of construction and surfaces to remain to condition existing prior to start operations. Repair adjacent construction or surfaces soiled or damaged by selective demolition Work.

END OF SECTION 02 41 19

SECTION 03 30 00 – CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with all applicable requirements and standards.

1.03 QUALITY ASSURANCE

A. Codes and Standards: Comply with provisions of the following codes, specifications, and standards, except where more stringent requirements are shown or specified:

1. American Concrete Institute (ACI) 301, "Specifications for Structural Concrete for Buildings."

2. ACI 318, "Building Code Requirements for Reinforced Concrete."

3. Concrete Reinforcing Steel Institute (CRSI) "Manual of Standard Practice."

B. Mockup: Cast mockup of size indicated or as required to demonstrate typical joints, form tie spacing, and proposed surface finish, texture, and color. Maintain sample panel exposed to view for duration of Project, after Owner's acceptance of visual qualities.

1. Demolish mockup and remove from Site when directed by Owner.

1.04 SUBMITTALS

A. Product Data:

1. Product data for proprietary materials and items, including reinforcement and forming accessories, admixtures, patching compounds, waterstops, joint systems, curing compounds, dry shake finish materials, and others if requested by Owner.

B. Samples:

1. Samples of materials including names, sources, and descriptions, as follows:

a. Color finishes.

b. Normal weight aggregates.

c. Fiber reinforcement.

d. Waterstops.

e. Vapor retarder/barrier.

f. Form liners.

C. Shop Drawings:

1. Shop Drawings for formwork indicating fabrication and erection of forms for specific finished concrete surfaces. Show form construction including jointing, special form joints or reveals, location and pattern of form tie placement, and other items that affect exposed concrete visually.

2. Shop Drawings for reinforcement detailing fabricating, bending, and placing concrete reinforcement. Comply with ACI 315 "Manual of Standard Practice for Detailing Reinforced Concrete Structures" showing bar schedules, stirrup spacing, bent bar diagrams, and arrangement of concrete reinforcement. Include special reinforcing required for openings through concrete structures.

3. Review is for general architectural applications and features only. Designing formwork for structural stability and efficiency is Contractor's responsibility.

D. Record Documents:

1. Laboratory test reports for concrete materials and mix design test.

2. Material certificates in lieu of material laboratory test reports when permitted by Owner. Material certificates shall be signed by manufacturer and Contractor, certifying that each material item complies with or exceeds specified requirements. Provide certification from admixture manufacturers that chloride content complies with specification requirements.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.02 FORM MATERIALS

A. Forms for Exposed Finish Concrete: Plywood, metal, metal framed plywood faced, or other acceptable panel type materials to provide continuous, straight, smooth, exposed surfaces. Furnish in largest practicable sizes to minimize number of joints and to conform to joint system shown on Drawings.

1. Use overlaid plywood complying with U.S. Product Standard PS 1 "A C or B B High Density Overlaid Concrete Form," Class I.

2. Use plywood complying with U.S. Product Standard PS 1 "B B (Concrete Form) Plywood," Class I, Exterior Grade or better, mill oiled and edge sealed, with each piece bearing legible inspection trademark.

B. Forms for Unexposed Finish Concrete: Plywood, lumber, metal, or another acceptable material. Provide lumber dressed on at least two edges and one side for tight fit.

C. Forms for Textured Finish Concrete: Units of face design, size, arrangement, and configuration to match Owner's control sample. Provide solid backing and form supports to ensure stability of textured form liners.

D. Forms for Cylindrical Columns and Supports: Metal, glass fiber reinforced plastic, or paper or fiber tubes that will produce smooth surfaces without joint indications. Provide units with sufficient wall thickness to resist wet concrete loads without deformation.

E. Pan Type Forms: Glass fiber reinforced plastic or formed steel, stiffened to support weight of placed concrete without deformation.

F. Carton Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.

G. Form Release Agent: Provide commercial formulation form release agent with a maximum of 350 g/L volatile organic compounds (VOCs) that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

H. Form Ties: Factory fabricated, adjustable length, removable or snap off metal form ties designed to prevent form deflection and to prevent spalling of concrete upon removal. Provide units that will leave no metal closer than 1-1/2 inches to the plane of the exposed concrete surface.

1. Provide ties that, when removed, will leave holes not larger than 1 inch in diameter in the concrete surface.

2.03 REINFORCING MATERIALS

A. Reinforcing Bars: ASTM A 615, Grade 60, deformed

B. Galvanized Reinforcing Bars: ASTM A 767, Class II (2.0 oz. zinc psf), hot dip galvanized after fabrication and bending.

C. Epoxy Coated Reinforcing Bars: ASTM A 775

D. Steel Wire: ASTM A 82, plain, cold drawn steel

E. Welded Wire Fabric: ASTM A 185, welded steel wire fabric

F. Deformed Steel Welded Wire Fabric: ASTM A 497

G. Epoxy Coated Welded Wire Fabric: ASTM A 884, Class A

H. Supports for Reinforcement: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place. Use wire bar type supports complying with CRSI specifications.

1. For slabs on grade, use supports with sand plates or horizontal runners where base material will not support chair legs.

2. For exposed to view concrete surfaces where legs of supports are in contact with forms, provide supports with legs that are protected by plastic (CRSI, Class 1) or stainless steel (CRSI, Class 2).

2.04 CONCRETE MATERIALS

A. Portland Cement: ASTM C 150, Type I.

1. Use one brand of cement throughout Project unless otherwise acceptable to Owner.

B. Fly Ash: ASTM C 618, Type F.

C. Normal Weight Aggregates: ASTM C 33 and as specified. Provide aggregates from a single source for exposed concrete.

1. For exposed exterior surfaces, do not use fine or coarse aggregates that contain substances that cause spalling.

2. Local aggregates not complying with ASTM C 33 that have been shown to produce concrete of adequate strength and durability by special tests or actual service may be used when acceptable to Owner.

D. Lightweight Aggregates: ASTM C 330

E. Water: Potable

F. Fiber Reinforcement: Polypropylene fibers engineered and designed for secondary reinforcement of concrete slabs, complying with ASTM C 1116, Type III. Subject to compliance with requirements, provide one of the following:

1. Gilco Fibers, Cormix Construction Chemicals

2. Durafiber, Durafiber Corp.

3. Fiberstrand 100, Euclid Chemical Co.

4. Fibermesh, Fibermesh Co., Div. Synthetic Industries, Inc.

5. Forta, Forta Corp.

6. Grace Fibers, W.R. Grace & Co.

7. Polystrand, Metalcrete Industries

G. Admixtures, General: Provide concrete admixtures that contain not more than 0.1 percent chloride ions.

H. Air Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures. Subject to compliance with requirements, provide one of the following:

1. Air Tite, Cormix Construction Chemicals

2. Air Mix or Perma Air, Euclid Chemical Co.
3. Darex AEA or Daravair, W.R. Grace & Co.
4. MB VR or Micro Air, Master Builders, Inc.
5. Sealtight AEA, W.R. Meadows, Inc.
6. Sika AER, Sika Corp.

I. Water Reducing Admixture: ASTM C 494, Type A. Subject to compliance with requirements, provide one of the following:

1. Chemtard, ChemMasters Corp.
2. PSI N, Cormix Construction Chemicals
3. Eucon WR 75, Euclid Chemical Co.
4. WRDA, W.R. Grace & Co.
5. Pozzolith Normal or Polyheed, Master Builders, Inc.
6. Metco W.R., Metalcrete Industries
7. Prokrete N, Prokrete Industries
8. Plastocrete 161, Sika Corp.

J. High Range Water Reducing Admixture: ASTM C 494, Type F or Type G. Subject to compliance with requirements, provide one of the following:

1. Super P, Anti Hydro Co., Inc.
2. Cormix 200, Cormix Construction Chemicals
3. Eucon 37, Euclid Chemical Co.
4. WRDA 19 or Daracem, W.R. Grace & Co.
5. Rheobuild or Polyheed, Master Builders, Inc.
6. Superslump, Metalcrete Industries
7. PSPL, Prokrete Industries
8. Sikament 300, Sika Corp.

K. Water Reducing, Accelerating Admixture: ASTM C 494, Type E. Subject to compliance with requirements, provide one of the following:

1. Q Set, Conspec Marketing & Manufacturing Co.
2. Lubricon NCA, Cormix Construction Chemicals

3. Accelguard 80, Euclid Chemical Co.

4. Daraset, W.R. Grace & Co.

5. Pozzutec 20, Master Builders, Inc.

6. Accel Set, Metalcrete Industries

L. Water Reducing, Retarding Admixture: ASTM C 494, Type D. Subject to compliance with requirements, provide one of the following:

1. PSI R Plus, Cormix Construction Chemicals

2. Eucon Retarder 75, Euclid Chemical Co.

3. Daratard 17, W.R. Grace & Co.

4. Pozzolith R, Master Builders, Inc.

5. Protard, Prokrete Industries

6. Plastiment, Sika Corp.

2.05 RELATED MATERIALS

A. Reglets: Where sheet flashing or bituminous membranes are terminated in reglets, provide reglets of not less than 0.0217 inch thick (26 gage) galvanized sheet steel. Fill reglet or cover face opening to prevent intrusion of concrete or debris.

B. Dovetail Anchor Slots: Hot dip galvanized sheet steel, not less than 0.0336 inch thick (22 gage) with bent tab anchors. Fill slot with temporary filler or cover face opening to prevent intrusion of concrete or debris.

C. Waterstops: Provide bentonite strip type waterstops; "Volclay Waterstop RX" by American Colloid Co.

D. Waterstops: Provide flat, dumbbell type or centerbulb type waterstops at construction joints and other joints as indicated. Size to suit joints.

E. Rubber Waterstops: Corps of Engineers CRD C 513. Subject to compliance with requirements, provide products of one of the following:

1. The Burke Co.

2. Progress Unlimited

3. Williams Products, Inc.

F. Polyvinyl Chloride Waterstops: Corps of Engineers CRD C 572. Subject to compliance with requirements, provide products of one of the following:

1. The Burke Co.

2. Greenstreak Plastic Products Co.

3. W.R. Meadows, Inc.

4. Progress Unlimited

5. Schlegel Corp.

6. Vinylex Corp.

G. Sand Cushion: Clean, manufactured or natural sand

H. Vapor Retarder: Provide vapor retarder that is resistant to deterioration when tested according to ASTM E 154, as follows:

1. Polyethylene sheet not less than 8 mils thick.

2. Water resistant barrier consisting of heavy kraft papers laminated together with glass fiber reinforcement and overcoated with black polyethylene on each side.

a. Product: Subject to compliance with requirements, provide Moistop by Fortifiber Corporation.

I. Vapor Barrier: Premolded seven ply membrane consisting of reinforced core and carrier sheet with fortified bitumen layers, protective weathercoating, and plastic antistick sheet. Water vapor transmission rate of 0.00 grains per square foot per hour when tested according to ASTM E 96, Method B. Provide manufacturer's recommended mastics and gusset tape.

1. Product: Subject to compliance with requirements, provide Sealtight Premoulded Membrane by W.R. Meadows, Inc.

J. Nonslip Aggregate Finish: Provide fused aluminum oxide granules or crushed emery as the abrasive aggregate for a nonslip finish, with emery aggregate containing not less than 50 percent aluminum oxide and not less than 25 percent ferric oxide. Use material that is factory graded, packaged, rustproof, nonglazing, and unaffected by freezing, moisture, and cleaning materials.

K. Colored Wear Resistant Finish: Packaged dry combination of materials consisting of portland cement, graded quartz aggregate, coloring pigments, and plasticizing admixture. Use coloring pigments that are finely ground nonfading mineral oxides interground with cement. Color as selected by Owner from manufacturers' standards, unless otherwise indicated. Subject to compliance with requirements, provide one of the following:

1. Conshake 600 Colortone, Conspec Marketing & Mfg. Co.

2. Floorcron, Cormix Construction Chemicals

3. Quartz Tuff, Dayton Superior

4. Surflex, Euclid Chemical Co.

5. Colorundum, A.C. Horn, Inc.

6. Quartz Plate, L&M Construction Chemicals, Inc.

7. Colorcron, Master Builders, Inc.

8. Floor Quartz, Metalcrete Industries

9. Lithochrome Color Hardener, L.M. Scofield Co.

10. Harcol Redi Mix, Sonneborn Chemrex

11. Hard Top, Symons Corp.

L. Absorptive Cover: Burlap cloth made from jute or kenaf, weighing approximately 9 oz. per sq. yd., complying with AASHTO M 182, Class 2.

M. Moisture Retaining Cover: One of the following, complying with ASTM C 171.

1. Waterproof paper

2. Polyethylene film

3. Polyethylene coated burlap

N. Liquid Membrane Forming Curing Compound: Liquid type membrane forming curing compound complying with ASTM C 309, Type I, Class A. Moisture loss not more than 0.55 kilograms per square meter when applied at 200 square feet per gallon.

1. Provide material that has a maximum volatile organic compound (VOC) rating of 350 millograms per liter.

2. Products: Subject to compliance with requirements, provide one of the following:

a. A H 3 Way Sealer, Anti Hydro Co., Inc.

b. Spartan Cote, The Burke Co.

c. Conspec #1, Conspec Marketing & Mfg. Co.

d. Sealco 309, Cormix Construction Chemicals

e. Day Chem Cure and Seal, Dayton Superior Corp.

f. Eucocure, Euclid Chemical Co.

g. Horn Clear Seal, A.C. Horn, Inc.

h. L&M Cure R, L&M Construction Chemicals, Inc.

i. Masterkure, Master Builders, Inc.

j. CS 309, W.R. Meadows, Inc.

k. Seal N Kure, Metalcrete Industries

l. Kure N Seal, Sonneborn Chemrex

m. Stontop CS2, Stonhard, Inc.

O. Water Based Acrylic Membrane Curing and Sealing Compound: ASTM C 309, Type I, Class B. Subject to compliance with requirements, provide one of the following:

1. Highseal, Conspec Marketing and Mfg. Co.
2. Sealco VOC, Cormix Construction Chemicals
3. Safe Cure and Seal, Dayton Superior Corp.
4. Aqua Cure, Euclid Chemical Co.
5. Dress & Seal WB, L&M Construction Chemicals, Inc.
6. Masterkure 100W, Master Builders, Inc.
7. Vocomp 20, W.R. Meadows, Inc.
8. Metcure, Metalcrete Industries
9. Stontop CS1, Stonhard, Inc.

P. Evaporation Control: Monomolecular film forming compound applied to exposed concrete slab surfaces for temporary protection from rapid moisture loss. Subject to compliance with requirements, provide one of the following:

1. Aquafilm, Conspec Marketing and Mfg. Co.
2. Eucobar, Euclid Chemical Co.
3. E Con, L&M Construction Chemicals, Inc.
4. Confilm, Master Builders, Inc.
5. Waterhold, Metalcrete Industries

Q. Underlayment Compound: Free flowing, self leveling, pumpable, cement based compound for applications from 1 inch thick to feathered edges. Subject to compliance with requirements, provide one of the following:

1. Ardex, Inc. "K-15"
2. Conspec Marketing and Mfg. Co. "Conflow"
3. Dayton Superior Corp. "LevelLayer II"
4. Euclid Chemical Co. "Flo-Top"
5. L&M Construction Chemicals, Inc. "Levelex"
6. Master Builders, Inc. "Pourcrete"
7. Sonneborn, "SonoFlow"

R. Bonding Agent: Polyvinyl acetate or acrylic base. Subject to compliance with requirements, provide one of the following:

1. Polyvinyl Acetate (Interior Only):
    a. Superior Concrete Bonder, Dayton Superior Corp.
    b. Euco Weld, Euclid Chemical Co.
    c. Weld Crete, Larsen Products Corp.
    d. Everweld, L&M Construction Chemicals, Inc.
    e. Herculox, Metalcrete Industries
    f. Ready Bond, Symons Corp.
2. Acrylic or Styrene Butadiene:
    a. Acrylic Bondcrete, The Burke Co.
    b. Strongbond, Conspec Marketing and Mfg. Co.
    c. Day Chem Ad Bond, Dayton Superior Corp.
    d. SBR Latex, Euclid Chemical Co.
    e. Daraweld C, W.R. Grace & Co.
    f. Hornweld, A.C. Horn, Inc.
    g. Everbond, L&M Construction Chemicals, Inc.
    h. Acryl Set, Master Builders Inc.
    i. Intralok, W.R. Meadows, Inc.
    j. Acrylpave, Metalcrete Industries
    k. Sonocrete, Sonneborn Chemrex
    l. Stonlock LB2, Stonhard, Inc.
    m. Strong Bond, Symons Corp.

S. Epoxy Adhesive: ASTM C 881, two component material suitable for use on dry or damp surfaces. Provide material type, grade, and class to suit Project requirements. Subject to compliance with requirements, provide one of the following:
1. Burke Epoxy M.V., The Burke Co.
2. Spec Bond 100, Conspec Marketing and Mfg. Co.
3. Resi Bond (J 58), Dayton Superior
4. Euco Epoxy System #452 or #620, Euclid Chemical Co.
5. Epoxtite Binder 2390, A.C. Horn, Inc.

6. Epabond, L&M Construction Chemicals, Inc.

7. Concresive Standard Liquid, Master Builders, Inc.

8. Rezi Weld 1000, W.R. Meadows, Inc.

9. Metco Hi Mod Epoxy, Metalcrete Industries

10. Sikadur 32 Hi Mod, Sika Corp.

11. Stonset LV5, Stonhard, Inc.

12. R 600 Series, Symons Corp.

2.06 PROPORTIONING AND DESIGNING MIXES

A. Prepare design mixes for each type and strength of concrete by either laboratory trial batch or field experience methods as specified in ACI 301. For the trial batch method, use an independent testing agency acceptable to Owner for preparing and reporting proposed mix designs.

1. Do not use the same testing agency for field quality control testing.

2. Limit use of fly ash to not exceed 25 percent of cement content by weight.

B. Submit written reports to Owner of each proposed mix for each class of concrete at least 15 days prior to start of Work. Do not begin concrete production until proposed mix designs have been reviewed by Owner.

C. Design mixes to provide normal weight concrete with the following properties as indicated on Drawings and schedules:

1. 4000 psi, 28 day compressive strength; water cement ratio, 0.44 maximum (non air entrained), 0.35 maximum (air entrained).

2. 3500 psi, 28 day compressive strength; water cement ratio, 0.51 maximum (non air entrained), 0.40 maximum (air entrained).

3. 3000 psi, 28 day compressive strength; water cement ratio, 0.58 maximum (non air entrained), 0.46 maximum (air entrained).

4. 2500 psi, 28 day compressive strength; water cement ratio, 0.67 maximum (non air entrained), 0.54 maximum (air entrained).

D. Water Cement Ratio: Provide concrete for following conditions with maximum water cement (W/C) ratios as follows:

1. Subjected to freezing and thawing: W/C 0.45.

2. Subjected to deicers/watertight: W/C 0.40.

3. Subjected to brackish water, salt spray, or deicers: W/C 0.40.

E. Slump Limits: Proportion and design mixes to result in concrete slump at point of placement as follows:

1. Ramps, slabs, and sloping surfaces: Not more than 3 inches.

2. Reinforced foundation systems: Not less than 1 inch and not more than 3 inches.

3. Concrete containing high range water reducing admixture (superplasticizer): Not more than 8 inches after adding admixture to Site verified 2 to 3 inch slump concrete.

4. Other concrete: Not more than 4 inches.

F. Lightweight Structural Concrete: Lightweight aggregate and concrete shall conform to ASTM C 330. Proportion mix to produce concrete with a minimum compressive strength of 3000 psi at 28 days and a calculated equilibrium unit weight of 110 pcf plus or minus 3 pcf as determined by ASTM C 567. Concrete slump at the point of placement shall be the minimum necessary for efficient mixing, placing, and finishing. Maximum slump shall be 6 inches for pumped concrete and 5 inches elsewhere. Air entrain concrete exposed to weather according to ACI 301 requirements.

G. Adjustment to Concrete Mixes: Mix design adjustments may be requested by Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant, as accepted by Owner. Laboratory test data for revised mix design and strength results must be submitted to and accepted by Owner before using in Work.

H. Fiber Reinforcement: Add to mix at rate of 1.5 lb per cu. yd. unless otherwise recommended by manufacturer.

2.07 ADMIXTURES

A. Use water reducing admixture or high range water reducing admixture (superplasticizer) in concrete, as required, for placement and workability.

B. Use accelerating admixture in concrete slabs placed at ambient temperatures below 50 degrees F (10 degrees C).

C. Use high range water reducing admixture in pumped concrete, concrete for heavy use industrial slabs, architectural concrete, parking structure slabs, concrete required to be watertight, and concrete with water cement ratios below 0.50.

D. Use air entraining admixture in exterior exposed concrete unless otherwise indicated. Add air entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having total air content with a tolerance of plus or minus 1½ percent within the following limits:

1. Concrete structures and slabs exposed to freezing and thawing, deicer chemicals, or hydraulic pressure:

a. 4.5 percent (moderate exposure); 5.5 percent (severe exposure) for 1½ inch maximum aggregate.

b. 4.5 percent (moderate exposure); 6.0 percent (severe exposure) for 1 inch maximum aggregate.

c. 5.0 percent (moderate exposure); 6.0 percent (severe exposure) for ¾ inch maximum aggregate.

d. 5.5 percent (moderate exposure); 7.0 percent (severe exposure) for ½ inch maximum aggregate.

2. Other concrete not exposed to freezing, thawing, or hydraulic pressure, or to receive a surface hardener: 2 to 4 percent air.

E. Use admixtures for water reduction and set accelerating or retarding in strict compliance with manufacturer's directions.

2.08 CONCRETE MIXING

A. Job Site Mixing: Mix concrete materials in appropriate drum type batch machine mixer. For mixers of 1 cubic yard or smaller capacity, continue mixing at least 1½ minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released. For mixers of capacity larger than 1 cubic yard, increase minimum 1½ minutes of mixing time by 15 seconds for each additional cubic yard.

1. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mix type, mix time, quantity, and amount of water introduced.

B. Ready Mixed Concrete: Comply with requirements of ASTM C 94, and as specified.

1. When air temperature is between 85 degrees F (30 degrees C) and 90 degrees F (32 degrees C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes, and when air temperature is above 90 degrees F (32 degrees C), reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.01 PREPARATION

A. Coordinate the installation of joint materials, vapor retarder/barrier, and other related materials with placement of forms and reinforcing steel.

3.02 VAPOR RETARDER/BARRIER INSTALLATION

A. General: Place vapor retarder/barrier sheeting in position with longest dimension parallel with direction of pour.

B. Lap joints 6 inches and seal with manufacturer's recommended mastic or pressure sensitive tape.

1. Cover vapor retarder/barrier with sand cushion and compact to depth indicated.

3.03 PLACING REINFORCEMENT

A. General: Comply with Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars," for details and methods of reinforcement placement and supports and as specified.

1. Avoiding cutting or puncturing vapor retarder/barrier during reinforcement placement and concreting operations. Repair damages before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials that reduce or destroy bond with concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers, as approved by Owner.

D. Place reinforcement to maintain minimum coverages as indicated for concrete protection. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.

E. Install welded wire fabric in lengths as long as practicable. Lap adjoining pieces at least one full mesh and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

3.04 INSTALLING EMBEDDED ITEMS

A. General: Set and build into formwork anchorage devices and other embedded items required for other work that is attached to or supported by cast in place concrete. Use setting Drawings, diagrams, instructions, and directions provided by suppliers of items to be attached.

B. Install reglets to receive top edge of foundation sheet waterproofing and to receive through wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, relieving angles, and other conditions.

C. Install dovetail anchor slots in concrete structures as indicated on Drawings.

D. Forms for Slabs: Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and contours in finished surfaces. Provide and secure units to support screed strips using strike off templates or compacting type screeds.

3.05 PREPARING FORM SURFACES

A. General: Coat contact surfaces of forms with an approved, nonresidual, low VOC, form coating compound before placing reinforcement.

B. Do not allow excess form coating material to accumulate in forms or come into contact with in place concrete surfaces against which fresh concrete will be placed. Apply according to manufacturer's instructions.

1. Coat steel forms with a nonstaining, rust preventative material. Rust stained steel formwork is not acceptable.

3.06 CONCRETE PLACEMENT

A. Inspection: Before placing concrete, inspect and complete formwork installation, reinforcing steel, and items to be embedded or cast in. Notify other trades to permit installation of their work.

B. General: Comply with ACI 304, "Guide for Measuring, Mixing, Transporting, and Placing Concrete," and as specified.

C. Deposit concrete continuously or in layers of such thickness that no new concrete will be placed on concrete that has hardened sufficiently to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as specified. Deposit concrete to avoid segregation at its final location.

D. Placing Concrete in Forms: Deposit concrete in forms in horizontal layers no deeper than 24 inches and in a manner to avoid inclined construction joints. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.

1. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping. Use equipment and procedures for consolidation of concrete complying with ACI 309.

2. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations no farther than the visible effectiveness of the machine. Place vibrators to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mix to segregate.

E. Placing Concrete Slabs: Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until completing placement of a panel or section.

1. Consolidate concrete during placement operations so that concrete is thoroughly worked around reinforcement, other embedded items and into corners.

2. Bring slab surfaces to correct level with a straightedge and strike off. Use bull floats or darbies to smooth surface free of humps or hollows. Do not disturb slab surfaces prior to beginning finishing operations.

3. Maintain reinforcing in proper position on chairs during concrete placement.

F. Cold Weather Placement: Comply with provisions of ACI 306 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

G. When air temperature has fallen to or is expected to fall below 40 degrees F (4 degrees C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 degrees F (10 degrees C) and not more than 80 degrees F (27 degrees C) at point of placement.

1. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.

2. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise accepted in mix designs.

H. Hot Weather Placement: When hot weather conditions exist that would impair quality and strength of concrete, place concrete complying with ACI 305 and as specified.

1. Cool ingredients before mixing to maintain concrete temperature at time of placement to below 90 degrees F (32 degrees C). Mixing water may be chilled or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.

2. Cover reinforcing steel with water soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedding in concrete.

3. Fog spray forms, reinforcing steel, and subgrade just before placing concrete. Keep subgrade moisture uniform without puddles or dry areas.

4. Use water reducing retarding admixture when required by high temperatures, low humidity, or other adverse placing conditions, as acceptable to Owner.

3.10 MONOLITHIC SLAB FINISHES

I. Scratch Finish: Apply scratch finish to monolithic slab surfaces to receive concrete floor topping or mortar setting beds for tile, portland cement terrazzo, and other bonded applied cementitious finish flooring material, and where indicated.

1. After placing slabs, finish surface to tolerances of F(F) 20 (floor flatness) and F(L) 15 (floor levelness) measured according to ASTM E 1155. Slope surfaces uniformly to drains where indicated. After leveling, roughen surface before final set with stiff brushes, brooms, or rakes.

J. Float Finish: Apply float finish to monolithic slab surfaces to receive trowel finish and other finishes as specified; slab surfaces to be covered with membrane or elastic waterproofing, membrane or elastic roofing, or sand bed terrazzo; and where indicated.

1. After screeding, consolidating, and leveling concrete slabs, do not work surface until ready for floating. Begin floating, using float blades or float shoes only, when surface water has disappeared, or when concrete has stiffened sufficiently to permit operation of power driven floats, or both. Consolidate surface with power driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to tolerances of F(F) 18 (floor flatness) and F(L) 15 (floor levelness) measured according to ASTM E 1155. Cut down high spots and fill low spots. Uniformly slope surfaces to drains where indicated. Immediately after leveling, refloat surface to a uniform, smooth, granular texture.

K. Trowel Finish: Apply a trowel finish to monolithic slab surfaces exposed to view and slab surfaces to be covered with resilient flooring, carpet, ceramic or quarry tile, paint, or another thin film finish coating system.

1. Uniformly slope surfaces to drains where indicated. After floating, begin first trowel finish operation using a power driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over surface. Consolidate concrete surface by final hand troweling operation, free of trowel marks, uniform in texture and appearance, and finish surfaces to tolerances of F(F) 20 (floor flatness) and F(L) 17 (floor levelness) measured according to ASTM E 1155. Grind smooth any surface defects that would telegraph through applied floor covering system.

L. Trowel and Fine Broom Finish: Where ceramic or quarry tile is to be installed with thin set mortar, apply a trowel finish as specified, then immediately follow by slightly scarifying the surface with a fine broom.

M. Nonslip Broom Finish: Apply a nonslip broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.

1. Immediately after float finishing, slightly roughen concrete surface by brooming with fiber bristle broom perpendicular to main traffic route. Coordinate required final finish with Owner before application.

N. Nonslip Aggregate Finish: Apply nonslip aggregate finish to concrete stair treads, platforms, ramps, sloped walks, and where indicated.

1. After completing float finishing and before starting trowel finish, uniformly spread 25 pounds of dampened nonslip aggregate per 100 square feet of surface. Tamp aggregate flush with surface using a steel trowel, but do not force below surface. After broadcasting and tamping, apply trowel finishing as specified.

2. After curing, lightly work surface with a steel wire brush or an abrasive stone, and water to expose nonslip aggregate.

O. Colored Wear Resistant Finish: Apply a colored wear resistant finish to monolithic slab surface indicated.

1. Apply dry shake materials for the colored wear resistant finish at a rate of 100 pounds per 100 square feet, unless a greater amount is recommended by material manufacturer.

2. Cast a trial slab approximately 10 feet square to determine actual application rate, color, and finish, as acceptable to Owner.

3. Immediately following the first floating operation, uniformly distribute with mechanical spreader approximately two thirds of the required weight of the dry shake material over the concrete surface, and embed by power floating. Follow floating operation with second shake application, uniformly distributing remainder of dry shake material with overlapping applications to ensure uniform color, and embed by power floating.

4. After broadcasting and floating, apply a trowel finish as specified. Cure slab surface with a curing compound recommended by the dry shake material manufacturer. Apply the curing compound immediately after the final finishing.

3.07 MISCELLANEOUS CONCRETE ITEMS

A. Filling In: Fill in holes and openings left in concrete structures for passage of work by other trades, unless otherwise shown or directed, after work of other trades is in place. Mix, place, and cure concrete as specified to blend with in place construction. Provide other miscellaneous concrete filling shown or required to complete Work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Floor Drains: At all interior floor drain locations, where the entire floor is not indicated to slope to drain, provide a depressed sump approximately 1 inch deep and 12 inches to 18 inches in diameter in the surface of the concrete to facilitate drainage.

D. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment to template at correct elevations, complying with diagrams or templates of manufacturer furnishing machines and equipment.

3.08 CONCRETE CURING AND PROTECTION

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. In hot, dry, and windy weather protect concrete from rapid moisture loss before and during finishing operations with an evaporation control material. Apply according to manufacturer's instructions after screeding and bull floating, but before power floating and troweling.

B. Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing. Weather permitting, keep continuously moist for not less than 7 days.

C. Curing Methods: Cure concrete by curing compound, by moist curing, by moisture retaining cover curing, or by combining these methods, as specified.

D. Provide moisture curing by the following methods:

1. Keep concrete surface continuously wet by covering with water.

2. Use continuous water fog spray.

3. Cover concrete surface with specified absorptive cover, thoroughly saturate cover with water, and keep continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges, with a 4 inch lap over adjacent absorptive covers.

E. Provide moisture retaining cover curing as follows:

1. Cover concrete surfaces with moisture retaining cover for curing concrete, placed in widest practicable width with sides and ends lapped at least 3 inches and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

F. Apply curing compound on exposed interior slabs and on exterior slabs, walks, and curbs as follows:

1. Apply curing compound to concrete slabs as soon as final finishing operations are complete (within 2 hours and after surface water sheen has disappeared). Apply uniformly in continuous operation by power spray or roller according to manufacturer's directions. Recoat areas subjected to heavy rainfall within 3 hours after initial application. Maintain continuity of coating and repair damage during curing period.

2. Use membrane curing compounds that will not affect surfaces to be covered with finish materials applied directly to concrete.

G. Curing Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces, by moist curing with forms in place for the full curing period or until forms are removed. If forms are removed, continue curing by methods specified above, as applicable.

H. Curing Unformed Surfaces: Cure unformed surfaces, including slabs, floor topping, and other flat surfaces, by applying the appropriate curing method.

1. Final cure concrete surfaces to receive finish flooring with a moisture retaining cover, unless otherwise directed.

3.09 CONCRETE SURFACE REPAIRS

A. Patching Defective Areas: Repair and patch defective areas with cement mortar immediately after removing forms, when acceptable to Owner.

B. Mix dry pack mortar, consisting of one part portland cement to 2½ parts fine aggregate passing a No. 16 mesh sieve, using only enough water as required for handling and placing.

1. Cut out honeycombs, rock pockets, voids over ¼ inch in any dimension, and holes left by tie rods and bolts down to solid concrete but in no case to a depth less than 1 inch. Make edges of cuts perpendicular to the concrete surface. Thoroughly clean, dampen with water, and brush coat the area to be patched with bonding agent. Place patching mortar before bonding agent has dried.

2. For surfaces exposed to view, blend white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Provide test areas at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.

C. Repairing Formed Surfaces: Remove and replace concrete having defective surfaces if defects cannot be repaired to satisfaction of Owner. Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycomb, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning. Flush out form tie holes and fill with dry pack mortar or precast cement cone plugs secured in place with bonding agent.

1. Repair concealed formed surfaces, where possible, containing defects that affect the concrete's durability. If defects cannot be repaired, remove and replace the concrete.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as monolithic slabs, for smoothness and verify surface tolerances specified for each surface and finish. Correct low and high areas as specified. Test unformed surfaces sloped to drain for trueness of slope and smoothness by using a template having the required slope.

1. Repair finished unformed surfaces containing defects that affect the concrete's durability. Surface defects include crazing and cracks in excess of 0.01 inch wide or that penetrate to the reinforcement or completely through nonreinforced sections regardless of width, spalling, popouts, honeycombs, rock pockets, and other objectionable conditions.

2. Correct high areas in unformed surfaces by grinding after concrete has cured at least 14 days.

3. Correct low areas in unformed surfaces during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete. Proprietary underlayment compounds may be used when acceptable to Owner.

4. Repair defective areas, except random cracks and single holes not exceeding 1 inch in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose reinforcing steel with at least ¾ inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials to provide concrete of same type or class as original concrete. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.

E. Repair isolated random cracks and single holes 1 inch or less in diameter by dry pack method. Groove top of cracks and cut out holes to sound concrete and clean of dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding compound. Place dry pack before bonding agent has dried. Compact dry pack mixture in place and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

F. Perform structural repairs with prior approval of Owner for method and procedure, using specified epoxy adhesive and mortar.

G. Repair methods not specified above may be used, subject to acceptance of Owner.

3.10 QUALITY CONTROL TESTING DURING CONSTRUCTION

A. The Owner will employ a testing agency to perform tests and to submit test reports.

B. Sampling and testing for quality control during concrete placement may include the following, as directed by Owner.

1. Sampling Fresh Concrete: ASTM C 172, except modified for slump to comply with ASTM C 94.

a. Slump: ASTM C 143; one test at point of discharge for each day's pour of each type of concrete; additional tests when concrete consistency seems to have changed.

b. Air Content: ASTM C 173, volumetric method for lightweight or normal weight concrete; ASTM C 231, pressure method for normal weight concrete; one for each day's pour of each type of air entrained concrete.

c. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F (4 deg C) and below, when 80 deg F (27 deg C) and above, and one test for each set of compressive strength specimens.

d. Compression Test Specimen: ASTM C 31; one set of four standard cylinders for each compressive strength test, unless otherwise directed. Mold and store cylinders for laboratory cured test specimens except when field cured test specimens are required.

e. Compressive Strength Tests: ASTM C 39; one set for each day's pour exceeding 5 cu. yd. plus additional sets for each 50 cubic yards more than the first 25 cubic yards of each concrete class placed in any one day; one specimen tested at 7 days, two specimens tested at 28 days, and one specimen retained in reserve for later testing if required.

2. When frequency of testing will provide fewer than five strength tests for a given class of concrete, conduct testing from at least five randomly selected batches or from each batch if fewer than five are used.

3. When total quantity of a given class of concrete is less than 50 cubic yards, Owner may waive strength testing if adequate evidence of satisfactory strength is provided.

4. When strength of field cured cylinders is less than 85 percent of companion laboratory cured cylinders, evaluate current operations and provide corrective procedures for protecting and curing the in place concrete.

5. Strength level of concrete will be considered satisfactory if averages of sets of three consecutive strength test results equal or exceed specified compressive strength and no individual strength test result falls below specified compressive strength by more than 500 psi.

C. Test results will be reported in writing to Owner, Structural Engineer, ready mix producer, and Contractor within 24 hours after tests. Reports of compressive strength tests shall contain the Project identification name and number, date of concrete placement, name of concrete testing service, concrete type and class, location of concrete batch in structure, design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength, and type of break for both 7 day tests and 28 day tests.

D. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted but shall not be used as the sole basis for acceptance or rejection.

E. Additional Tests: The testing agency will make additional tests of in place concrete when test results indicate specified concrete strengths and other characteristics have not been attained in the structure, as directed by Owner. Testing agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42, or by other methods as directed.

END OF SECTION 03 30 00

SECTION 04 20 00 – UNIT MASONRY

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with all applicable requirements and standards.

1.03 QUALITY ASSURANCE

A. Single Source Responsibility for Masonry Units: Obtain exposed masonry units of uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from one manufacturer for each different product required for each continuous surface or visually related surfaces.

B. Single Source Responsibility for Mortar Materials: Obtain mortar ingredients of uniform quality, including color for exposed masonry, from one manufacturer for each cementitious component and from one source and producer for each aggregate.

C. Field Constructed Mock Ups: Prior to installation of unit masonry, erect sample wall panels to further verify selections made under sample submittals and to demonstrate aesthetic effects as well as qualities of materials and execution. Build mock ups to comply with the following requirements, using materials indicated for final unit of Work:

1. Locate mock ups on Site in locations indicated or, if not indicated, as directed by Architect.

2. Build mock ups for the following types of masonry in sizes of approximately 4 feet long by 4 feet high by full thickness, including face and backup wythes as well as accessories.

a. Each type of exposed unit masonry construction.

b. Typical exterior face brick wall.

c. Typical exterior face brick wall with framed window opening.

d. Typical interior unit masonry wall.

3. Where masonry is to match existing, erect panels parallel to existing surface.

4. Notify Architect one week in advance of the dates and times when mock ups will be erected.

5. Protect mock ups from the elements with weather resistant membrane.

6. Retain and maintain mock ups during construction in undisturbed condition as standard for judging completed unit masonry construction.

   a. When directed, demolish and remove mock ups from the Project Site.

   b. Accepted mock ups in undisturbed condition at time of Substantial Completion may become part of completed unit of Work.

D. Preinstallation Conference: Conduct conference at the Project Site to comply with requirements of Division 01.

1.04 SUBMITTALS

A. Product Data:

1. Material certificates for the following signed by manufacturer and Contractor certifying that each material complies with requirements.

   a. Each different cement product required for mortar and grout including name of manufacturer, brand, type, and weight slips at time of delivery.

   b. Each material and grade indicated for reinforcing bars.

   c. Each type and size of joint reinforcement.

      1) Each type and size of anchors, ties, and metal accessories.

B. Samples:

1. Samples for initial selection purposes of the following:

   a. Unit masonry samples in small scale form showing full extent of colors and textures available for each different exposed masonry unit required.

   b. Colored masonry mortar samples showing full extent of colors available.

2. Samples for verification purposes of the following:

   a. Full size units for each different exposed masonry unit required showing full range of exposed color, texture, and dimensions to be expected in completed construction.

      1) Include size variation data verifying that actual range of sizes for brick falls within ASTM C 216 dimension tolerances for brick where modular dimensioning is indicated.

   b. Colored masonry mortar samples for each color required showing the full range of colors expected in the finished construction. Label samples to indicate type and amount of colorant used.

c. Weep holes/vents in color to match mortar color.

d. Accessories embedded in the masonry.

C. Record Documents:

1. Shop drawings for reinforcing detailing fabrication, bending, and placement of unit masonry reinforcing bars. Comply with ACI 315 "Details and Detailing of Concrete Reinforcing" showing bar schedules, stirrup spacing, diagrams of bent bars, and arrangement of masonry reinforcement.

2. Cold weather construction procedures evidencing compliance with requirements specified in referenced unit masonry standard.

3. Hot weather construction procedures evidencing compliance with requirements specified in referenced unit masonry standard.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver masonry materials to Project in undamaged condition.

B. Store and handle masonry units off the ground, under cover, and in a dry location to prevent their deterioration or damage due to moisture, temperature changes, contaminants, corrosion, and other causes. If units become wet, do not place until units are in an air dried condition.

C. Store cementitious materials off the ground, under cover, and in dry location.

D. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

E. Store masonry accessories including metal items to prevent corrosion and accumulation of dirt and oil.

1.06 PROJECT CONDITIONS

A. During erection, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

1. Extend cover a minimum of 24 inches down both sides and hold cover securely in place.

2. Where one wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches down face next to unconstructed wythe and hold cover in place.

B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least 3 days after building masonry walls or columns.

C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Remove immediately any grout, mortar, and soil that comes in contact with such masonry.

1. Protect base of walls from rain splashed mud and mortar splatter by means of coverings spread on ground and over wall surface.

2. Protect sills, ledges, and projections from mortar droppings.

3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes from mortar droppings.

D. Cold Weather Construction: Comply with referenced unit masonry standard for cold weather construction and the following:

1. Do not lay masonry units that are wet or frozen.

2. Remove masonry damaged by freezing conditions.

E. Hot Weather Construction: Comply with referenced unit masonry standard.

1.07 ALLOWANCES

A. Furnish face brick, excluding special molded shapes.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

B. Comply with referenced unit masonry standard and other requirements specified in this Section applicable to each material indicated.

2.02 BRICK UNITS

A. Comply with the following requirements applicable to each form of brick required:

1. Provide special molded shapes where indicated and as follows:

a. For applications requiring brick of form, color, texture, and size on exposed surfaces that cannot be produced by sawing standard brick sizes.

b. For applications where stretcher units cannot accommodate special conditions including those at corners, movement joints, bond beams, sashes, and lintels.

2. Provide units without cores or frogs and with all exposed surfaces finished for ends of sills, caps, and similar applications that expose brick surfaces that otherwise would be concealed from view.

B. Face Brick Standard: ASTM C 216 and as follows:

1. Grade and Unit Compressive Strength: Provide units of grade SW and minimum average net area compressive strength not less than the unit compressive strengths required to produce clay masonry construction of compressive strength indicated.

2. Type FBS (for general use in exposed masonry requiring wider variations in size and color ranges than Type FBX).

3. Type FBX (for general use in exposed masonry requiring minimum variations in size and color ranges).

4. Type FBA (for special architectural effects resulting from non-uniformity in size, color, and texture of individual units).

5. Provide bricks manufactured to the dimensions within the tolerances specified in ASTM C 216 for Standard Modular Brick; 3-5/8 inches thick by 2-1/4 inches high by 7-5/8 inches long.

6. Application: Use where brick is exposed, unless otherwise indicated.

7. Wherever shown to "match existing," provide face brick of matching color, texture, and size as existing adjacent brickwork.

8. Color and Texture: Match Architect's sample.

2.03 CONCRETE MASONRY UNITS

A. Comply with requirements indicated below applicable to each form of concrete masonry unit required.

1. Provide special shapes where indicated and as follows:

a. For lintels, corners, jambs, sash, control joints, headers, bonding, and other special conditions.

b. Bullnose units for outside corners unless otherwise indicated.

c. Square edged units for outside corners, except where indicated as bullnose.

2. Size: Provide concrete masonry units complying with requirements indicated below for size that are manufactured to specified face dimensions within tolerances specified in the applicable referenced ASTM specification for concrete masonry units.

a. Concrete Masonry Units: Manufactured to specified dimensions of 3/8 inch less than nominal widths by nominal heights by nominal lengths indicated on drawings.

b. Prefaced Concrete Masonry Units: Manufactured to specified dimensions of 3/8 inch less than nominal widths by nominal heights by nominal lengths indicated on drawings, with prefaced surfaces having 1/16 inch thick returns of facing to create 1/4 inch wide mortar joints with modular coursing.

3. Provide Type I, moisture controlled units.

4. Exposed Faces: Manufacturer's standard color and texture, unless otherwise indicated.

   a. Where special finishes are indicated, provide units with exposed faces of the following general description matching color and texture of Architect's sample.

      1) Standard aggregate, ground finish

      2) Special aggregate, ground finish

      3) Standard aggregate, split face finish

      4) Special aggregate, split face finish

      5) Standard aggregate, split ribbed finish

      6) Special aggregate, split ribbed finish

   b. Where special patterns are indicated, provide units with exposed faces matching color, texture and pattern of Architect's sample.

B. Hollow Load Bearing Concrete Masonry Units: ASTM C 90, and as follows:

   1. Unit Compressive Strength: Provide units with minimum average net area compressive strength not less than the unit compressive strengths required to produce concrete unit masonry construction of compressive strength indicated.

   2. Weight Classification: Lightweight unless otherwise indicated or required by Project conditions.

C. Solid Load Bearing Concrete Masonry Units: ASTM C 90, and as follows:

   1. Unit Compressive Strength: Provide units with minimum average net area compressive strength not less than the unit compressive strengths required to produce concrete unit masonry construction of compressive strength indicated.

   2. Weight Classification: Lightweight unless otherwise indicated or required by Project conditions.

D. Prefaced Concrete Block: Lightweight concrete units indicated below with manufacturer's standard smooth resinous tile facing complying with ASTM C 744:

   1. For units on which prefaced surfaces are molded, comply with the following:

      a. Hollow Load Bearing Concrete Block: ASTM C 90

      b. Unit Compressive Strength: Provide units with minimum average net area compressive strength not less than the unit compressive strengths required to produce concrete unit masonry construction of compressive strength indicated.

2. Color and Pattern: Match Architect's sample

3. Color and Pattern: Provide color and pattern selected by Architect from manufacturer's full range of standard colors and patterns.

4. Available Products: Subject to compliance with requirements, prefaced concrete masonry units that may be incorporated in the Work include, but are not limited to, the following:

   a. "Astra Glaze," Trenwyth Industries, Inc.

   b. "Spectra Glaze II," The Burns & Russell Co.

2.04 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold weather construction. Provide natural color or white cement as required to produce required mortar color.

B. Mortar Cement: U.B.C. Standard No. 21-14

   1. For pigmented mortars, use premixed, colored martar cements of formulation required to produce color indicated, or if not indicated, as selected from manufacturer's standard formulations. Pigments shall not exceed 5 percent of mortar cement by weight for mineral oxides nor 1 percent for carbon black.

C. Ready Mixed Mortar: Cementitious materials, water, and aggregate complying with requirements specified in this article, combined with set controlling admixtures to produce a ready mixed mortar complying with ASTM C 1142.

D. Hydrated Lime: ASTM C 207, Type S

E. Aggregate for Mortar: ASTM C 144, except for joints less than 1/4 inch use aggregate graded with 100 percent passing the No. 16 sieve.

   1. White Mortar Aggregates: Natural white sand or ground white stone

   2. Colored Mortar Aggregates: Ground marble, granite, or other sound stone, as required to match Architect's sample.

F. Aggregate for Grout: ASTM C 404

G. Colored Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes. Use only pigments with record of satisfactory performance in masonry mortars.

H. Water: Clean and potable

2.05 REINFORCING STEEL

A. Provide reinforcing steel complying with requirements of referenced unit masonry standard and this article.

B. Steel Reinforcing Bars: Material and grade as follows:

1. Billet steel complying with ASTM A 615

2. Epoxy coated billet steel complying with ASTM A 615 and ASTM A 775

3. Grade 60

C. Deformed Reinforcing Wire: ASTM A 496

D. Plain Welded Wire Fabric: ASTM A 185

E. Deformed Welded Wire Fabric: ASTM A 497

2.06 JOINT REINFORCEMENT

A. Provide joint reinforcement complying with requirements of referenced unit masonry standard and this article, formed from galvanized carbon steel wire, coating class as required by referenced unit masonry standard for application indicated.

B. Description: Welded wire units prefabricated with deformed continuous side rods and plain cross rods into straight lengths of not less than 10 feet, with prefabricated corner and tee units, and complying with requirements indicated below:

1. Wire Diameter for Side Rods: 0.1483 inch (9 gage)

2. Wire Diameter for Cross Rods: 0.1483 inch (9 gage)

3. For single wythe masonry provide type as follows with single pair of side rods:

a. Ladder design with perpendicular cross rods spaced not more than 16 inches on center.

b. Truss design with continuous diagonal cross rods spaced not more than 16 inches on center.

4. For multiwythe masonry provide type as follows:

a. Tab design with single pair of side rods and rectangular box type cross ties spaced not more than 16 inches on center; with side rods spaced for embedment within each face shell of backup wythe and ties extended to engage the outer wythe by at least 1½ inches.

b. Acceptable products include Masonry Reinforcing Corp. "Series 800", Dur O waL "Ladur-Eye", or Hohman & Barnard "Hookit with 2Z Ties".

2.07 TIES AND ANCHORS, GENERAL

A. Provide ties and anchors specified in subsequent articles that comply with requirements for metal and size of referenced unit masonry standard and of this article.

B. Galvanized Carbon Steel Wire: ASTM A 82, coating class as required by referenced unit masonry standard for application indicated.

C. Galvanized Steel Sheet: ASTM A 366 (commercial quality) cold rolled carbon steel sheet, hot dip galvanized after fabrication to comply with ASTM A 525, Class B2 (for unit lengths over 15 inches) and Class B3 (for unit lengths under 15 inches), for sheet metal ties and anchors.

2.08 ADJUSTABLE ANCHORS FOR CONNECTING MASONRY TO STRUCTURAL FRAMEWORK

A. Two piece assemblies as described below allowing vertical or horizontal differential movement between wall and framework parallel to plane of wall, but resisting tension and compression forces perpendicular to it.

B. For anchorage to concrete framework, provide manufacturer's standard with dovetail anchor section formed from sheet metal and triangular shaped wire tie section sized to extend within 1 inch of masonry face and as follows:

1. Furnish dovetail slots to concrete trade for installation.

2. Acceptable products include Masonry Reinforcing Corp. "1304/2102", Dur O waL "D/A100/D/A720 723", or Heckman "100/103".

C. For anchorage to steel framework provide manufacturer's standard anchors with crimped 1/4 inch diameter wire anchor section for welding to steel and triangular shaped wire tie section sized to extend within 1 inch of masonry face and as follows:

1. Acceptable products include Masonry Reinforcing Corp. "1000, Type 1/1100", Dur O waL "D/A100/D/A720 723", or Heckman "100/103".

2.09 RIGID ANCHORS

A. Provide straps of form and length indicated, fabricated from metal strips of following width and thickness.

1. 1½ inches wide by ¼ inch thick.

2. As indicated.

2.10 ADJUSTABLE MASONRY VENEER ANCHORS

A. Provide two piece assemblies allowing vertical or horizontal differential movement between wall and framework parallel to plane of wall, but resisting tension and compression forces perpendicular to it; for attachment over sheathing to metal studs; and with the following structural performance characteristics:

1. Structural Performance Characteristics: Capable of withstanding a 100 pound/foot load in either tension or compression without deforming over, or developing play in excess of, 0.05 inch.

B. Provide anchors and ties as specified below with all components hot-dipped galvanized after fabrication. Size ties to extend to within ¾ inch of outside face of brick veneer.

1. Brick Veneer Anchors at Metal Stud Back Up Construction: Flexible two piece anchors consisting of 3/16 inch diameter trapezoidal shaped wire ties and 16 gage minimum steel strap designed for screw attachment into metal stud framing.

a. Acceptable products include Hohman & Barnard "DW 10/VWT", Masonry Reinforcing Corp. "1004/1100", or Dur O WaL "D/A213-.5/D/A701 708".

2. Brick Veneer Anchors at Solid Back Up Construction: Flexible two piece anchors consisting of 3/16 inch diameter trapezoidal shaped wire ties with 16 gage channel locking tab and 16 gage minimum steel "channel slot" designed for surface attachment to concrete or CMU back up.

a. Acceptable products include Masonry Reinforcing Corp. "1302/2103", Dur O WaL "D/A901/918 921", or Heckman "132/129".

C. Steel Drill Screws for Steel Studs: ASTM C 954 except manufactured with hex washer head and neoprene washer, #10 diameter by length required to penetrate steel stud flange by not less than 3 exposed threads, and with the following corrosion protective coating:

1. Organic polymer coating with salt spray resistance to red rust of more than 800 hours per ASTM B 117.

2. Organic Polymer Coated Steel Drill Screws:

a. "Traxx," ITW Buildex

b. "Dril Flex," Elco Industries, Inc.

2.11 MISCELLANEOUS ANCHORS

A. Unit Type Masonry Inserts in Concrete: Cast iron or malleable iron inserts of type and size indicated.

B. Dovetail Slots: Furnish dovetail slots, with filler strips, of slot size indicated, fabricated from 0.0336 inch (22 gage) sheet metal.

C. Anchor Bolts: Steel bolts complying with A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers; hot dip galvanized to comply with ASTM A 153, Class C; of diameter and length indicated and in the following configurations:

1. Headed bolts.

2. Nonheaded bolts, straight.

3. Nonheaded bolts, bent in manner indicated.

2.12 POSTINSTALLED ANCHORS

A. Anchors as described below, with capability to sustain, without failure, load imposed within factors of safety indicated, as determined by testing per ASTM E 488, conducted by a qualified independent testing laboratory.

1. Type: Chemical anchors.

2. Type: Expansion anchors.

3. Type: Undercut anchors.

4. Corrosion Protection: Carbon steel components zinc plated to comply with ASTM B 633, Class Fe/Zn 5 (5 microns) for Class SC 1 service condition (mild).

5. Corrosion Protection: Stainless steel components complying with ASTM F 593 and ASTM F 594, Group 1 alloy 304 or 316 for bolts and nuts; alloy 304 or 316 for anchor.

6. For cast in place and postinstalled anchors in concrete: Capability to sustain, without failure, a load equal to 4 times loads imposed by masonry.

7. For postinstalled anchors in grouted concrete masonry units: Capability to sustain, without failure, a load equal to 6 times loads imposed by masonry.

2.13 EMBEDDED THROUGH-WALL FLASHING MATERIALS

A. Copper Fabric Laminate: 5 ounce copper sheet bonded with asphalt between 2 layers of glass fiber cloth.

1. "Copper Fabric," Afco Products Inc.

2. "Type FCC Fabric Covered Copper," Phoenix Building Products

3. "Copper Fabric Flashing," Sandell Manufacturing Co., Inc.

4. "York Copper Fabric Flashing," York Manufacturing, Inc.

B. Adhesive for Flashings: Of type recommended by manufacturer of flashing material for use indicated.

2.14 MISCELLANEOUS MASONRY ACCESSORIES

A. Expansion and Control Joint Fillers:

1. Premolded Expansion Joint Filler: Closed cell polyethylene foam material with a density of ±2 psf, and compatible with most sealants. Acceptable products include Sonneborn "Sonoflex F" and Williams Products Inc. "Expand O Foam 1380 Series".

2. Construction Joint Filler: Closed cell expanded neoprene foam material with a density of 15 to 35 psf, flame resistant, and compatible with most sealants. Acceptable products include Williams Products Inc. "Neoprene Type NN1" and Rubatex Corp. "R 1800 FS".

3. Premolded Control Joint Strip: Solid rubber strips with a Shore A durometer hardness of 60 to 80, designed to fit standard sash blocks and maintain lateral stability of masonry wall. Provide strips in width approximately 2" less than thickness of masonry wythe. Acceptable products include Dur O waL "Rapid Control Joint" and Hohman & Barnard "QS Series".

B. Bond Breaker Strips: Asphalt saturated organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).

C. Weep Holes: Provide one of the following at Contractor's option:

1. Aluminum Weep Hole/Vent: One piece L shaped units made to fit in a vertical mortar joint from sheet aluminum and consisting of a vertical channel with louvers stamped in web and a flat horizontal; prepainted prior to installation, in color to match that of masonry or mortar as selected by Architect.

   a. "Louvered Weephole", Masonry Reinforcing Corp.

2. Plastic Weep Hole/Vent: One piece flexible extrusion manufactured from ultraviolet resistant polypropylene co polymer, designed to weep moisture in masonry cavity to exterior, sized to fill head joints with outside face held back 1/8 inch from exterior face of masonry, in custom color to match that of masonry or mortar as selected by Architect.

   a. "Cell Vent," Dur O Wal, Inc.

D. Cavity Drainage Material: To prevent mortar from blocking cavity weep holes, provide one of the following:

1. 1-inch-(25-mm-) thick, reticulated, nonabsorbent mesh, made from polyethylene strands and shaped to maintain drainage at weep holes without being clogged by mortar droppings. Product: "Mortar Net".

2.15 INSULATION

A. Loose Granular Perlite Insulation: ASTM C 549, Type II (surface treated for water repellency and limited moisture absorption) or IV (surface treated for water repellency and to limit dust generation).

B. Loose Granular Vermiculite Insulation: ASTM C 516, Type II (surface treated for water repellency and limited moisture absorption), Grade 3 (Fine), complying with 29 CFR 1926 by containing less than 0.10 percent by weight of asbestos and that demonstration shows will not release asbestos fibers in excess of 0.1 fibers per cubic centimeter under reasonably foreseeable Site conditions.

C. Extruded Polystyrene Board Insulation: Rigid cellular polystyrene thermal insulation with closed cells and integral high density skin, formed by the expansion of polystyrene base resin in an extrusion process to comply with ASTM C 578, Type IV; in manufacturer's standard lengths and widths; thicknesses as indicated.

D. Molded Polystyrene Board Insulation: Rigid, cellular thermal insulation formed by the expansion of polystyrene resin beads or granules in a closed mold to comply with ASTM C 578, Type I; in manufacturer's standard lengths and widths; thicknesses as indicated.

1. Provide specially shaped units designed for installation in cores of concrete blocks.

E. Adhesive: Type recommended by insulation board manufacturer for application indicated.

2.16 MORTAR AND GROUT MIXES

A. Do not add admixtures including coloring pigments, air entraining agents, accelerators, retarders, water repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.

B. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification, for types of mortar indicated below:

C. Proportions listed are in the following order, by volume of cementitious materials: (Portland Cement):(Hydrated Lime or Lime Putty):(Aggregate). Aggregate volume is based on the sum of the separate volumes of other cementitious materials.

1. Limit cementitious materials in mortar to portland cement lime.

2. Use Type M mortar for masonry below grade and in contact with earth, and where indicated: (1):(1/4):(2 1/4 to 3).

3. Use Type S mortar for reinforced masonry: (1):(1/4 to 1/2):(2 1/4 to 3).

4. Use Type N mortar for all other exterior and interior walls: (1):(1/2 to 1 1/4):(2 1/4 to 3).

5. Colored Pigmented Mortar: Select and proportion pigments with other ingredients to produce color required. Do not exceed pigment to-cement ratio of 1:10, by weight. Match Architect's sample.

D. Provide grout complying with ASTM C 476, of consistency indicated or, if not otherwise indicated, of consistency (fine or coarse) at time of placement which will completely fill all spaces intended to receive grout.

1. Provide grout in the following proportions, by volume: (1 part portland cement):(0 to 1/10 part hydrated lime or lime putty):(aggregate, 2½ to 3 times the sum of the volumes of other cementitious materials). Add coarse aggregate in the proportion of 1 to 2 times the sum of the volumes of other cementitious materials for "coarse" grout.

2. Use fine grout in grout spaces less than 2 inches in horizontal direction, unless otherwise indicated.

3. Use coarse grout in grout spaces 2 inches or more in least horizontal dimension, unless otherwise indicated.

PART 3 - EXECUTION

3.01 PREPARATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other specific conditions, and other conditions affecting performance of unit masonry.

1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of unit masonry.

B. Examine rough in and built in construction to verify actual locations of piping connections prior to installation.

C. Do not proceed until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. All installation shall be in accordance with manufacturer's published recommendations.

C. Comply with referenced unit masonry standard and other requirements indicated applicable to each type of installation included in Project.

D. Thickness: Build cavity and composite walls and other masonry construction to the full thickness shown. Build single wythe walls to the actual thickness of the masonry units, using units of nominal thickness indicated.

E. Build chases and recesses as shown or required to accommodate items specified in this and other Sections of the Specifications. Provide not less than 8 inches of masonry between chase or recess and jamb of openings and between adjacent chases and recesses.

F. Leave openings for equipment to be installed before completion of masonry. After installation of equipment, complete masonry to match construction immediately adjacent to the opening.

G. Cut masonry units with motor driven saws to provide clean, sharp, unchipped edges. Cut units as required to provide continuous pattern and to fit adjoining construction. Use full size units without cutting where possible.

H. Matching Existing Masonry: Match coursing, bonding, color, and texture of new masonry with existing masonry.

3.03 CONSTRUCTION TOLERANCES

A. Comply with construction tolerances of referenced unit masonry standard.

3.04 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint widths and for accurate locating of openings, movement type joints, returns, and offsets. Avoid the use of less than half size units at corners, jambs, and where possible at other locations.

B. Lay up walls to comply with specified construction tolerances, with courses accurately spaced and coordinated with other construction.

C. Bond Pattern for Exposed Masonry: Lay exposed masonry in the following bond pattern; do not use units with less that nominal 4 inch horizontal face dimensions at corners or jambs.

1. One half running bond with vertical joint in each course centered on units in courses above and below.

2. Stack bond

3. One third running bond

4. As indicated on drawings

D. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 2 inches. Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4 inch horizontal face dimensions at corners or jambs.

E. Stopping and Resuming Work: In each course, rack back 1/2 unit length for one half running bond or 1/3 unit length for one third running bond; do not tooth. Clean exposed surfaces of set masonry, wet clay masonry units lightly (if required), and remove loose masonry units and mortar prior to laying fresh masonry.

F. Built In Work: As construction progresses, build in items specified under this and other Sections of the Specifications. Fill in solidly with masonry around built in items.

1. Fill space between hollow metal frames and masonry solidly with mortar, unless otherwise indicated.

a. At exterior frames insert extruded polystyrene board insulation around perimeter of frame in thickness indicated but not less than ¾ inch to act as a thermal break between frame and masonry.

2. Where built in items are to be embedded in cores of hollow masonry units, place a layer of metal lath in the joint below and rod mortar or grout into core.

3. Fill cores in hollow concrete masonry units with grout 3 courses (24 inches) under bearing plates, beams, lintels, posts, and similar items, unless otherwise indicated.

3.05 MORTAR BEDDING AND JOINTING

A. Lay brick units with full mortar coverage on bed and head joints. Furrowing of joints will not be permitted.

B. Lay hollow concrete masonry units as follows:

1. With full mortar coverage on horizontal and vertical face shells.

2. Bed webs in mortar in starting course on footings and in all courses of piers, columns, and pilasters, and where adjacent to cells or cavities to be filled with grout.

3. For starting course on footings where cells are not grouted, spread out full mortar bed including areas under cells.

C. Cut joints flush for masonry walls to be concealed or to be covered by other materials, unless otherwise indicated.

3.06 STRUCTURAL BONDING OF MULTIWYTHE MASONRY

A. Use individual metal ties installed in horizontal joints to bond wythes together.

B. Use continuous horizontal joint reinforcement installed in horizontal mortar joints for bond tie between wythes.

C. Use either of the structural bonding systems specified above.

D. Use structural bonding system indicated on Drawings.

E. Corners: Provide interlocking masonry unit bond in each course at corners, unless otherwise shown.

1. Provide continuity with horizontal joint reinforcement at corners using prefabricated "L" units, in addition to masonry bonding.

F. Intersecting and Abutting Walls: Unless vertical expansion or control joints are shown at juncture, provide same type of bonding specified for structural bonding between wythes and space as follows:

1. Provide individual metal ties.

2. Provide continuity with horizontal joint reinforcement using prefabricated "T" units.

G. Nonbearing Interior Partitions: Build full height of story to underside of solid floor or roof structure above and as follows:

1. Install pressure relieving joint filler in joint between top of partition and underside of structure above.

3.07 CAVITIES/AIR SPACES

A. Keep cavities/air spaces clean of mortar droppings and other materials during construction. Strike joints facing cavities/air spaces flush.

B. Tie exterior wythe to backup with individual metal ties. Stagger alternate courses.

C. Tie exterior wythe to backup with continuous horizontal joint reinforcing.

D. Install vents in vertical head joints at the top of each continuous cavity/air space. Space vents and close off cavities/air spaces vertically and horizontally with blocking in manner indicated.

3.08 CAVITY WALL AND MASONRY CELL INSULATION

A. On units of plastic insulation, install small pads of adhesive spaced approximately 1' 0" on center both ways on inside face or attach to inside face with plastic fasteners designed for this purpose. Fit courses of insulation between wall ties and other confining obstructions in cavity, with edges butted tightly both ways. Press units firmly against inside wythe of masonry or other construction as shown.

1. Fill all cracks and open gaps in insulation with crack sealer compatible with insulation and masonry.

B. Pour granular insulation into cavities as shown to fill void spaces completely. Maintain inspection ports to show presence of insulation at extremities of each pour area. Close ports after complete coverage has been confirmed. Limit fall of insulation to one story in height, but not to exceed 20 feet.

3.09 HORIZONTAL JOINT REINFORCEMENT

A. Provide continuous horizontal joint reinforcement as indicated. Install longitudinal side rods in mortar for their entire length with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcing a minimum of 6 inches.

B. Cut or interrupt joint reinforcement at control and expansion joints, unless otherwise indicated.

C. Provide continuity at corners and wall intersections by use of prefabricated "L" and "T" sections. Cut and bend reinforcement units as directed by manufacturer for continuity at returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.10 ANCHORING MASONRY TO STRUCTURAL MEMBERS

A. Anchor masonry to structural members where masonry abuts or faces structural members to comply with the following:

1. Provide an open space not less than 1 inch in width between masonry and structural member, unless otherwise indicated. Keep open space free of mortar or other rigid materials.

2. Anchor masonry to structural members with flexible anchors embedded in masonry joints and attached to structure.

3. Space anchors as indicated, but not more than 24 inches on center vertically and 36 inches on center horizontally.

3.11 ANCHORING SINGLE WYTHE MASONRY VENEER

A. Anchor single wythe masonry veneer to metal studs with masonry veneer anchors to comply with the following requirements:

1. Fasten each anchor section through sheathing to metal studs with 2 metal fasteners of type indicated.

2. Embed tie section in masonry joints. Provide not less than 2 inch air space between back of masonry veneer wythe and face of sheathing.

3. Locate anchor section relative to course in which tie section is embedded to allow maximum vertical differential movement of tie up and down.

4. Space anchors as indicated but not more than 16 inches on center vertically and 18 inches on center horizontally with not less than one anchor for each 3 square feet of wall area. Install additional anchors within 12 inches of openings and at intervals around perimeter not exceeding 8 inches.

B. Install vents at the top of each continuous air space in masonry veneer walls.

3.12 MOVEMENT (CONTROL AND EXPANSION) JOINTS

A. Install control and expansion joints in unit masonry where indicated. Build in related items as the masonry progresses. Do not form a continuous span through movement joints unless provisions are made to prevent in plane restraint of wall or partition movement.

B. Joint Spacing: If location of control joints and expansion joints is not shown, place vertical joints spaced not to exceed 35 feet on center and horizontal joints not to exceed story height.

1. Locate control joints in face brick at all points of discontinuity of back up construction, vertical and horizontal.

C. Form control joints in concrete masonry as follows:

1. Fit bond breaker strips into hollow contour in ends of block units on one side of control joint. Fill the resultant core with grout and rake joints in exposed faces.

2. Install preformed control joint gaskets designed to fit standard sash block.

3. Install special shapes designed for control joints. Install bond breaker strips at joint. Keep head joints free and clear of mortar or rake joint.

D. Form expansion joints in brick made from clay or shale as follows:

1. Build flanges of metal expansion strips into masonry. Lap each joint 4 inches in direction of water flow. Seal joints below grade and at junctures with horizontal expansion joints, if any.

2. Build flanges of factory fabricated expansion joint units into masonry.

3. Build in joint fillers where indicated.

4. Form open joint of width indicated but not less than 3/8 inch for installation of sealant and backer rod. Maintain joint free and clear of mortar.

E. Build in horizontal pressure relieving joints where indicated; construct joints by either leaving an air space or inserting nonmetallic 50 percent compressible joint filler of width required to permit installation of sealant and backer rod.

1. Locate horizontal pressure relieving joints beneath shelf angles supporting masonry veneer and attached to structure behind masonry veneer.

3.13 LINTELS

A. Install steel lintels where indicated.

B. Provide masonry lintels where shown and wherever openings of more than 12 inches for brick size units and 24 inches for block size units are shown without structural steel or other supporting lintels. Provide precast or formed in place masonry lintels. Cure precast lintels before handling and installation. Temporarily support formed in place lintels.

1. For hollow concrete masonry unit walls, use specially formed bond beam units with reinforcement bars placed as indicated and filled with coarse grout.

C. Provide minimum bearing of 8 inches at each jamb, unless otherwise indicated.

3.14 THROUGH-WALL FLASHING/WEEP HOLES

A. Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to the downward flow of water in the wall, and where indicated.

B. Prepare masonry surfaces so that they are smooth and free from projections that could puncture flashing. Place through wall flashing on sloping bed of mortar and cover with mortar. Seal penetrations in flashing with adhesive/sealant/tape as recommended by flashing manufacturer before covering with mortar.

C. Install flashings as follows:

1. At masonry backup construction, extend flashing from exterior face of outer wythe of masonry, through the outer wythe, turned up a minimum of 8 inches, and through the inner wythe to within ½ inch of the interior face of the wall in exposed masonry. Where interior surface of inner wythe is concealed by furring, carry flashing completely through the inner wythe and turn up approximately 2 inches, unless otherwise indicated.

2. At sheathing backup construction, extend flashing from exterior face of outer wythe of masonry, through the outer wythe to the face of the sheathing, and turn up a minimum of 8 inches onto the sheathing.

a. Fully adhere flashing to substrate with adhesive; using a roller or other device to ensure full and complete adhesion.

b. At joints, lap flashing sheets a minimum of 4 inches onto adjacent sheet and seal with adhesive.

3. At lintels and shelf angles, extend flashing a minimum of 4 inches into masonry at each end.

4. At heads and sills, extend flashing as specified above unless otherwise indicated but turn up ends not less than 2 inches to form a pan.

5. Turn down sheet metal flashings at exterior face of masonry to form drip.

6. Strip in top edge of flashing installed against inner face of cavity with mastic and reinforcing fabric.

D. Install weep holes in the head joints in exterior wythes of the first course of masonry immediately above embedded flashings and as follows:

1. Form weep holes by using open head-joints in brick veneer.

2. Form weep holes with product specified in Part 2 of this Section.

3. Space weep holes 24 inches on center.

4. In uninsulated cavities/air spaces place cavity drainage material immediately above flashing embedded in the wall, as masonry construction progresses, to splatter mortar droppings and to maintain drainage.

E. Install reglets and nailers for flashing and other related construction where shown to be built into masonry.

3.15 INSTALLATION OF REINFORCED UNIT MASONRY

A. Install reinforced unit masonry to comply with requirements of referenced unit masonry standard.

1. Provide continuous vertical reinforcing as indicated on the Drawings or otherwise required, including additional reinforcing bars at corners, around openings, at attachments of other work, and similar work.

2. Install bars to provide proper embedment and laps where indicated as "continuous reinforcing".

3. Fill cores containing vertical reinforcing with grout to full height of wall.

B. Temporary Formwork: Construct formwork and shores to support reinforced masonry elements during construction.

1. Construct formwork to conform to shape, line, and dimensions shown. Make sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.

C. Do not place grout until entire height of masonry to be grouted has attained sufficient strength to resist grout pressure.

D. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other temporary loads that may be placed on them during construction.

3.16 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or if units do not match adjoining units. Install new units to match adjoining units and in fresh mortar or grout, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge any voids or holes, except weep holes, and completely fill with mortar. Point up all joints including corners, openings, and adjacent construction to provide a neat, uniform appearance, prepared for application of sealants.

C. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.

2. Test cleaning methods on sample wall panel; leave ½ panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.

3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent, polyethylene film, or waterproof masking tape.

4. Wet wall surfaces with water prior to application of cleaners; remove cleaners promptly by rinsing thoroughly with clear water.

5. Clean brick by means of bucket and brush hand cleaning method described in BIA "Technical Note No. 20 Revised".

6. Clean concrete masonry by means of cleaning method indicated in NCMA TEK 45 applicable to type of stain present on exposed surfaces.

D. Provide final protection and maintain conditions, in a manner acceptable to Installer, that ensure unit masonry is without damage and deterioration at time of Substantial Completion.

END OF SECTION 04 20 00

SECTION 05 12 00 – STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with all applicable requirements and standards.

1.03 QUALITY ASSURANCE

A. Comply with applicable provisions of the following specifications and documents.

1. AISC's "Specification for Structural Steel Buildings - Allowable Stress Design and Plastic Design."

2. AISC's "Load and Resistance Factor Design (LFRD) Specification for Structural Steel Buildings."

3. AISC's "Specification for Allowable Stress Design of Single-Angle Members."

4. AISC's "Specification for Load and Resistance Factor Design of Single-Angle Members."

5. AISC's "Seismic Provisions for Structural Steel Building."

6. ASTM A 6 (ASTM A 6M) "Specification for General Requirements for Rolled Steel Plates, Shapes, Sheet Piling, and Bars for Structural Use."

7. Research Council on Structural Connections' (RCSC) "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

8. Research Council on Structural Connections' (RCSC) "Load and Resistance Factor Design Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

B. Qualifications for Welding Work: Qualify welding procedures and welding operators in accordance with AWS "Qualification" requirements.

1. Provide certification that welders to be employed in work have satisfactorily passed AWS qualification tests.

2. If recertification of welders is required, retesting will be Contractor's responsibility.

1.04 SUBMITTALS

A. Product Data:

1. Product data or manufacturer's specifications and installation instructions for following products. Include laboratory test reports and other data to show compliance with specifications (including specified standards).

a. Structural steel (each type), including certified copies of mill reports covering chemical and physical properties.

b. High strength bolts (each type), including nuts and washers.

1) Include Direct Tension Indicators if used.

c. Structural steel primer paint.

d. Shrinkage resistant grout.

B. Record Documents:

1. Shop drawings prepared under supervision of a licensed Structural Engineer, including complete details and schedules for fabrication and assembly of structural steel members, procedures, and diagrams.

a. Include details of cuts, connections, camber, holes, and other pertinent data. Indicate welds by standard AWS symbols and show size, length, and type of each weld.

b. Provide setting drawings, templates, and directions for installation of anchor bolts and other anchorages to be installed as work of other sections.

2. Test reports conducted on shop and field bolted and welded connections. Include data on type(s) of tests conducted and test results.

3. Certified copies of each survey conducted by a licensed Land Surveyor, showing elevations and locations of base plates and anchor bolts to receive structural steel and final elevations and locations for major members. Indicate discrepancies between actual installation and contract documents.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to the Project Site at such intervals to ensure uninterrupted progress of work.

B. Deliver anchor bolts and anchorage devices, which are to be embedded in cast in place concrete or masonry, in ample time to not to delay work.

C. Store materials to permit easy access for inspection and identification. Keep steel members off ground by using pallets, platforms, or other supports. Protect steel members and packaged materials from erosion and deterioration. If bolts and nuts become dry or rusty, clean and re-lubricate before use.

1. Do not store materials on structure in a manner that might cause distortion or damage to members or supporting structures. Repair or replace damaged materials or structures as directed.

1.06 PERFORMANCE REQUIREMENTS

A. Engineer structural steel connections required by the Contract Documents to be selected or completed by the fabricator to withstand design loadings indicated.

B. Engage a fabricator who utilizes a qualified professional engineer to prepare calculations, Shop Drawings, and other structural data for structural steel connections.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.02 MATERIALS

A. Metal Surfaces, General: For fabrication of work that will be exposed to view, use only materials that are smooth and free of surface blemishes including pitting, rust and scale seam marks, roller marks, rolled trade names, and roughness. Remove such blemishes by grinding, or by welding and grinding, prior to cleaning, treating, and applying surface finishes.

B. Structural Steel Shapes, Plates, and Bars: ASTM A 36 (ASTM A 36M).

C. Cold Formed Steel Tubing: ASTM A 500, Grade B.

D. Hot Formed Steel Tubing: ASTM A 501.

E. Headed Stud Type Shear Connectors: ASTM A 108, Grade 1015 or 1020, cold finished carbon steel with dimensions complying with AISC Specifications.

F. Anchor Rods, Bolts, Nuts, and Washers: As follows:

1. Unheaded Rods: ASTM A 36 (ASTM A 36M)

2. Unheaded Rods: ASTM A 572, Grade 50 (ASTM A 572M, Grade 345)

3. Unheaded Bolts: ASTM A 687, high strength

4. Headed Bolts: ASTM A 307, Grade A (ASTM F 568, Property Class 4.6); carbon-steel, hex-head bolts; and carbon-steel nuts.

5. Headed Bolts: ASTM A325 (ASTM A 325M), Type 1, heavy hex steel structural bolts and heavy hex carbon-steel nuts.

6. Headed Bolts: ASTM A 490 (ASTM A 490M), Type 1, heavy hex steel structural bolts and heavy hex carbon-steel nuts.

7. Washers: ASTM A 36 (ASTM A 36M)

G. Nonhigh-Strength Bolts, Nuts, and Washers: ASTM A 307, Grade A (ASTM F 58, Property Class 4.6); carbon-steel, hex-head bolts; carbon-steel nuts; and flat, unhardened steel washers.

1. Finish: Plain, uncoated

2. Finish: Hot-dip zinc-coating, ASTM A 153, Class C

3. Finish: Mechanically deposited zinc-coating, ASTM B 695, Class 50

H. High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy hex steel structural bolts, heavy hex carbon-steel nuts, and hardened carbon-steel washers.

1. Finish: Plain, uncoated

2. Finish: Hot-dip zinc-coating, ASTM A 153, Class C

3. Finish: Mechanically deposited zinc-coating, ASTM B 695, Class 50, epoxy coated

4. Direct-Tension Indicators: ASTm F 959, Type 325

a. Finish: Plain, uncoated

b. Finish: Mechanically deposited zinc-coating, ASTM B 695, Class 50

c. Finish: Mechanically deposited zinc-coating, ASTM B 695, Class 50, epoxy coated

I. High-Strength Bolts, Nuts, and Washers: ASTM A 490 (ASTM A 490M), Type 1, heavy hex steel structural bolts, heavy hex carbon-steel nuts, and hardened carbon-steel washers, uncoated.

1. Direct-Tension Indicators: ASTM F 959, Type 490 uncoated

J. Welding Electrodes: Comply with AWS requirements.

2.03 PRIMER

A. Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer with good resistance to normal atmospheric corrosion, complying with performance requirements of FS TT-P-664.

B. Primer: SSPC-Paint 23, latex primer.

C. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds and repair painting galvanized steel, with dry film containing not less than 93 percent zinc dust by weight, and complying with DOD-P-21035A or SSPC-Paint 20.

2.04 GROUT

A. Cement Grout: Portland cement (ASTM C 150, Type I or Type III) and clean, uniformly graded, natural sand (ASTM C 404, Size No. 2). Mix at a ratio of 1.0 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.

B. Nonmetallic Shrinkage Resistant Grout: Premixed, nonmetallic, noncorrosive, nonstaining product containing selected silica sands, Portland cement, shrinkage compensating agents, plasticizing and water reducing agents, complying with ASTM C 1107 of consistency suitable for application, and a 30 minute working time.

2.05 FABRICATION

A. Shop Fabrication and Assembly: Fabricate and assemble structural assemblies in shop to greatest extent possible. Fabricate items of structural steel in accordance with AISC Specifications and as indicated on final shop drawings. Provide camber in structural members where indicated.

1. Properly mark and match mark materials for field assembly. Fabricate for delivery sequence that will expedite erection and minimize field handling of materials.

2. Where finishing is required, complete assembly, including welding of units, before start of finishing operations. Provide finish surfaces of members exposed in final structure free of markings, burrs, and other defects.

B. Connections: Weld or bolt shop connections, as indicated.

C. Bolt field connections, except where welded connections or other connections are indicated.

1. Provide high strength threaded fasteners for principal bolted connections, except where unfinished bolts are indicated.

2. Provide unfinished threaded fasteners for only bolted connections of secondary framing members to primary members (including purlins, girts, and other framing members taking only nominal stresses) and for temporary bracing to facilitate erection.

D. High Strength Bolted Construction: Install high strength threaded fasteners in accordance with AISC "Specifications for Structural Joints using ASTM A 325 or A 490 Bolts."

E. Welded Construction: Comply with AWS Code for procedures, appearance and quality of welds, and methods used in correcting welding work.

F. Assemble and weld built up sections by methods that will produce true alignment of axes without warp.

G. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld shear connectors in field, spaced as shown, to beams and girders in composite construction. Use automatic end welding of headed stud shear connectors in accordance with manufacturer's printed instructions.

H. Steel Wall Framing: Select members that are true and straight for fabrication of steel wall framing. Straighten as required to provide uniform, square, and true members in completed wall framing.

I. Build up welded door frames attached to structural steel framing. Weld exposed joints continuously and grind smooth. Plug weld steel bar stops to frames, except where shown removable. Secure removable stops to frames with countersunk, cross recessed head machine screws, uniformly spaced not more than 10 inches on center, unless otherwise indicated.

J. Holes for Other Work: Provide holes required for securing other work to structural steel framing and for passage of other work through steel framing members, as shown on final shop drawings.

K. Provide threaded nuts welded to framing and other specialty items as indicated to receive other work.

L. Cut, drill, or punch holes perpendicular to metal surfaces. Do not flame cut holes or enlarge holes by burning. Drill holes in bearing plates.

M. Expansion Joints: Provide expansion joints in steel shelf angles when part of structural steel frame; locate at vertical brick expansion joints as indicated on drawings.

2.06 SHOP PAINTING

A. Shop paint structural steel, except those members or portions of members to be embedded in concrete or mortar. Paint embedded steel that is partially exposed on exposed portions and initial 2 inches of embedded areas only.

1. Do not paint surfaces to be welded or high strength bolted with friction type connections.

2. Do not paint surfaces scheduled to receive sprayed on fireproofing.

3. Apply 2 coats of paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

B. Surface Preparation: After inspection and before shipping, clean steelwork to be painted. Remove loose rust, loose mill scale, and spatter, slag, or flux deposits. Clean steel in accordance with Steel Structures Painting Council (SSPC) as follows:

1. SP 2 "Hand Tool Cleaning"

2. SP 3 "Power Tool Cleaning"

3. SP 6 "Commercial Blast Cleaning"

4. SP 7 "Brush Off Blast Cleaning"

5. SP 10 "Near White Blast Cleaning"

C. Painting: Immediately after surface preparation, apply structural steel primer paint in accordance with manufacturer's instructions and at a rate to provide dry film thickness of not less than 1.5 mils. Use painting methods that result in full coverage of joints, corners, edges, and exposed surfaces.

2.07 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel indicated for galvanizing according to ASTM A 123.

2.08 SOURCE QUALITY CONTROL

A. Materials and fabrication procedures are subject to inspection and tests in mill, shop, and field, conducted by a qualified inspection agency. Such inspections and tests will not relieve Contractor of responsibility for providing materials and fabrication procedures in compliance with specified requirements.

1. Promptly remove and replace materials or fabricated components that do not comply.

B. Design of Members and Connections: Details shown are typical; similar details apply to similar conditions, unless otherwise indicated. Verify dimensions at the Project Site whenever possible without causing delay in the work.

1. Promptly notify Owner whenever design of members and connections for any portion of structure are not clearly indicated.

PART 3 - EXECUTION

3.01 ERECTION

A. Surveys: Employ a licensed land surveyor for accurate erection of structural steel. Check elevations of concrete and masonry bearing surfaces, and locations of anchor bolts and similar devices, before erection work proceeds, and report discrepancies to Owner. Do not proceed with erection until corrections have been made or until compensating adjustments to structural steel work have been agreed upon with Owner.

B. Temporary Shoring and Bracing: Provide temporary shoring and bracing members with connections of sufficient strength to bear imposed loads. Remove temporary members and connections when permanent members are in place and final connections are made. Provide temporary guy lines to achieve proper alignment of structures as erection proceeds.

C. Setting Bases and Bearing Plates: Clean concrete and masonry bearing surfaces of bond reducing materials and roughen to improve bond to surfaces. Clean bottom surface of base and bearing plates.

1. Set loose and attached base plates and bearing plates for structural members on wedges or other adjusting devices.

2. Tighten anchor bolts after supported members have been positioned and plumbed. Do not remove wedges or shims, but if protruding, cut off flush with edge of base or bearing plate prior to packing with grout.

3. Pack grout solidly between bearing surfaces and bases or plates to ensure that no voids remain. Finish exposed surfaces, protect installed materials, and allow to cure.

4. For proprietary grout materials, comply with manufacturer's instructions.

D. Field Assembly: Set structural frames accurately to lines and elevations indicated. Align and adjust various members forming part of complete frame or structure before permanently fastening. Clean bearing surfaces and other surfaces that will be in permanent contact before assembly. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

E. Level and plumb individual members of structure within specified AISC tolerances.

F. Establish required leveling and plumbing measurements on mean operating temperature of structure. Make allowances for difference between temperature at time of erection and mean temperature at which structure will be when completed and in service.

G. Splice members only where indicated and accepted on shop drawings.

H. Erection Bolts: On exposed welded construction, remove erection bolts, fill holes with plug welds, and grind smooth at exposed surfaces.

1. Comply with AISC Specifications for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.

2. Do not enlarge unfair holes in members by burning or by using drift pins, except in secondary bracing members. Ream holes that must be enlarged to admit bolts.

I. Gas Cutting: Do not use gas cutting torches in field for correcting fabrication errors in primary structural framing. Cutting will be permitted only on secondary members that are not under stress, as acceptable to Owner. Finish gas cut sections equal to a sheared appearance when permitted.

J. Touch Up Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint. Apply paint to exposed areas using same material as used for shop painting.

1. Apply by brush or spray to provide minimum dry film thickness of 1.5 mils.

3.02 QUALITY CONTROL

A. Owner will engage an independent testing and inspection agency to inspect high-strength bolted connections and welded connections and to perform tests and prepare test reports. Testing agency shall conduct and interpret tests and state in each report whether test specimens comply with requirements, and specifically state any deviations there from. Provide access for testing agency to places where structural steel work is being fabricated or produced so that required inspection and testing can be accomplished.

1. Testing agency shall comply with all the regulations of the Department of Public Works of the City of Houston and shall certify in writing, upon completion of the Work, that all Work was performed in accordance with the construction documents and all applicable city ordinances.

B. Testing agency shall conduct and interpret tests, state in each report whether test specimens comply with requirements, and specifically state any deviations there from.

C. Provide access for testing agency to places where structural steel work is being fabricated or produced so that required inspection and testing can be accomplished.

D. Testing agency may inspect structural steel at plant before shipment; however, Owner reserves right, at any time before final acceptance, to reject material not complying with specified requirements.

E. Correct deficiencies in structural steel work that inspections and laboratory test reports have indicated to be not in compliance with requirements. Perform additional tests, at Contractor's expense, as necessary to reconfirm any noncompliance of original work and to show compliance of corrected work.

F. Field-bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

G. Field-bolted connections will be tested and inspected according to RCSC's "Load and Resistance Factor Design Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

1. Direct-tension indicator gaps will be verified to comply with ASTM F 959, Table 2

H. In addition to visual inspection, field-welded connections will be inspected and tested according to AWS D1.1 and the inspection procedures listed below, at testing agency's options.

1. Liquid Penetrant Inspection: ASTM E 165

2. Magnetic Particle Inspection: ASTM E 709; performed on roof pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.

3. Radiographic Inspection: ASTM E 94 and ASTM E 142; minimum quality level "2-2T"

4. Ultrasonic Inspection: ASTM E 164

I. In addition to visual inspection, field-welded shear connectors will be inspected and tested according to requirements of AWS D1.1 for stud welding and as follows:

1. Bend tests will be performed when visual inspections reveal either less than a continuous 360 degree flash or welding repairs to any shear connector.

2. Tests will be conducted on additional shear connectors when weld fracture occurs on shear connectors already tested, according to requirements of AWS D1.1.

3.03 CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint. Apply paint to exposed areas using same material as used for shop painting.

1. Apply by brush or spray to provide a minimum dry film thickness of 1.5 mils (0.038 mm).

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and apply galvanizing repair paint according to ASTM A 780.

END OF SECTION 05 12 00

SECTION 05 40 00 – COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with all applicable requirements and standards.

1.03 QUALITY ASSURANCE

A. Component Design: Calculate structural properties of studs and joists in accordance with American Iron and Steel Institute (AISI) "Specification for Design of Cold Formed Steel Structural Members."

B. Welding: Use qualified welders and comply with American Welding Society (AWS) D1.3, "Structural Welding Code Sheet Steel."

C. Fire Rated Assemblies: Where framing units are components of assemblies indicated for a fire resistance rating, including those required for compliance with governing regulations, provide units that have been approved by governing authorities that have jurisdiction.

1.04 SUBMITTALS

A. Product Data:

1. Product data and installation instructions for each item of cold formed metal framing and accessories

B. Record Documents:

1. Shop drawings for special components and installations not fully dimensioned or detailed in manufacturer's product data.

a. Include placing drawings for framing members showing size and gage designations, number, type, location, and spacing. Indicate supplemental strapping, bracing, splices, bridging, accessories, and details required for proper installation.

1.05 PERFORMANCE REQUIREMENTS

A. AISI "Specification": Calculate structural characteristics of cold-formed metal framing according to AISI's "Specification for the Design of Cold-Formed Steel Structural Members" and the following:

B. AISI "Specification": Calculate structural characteristics of cold-formed metal framing according to AISI's "Load and Resistance Factor Design Specification for Cold-Formed Steel Structural Members" and the following:

1. Center for Cold-Formed Steel Structures (CCFSS) Technical Bulletin, Vol. 2, No. 1, February 1993 "AISI Specification Provisions for Screw Connections."

C. Structural Performance: Engineer, fabricate and erect cold-formed metal framing with the following minimum physical and structural properties:

1. Physical and Structural Properties: As indicated.

D. Structural Performance: Engineer, fabricate, and erect cold-formed metal framing to withstand design loads within limits and under conditions required.

1. Design framing systems to withstand design loads without deflections greater than the following:

a. Exterior Load-Bearing Walls: Lateral deflection of 1/360 of the wall height, unless otherwise indicated.

b. Interior Load-Bearing Walls: Lateral deflection of 1/360 of the wall height.

c. Exterior Nonload-Bearing Curtainwall: Lateral deflection of 1/240 of the wall height.

d. Exterior Nonload-Bearing Curtainwall: Lateral deflection of 1/360 of the wall height.

e. Exterior Nonload-Bearing Curtainwall: Lateral deflection of 1/600 of the wall height.

f. Exterior Nonload-Bearing Curtainwall: Lateral deflection of 1/720 of the wall height.

g. Floor Joists: Vertical deflection of 1/240 of the span.

h. Floor Joists: Vertical deflection of 1/360 of the span.

i. Roof Trusses: Vertical deflection of 1/240 of the span.

j. Roof Trusses: Vertical deflection of 1/360 of the span.

2. Design framing systems to provide for movement of framing members without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects with subject to a maximum ambient temperature change (range) of 120 degrees F (67 degrees C).

3. Design framing system to accommodate deflection of primary building structure and construction tolerances, and to maintain clearances at openings.

E. Design exterior nonload-bearing curtainwall framing to accommodate lateral deflection without regard to contribution of sheathing materials.

F. Engineering Responsibility: Engage a fabricator who assumes undivided responsibility for engineering cold formed metal framing by employing a qualified professional engineer to prepare design calculations, shop drawings, and other structural data.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.02 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include:

1. Alabama Metal Industries Corp.
2. American Studco, Inc.
3. Dale/Incor, Industries of Florida
4. Dale Industries, Inc.
5. Dietrich Industries, Inc.
6. Incor Plant Dale Industries
7. Marino/Ware; Div. of Ware Industries, Inc.
8. Super Stud Building Products, Inc.
9. Unimast, Inc.
10. United Construction Supply
11. United States Steel

2.03 METAL FRAMING

A. System Components: Manufacturers' standard load bearing steel studs and joists of type, size, shape, and gage as indicated. With each type of metal framing required, provide manufacturer's standard, steel runners (tracks), blocking, lintels, clip angles, shoes, reinforcements, fasteners, and accessories for applications indicated, as needed to provide a complete metal framing system.

B. Materials and Finishes:

1. For 16 gage and heavier units, fabricate metal framing components of structural quality steel sheet with a minimum yield point of 40,000 psi; ASTM A 446, A 570, or A 611.

2. For 18 gage and lighter units, fabricate metal framing components of commercial quality steel sheet with a minimum yield point of 33,000 psi; ASTM A 446, A 570, or A 611.

3. Provide galvanized finish to metal framing components complying with ASTM A 525 for minimum G 60 coating.

   a. Where metal framing provides back-up support for brick veneer, provide G90 (Z275) coating.

4. Prime-Painted Steel Sheet: ASTM A 570 (ASTM A 570M) or ASTM A 611, cleaned, pretreated, and primed with manufacturer's baked-on, lead- and chromate-free, rust-inhibitive prime conforming to the performance requirements of FS TT-P-664.

   a. Finish of installation accessories to match that of main framing components, unless otherwise indicated.

5. Fasteners: Provide nuts, bolts, washers, screws, and other fasteners with corrosion resistant plated finish.

6. Electrodes for Welding: Comply with AWS Code and as recommended by stud manufacturer.

7. Galvanizing Repair: Where galvanized surfaces are damaged, prepare surfaces and repair in accordance with procedures specified in ASTM A 780.

2.04 FRAMING ACCESSORIES

A. Fabricate steel-framing accessories of the same material and finish used for framing members, with minimum yield strength of 33,000 psi (230 MPa).

B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, including:

   1. Supplementary framing

   2. Bracing, bridging, and solid blocking

   3. Web stiffeners

   4. Gusset plates

   5. Deflection track and vertical slide clips

   6. Reinforcement plates

2.05 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A 36 (ASTM A 36M), zinc coated by the hot-dip process according to ASTM A 123.

B. Cast-in-Place Anchor Bolts and Studs: ASTM A 307, Grade A (ASTM F 568, Property Class 4.6); carbon-steel hex-head bolts and studs; carbon-steel nuts; and flat, unhardened-steel washers. Zinc coated by hot-dip process according to ASTM A 153.

C. Welding Electrodes: Comply with AWS standards.

2.06 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: SSPC-Paint 20 or DOD-P-21035, with dry film containing a minimum of 94 percent zinc dust by weight.

B. Cement Grout: Portland cement, ASTM C 150, Type I; and clean, natural sand, ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.

C. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, plasticizing and water-reducing agents, complying with ASTM C 1107, with fluid consistency and a 30-minute working time.

2.07 FABRICATION

A. Framing components may be prefabricated into assemblies before erection. Fabricate panels plumb, square, true to line, and braced against racking with joints welded. Perform lifting of prefabricated units to prevent damage or distortion.

B. Fabricate units in jig templates to hold members in proper alignment and position and to assure consistent component placement.

C. Fastenings: Attach similar components by welding. Attach dissimilar components by welding, bolting, or screw fasteners, as standard with manufacturer.

D. Wire tying of framing components is not permitted.

E. Fabrication Tolerances: Fabricate units to a maximum allowable tolerance variation from plumb, level, and true to line of 1/8 inch in 10 feet.

1. Spacing: Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

2. Squareness: Fabricate each cold-formed metal framing assembly to a maximum out-of-square tolerance of 1/8 inch (3 mm).

PART 3 - EXECUTION

3.01 PREPARATION

A. Pre-Installation Conference:

1. Prior to start of installation of metal framing systems, meet at Project Site with installers of other work including door and window frames and mechanical and electrical work.

2. Review areas of potential interference and conflicts, and coordinate layout and support provisions for interfacing work.

3.02 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. All installation shall be in accordance with manufacturer’s published recommendations.

C. Install metal framing systems in accordance with manufacturer's printed or written instructions and recommendations.

D. Runner Tracks: Install continuous tracks sized to match studs. Align tracks accurately to layout at base and tops of studs. Secure tracks as recommended by stud manufacturer for type of construction involved, except do not exceed 24 inches on center spacing for nail or powder driven fasteners or 16 inches on center for other types of attachment. Provide fasteners at corners and ends of tracks.

E. Installation of Wall Studs: Secure studs to top and bottom runner tracks by either welding or screw fastening at both inside and outside flanges.

F. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.

G. Where stud system abuts structural columns or walls, including masonry walls, anchor ends of stiffeners to supporting structure.

H. Install supplementary framing, blocking, and bracing in metal framing system wherever walls or partitions are indicated to support fixtures, equipment, services, casework, heavy trim and furnishings, and similar work requiring attachment to the wall or partition. Where type of supplementary support is not otherwise indicated, comply with stud manufacturer's recommendations and industry standards in each case, considering weight or loading resulting from item supported.

I. Frame wall openings larger than two feet square with double stud at each jamb of frame except where more than two are either shown or indicated in manufacturer's instructions. Install runner tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with stud shoes or by welding, and space jack studs same as full height studs of wall. Secure stud system wall opening frame in manner indicated.

J. Frame both sides of expansion and control joints with separate studs; do not bridge the joint with components of stud system.

K. Install horizontal stiffeners in stud system, spaced (vertical distance) at not more than 54 inches on center. Weld at each intersection.

L. Erection Tolerances: Bolt or weld wall panels (at both horizontal and vertical junctures) to produce flush, even, true to line joints.

   1. Maximum variation in plane and true position between prefabricated assemblies should not exceed 1/16 inch.

M. Installation of Joists: Install level, straight, and plumb, complete with bracing and reinforcing as indicated on drawings. Provide not less than 1-1/2 inch end bearing.

N. Reinforce ends with end clips, steel hangers, steel angle clips, steel stud section, or as otherwise recommended by joist manufacturer.

O. Where required, reinforce joists at interior supports with single short length of joist section located directly over interior support, snap on shoe, 30 percent side piece lapped reinforcement, or other method recommended by joist manufacturer.

P. Secure joists to interior support systems to prevent lateral movement of bottom flange.

Q. Field Painting: Touch up damaged shop applied protective coatings. Use compatible primer for prime coated surfaces; use galvanizing repair system for galvanized surfaces.

END OF SECTION 05 40 00

SECTION 05 50 00 – METAL FABRICATIONS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with all applicable requirements and standards.

1.03 QUALITY ASSURANCE

A. Fabricator Qualifications: Firm experienced in successfully producing metal fabrications similar to that indicated for this Project, with sufficient production capacity to produce required units without causing delay in the Work.

B. Installer Qualifications: Arrange for installation of metal fabrications specified in this section by same firm that fabricated them.

C. Qualify welding processes and welding operators in accordance with AWS D1.1 "Structural Welding Code Steel," D1.3 "Structural Welding Code Sheet Steel", and D1.2 "Structural Welding Code Aluminum."

1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

1.04 SUBMITTALS

A. Product Data:

1. Product data and installation instructions for each prefabricated item of miscellaneous metal fabrications and accessories.

2. Samples representative of materials and finished products as may be requested by Owner.

B. Record Documents:

1. Shop drawings detailing fabrication and erection of each metal fabrication indicated. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide templates for anchors and bolts specified for installation under other sections.

    a. Where installed metal fabrications are indicated to comply with certain design loadings, include structural computations, material properties, and other information needed for structural analysis that has been signed and sealed by the qualified professional engineer who was responsible for their preparation.

1.05 PROJECT CONDITIONS

A. Field Measurements: Check actual locations of walls and other construction to which metal fabrications must fit, by accurate field measurements before fabrication; show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delay of Work.

1. Where field measurements cannot be made without delaying the Work, guarantee dimensions and proceed with fabrication of products without field measurements. Coordinate construction to ensure that actual opening dimensions correspond to guaranteed dimensions. Allow for trimming and fitting.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.02 FERROUS METALS

A. For metal fabrications exposed to view upon completion of the Work, provide materials selected for their surface flatness, smoothness, and freedom from surface blemishes. Do not use materials whose exposed surfaces exhibit pitting, seam marks, roller marks, rolled trade names, roughness, and, for steel sheet, variations in flatness exceeding those permitted by reference standards for stretcher leveled sheet.

B. Steel Plates, Shapes, and Bars: ASTM A 36.

C. Rolled Steel Floor Plates: ASTM A 786.

D. Steel Bars for Gratings: ASTM A 569 or ASTM A 36.

E. Wire Rod for Grating Cross Bars: ASTM A 510.

F. Steel Tubing: Product type (manufacturing method) and as follows:

1. Cold Formed Steel Tubing: ASTM A 500, grade as indicated below:

    a. Grade A, unless otherwise indicated or required for design loading.

    b. For exterior installations and where indicated, provide tubing with hot dip galvanized coating per ASTM A 53.

G. Uncoated Steel Sheet: Commercial quality, product type (method of manufacture) as follows:

1. Cold Rolled Steel Sheet: ASTM A 366

H. Galvanized Steel Sheet: Commercial Quality; ASTM A 526, G90 coating designation unless otherwise indicated.

I. Steel Pipe: ASTM A 53; finishand type as follows:

1. Black finish, unless otherwise indicated.

2. Galvanized finish for exterior installations and where indicated.

J. Gray Iron Castings: ASTM A 48, Class 30.

K. Malleable Iron Castings: ASTM A 47, grade 32510.

L. Brackets, Flanges and Anchors: Cast or formed metal of the same type material and finish as supported rails, unless otherwise indicated.

M. Concrete Inserts: Threaded or wedge type; galvanized ferrous castings, either malleable iron, ASTM A 47, or cast steel, ASTM A 27. Provide bolts, washers, and shims as required, hot dip galvanized per ASTM A 153.

N. Welding Rods and Bare Electrodes: Select in accordance with AWS specifications for the metal alloy to be welded.

2.03 STAINLESS STEEL

A. Bar Stock: ASTM A 276, Type 302 or 304.

B. Plate: ASTM A 167, Type 302 or 304.

2.04 ALUMINUM

A. Extruded Bars and Shapes: ASTM B 221, alloys 6063-T6:

B. Aluminum Alloy Rolled Tread Plate: ASTM B 632, alloys 6061-T6:

C. Aluminum Sheet for Expanded Aluminum Grating: ASTM B 209, alloy 5052 H32.

2.05 GROUT AND ANCHORING CEMENT

A. Nonshrink Nonmetallic Grout: Premixed, factory packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications of type specified in this section.

1. "B-6 Construction Grout"; W. R. Bonsal Co.

2. "Diamond Crete Grout"; Concrete Service Materials Co.

3. "Euco N S Grout"; Euclid Chemical Co.

4. "Masterflow 928 and 713"; Master Builders.

5. "Sealtight 588 Grout"; W. R. Meadows, Inc.

6. "Sonogrout 14"; Sonneborn Building Products.

7. "Stoncrete NM1"; Stonhard, Inc.

8. "Five Star Grout"; U. S. Grout Corp.

9. "Vibropruf #11"; Lambert Corp.

B. Interior Anchoring Cement: Factory prepackaged, nonshrink, nonstaining, hydraulic controlled expansion cement formulation for mixing with water at Project Site to create pourable anchoring, patching, and grouting compound. Use for interior applications only.

1. "Bonsal Anchor Cement"; W. R. Bonsal Co.

2. "Por Rok"; Minwax Construction Products Division.

C. Nonshrink Metallic Grout: Premixed, factory packaged, ferrous aggregate grout complying with ASTM C 1107 2, specifically recommended by manufacturer for heavy duty loading applications of type specified in this section.

1. "Metox RM"; Chem Masters Corp.

2. "Hi Mod Grout"; Euclid Chemical Co.

3. "Embeco 885 and 636"; Master Builders.

4. "Ferrolith G Redi Mix and G NC"; Sonneborn Building Products Div., Rexnord Chemical Products, Inc.

2.06 FASTENERS

A. Provide zinc coated fasteners for exterior use or where built into exterior walls. Select fasteners for the type, grade, and class required.

B. Bolts and Nuts: Regular hexagon head type, ASTM A 307, Grade A.

C. Lag Bolts: Square head type, FS FF B 561.

D. Machine Screws: Cadmium plated steel, FS FF S 92.

E. Wood Screws: Flat head carbon steel, FS FF S 111.

F. Plain Washers: Round, carbon steel, FS FF W 92.

G. Drilled In Expansion Anchors: Expansion anchors complying with FS FF S 325, Group VIII (anchors, expansion, [nondrilling]), Type I (internally threaded tubular expansion anchor); and machine bolts complying with FS FF B 575, Grade 5.

H. Toggle Bolts: Tumble wing type, FS FF B 588, type, class, and style as required.

I. Lock Washers: Helical spring type carbon steel, FS FF W 84.

2.07 PAINT

A. Shop Primer for Ferrous Metal: Manufacturer's or fabricator's standard, fast curing, lead free, universal modified alkyd primer selected for good resistance to normal atmospheric corrosion, for compatibility with finish paint systems indicated, and for capability to provide a sound foundation for field applied topcoats despite prolonged exposure complying with performance requirements of FS TT P 645.

B. Galvanizing Repair Paint: High zinc dust content paint for regalvanizing welds in galvanized steel, with dry film containing not less than 94 percent zinc dust by weight, and complying with DOD P 21035 or SSPC Paint 20.

C. Bituminous Paint: Cold applied asphalt mastic complying with SSPC Paint 12 except containing no asbestos fibers.

2.08 FABRICATION, GENERAL

A. Form metal fabrications from materials of size, thickness, and shapes indicated but not less than that needed to comply with performance requirements indicated. Work to dimensions indicated or accepted on shop drawings, using proven details of fabrication and support. Use type of materials indicated or specified for various components of each metal fabrication.

B. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges.

C. Allow for thermal movement resulting from 100 degrees F (55.5 degrees C) maximum change (range) in ambient temperature in the design, fabrication, and installation of installed metal assemblies to prevent buckling, opening up of joints, and overstressing of welds and fasteners. Base design calculations on actual surface temperatures of metals due to both solar heat gain and nighttime sky heat loss.

D. Shear and punch metals cleanly and accurately. Remove burrs.

E. Ease exposed edges to a radius of approximately 1/32 inch, unless otherwise indicated. Form bent metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

F. Remove sharp or rough areas on exposed traffic surfaces.

G. Weld corners and seams continuously to comply with AWS recommendations and the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

2. Obtain fusion without undercut or overlap.

3. Remove welding flux immediately.

4. At exposed connections, finish exposed welds and surfaces smooth and blended so that no roughness shows after finishing and contour of welded surface matches those adjacent.

H. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners wherever possible. Use exposed fasteners of type indicated or, if not indicated, Phillips flat head (countersunk) screws or bolts. Locate joints where least conspicuous.

I. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space anchoring devices to provide adequate support for intended use.

J. Preassemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

K. Cut, reinforce, drill and tap miscellaneous metal work as indicated to receive finish hardware, screws, and similar items.

L. Fabricate joints that will be exposed to weather in a manner to exclude water, or provide weep holes where water may accumulate.

2.09 ROUGH HARDWARE

A. Furnish bent or otherwise custom fabricated bolts, plates, anchors, hangers, dowels, and other miscellaneous steel and iron shapes as required for framing and supporting woodwork, and for anchoring or securing woodwork to concrete or other structures. Straight bolts and other stock rough hardware items are specified in Division 06 sections.

B. Fabricate items to sizes, shapes, and dimensions required. Furnish malleable iron washers for heads and nuts which bear on wood structural connections; elsewhere, furnish steel washers.

2.10 STEEL LADDERS

A. Fabricate ladders for the locations shown, with dimensions, spacing, and anchorages as indicated. Unless otherwise indicated, fabricate ladders with component parts specified herein. Comply with requirements of ANSI A14.3.

B. Siderails: Continuous steel flat bars, 1/2 inch x 2 1/2 inches, with eased edges, spaced 18 inches apart.

C. Bar Rungs: Round steel bars, 3/4 inch diameter, spaced 12 inches on center.

D. Bar Rungs: Square steel bars, 3/4 inch, spaced 12 inches on center.

E. Fit rungs in centerline of side rails, plug weld and grind smooth on outer rail faces.

F. Support each ladder at top and bottom and at intermediate points spaced not more than 5' 0" on center by means of welded or bolted steel brackets.

1. Size brackets to support design dead and live loads indicated and to hold centerline of ladder rungs clear of the wall surface by not less than 7 inches.

2. Extend side rails 42 inches above top rung, and return rails to wall or structure unless other secure handholds are provided. If the adjacent structure does not extend above the top rung, goose neck the extended rails back to the structure to provide secure ladder access.

G. Provide non slip surface on top of each rung, either by coating the rung with aluminum oxide granules set in epoxy resin adhesive, or by using a type of manufactured rung which is filled with aluminum oxide grout.

2.11 ALUMINUM LADDERS

A. Vertical ladders manufacturer: produce assembled ladder that comply with OSHA and local building codes with all edges rounded, clean smooth , and burr free; dimensions as indicated on Drawings.

B. Acceptable Manufacturer: Royalite Manufacturing, Inc; 1055 Terminal Way, San Carlos, CA 94070. ASD. Tel: (650) 637-1440 or (800) 875-9548. Fax: (650) 637-9770. www.royalite-mfg.com.

C. Substitution: Not permitted.

D. Ladder Treads: Extruded aluminum, 6063-T5 alloy, with self-cleaning serrated top surface and rounded front and back edges; fastened to handrails with concealed stainless steel screws; capable of withstanding 1200 pounds (3179 kg) load per tread without damage.

E. Cross Section for Vertical Ladders: Minimum 2 inches (50.8 mm) horizontal, nominal 1 inch (25 mm) vertical.

F. Width: 24 inches (610 mm).

G. Spacing: 12 inches (305 mm) vertically.

H. Vertical Ladder Rails Supporting Treads: Extruded aluminum, 6063-T5 alloy, with rounded corners, approximately 4 inches (100 mm) deep; mounted so that centerline of tread is minimum of 7 inches (178 mm) from face of wall.

I. Wall Brackets: Bent aluminum plate, 2 inches (50 mm) wide by 3/16 inch (5 mm) thick.

J. Base Brackets: Aluminum angle floor bracket, 2 by 2 by 2 by 1/8 inch (50 by 50 by 50 by 3 mm).

K. Base Brackets: Wall bracket with additional angle brace; supporting foot of rail at least 4 inches (100 mm) above floor or grade.

L. Extended Rails: 0.875 inch (22 mm) diameter aluminum tubing; formed with two parallel tubes for each length of rail, with radiused corners, assembled by welding or with stainless steel fasteners.

1. At Top of Ladders Leading to Landings: Extending minimum of 42 inches (1067 mm) vertically above top of landing and extending minimum of 10 inches (254 mm) past edge of landing; with free side step on to landing

M. LOOSE BEARING AND LEVELING PLATES

N. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction, made flat, free from warps or twists, and of required thickness and bearing area. Drill plates to receive anchor bolts and for grouting as required. Galvanize after fabrication.

2.12 MISCELLANEOUS FRAMING AND SUPPORTS

A. Provide steel framing and supports for applications indicated or which are not parts of structural steel framework, as required to complete work.

B. Fabricate units to sizes, shapes, and profiles indicated and required to receive adjacent other construction retained by framing and supports. Fabricate from structural steel shapes, plates, and steel bars of welded construction using mitered joints for field connection. Cut, drill, and tap units to receive hardware, hangers, and similar items.

1. Equip units with integrally welded anchors for casting into concrete or building into masonry. Furnish inserts if units must be installed after concrete is placed.

a. Except as otherwise indicated, space anchors 24 inches on center and provide minimum anchor units in the form of steel straps 1-1/4 inches wide x 1/4 inch x 8 inches long.

2.13 METAL BAR GRATINGS

A. Produce metal bar gratings of description indicated per NAAMM marking system that comply with the following:

1. Metal Bar Grating Standard "Standard Specifications for Metal Bar Grating and Metal Bar Grating Treads" published in ANSI/NAAMM A202.1 "Metal Bar Grating Manual."

2. Heavy Duty Metal Bar Grating Standard: "Guide Specifications for Heavy Duty Metal Bar Grating" published in NAAMM "Heavy Duty Metal Bar Grating Manual."

B. To establish standards of manufacturer, specification is based upon products of Reliance Steel Products, Inc. Subject to compliance with requirements, other manufacturers offering metal bar gratings that may be incorporated in the Work include, but are not limited to, the following:

1. Alabama Metal Industries Corp.

2. Barnett/Bates Corp.

3. Blaw Knox Grating Div., Blaw Knox Corp.

4. IKG Industries

5. Klemp Corp.

6. Ohio Gratings, Inc.

7. Seidelhuber Metal Products, Inc.

8. Trueweld, Inc.

C. Galvanized Steel Bar Grating: Provide Reliance Steel Products Company hot dipped galvanized steel "Type 3/4R4 Electro Pressure Welded" grating with 1-1/2 inch x ¼ inch bearing bars spaced at 1 inch centers and ½ inch x 3/16 inch rectangular cross bars spaced at 4 inch centers. Slot bearing bars for rectangular cross bars prior to electropressure welding. Provide banding bars of same size as bearing bars.

D. Prime Painted Steel Bar Grating: Provide Reliance Steel Products Company "Type 1R4 Electro Pressure Welded" grating with 1-1/2 inch x ¼ inch bearing bars spaced 1-1/4 inch centers and ½ inch x 3/16 inch rectangular cross bars spaced at 4 inch centers. Provide one shop coat Tnemec 10 99G (green) modified alkyd rust inhibitive primer as specified after fabrication.

2.14 STEEL PIPE RAILINGS AND HANDRAILS

A. Fabricate pipe railings and handrails to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of pipe, post spacings, and anchorage, but not less than that required to support structural loads.

B. Interconnect railing and handrail members by butt welding or welding with internal connectors, at fabricator's option, unless otherwise indicated.

1. At tee and cross intersections, notch ends of intersecting members to fit contour of pipe to which end is joined and weld all around.

C. Form changes in direction of railing members as follows:

1. By insertion of prefabricated elbow fittings.

2. By radius bends of radius indicated.

3. By mitering at elbow bends.

4. By bending.

5. By any method indicated above, applicable to change of direction involved.

D. Form simple and compound curves by bending pipe in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross section of pipe throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of pipe.

E. Provide wall returns at ends of wall mounted handrails, unless otherwise indicated.

F. Close exposed ends of pipe by welding 3/16 inch thick steel plate in place or by use of prefabricated fittings, except where clearance of end of pipe and adjoining wall surface is 1/4 inch or less.

G. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, end closures, flanges, miscellaneous fittings, and anchors for interconnections of pipe and attachment of railings and handrails to other work. Furnish inserts and other anchorage devices for connecting railings and handrails to concrete or masonry work.

H. For exterior steel railings and handrails formed from steel pipe with galvanized finish, galvanize fittings, brackets, fasteners, sleeves, and other ferrous components.

I. For interior steel railings and handrails formed from steel pipe with galvanized finish, galvanize fittings, brackets, fasteners, sleeves, and other ferrous components.

J. For interior steel railings formed from steel pipe with black finish, provide nongalvanized ferrous metal fittings, brackets, fasteners, and sleeves, except galvanize anchors embedded in exterior masonry and concrete construction.

2.15 STEEL AND IRON FINISHES

A. Galvanizing: For those items indicated for galvanizing, apply zinc coating by the hot dip process compliance with the following requirements:

1. ASTM A 153 for galvanizing iron and steel hardware.

2. ASTM A 123 for galvanizing both fabricated and unfabricated iron and steel products made of uncoated rolled, pressed, and forged shapes, plates, bars, and strip 0.0299 inch thick and heavier.

B. Preparation for Shop Priming: Prepare uncoated ferrous metal surfaces to comply with minimum requirements indicated below for SSPC surface preparation specifications and environmental exposure conditions of installed metal fabrications:

1. Exteriors (SSPC Zone 1B): SSPC SP6 "Commercial Blast Cleaning."

2. Interiors (SSPC Zone 1A): SSPC SP3 "Power Tool Cleaning:

C. Apply shop primer to uncoated surfaces of metal fabrications, except those with galvanized finish or to be embedded in concrete, sprayed on fireproofing, or masonry, unless otherwise indicated. Comply with requirements of SSPC PA1 "Paint Application Specification No. 1" for shop painting.

1. Stripe paint all edges, corners, crevices, bolts, welds, and sharp edges.

PART 3 - EXECUTION

3.01 PREPARATION

A. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions, and directions for installation of anchorages, including concrete inserts, sleeves, anchor bolts, and miscellaneous items having integral anchors that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to the Project Site.

B. Center nosings on tread widths with noses flush with riser faces and tread surfaces.

C. Set sleeves in concrete with tops flush with finish surface elevations; protect sleeves from water and concrete entry.

D. Sequencing and Scheduling:

1. Sequence and coordinate installation of wall handrails as follows:

a. Mount handrails only on completed walls. Do not support handrails temporarily by any means not satisfying structural performance requirements.

b. Mount handrails only on gypsum board assemblies reinforced to receive anchors, and where the location of concealed anchor plates has been clearly marked for benefit of Installer.

3.02 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. All installation shall be in accordance with manufacturer's published recommendations.

C. Fastening to In Place Construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous metal fabrications to in place construction; include threaded fasteners for concrete and masonry inserts, toggle bolts, through bolts, lag bolts, wood screws, and other connectors as required.

D. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installation of miscellaneous metal fabrications. Set metal fabrication accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete masonry or similar construction.

F. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints, but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade the surfaces of exterior units which have been hot dip galvanized after fabrication, and are intended for bolted or screwed field connections.

G. Field Welding: Comply with AWS Code for procedures of manual shielded metal arc welding, appearance and quality of welds made, methods used in correcting welding work, and the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

2. Obtain fusion without undercut or overlap.

3. Remove welding flux immediately.

4. At exposed connections, finish exposed welds and surfaces smooth and blended so that no roughness shows after finishing and contour of welded surface matches those adjacent.

H. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with a heavy coat of bituminous paint or zinc chromate primer.

3.03 FABRICATION

A. Provide miscellaneous metal work fabricated by processes and techniques which will result in the appropriate workmanship class as scheduled.

1. Class 1 Workmanship: Sandblast exposed surfaces smooth with pits, mill marks, nicks, and scratches filled and ground smooth so that no defects are visible from a distance of 6' after painting.

a. Conceal welds where possible. Where exposed, grind welds to small radius with uniform size cove. Welds shall be undetectable after painting.

b. Use only flat head countersunk bolts in exposed locations.

c. Fit all joints to hairline finish.

d. Distortions visible to the eye will be cause for rejection.

2. Items required to have Class 1 Workmanship include:

a. Stair railings, handrails, and guardrails in public and "high finish level" areas, interior and exterior.

b. Steel framed stairs in public and "high finish level" areas, interior and exterior.

3. Class 2 Workmanship: Grind exposed surfaces to remove surface irregularities. Moderate imperfections not visible at 20 feet may remain. Mill marks may remain.

a. Grind welds to small radius with uniform sized core and smooth transition between joined pieces.

b. Use only flat or oval head, countersunk bolts where exposed to view.

c. Straightness: Minor distortions will be permitted.

d. Joints: Provide maximum gap of 1/16 inches.

4. Items required to have Class 2 Workmanship include:

a. Stair railings, handrails, and guardrails in "back of house" areas, interior and exterior.

b. Steel ladders.

c. Steel framed stairs in "back of house" areas, interior and exterior.

d. Steel bollards.

e. Exposed door supports, guides, and bracing.

f. Lavatory countertop supports.

g. Garage overhead clearance bars.

5. Class 3 Workmanship: No improvement from mill finish required except preparation for priming and galvanizing.

6. Items required to have Class 3 Workmanship include all concealed items and those items exposed to view only in "service" areas such as mechanical equipment rooms, and other areas accessible only to building maintenance staff.

3.04 SETTING LOOSE PLATES

A. Clean concrete and masonry bearing surfaces of any bond reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of bearing plates.

B. Set loose leveling and bearing plates on wedges, or other adjustable devices. After the bearing members have been positioned and plumbed, tighten the anchor bolts. Do not remove wedges or shims, but if protruding, cut off flush with the edge of the bearing plate before packing with grout.

1. Use metallic nonshrink grout in concealed locations where not exposed to moisture; use nonmetallic nonshrink grout in exposed locations, unless otherwise indicated.

2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.05 INSTALLATION OF STEEL PIPE RAILINGS AND HANDRAILS

A. Adjust railings prior to anchoring to ensure matching alignment at abutting joints. Space posts at spacing indicated, or if not indicated, as required by design loadings. Plumb posts in each direction.

B. Secure handrails to wall with wall brackets and end fittings. Provide bracket with not less than 1-1/2 inch clearance from inside face of handrail and finished wall surface. Locate brackets as indicated, or if not indicated, at spacing required to support structural loads. Secure wall brackets and wall return fittings to building construction as follows:

1. Use type of bracket with flange tapped for concealed anchorage to threaded hanger bolt.

2. Use type of bracket with pre drilled hole for exposed bolt anchorage.

3. For concrete and solid masonry anchorage, use drilled in expansion shield and either concealed hanger bolt or exposed lag bolt, as applicable.

4. For hollow masonry anchorage, use toggle bolts having square heads.

5. For wood stud partitions, use lag bolts set into wood backing between studs. Coordinate with stud installations for accurate location of backing members.

6. For steel framed gypsum board assemblies, fasten brackets directly to steel framing or concealed anchors using self tapping screws of size and type required to support structural loads.

3.06 ADJUSTING AND CLEANING

A. Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC PA 1 requirements for touch up of field painted surfaces.

1. Apply by brush or spray to provide a minimum dry film thickness of 2.0 mils.

B. For galvanized surfaces clean welds, bolted connections and abraded areas and apply galvanizing repair paint to comply with ASTM A 780.

END OF SECTION 05 50 00

SECTION 06 10 00 – MISCELLANEOUS CARPENTRY

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with all applicable requirements and standards.

1.03 QUALITY ASSURANCE

A. Single Source Responsibility for Fire Retardant Treated Wood: Obtain each type of fire retardant treated wood products from one source for both treatment and fire retardant formulation.

1.04 SUBMITTALS

A. Product Data:

1. Material certificates for dimensional lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use as well as design values approved by the Board of Review of American Lumber Standards Committee.

2. Wood treatment data as follows including chemical treatment manufacturer's instructions for handling, storing, installation, and finishing of treated material:

a. For each type of preservative treated wood product include certification by treating plant stating type of preservative solution and pressure process used, net amount of preservative retained, and compliance with applicable standards.

b. For water borne treated products include statement that moisture content of treated materials was reduced to levels indicated prior to shipment to the Project Site.

c. For fire retardant treated wood products include certification by treating plant that treated material complies with specified standard and other requirements.

d. Material test reports from qualified independent testing laboratory indicating and interpreting test results relative to compliance of fire retardant treated wood products with requirements indicated.

e. Warranty of chemical treatment manufacturer for each type of treatment.

3. Research reports or evaluation reports of the model code organization acceptable to authorities having jurisdiction evidencing compliance of the following wood products with specified requirements and International Building Code 2009 in effect for Project.

a. Engineered wood products

b. Power driven fasteners

c. Fire retardant treated wood

B. Record Documents:

1. Provide record approved submittals.

1.05 DELIVERY, STORAGE AND HANDLING

A. Delivery and Storage: Keep materials under cover and dry. Protect against exposure to weather and contact with damp or wet surfaces. Stack material above ground level on uniformly spaced supports to prevent deformation.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.02 LUMBER, GENERAL

A. Furnish lumber manufactured to comply with PS 20 "American Softwood Lumber Standard" and with applicable grading rules of inspection agencies certified by American Lumber Standards Committee's (ALSC) Board of Review.

B. Furnish lumber with each piece factory marked with grade stamp of inspection agency that indicates grading agency, grade, species, moisture content at time of surfacing, and mill.

C. Inspection Agencies: Inspection agencies and the abbreviations used to reference them with lumber grades and species include the following:

1. RIS Redwood Inspection Service

2. SPIB Southern Pine Inspection Bureau

3. WWPA Western Wood Products Association

D. Nominal sizes are indicated, except as shown by detail dimensions. Provide actual sizes as required by PS 20, for moisture content specified for each use.

1. Provide dressed lumber, S4S, unless otherwise indicated.

2. Provide seasoned lumber with 19 percent maximum moisture content at time of dressing and shipment for sizes 2 inches or less in nominal thickness, unless otherwise indicated.

2.03 DIMENSION LUMBER AND BOARDS FOR CONCEALED CONDITIONS

A. Species: Any wood species listed by PS 20.

B. Moisture Content: S DRY, KD 19 or MC 19 (19 percent maximum moisture content).

C. Grade: No. 2 or standard grade.

2.04 CONSTRUCTION PANELS

A. Comply with requirements of PS 1 Voluntary Product Standard "Construction and Industrial Plywood" for veneer plywood and APA PRP 108 "Performance Standards and Policies for Structural Use Panels" for performance rated panels.

1. Furnish construction panels that are each factory marked with APA trademark for grade specified.

B. Miscellaneous Concealed Panels: APA RATED SHEATHING, Exposure 1, span rating to suit framing in each location.

C. Miscellaneous Exposed Plywood: A D Interior, thickness as indicated but not less than 3/4 inch nominal.

D. Electrical/Telephone Backing Panels: C D Plugged, Exposure 1 plywood panels, fire retardant treated, thickness as indicated but not less than 1/2 inch (30.5 cm) nominal.

2.05 FASTENERS

A. Where miscellaneous carpentry is exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners with a hot dip zinc coating per ASTM A 153 or of AISI Type 304 stainless steel.

B. Nails, Wire, Brads and Staples: FS FF N 105.

C. Bolts: ASTM A 307, Grade A; with ASTM A 563 hex nuts and flat washers.

D. Wall Plug Anchors: "Anchortite" or equivalent, 24 gage galvanized metal plugs extending 2-1/2 inch minimum into masonry substrate.

E. Adhesives: Formulation complying with APA AFG 01 that is approved for use with type of construction panel indicated by both adhesive and panel manufacturer.

2.06 PRESERVATIVE WOOD TREATMENT BY PRESSURE PROCESS

A. Obtain preservative treated lumber complying with AWPA Standard C2. Mark each treated item with AWPB or SPIB Quality Mark Requirements. Coat surfaces cut after treatment to comply with AWPA M4.

B. Above Ground Wood Treatment: Pressure treat with waterborne preservatives to a minimum retention of 0.25 pcf.

1. Kiln dry interior dimension lumber after treatment to 19 percent maximum moisture content.

2. Kiln dry interior construction panels after treatment to 15 percent maximum moisture content.

3. Treat wood items indicated and in the following circumstances:

a. In contact with roofing, flashing, or waterproofing.

b. In contact with masonry or concrete.

c. Within 18 inches (45.7 cm) of grade.

C. Ground Contact Wood Treatment: Pressure treat with waterborne preservatives to a minimum retention of 0.40 pcf.

D. Subject to compliance with requirements, provide one of the following:

1. "Wolmanized," Hickson Corporation.

2. "Dixie CCA" Hoover Treated Wood Products.

3. "K-33," Osmose Wood Preserving Co, Inc.

2.07 FIRE RETARDANT TREATMENT BY PRESSURE PROCESS

A. Identify treated wood with appropriate classification marking of Underwriters Laboratories Inc. or other testing and inspection agency acceptable to authorities having jurisdiction.

B. Dimension Lumber: Comply with AWPA C20.

C. Plywood: Comply with AWPA C27.

D. Treatment Types: Interior Type A for protected wood and Exterior Type for wood exposed to weather.

E. Inspect each piece after drying and discard damaged or defective pieces.

F. Products: Subject to compliance with requirements, provide one of the following:

1. Interior Type A Fire Retardant Treated Wood:

a. "Dricon," Hickson Corporation.

b. "Pyro Guard," Hoover Treated Wood Products.

c. "Flameproof LHC HTT," Osmose Wood Preserving Co, Inc.

2. Exterior Type Fire Retardant Treated Wood:

a. "Exterior Fire X," Hoover Treated Wood Products.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. All installation shall be in accordance with manufacturer's published recommendations.

C. Discard units of material with defects that impair quality of miscellaneous carpentry and in sizes that would require an excessive number or poor arrangement of joints.

D. Cut and fit miscellaneous carpentry accurately. Install members plumb and true to line and level.

E. Coat cut edges of preservative treated wood to comply with AWPA M4.

F. Securely fasten miscellaneous carpentry as indicated and according to applicable codes and recognized standards.

G. Countersink nail heads on exposed carpentry work and fill holes.

H. Use fasteners of appropriate type and length. Predrill members when necessary to avoid splitting wood.

3.02 WOOD GROUNDS, NAILERS, BLOCKING, AND SLEEPERS

A. Install where shown and where required for screeding or attachment of other work. Cut and shape to required size. Coordinate location with other work involved.

B. Attach to substrates as required to support applied loading. Countersink bolts and nuts flush with surfaces, unless otherwise indicated.

3.03 WOOD FURRING

A. Install at spacing indicated, with closure strips at edges and openings. Shim with wood as required for tolerance of finished work.

B. Furring to Receive Plywood Paneling: Install 1 inch (2.5 cm) by 3 inch (7.6 cm) furring at 2 feet (0.6 meters) on center, horizontally and vertically. Select furring strips for freedom from knots that could cause bent over nails and damage to paneling.

C. Furring to Receive Gypsum Board: Install 1 inch (2.5 cm) by 2 inch (5.1 cm) furring at 16 inches (40.6 cm) on center, vertically.

D. Furring to Receive Plaster Lath: Install 1 inch (2.5 cm) by 2 inch (5.1 cm) furring at 16 inches (40.6 cm) on center, vertically.

3.04 CONSTRUCTION PANELS

A. Comply with applicable installation recommendations in APA Form E30 "Design/Construction Guide Residential & Commercial."

END OF SECTION 06 10 00

SECTION 06 40 00 – ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with all applicable federal, state, and local requirements, and conform to codes and ordinances of the authorities having jurisdiction.

1.03 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firm with minimum five years experience in successfully producing architectural woodwork similar to that indicated for this Project, with sufficient production capacity to produce required units without causing delay in the Work.

B. Single Source Manufacturing and Installation Responsibility: Engage the Manufacturer to assume undivided responsibility for woodwork specified in this section, including fabrication, finishing, and installation.

C. AWI Quality Standard: Comply with applicable requirements of "Architectural Woodwork Quality Standards" published by the Architectural Woodwork Institute (AWI) except as otherwise indicated.

1.04 MOCKUP

A. Follow Section 01 45 00.

1.05 SUBMITTALS

A. Samples:

1. Provide samples for initial selection purposes of the following materials and finishes in the form of manufacturer's color charts consisting of actual units or sections of units showing full range of colors, textures, and patterns available for each type of material indicated.

a. Solid surfacing materials.

2. Provide samples for verification purposes of the following:

   a. Solid surfacing materials.

B. Product Data:

1. Provide manufacturer's catalog cuts and descriptive information on each product used.

C. Shop Drawings:

1. Shop drawings showing location of each item, dimensioned plans and elevations, large scale details, attachment devices, and other components.

   a. Indicate all field measurements and all proposed deviations from the contract documents.

   b. Show all approved change orders, clarification, and addendum items related to the scope of the architectural woodwork.

   c. Show locations and size of furring, blocking, and hanging strips, including concealed blocking and reinforcing specified in other Sections.

   d. Show locations and sizes of cutouts and holes for plumbing fixtures and other items installed in architectural woodwork.

D. Record Documents:

1. Provide record approved shop drawings, samples, and warranties.

1.06 DELIVERY, STORAGE AND HANDLING

A. Protect woodwork during transit, delivery, storage, and handling to prevent damage, soilage, and deterioration.

B. Do not deliver woodwork until painting, wet work, grinding, and similar operations that could damage, soil, or deteriorate woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas whose environmental conditions meet requirements specified in "Project Conditions."

1.07 PROJECT CONDITIONS

A. Environmental Conditions: Obtain and comply with Woodwork Manufacturer's and Installer's coordinated advice for optimum temperature and humidity conditions for woodwork during its storage and installation. Do not install woodwork until these conditions have been attained and stabilized so that woodwork is within plus or minus 1.0 percent of optimum moisture content from date of installation through remainder of construction period.

B. Field Measurements: Where woodwork is indicated to be fitted to other construction, check actual dimensions of other construction by accurate field measurements before manufacturing woodwork; show recorded measurements on final shop drawings. Coordinate manufacturing schedule with construction progress to avoid delay of Work.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.02 WOODWORK MATERIALS

A. Provide materials that comply with requirements of the AWI woodworking standard for each type of woodwork and quality grade indicated and, where the following products are part of woodwork, with requirements of the referenced product standards, that apply to product characteristics indicated:

1. Softwood Plywood: PS 1

B. Solid Surface Materials: Refer Section 06 61 16.

2.03 FABRICATION, GENERAL

A. Wood Moisture Content: Comply with requirements of referenced quality standard for moisture content of lumber in relation to relative humidity conditions existing during time of fabrication and in installation areas.

B. Fabricate woodwork to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:

C. Complete fabrication, including assembly, finishing, and hardware application, before shipment to the Project Site to maximum extent possible. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at the Project Site, provide ample allowance for scribing, trimming, and fitting.

D. Factory cut openings, to maximum extent possible, to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing in diagrams to produce accurately sized and shaped openings. Smooth edges of cutouts and, where located in countertops and similar exposures, seal edges of cutouts with a water resistant coating.

2.04 FASTENERS AND ANCHORS

A. Screws: Select material, type, size, and finish required for each use. Comply with FS FF S 111 for applicable requirements.

1. For metal framing supports, provide screws as recommended by metal framing manufacturer.

B. Nails: Provide the following of type and size required for each use. Comply with FS FF N 105 for applicable requirements.

1. Stainless steel nails.

C. Anchors: Select material, type, size, and finish required by each substrate for secure anchorage. Provide nonferrous metal or hot dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed steel or lead expansion bolt devices for drilled in place anchors. Furnish inserts and anchors, as required, to be set into concrete or masonry work for subsequent woodwork anchorage.

PART 3 - EXECUTION

3.01 PREPARATION

A. Condition woodwork to average prevailing humidity conditions in installation areas before installing.

B. Deliver concrete inserts and similar anchoring devices to be built into substrates well in advance of time substrates are to be built.

C. Before installing architectural woodwork, examine shop fabricated work for completion and complete work as required, including back priming and removal of packing.

3.02 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. All installation shall be in accordance with manufacturer’s published recommendations.

C. Quality Standard: Install woodwork to comply with AWI Section 1700 for same grade specified in Part 2 of this section for type of woodwork involved.

D. Install woodwork plumb, level, true, and straight with no distortions. Shim as required with concealed shims. Install to a tolerance of 1/8 inch in 8' 0" for plumb and level (including tops) and with no variations in flushness of adjoining surfaces.

E. Scribe and cut woodwork to fit adjoining work and refinish cut surfaces or repair damaged finish at cuts.

F. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure to grounds, stripping and blocking with countersunk, concealed fasteners and blind nailing as required for a complete installation. Except where prefinished matching fastener heads are required, use fine finishing nails for exposed nailing, countersunk and filled flush with woodwork and matching final finish where transparent finish is indicated.

G. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.

1. Align adjacent solid-surfacing-material countertops and form seams to comply with manufacturer's written recommendations using adhesive in color to match countertop. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

2. Install countertops with no more than 1/8 inch in 96-inch (3 mm in 2400-mm) sag, bow, or other variation from a straight line.

3. Secure backsplashes to tops with concealed metal brackets at 16 inches (400 mm) o.c. and to walls with adhesive.

4. Provide silicone seal prior to installation. Calk space between backsplash and wall with sealant specified in Division 07 Section "Joint Sealants."

5. Seal sink and faucet fitting with silicone in shop environment prior to installation.

H. Complete the finishing work specified in this section to whatever extent not completed at shop or before installation of woodwork.

3.03 ADJUSTMENT AND CLEANING

A. Repair damaged and defective woodwork where possible to eliminate defects functionally and visually; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.

B. Clean woodwork on exposed and semi-exposed surfaces. Touch up factory applied finishes to restore damaged or soiled areas.

3.04 PROTECTION

A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, which ensures that woodwork is without damage or deterioration at time of Substantial Completion.

END OF SECTION 06 40 00

SECTION 06 61 16 – SOLID SURFACING FABRICATIONS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 SUMMARY

A. This Section includes solid surfacing material for the following:

1. Lavatory Countertops with apron and backsplash.

1.03 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with all applicable requirements and standards.

1.04 QUALITY ASSURANCE

A. Fabricator Qualifications: All work of this section shall be fabricated and installed by a fabrication professional who has been accredited by the manufacturer of the solid surfacing materials. The fabricator shall be skilled in the knowledge and ability required to provide work in accordance with the manufacturer's "Fabrication and Installation Manual" and shall have a minimum of five (5) years of fabrication experience and shall have completed a minimum of five (5) fabrication projects of similar scope and size to the fabrication and installation work of this Project.

B. Source Quality Control: Obtain and provide materials from a single manufacturer of solid surfacing materials with not less than five (5) years of successful experience in supplying principal materials. Provide secondary and alternate materials only as recommended by the manufacturer of the primary materials.

C. Wherever possible, check dimensions of supporting structure at the Project Site by accurate field measurements before final submittal of shop drawings and fabrication of items. Where necessary, proceed without field measurements and coordinate installation tolerances to ensure proper fit of solid surfacing fabrications.

1.05 SUBMITTALS

A. Samples:

1. Samples for Verification Purposes: Submit three sets not less than 12 inches by 12 inches in size, of color, grade, and finish of each type of solid surfacing material required. Include the full range of exposed color and texture to be expected in the completed work. Architect's review will be for color and texture only. Compliance with all other requirements is the exclusive responsibility of the Contractor.

2. Samples of fabricated backsplash/countertop and raised lip at toilet room countertops.

3. Samples of fabricated toilet room thresholds.

B. Product Data:

1. Provide manufacturer's catalog cuts and descriptive information, including cleaning and maintenance requirements, on each product used.

C. Shop Drawings:

1. Submit cutting and setting drawings showing sizes, dimensions, sections, and profiles of solid surfacing material units, the arrangement, and provisions for jointing and other necessary details for reception of other work.

2. Submit drawings for the fabrication and installation of countertops with integral bowls. Indicate dimensions, size, and location of cutouts, and relation to plumbing work.

D. Record Documents:

1. Provide record approved product data, shop drawings, samples, and warranties.

1.06 DELIVERY, STORAGE AND HANDLING

A. Protect solid surfacing material from damage during loading, shipment, delivery, and storage. Use non staining materials for blocking and packing. Stack and block solid surfacing material units at the Project Site in accordance with fabricator's recommendations.

1.07 WARRANTY

A. Solid Surfacing Material Fabrication and Installation:

1. Provide manufacturer's standard ten (10) year limited warranty. The manufacturer shall warrant that the materials provided under this Section shall not develop visible defects or otherwise fail due to manufacturing defects within a period of ten (10) years from the date of Substantial Completion of the Work.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.02 MANUFACTURERS

A. The notes and schedules on the Drawings establish manufacturer, model/design, and color required for the Project. Provide the products listed unless Architect approves products of other manufacturer specifically for this Project.

B. Products: Subject to compliance with requirements, provide one of the following products:

1. Countertops, Basksplash and Base:

a. Corian by DuPont.

b. Surell by Formica Corporation.

C. Performance

1. Solid, nonporous surfacing material composed of a unique blend of natural minerals and high-performance acrylic meeting the following criteria:

a. Wear and Cleanability: Passes per ASI Z124.3.

b. Abrasion Resistance: No loss of pattern per NEMA LD3-3.01 and ANSI Z 124.3; weight loss, 1,000 cycles, 0.2 gm; wear, 10,000 cycles, 0.008 inches.

c. Boiling Water Surface Resistance: No change per NEMA LD3-3.05.

d. High Temperature Resistance: No change per NEMA LD3-3.06.

e. Conductive Heat Resistance: No change per NEMA LD3-3.08.

f. Impact Resistance, Notched Izod: 0.28 ft-lbs/in of notch per ASTM D 256, Method A.

g. Impact Resistance, Ball Drop: 3/4 inch thick sheet, 36 inches with 1/2 pound ball, no failure per NEMA LD3-3.03.

h. Stain Resistance: Passes, Rating-41, modified with additional stains used, per ANSI Z124.3.

i. Weatherability: No change, 1000 hours, per ASTM D 1499.

j. Fungi and Bacteria: No attack per ASTM G 21, G 22.

k. Water Absorption: 3/4 inch sheet, 0.04 percent after 24 hours, 0.94 percent long term, per ASTM D 570.

l. Flammability: Solid colors per ASTM E 84.

1) Flame Spread: Less than 5.

2) Smoke Developed: Less than 15.

3) Class Rating: 1.

m. Thickness: 1/2 inch (12 mm) unless noted or scheduled otherwise.

n. Colors and Sheen: As selected by Architect.

o. Acceptable Product: Corian by DuPont.

2.03 FABRICATION

A. Quality Standard: Comply with AWI Section 400 requirements for countertops.

B. Solid-Surfacing-Material Thickness: 3/4 inch (19 mm).

C. Colors, Patterns, and Finishes: Provide materials and products that result in colors of solid-surfacing material complying with the following requirements:

D. Color: As selected by Architect from manufacturer's standard range of colors.

E. Fabricate tops in one piece with shop-applied backsplashes and edges, unless otherwise indicated. Comply with solid-surfacing-material manufacturer's written recommendations for adhesives, sealers, fabrication, and finishing.

F. Fabrication shall be performed by a fabricator, accredited by the manufacturer, in accordance with manufacture's recommendations and reference manuals.

G. Shop fabricate components to greatest extent practicable to size and shapes indicated, in accordance with approved shop drawings.

H. Comply with the manufacturer's recommendations for the use of specific types of stationary equipment and stationary tools. Site fabrication and finishing processes shall be in accordance with the manufacturer's recommendations.

I. Form seams between components, unless otherwise indicated, using manufacturer's standard structural adhesive. Adhesive shall be color coordinated to match solid surfacing material color and shall form inconspicuous seams. Seams shall not be permitted along the long side of any areas of less than 36 inches across.

J. Provide factory cutouts for plumbing fittings and bath accessories as indicated on the drawings and as recommended by the solid surfacing manufacturer.

K. Cut and finish component edges with clean sharp returns. Rout radii and contours to exact template sizes, and as indicated on the drawings. Repair or reject defective or inaccurate work.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. All installation shall be in accordance with manufacturer's published recommendations.

C. Prepare substrate plane, plumb and level, secure in place with all fasteners set flush. Shim supporting structure as required to provide an acceptable surface for attaching finish materials.

D. Install components plane, plumb and level, in accordance with approved shop drawings and product data.

E. Pre-fit finish material in place. Scribe material as required to provide proper fit with adjacent materials.

F. Provide additional support for material seams in both horizontal and vertical locations. Separation/release paper shall be provided between all supports and seams to prevent direct adhering of finish material to substrate.

G. Form field joints using manufacturer's recommended adhesive, with inconspicuous joints in finished work.

H. Prior to installing fabrications, make sure that substrate is clean and dry. Place silicone "dads" on substrate in accordance with manufacturer's recommendations.

3.02 CLEANING

A. At Substantial Completion remove temporary protection and thoroughly clean work in accordance with manufacturer’s published care and maintenance guidelines.

B. Do not use wire brushes, acids, abrasive cleansers, or solutions which might cause discoloration or abrasion.

C. Clean by scrubbing with a soft cloth using liquid detergents and water as recommended by the manufacturer. Rinse with clean water. Repair joints where necessary.

END OF SECTION 06 61 16

SECTION 06 82 13 - GLASS-FIBER-REINFORCED PLASTIC PANELING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 SUMMARY

A. This Section includes the following:

1. Glass fiber reinforced plastic (FRP) wall paneling.

2. Trim and accessories.

B. Related Sections include the following:

1. Division 10 Section "Wall and Corner Guards" for corner guards installed over plastic paneling.

1.03 ACTION SUBMITTALS

A. Product Data: Submit manufacturer’s data sheets on each product used, including the following

1. Preparation instructions and recommendations.

2. Storage and handling requirements and recommendations.

3. Installation methods.

B. Samples for Initial Selection: For plastic paneling and trim accessories.

C. Samples for Verification: For each finish specified, submit two complete sets of color chips representing manufacturer’s full range of available colors and patterns.

1.04 INFORMATIONAL SUBMITTALS

A. Instructions: Manufacturer's latest installation instructions.

1.05 CLOSEOUT SUBMITTALS

A. Maintenance Data: Maintenance data for installed products in accordance with Section 01 78 23. Include methods for maintaining FRP panels, and precautions against cleaning materials and methods detrimental to finishes and performance

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firm with minimum three years experience specializing in manufacturer of glass reinforced panels.

B. Installer: Approved by manufacturer and having successfully completed five projects of similar scope and complexity.

C. Source Limitations: Obtain plastic paneling and trim accessories from single manufacturer.

D. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.

2. Smoke-Developed Index: 450 or less.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Comply with manufacturer's ordering instructions and lead time requirements to avoid delays in the performance of the Work.

B. Deliver materials in manufacturer's original, unopened packages with factory labels attached indicating brand, pattern, size and fire rating as applicable.

C. Store materials protected from exposure to harmful weather conditions and at temperature and humidity conditions recommended by manufacturer. Store panels in a dry location at Project site.

D. Cover and protect material in transit and at job site. Damaged or defaced material will be rejected and shall be replaced at no cost to Owner.

1.08 PROJECT CONDITIONS

A. Remove panels from cartons and allow to acclimate to room conditions for at least 48 hours prior to installation.

B. Installation shall not begin until building is enclosed and permanent HVAC equipment is in operation, and residual moisture from gypsum board finishing operations has dissipated.

C. During installation, and for not less than 48 hours before, maintain an ambient temperature and relative humidity within limits required by type of adhesive used and recommendations of adhesive manufacturer.

D. Provide ventilation to disperse fumes during application of adhesive as recommended by adhesive manufacturer.

E. Field Measurements: Verify actual measurements and openings by field measurements prior to fabrication. Show recorded measurements on shop drawings. Coordinate field measurements and fabrication schedule with construction progress to avoid delays.

1.09 COORDINATION

A. Consult with other trades in advance and make provisions for their work to avoid cutting and patching.

B. Notify responsible trades of schedules so as to allow adequate time for installation and coordination of their work.

1.10 EXTRA MATERIALS

A. Extra Stock: At the end of the Project, deliver to Owner extra materials from same production run as products installed. Extra stock shall be packaged with protective covering and identified with descriptive labels.

B. Furnish quantity of panels and trim moldings equal to 5% of amount installed.

PART 2 - - PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Citadel Architectural Products.

2. Kemlite Company.

3. Marlite.

4. Nudo Products, Inc.

B. Substitutions: None accepted.

2.02 FRP PANELING

A. General: Gelcoat-finished, glass-fiber reinforced plastic panels complying with ASTM D 5319.

B. Panels, General:

1. Fire Resistance Rating, ASTM E 84: Class A.

2. Physical Characteristics:

a. Flexural Strength, ASTM D 790: 10,000 psi (69 Mpa).

b. Tensile Strength, ASTM D 638: 7,000 (48 Mpa) psi.

c. Impact Resistance, ASTM D 256, Izod Method: 7.2 ft-lb/in (1260 N/m).

3. USDA Approved.

4. Surface Finish: Molded pebbled texture, high gloss.

C. Basis of Design, Wall Panels: Kemlite, Fire-X Glasbord FRP panels.

1. Nominal Panel Thickness: 2.3 mm, minimum.

2. Color: Refer to Finish Legend on Drawings, or if not indicated, as selected by Architect from manufacturer's complete line.

2.03 ACCESSORIES

A. Trim Accessories: Manufacturer's standard one-piece vinyl extrusions designed to retain and cover edges of panels. Provide division bars, inside corners, outside corners, and caps as needed to conceal edges.

1. Color: Refer to Finish Legend on Drawings, or if not indicated, as selected by Architect from manufacturer’s complete line.

B. Exposed Fasteners: Nylon drive rivets recommended by panel manufacturer.

C. Adhesive: As recommended by plastic paneling manufacturer.

D. Sealant: Single-component, mildew-resistant, neutral-curing or acid-curing sanitary silicone sealant recommended by plastic paneling manufacturer and complying with requirements in Division 07 Section "Joint Sealants."

1. Color: As selected by Architect.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Verify that surfaces and conditions are ready to receive work of this Section.

C. Examine backup surfaces to determine that corners are plumb and straight, surfaces are smooth, uniform, clean, free from foreign matter, nails and screws are countersunk, and joints and cracks are filled flush and smooth with the adjoining surface.

D. Do not proceed until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Remove wallpaper, vinyl wall covering, loose or soluble paint, and other materials that might interfere with adhesive bond.

B. Prepare substrate by sanding high spots and filling low spots as needed to provide flat, even surface for panel installation.

C. Clean substrates of substances that could impair bond of adhesive, including oil, grease, dirt, and dust.

D. Condition panels by unpacking and placing in installation space before installation according to manufacturer's written recommendations.

E. Lay out paneling before installing. Locate panel joints to provide equal panels at ends of walls not less than half the width of full panels so that trimmed panels at corners are not less than 12 inches (300 mm) wide.

1. Mark plumb lines on substrate at trim accessory locations for accurate installation.

2. Locate trim accessories to allow clearance at panel edges according to manufacturer's written instructions.

3.03 INSTALLATION

A. Install plastic paneling according to manufacturer's written instructions.

B. Install panels in a full spread of adhesive.

C. Install sheets plumb, level, securely anchored or fastened, and with uniform joints between adjacent panels. Install panels with manufacturer’s recommended gap between panels and at corners.

D. Install division molding between sheets, and continuous cap molding at top and bottom edges of panels. Install continuous corner molding at vertical corner joints.

E. Apply continuous bead of sealant in each joint and trim groove and between trim and adjacent construction, maintaining 1/8 inch expansion space.

F. Remove excess sealant and smears as paneling is installed. Clean with solvent recommended by sealant manufacturer and then wipe with clean dry cloths until no residue remains.

3.04 CLEANING

A. Remove temporary coverings and protection of adjacent work areas.

B. Clean installed products in accordance with manufacturer’s instructions. Remove adhesive and excess sealant from panel and molding face using solvent or cleaner recommended by panel manufacturer.

C. Perform final cleaning in accordance with Section 01 77 00.

3.05 PROTECTION

A. Provide necessary protection to ensure reinforced panels will be without damage or deterioration at time of Substantial Completion.

B. Repair or replace all damaged or soiled units. If patching is noticeable after work is completed, replace entire item.

C. Upon acceptance of Project, provide full instructions and demonstrate to Owner's designated representatives, the proper methods of care and maintenance of the panels.

END OF SECTION 06 82 13

SECTION 07 21 00 – THERMAL INSULATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with all applicable requirements and standards.

1.03 DEFINITIONS

A. Thermal Resistivity: Where the thermal resistivity of insulation products is designated by "r values," they represent the reciprocal of thermal conductivity (k values). Thermal conductivity is the rate of heat flow through a homogenous material exactly 1 inch thick. Thermal resistivities are expressed by the temperature difference in degrees F between the two exposed faces required to cause one BTU to flow through one square foot per hour at mean temperatures indicated.

1.04 QUALITY ASSURANCE

A. Fire Performance Characteristics: Provide insulation materials identical to those whose indicated fire performance characteristics have been determined per the ASTM test method indicated below, by UL or other testing and inspecting organizations acceptable to authorities having jurisdiction. Identify products with appropriate markings of applicable testing and inspecting organization.

1. Surface Burning Characteristic: ASTM E 84

2. Fire Resistance Ratings: ASTM E 119

B. Single Source Responsibility for Insulation Products: Obtain each type of building insulation from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work.

1.05 SUBMITTALS

A. Product Data:

1. Submit a complete listing of all manufacturers, products, model numbers, and designs proposed for use in the Work of this Section.

2. Include code compliance verification, R-values, moisture permeability, fire ratings and installation instructions.

B. Record Documents:

1. Maintain two copies of all shop drawings, product data, and samples, manufacturer's specifications, recommendations, installation instructions, and maintenance data at the Project Site.

2. At Project Closeout, turn over both copies to the Architect who will transmit one copy to the Owner.

1.06 DELIVERY, STORAGE AND HANDLING

A. Protect insulation materials from physical damage and from deterioration by moisture, soiling, and other sources. Store inside and in a dry location.

B. Comply with manufacturer's recommendations for handling, storage, and protection during installation.

C. Protect plastic insulation as follows:

1. Do not expose to sunlight, except to extent necessary for period of installation and concealment.

2. Protect against ignition at all times. Do not deliver plastic insulating materials to the Project Site ahead of installation time.

3. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.02 INSULATING MATERIALS

A. Provide insulating materials that comply with requirements and with referenced standards.

1. Preformed Units: Sizes to fit applications indicated, selected from manufacturer's standard thicknesses, widths, and lengths.

B. Unfaced Glass Fiber Board Insulation: Thermal insulation produced by combining glass fibers with thermosetting resin binders to comply with ASTM C 612 for Class indicated; and as follows:

1. Low Density Semi Rigid Board: Class 1, nominal density of 2.25 pcf, r value of 4.3 at 75 degrees F (23.9 degrees C).

2. Medium Density Semi Rigid Board: Class 1 and 2, nominal density of 3.0 pcf, r value of 4.3 at 75 degrees F (23.9 degrees C).

3. Rigid Board: Class 1 and 2, nominal density of 6.0 pcf, r value of 4.3 at 75 degrees F (23.9 degrees C).

   a. CertainTeed "WP 225".

   b. Knauf "IB 2.25".

   c. Schuller "Insul-Shield 225"

   d. Owens Corning "225".

C. Unfaced Mineral Fiber Blanket/Batt Insulation: Thermal insulation produced by combining mineral fibers of type described below with thermosetting resins to comply with ASTM C 665 for Type I (blankets without membrane facing); and as follows:

1. Mineral Fiber Type: Fibers manufactured from glass or slag.

2. Surface Burning Characteristics: Maximum flame spread and smoke developed values of 25 and 50, respectively.

3. Products:

   a. CertainTeed "Building Insulation".

   b. Knauf "Light Density".

   c. Schuller "C.I. Unfaced".

   d. Owens Corning "Fire-Core 60 S.A. Batts".

2.03 SAFING INSULATION AND ACCESSORIES

A. Semi Refractory Fiber Board Safing Insulation: Semi rigid boards designed for use as a fire stop at openings between edge of slab and exterior wall panels, produced by combining semi refractory mineral fiber manufactured from slag with thermosetting resin binders to comply with ASTM C 612, Class 1 and 2; nominal density of 4.0 pcf; passing ASTM E 136 for combustion characteristics; r value of 4.0 at 75 degrees F (23.9 degrees C).

1. Fibrex Inc., "FBX Safing Insulation".

2. USG "Thermafiber Safing Insulation".

B. Caulking Compound: Material approved by manufacturer of safing insulation for sealing joint between foil backing of safing insulation and edge of concrete floor slab against penetration of smoke.

C. Safing Clips: Galvanized steel safing clips approved by manufacturer of safing insulation for holding safing insulation in place.

2.04 AUXILIARY INSULATING MATERIALS

A. Adhesive for Bonding Insulation: Product with demonstrated capability to bond insulation or mechanical anchors securely to substrates indicated without damaging or corroding either insulation, anchors, or substrates.

B. Adhesively Attached Pin Anchors: Perforated plate, 2 inches square, welded to projecting pin, with self locking washer, complying with the following requirements:

1. Plate: Zinc plated steel, 0.106 inch thick.

2. Pin: Copper coated low carbon steel, fully annealed, 0.106 inches in diameter, length to suit depth of insulation indicated and, with washer in place, to hold insulation tightly to substrate behind insulation.

3. Self Locking Washer: Mild steel, 0.016 inch thick, size as required to hold insulation securely.

a. Where spindles will be exposed to human contact after installation, protect ends with capped self locking washers.

C. Asphalt Coating for Cellular Glass Block Insulation: Cutback asphalt or asphalt emulsion of type recommended by cellular glass block insulation manufacturer.

1. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:

a. "PITTCOTE 300 Coating," Pittsburgh Corning Corp.

b. "Karnak 100," Karnak Corp.

D. Protection Board: Premolded, semi rigid asphalt/fiber composition board, 1/4 inch thick, formed under heat and pressure, standard sizes.

E. Eave Ventilation Troughs: Preformed rigid fiberboard or plastic sheets designed and sized to fit between roof framing members and to provide cross ventilation between insulated attic spaces and vented eaves.

PART 3 - EXECUTION

3.01 PREPARATION

A. Examine substrates and conditions with Installer present, for compliance with requirements of the Sections in which substrates and related work are specified and to determine if other conditions affecting performance of insulation are satisfactory. Do not proceed with installation of insulation until unsatisfactory conditions have been corrected.

B. Clean substrates of substances harmful to insulations or vapor retarders, including removal of projections that might puncture vapor retarders.

C. Close off openings in cavities receiving poured in place insulation to prevent the escape of insulation. Provide bronze or stainless steel screen (inside) where openings must be maintained for drainage or ventilation.

3.02 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. All installation shall be in accordance with manufacturer's published recommendations.

3.03 INSTALLATION OF GENERAL BUILDING INSULATION

A. Apply insulation units to substrate by method indicated, complying with manufacturer's recommendations. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.

1. Where insulation units are not held tightly in place by adjacent materials on all sides, provide wire ties or other acceptable mechanical means to prevent displacement or sagging of insulation.

B. Extend insulation full thickness as indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions, and fill voids with insulation. Remove projections that interfere with placement.

C. Apply a single layer of insulation of required thickness, unless otherwise shown or required to make up total thickness.

3.04 INSTALLATION OF SAFING INSULATION

A. Install safing insulation to fill gap between edge of concrete floor slab and back of exterior spandrel panels on safing clips spaced as needed to support insulation but not further apart then 24 inches on center.

B. Cut safing insulation wider than gap to be filled to ensure compression fit and seal joint between insulation and edge of slab with caulking approved by safing insulation manufacturer for this purpose. Leave no voids in completed installation.

3.05 PROTECTION

A. General:

1. Protect installed insulation and vapor retarders from damage due to harmful weather exposures, physical abuse, and other causes.

2. Provide temporary coverings or enclosures where insulation will be subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 07 21 00

SECTION 07 84 13 – PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with all applicable requirements and standards.

1.03 QUALITY ASSURANCE

A. Arrange for work to be performed by a single applicator having at least two years experience installing UL classified firestopping. If requested, provide a list of past projects for verification of required experience.

B. Materials shall have been tested to provide fire rating equal to that of the construction, within the actual depth and thickness of the construction.

1.04 SUBMITTALS

A. Product Data:

1. Submit a complete listing of all manufacturers, products, model numbers, and designs proposed for use in the Work of this Section.

B. Shop Drawings:

1. Show each condition requiring penetration seals indicating proposed UL systems materials, anchorage, methods of installation, and actual adjacent construction.

2. Submit UL illustration of each proposed system indicating manufacturer approved modifications.

C. Record Documents:

1. Maintain two copies of all shop drawings, product data, and samples, manufacturer's specifications, recommendations, installation instructions, and maintenance data at the Project Site.

2. At Project Closeout, turn over both copies to the Architect who will transmit one copy to the Owner.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver materials undamaged in manufacturer's clearly labeled unopened containers, identified with brand, type, grade and UL label where applicable.

1.06 PROJECT CONDITIONS

A. Verify existing conditions and substrates before starting Work. Correct unsatisfactory conditions before proceeding.

B. Proceed with installation only after penetrations of the substrate and supporting brackets have been installed.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.02 MANUFACTURERS

A. Subject to compliance with requirements, provide products of one of the following manufacturers:

1. Hilti Firestop Systems.

2. 3M, Electrical Products Division, St. Paul, Minnesota.

3. Metacaulk; Rectorseal Corp., Houston, Texas

4. Specified Technologies Inc., Somerville, New Jersey.

5. United States Gypsum Company.

2.03 MATERIALS

A. Provide materials classified by UL to provide fire barrier equal to time rating of construction being penetrated.

B. Provide asbestos free materials that comply with applicable Codes and have been tested in accordance with UL 1479 or ASTM E 814.

PART 3 - EXECUTION

3.01 PREPARATION

A. Clean surfaces to be in contact with penetration seal materials of dirt, grease, oil, loose materials, rust, or other substances that may affect proper fitting, adhesion, or the required fire resistance.

3.02 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. All installation shall be in accordance with manufacturer’s published recommendations.

C. Install penetration seal materials in accordance with printed instructions of the UL Building Materials Directory and in accordance with manufacturer's instructions.

D. Seal holes or voids made by penetrations to ensure an effective smoke barrier.

E. Remove damming materials after curing if made of other than fire resistant materials.

F. Protect materials from damage on surfaces subject to traffic.

G. Environmental Requirements:

1. Keep flammable materials away from sparks or flame.

2. Provide masking and drop cloths to prevent contamination of adjacent surfaces by firestopping materials.

3. Maintain minimum 40 degrees F temperature of substrates for 24 hours before, during, and 24 hours after application of firestopping materials.

3.03 FIELD QUALITY CONTROL

A. Examine penetration sealed areas to ensure proper installation before concealing or enclosing areas.

B. Keep areas of work accessible until inspection by applicable authorities having jurisdiction.

C. Perform under this Section patching and repairing of firestopping caused by cutting or penetration by other trades.

3.04 ADJUSTING AND CLEANING

A. Clean up spills of liquid components with solvent.

B. Neatly cut and trim materials with sharp knife or blade as required.

C. Remove materials and debris, leaving area in undamaged, clean condition.

3.05 THROUGH-PENETRATION FIRESTOP SYSTEM SCHEDULE

A. Where UL-classified systems are indicated, they refer to the alpha-alpha-numeric designations listed in UL's "Fire Resistance Directory" under product Category XHEZ. Indications are for common penetrating conditions. Provide special firestop systems for unique penetration conditions as required; comply with applicable UL-classified systems for penetrating items and assembly penetrated.

B. Frame Wall Assembly Firestop Systems for Metallic Pipes, Conduit, or Tubing:

1. Type of Fill Materials: Intumescent putty or sealant.

2. UL-Classified Systems: W-L-1049.

C. Frame Wall Assembly Firestop Systems for Nonmetallic Pipe, Conduit, or Tubing:

1. Type of Fill Materials: Intumescent putty or sealant, with intumescent wrap strips and steel collars each side where required for size of pipe.

2. UL-Classified Systems: W-L-2093, W-L-2059, or W-L-2074 as applicable for size of pipe.

D. Frame Wall Assembly Firestop Systems for Glass Fiber-Insulated Metallic Pipe, Conduit, or Tubing:

1. Type of Fill Materials: Intumescent putty or sealant.

2. UL-Classified Systems: W-L-5014.

E. Frame Wall Assembly Firestop Systems for Square or Rectangular Sheet Steel Ducts:

1. Type of Fill Materials: Intumescent putty or sealant.

2. UL-Classified Systems: W-L-7025.

F. Frame Wall Assembly Firestop Systems for Square or Round Sheet Steel Ducts:

1. Type of Fill Materials: Intumescent putty or sealant.

2. UL-Classified Systems: W-L-7026.

G. Frame Wall Assembly Firestop Systems for Electrical Cables:

1. Type of Fill Materials: Intumescent putty or sealant.

2. UL-Classified Systems: W-L-3076.

H. Frame Wall Assembly Firestop Systems for Cable Trays:

1. Type of Fill Materials: Pillows/bags.

2. UL-Classified Systems: W-L-4008 or W-L-4029, as applicable.

I. Frame Wall Assembly Firestop Systems for Miscellaneous Multiple Mechanical and Electrical Penetrants:

1. Type of Fill Materials: Intumescent putty or sealant.

2. UL-Classified Systems: W-L-8003.

J. Concrete Floor or Wall Assembly Firestop Systems with No Penetrating Items:

1. Type of Fill Materials: Non-shrink mortar or intumescent putty.

2. UL-Classified Systems: C-AJ-0014 or C-AJ-0015, as applicable.

K. Concrete Floor Assembly Firestop Systems for Metallic Pipes, Conduit, or Tubing:

1. Type of Fill Materials: Intumescent putty or sealant.

2. UL-Classified Systems: C-AJ-1080.

L. Concrete Floor Assembly Firestop Systems for Nonmetallic Pipe, Conduit, or Tubing:

1. Type of Fill Materials: Intumescent putty or sealant, with intumescent wrap strips and steel collar where required for size of pipe.

2. UL-Classified Systems: C-AJ-2031, C-AJ-2063, or C-AJ-2089 as applicable for size of pipe.

M. Concrete Floor Assembly Firestop Systems for Glass Fiber-Insulated Metallic Pipe, Conduit, or Tubing:

1. Type of Fill Materials: Intumescent putty or sealant.

2. UL-Classified Systems: C-AJ-5087.

N. Concrete Floor Assembly Firestop Systems for Square or Rectangular Sheet Steel Ducts:

1. Type of Fill Materials: Intumescent putty or sealant.

2. UL-Classified Systems: C-AJ-7027.

O. Concrete Floor Assembly Firestop Systems for Square or Round Sheet Steel Ducts:

1. Type of Fill Materials: Intumescent putty or sealant.

2. UL-Classified Systems: C-AJ-7023.

P. Concrete Floor Assembly Firestop Systems for Electrical Cables:

1. Type of Fill Materials: Intumescent putty or sealant.

2. UL-Classified Systems: C-AJ-3154.

Q. Concrete Floor Assembly Firestop Systems for Cable Trays:

1. Type of Fill Materials: Pillows/bags.

2. UL-Classified Systems: C-AJ-4029.

R. Concrete Floor Assembly Firestop Systems for Miscellaneous Multiple Mechanical and Electrical Penetrants:

1. Type of Fill Materials: Intumescent putty or sealant.

2. UL-Classified Systems: C-AJ-8053.

S. Concrete or Masonry Wall Assembly Firestop Systems for Metallic Pipes, Conduit, or Tubing:

1. Type of Fill Materials: Intumescent putty or sealant.

2. UL-Classified Systems: C-AJ-1080.

T. Concrete or Masonry Wall Assembly Firestop Systems for Nonmetallic Pipe, Conduit, or Tubing:

1. Type of Fill Materials: Intumescent putty or sealant, with intumescent wrap strips and steel collar where required for size of pipe.

2. UL-Classified Systems: W-J-2018, C-AJ-2063, or C-AJ-2089 as applicable for size of pipe.

U. Concrete or Masonry Wall Assembly Firestop Systems for Glass Fiber-Insulated Metallic Pipe, Conduit, or Tubing:

1. Type of Fill Materials: Intumescent putty or sealant.

2. UL-Classified Systems: W-J-5005.

V. Concrete or Masonry Wall Assembly Firestop Systems for Square or Rectangular Sheet Steel Ducts:

1. Type of Fill Materials: Intumescent putty or sealant.

2. UL-Classified Systems: W-J-7006 or W-J-7007 as applicable

W. Concrete or Masonry Wall Assembly Firestop Systems for Square or Round Sheet Steel Ducts:

1. Type of Fill Materials: Intumescent putty or sealant.

2. UL-Classified Systems: W-J-7005.

X. Concrete or Masonry Wall Assembly Firestop Systems for Electrical Cables:

1. Type of Fill Materials: Intumescent putty or sealant.

2. UL-Classified Systems: W-J-3022.

Y. Concrete or Masonry Wall Assembly Firestop Systems for Cable Trays:

1. Type of Fill Materials: Pillows/bags.

2. UL-Classified Systems: W-J-4021 or W-J-4022 as applicable.

Z. Concrete or Masonry Wall Assembly Firestop Systems for Miscellaneous Multiple Mechanical and Electrical Penetrants:

1. Type of Fill Materials: Intumescent putty or sealant.

2. UL-Classified Systems: C-AJ-8053.

3.06 WALL OPENING PROTECTIVE MATERIALS SCHEDULE

A. Products listed in UL's "Fire Resistance Directory" under product Category CLIV used to maintain hourly ratings of fire resistive walls and partitions containing flush mounted devices such as outlet boxes, electrical cabinets and mechanical cabinets.

B. Frame Wall Assembly Metallic or Nonmetallic Outlet and Switch Boxes:

1. Type of Materials: Intumescent putty pads.

2. Provide at all outlet box locations.

END OF SECTION 07 84 13

SECTION 07 84 46 - FIRE-RESISTIVE JOINT SYSTEMS

PART 1 - **GENERAL**

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 SUMMARY

A. Section includes:

1. Joints in or between fire-resistance-rated constructions.

2. Joints in smoke barriers.

B. Related Requirements:

1. Division 07 Section “Penetration Firestopping”.

1.03 COORDINATION

A. Coordinate construction of joints to ensure that fire-resistive joint systems are installed per specified requirements.

B. Coordinate sizing of joints to accommodate fire-resistive joint systems.

C. Notify testing agency at least 7 days in advance of fire-resistive joint system installations; confirm dates and times on day preceding each series of installations.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Product Schedule: For each fire-resistive joint system. Include location and design designation of qualified testing agency.

1. Where Project conditions require modification to a qualified testing agency's illustration for a particular fire-resistive joint system condition, submit illustration, with modifications marked, approved by fire-resistive joint system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified installer.

B. Installer Certificates: From installer indicating fire-resistive joint systems have been installed in compliance with requirements and manufacturer's written recommendations.

C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for fire-resistive joint systems.

1.06 QUALITY ASSURANCE

A. Installer Qualifications: A firm experienced in installing fire-resistive joint systems similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its fire-resistive joint system products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.

B. Fire-Test-Response Characteristics: Fire-resistive joint systems shall comply with the following requirements:

1. Fire-resistive joint system tests are performed by a qualified testing agency acceptable to authorities having jurisdiction.

2. Fire-resistive joint systems are identical to those tested per testing standard referenced in "Fire-Resistive Joint Systems" Article. Provide rated systems complying with the following requirements:

a. Fire-resistive joint system products bear classification marking of qualified testing agency.

b. Fire-resistive joint systems correspond to those indicated by reference to designations listed by UL in its “Fire Resistance Directory.”

1.07 FIELD CONDITIONS

A. Environmental Limitations: Do not install fire-resistive joint systems when ambient or substrate temperatures are outside limits permitted by fire-resistive joint system manufacturers or when substrates are wet.

B. Install and cure fire-resistive joint systems per manufacturer's written instructions using natural means of ventilation or, where this is inadequate, forced-air circulation.

PART 2 - **PRODUCTS**

2.01 MANUFACTURERS

A. Subject to requirements, provide products by one of the following:

1. A/D Fire Protection Systems Inc.

2. Hilti, Inc.

3. Nelson Firestop Products

4. RectorSeal Corporation

5. Specified Technologies Inc.

6. 3M Fire Protection Products

7. Tremco, Inc.; Tremco Fire Protection Systems Group

8. USG Corporation

2.02 FIRE-RESISTIVE JOINT SYSTEMS

A. Where required, provide fire-resistive joint systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which fire-resistive joint systems are installed. Fire-resistive joint systems shall accommodate building movements without impairing their ability to resist the passage of fire and hot gases.

B. Joints in or between Fire-Resistance-Rated Construction: Provide fire-resistive joint systems with ratings determined per ASTM E 1966 or UL 2079:

1. Joints include those installed in or between fire-resistance-rated walls, floor or floor/ceiling assemblies, and roofs or roof/ceiling assemblies.

2. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of construction they will join.

C. Joints in Smoke Barriers: Provide fire-resistive joint systems with ratings determined per UL 2079.

1. L-Rating: Not exceeding 5.0 cfm/ft of joint at 0.30" wg (74.7 Pa) at both ambient and elevated temperatures.

D. Exposed Fire-Resistive Joint Systems: Provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

E. VOC Content: Fire-resistive joint system sealants shall comply with the following limits for VOC content when calculated per 40 CFR 59, Subpart D (EPA Method 24):

1. Architectural Sealants: 250 g/L.

2. Sealant Primers for Nonporous Substrates: 250 g/L.

3. Sealant Primers for Porous Substrates: 775 g/L.

F. Accessories: Provide components of fire-resistive joint systems, including primers and forming materials, that are needed to install fill materials and to maintain ratings required. Use only components specified by fire-resistive joint system manufacturer and approved by the qualified testing agency for systems indicated.

PART 3 - **EXECUTION**

3.01 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for joint configurations, substrates, and other conditions affecting performance of the Work.

B. Do not proceed until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Surface Cleaning: Clean joints immediately before installing fire-resistive joint systems to comply with fire-resistive joint system manufacturer's written instructions and the following requirements:

1. Remove from surfaces of joint substrates foreign materials that could interfere with adhesion of fill materials.

2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with fill materials. Remove loose particles remaining from cleaning operation.

3. Remove laitance and form-release agents from concrete.

B. Priming: Prime substrates where recommended in writing by fire-resistive joint system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. Masking Tape: Use to prevent fill materials of fire-resistive joint system from contacting adjoining surfaces that will remain exposed on completion of the Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove stains. Remove tape as soon as possible without disturbing fire-resistive joint system's seal with substrates.

3.03 INSTALLATION

A. General: Install fire-resistive joint systems per manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install forming materials and other accessories of types required to support fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of fire-resistive joint system.

C. Install fill materials for fire-resistive joint systems by proven techniques to produce the following results:

1. Fill voids and cavities formed by joints and forming materials as required to achieve fire-resistance ratings indicated.

2. Apply fill materials so they contact and adhere to substrates formed by joints.

3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.04 IDENTIFICATION

A. Identify fire-resistive joint systems with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6" of joint edge so labels will be visible to anyone seeking to remove or penetrate joint system. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

1. The words "Warning - Fire-Resistive Joint System - Do Not Disturb. Notify Building Management of Any Damage."

2. Contractor's name, address, and phone number.

3. Designation of applicable testing agency.

4. Date of installation.

5. Manufacturer's name.

6. Installer's name.

3.05 FIELD QUALITY CONTROL

A. Inspecting Agency: Architect will engage a qualified testing agency to perform tests and inspections.

B. Where deficiencies are found or fire-resistive joint systems are damaged or removed due to testing, repair or replace fire-resistive joint systems so they comply with requirements.

C. Proceed with enclosing fire-resistive joint systems with other construction only after inspection reports are issued and installations comply with requirements.

3.06 CLEANING AND PROTECTING

A. Clean off excess fill materials adjacent to joints as the Work progresses by methods and with cleaning materials that are approved in writing by fire-resistive joint system manufacturers and that do not damage materials in which joints occur.

B. Provide final protection and maintain conditions during and after installation that ensure fire-resistive joint systems are without damage or deterioration at time of Substantial Completion. If damage or deterioration occurs despite such protection, cut out and remove damaged or deteriorated fire-resistive joint systems immediately and install new materials to produce fire-resistive joint systems complying with specified requirements.

3.07 FIRE-RESISTIVE JOINT SYSTEM SCHEDULE

A. Where UL-classified systems are indicated, they refer to system numbers in UL's "Fire Resistance Directory" under product Category XHBN or Category XHDG.

B. Floor-to-Floor, Fire-Resistive Joint Systems:

1. UL-Classified Systems: FF-D- 0000-0999, 1000-1999, 2000-2999, 3000-3999, 4000-4999.

C. Wall-to-Wall, Fire-Resistive Joint Systems:

1. UL-Classified Systems: WW-D- 0000-0999, 1000-1999, 2000-2999, 3000-3999, 4000-4999.

D. Floor-to-Wall, Fire-Resistive Joint Systems:

1. UL-Classified Systems: FW-D- 0000-0999, 1000-1999, 2000-2999, 3000-3999, 4000-4999.

E. Head-of-Wall, Fire-Resistive Joint Systems:

1. UL-Classified Systems: HW-D- 0000-0999, 1000-1999, 2000-2999, 3000-3999, 4000-4999.

F. Bottom-of-Wall, Fire-Resistive Joint Systems:

1. UL-Classified Systems: BW-D- 0000-0999, 1000-1999, 2000-2999, 3000-3999, 4000-4999.

G. Wall-to-Wall, Fire-Resistive Joint Systems Intended for Use as Corner Guards:

1. UL-Classified Systems: CG-D- 0000-0999, 1000-1999, 2000-2999, 3000-3999, 4000-4999.

H. Perimeter Fire-Resistive Joint Systems:

1. UL-Classified Perimeter Fire-Containment Systems: CW-D- 0000-0999, 1000-1999, 2000-2999.

END OF SECTION 07 84 46

SECTION 07 92 00 - JOINT SEALANTS

PART 1 - **GENERAL**

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 SUMMARY

A. This Section includes joint sealants for the applications indicated in the Joint-Sealant Schedule at the end of Part 3.

B. Related Sections include the following:

1. Division 07 Section "Fire-Resistive Joint Systems" for sealing joints in fire-resistance-rated construction.

2. Division 08 Section "Glazing" for glazing sealants.

3. Division 09 Section "Gypsum Board" for sealing perimeter joints of gypsum board partitions to reduce sound transmission.

4. Division 09 Section "Tile" for sealing tile joints.

1.03 PERFORMANCE REQUIREMENTS

A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.

B. Provide joint sealants for interior applications that establish and maintain airtight and water-resistant continuous joint seals without staining or deteriorating joint substrates.

1.04 ACTION SUBMITTALS

A. Product Data: For each joint-sealant product indicated.

B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

C. Samples for Verification: For each type and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- wide joints formed between two 6-inch-long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

1.05 INFORMATIONAL SUBMITTALS

A. LEED Submittals:

1. Product Data for Credit IEQ 4.1: For sealants and sealant primers used inside the weatherproofing system, documentation including printed statement of VOC content.

B. Product Certificates: For each type of joint sealant and accessory, signed by product manufacturer.

C. Qualification Data: For Installer

D. Preconstruction Field Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on preconstruction testing specified in "Quality Assurance" Article.

E. Warranties: Special warranties specified in this Section.

1.06 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized Installer who is approved or licensed for installation of elastomeric sealants required for this Project.

B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

C. Preconstruction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.

1. Use manufacturer's standard test method to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.

2. Submit not fewer than eight pieces of each type of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.

3. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.

4. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures including use of specially formulated primers.

5. Testing will not be required if joint-sealant manufacturers submit joint preparation data that are based on previous testing of current sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted.

D. Mockups: Build mockups incorporating sealant joints, as follows, to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution:

1. Joints in mockups of assemblies specified in other Sections that are indicated to receive elastomeric joint sealants, which are specified by reference to this Section.

1.07 PROJECT CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer

2. When joint substrates are wet.

3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.

4. Contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.08 WARRANTY

A. Special Installer's Warranty: Installer's standard form in which Installer agrees to repair or replace elastomeric joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

B. Special Manufacturer's Warranty: Manufacturer's standard form in which elastomeric sealant manufacturer agrees to furnish elastomeric joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

C. Special warranties specified in this Article exclude deterioration or failure of elastomeric joint sealants from the following:

1. Movement of the structure resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression caused by structural settlement or errors attributable to design or construction.

2. Disintegration of joint substrates from natural causes exceeding design specifications.

3. Mechanical damage caused by individuals, tools, or other outside agents.

4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - **PRODUCTS**

2.01 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the products listed in other Part 2 articles.

2.02 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer, based on testing and field experience.

B. VOC Content of Interior Sealants: Provide sealants and sealant primers for use inside the weatherproofing system that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

1. Architectural Sealants: 250 g/L.

2. Nonmembrane Roof Sealants: 300 g/L.

3. Sealant Primers for Nonporous Substrates: 250 g/L.

4. Sealant Primers for Porous Substrates: 775 g/L.

5. Modified Bituminous Sealant Primers: 500 g/L.

C. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.03 ELASTOMERIC JOINT SEALANTS

A. Elastomeric Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

B. Stain-Test-Response Characteristics: Where elastomeric sealants are specified to be non-staining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

C. Suitability for Immersion in Liquids. Where elastomeric sealants are indicated for Use I for joints that will be continuously immersed in liquids, provide products that have undergone testing according to ASTM C 1247 and qualify for the length of exposure indicated by reference to ASTM C 920 for Class 1 or 2. Liquid used for testing sealants is deionized water, unless otherwise indicated.

D. Single-Component Pourable Neutral-Curing Silicone Sealant, ES-1:

1. Products:

a. Dow Corning Corporation; Dow Parking Structure Sealant NS.

b. Pecora Corporation; 300 Pavement Sealant (Self Leveling).

c. Dow Corning Corporation; SL Parking Structure Sealant.

2. Type and Grade: S (single component) and P (pourable).

3. Class: 100/50.

4. Uses Related to Exposure: NT and T (traffic).

5. Uses Related to Joint Substrates: M, A, and O, as applicable to joint substrates indicated.

a. Use O Joint Substrates: Galvanized steel, limestone, marble, granite and ceramic tile.

E. Single-Component Neutral-Curing Silicone Sealant, ES-2:

1. Products:

a. Dow Corning Corporation; 790.

b. GE Silicones; SilPruf LM SCS2700.

c. Tremco; Spectrem 1 (Basic).

2. Type and Grade: S (single component) and NS (nonsag).

3. Class: 100/50.

4. Use Related to Exposure: NT (nontraffic).

5. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.

a. Use O Joint Substrates: aluminum coated with a high-performance coating

6. Stain-Test-Response Characteristics: Nonstaining to porous substrates per ASTM C 1248.

F. Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant, ES-3

1. Products: Subject to compliance with requirements, provide one of the following:

a. Dow Corning Corporation; 756 SMS.

b. GE Advanced Materials - Silicones; SilPruf NB SCS9000.

c. Tremco Incorporated; Spectrem 3.

2. Type and Grade: S (single component) and NS (nonsag).

3. Class: 50.

4. Use Related to Exposure: NT (nontraffic).

G. Single-Component Mildew-Resistant Neutral-Curing Silicone Sealant, ES-4:

1. Products:

a. Pecora Corporation; 898.

b. Tremco; Tremsil 600 White.

c. Dow Corning 786.

2. Type and Grade: S (single component) and NS (nonsag).

3. Class: 25.

4. Use Related to Exposure: NT (nontraffic).

5. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.

a. Use O Joint Substrates: aluminum coated with a high-performance coating, galvanized steel, ceramic tile.

2.04 SOLVENT-RELEASE JOINT SEALANTS

A. Butyl-Rubber-Based Solvent-Release Joint Sealant, SRS-2: Comply with ASTM C 1085.

1. Products:

a. Bostik Findley; Bostik 300.

b. Fuller, H. B. Company; SC-0296.

c. Fuller, H. B. Company; SC-0288.

d. Pecora Corporation; BC-158.

e. Polymeric Systems Inc.; PSI-301

f. Sonneborn, Division of ChemRex Inc.; Sonneborn Multi-Purpose Sealant.

g. Tremco; Tremco Butyl Sealant.

B. Pigmented Narrow-Joint Sealant, SRS-3: Manufacturer's standard, solvent-release-curing, pigmented, synthetic-rubber sealant complying with AAMA 803.3 and formulated for sealing joints 3/16 inch or smaller in width.

1. Products:

a. Fuller, H. B. Company; SC-0289.

b. Schnee-Morehead, Inc.; SM 5504 Acryl-R Narrow Joint Sealant.

2.05 LATEX JOINT SEALANTS

A. Latex Sealant, LS-1: Comply with ASTM C 834, Type OP, Grade NF.

B. Products:

1. Bostik Findley; Chem-Calk 600.

2. Pecora Corporation; AC-20+.

3. Sonneborn, Division of ChemRex Inc.; Sonolac.

4. Tremco; Tremflex 834.

2.06 ACOUSTICAL JOINT SEALANTS

A. Acoustical Sealant for Exposed and Concealed Joints, AS-1: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834 and the following:

1. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

2. Products:

a. Pecora Corporation; AC-20 FTR Acoustical and Insulation Sealant.

b. United States Gypsum Co.; SHEETROCK Acoustical Sealant.

B. Acoustical Sealant for Concealed Joints, AS-2: Manufacturer's standard, nondrying, non-hardening, nonskinning, nonstaining, gunnable, synthetic-rubber sealant recommended for sealing interior concealed joints to reduce airborne sound transmission.

1. Products:

a. Pecora Corporation; BA-98.

b. Tremco; Tremco Acoustical Sealant.

2.07 PREFORMED JOINT SEALANTS

A. Preformed Foam Sealant, PS-2: Manufacturer's standard preformed, precompressed, open-cell foam sealant that is manufactured from high-density urethane foam impregnated with a nondrying, water-repellent agent; is factory produced in precompressed sizes in roll or stick form to fit joint widths indicated; is coated on one side with a pressure-sensitive adhesive and covered with protective wrapping; develops a watertight and airtight seal when compressed to the degree specified by manufacturer; and complies with the following:

1. Products:

a. EMSEAL Joint Systems, Ltd.; Emseal 25V.Emseal Colorseal

b. Polytite Manufacturing Corporation; Polytite B.

2. Properties: Permanently elastic, mildew resistant, nonmigratory, nonstaining, and compatible with joint substrates and other joint sealants.

a. Density: Manufacturer's standard

B. Refer Section 07 95 00 Expansion Control for exterior wall expansion joint.

2.08 JOINT-SEALANT BACKING

A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin) , and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance:

C. Elastomeric Tubing Sealant Backings: Neoprene, butyl, EPDM, or silicone tubing complying with ASTM D 1056, nonabsorbent to water and gas, and capable of remaining resilient at temperatures down to minus 26 deg F. Provide products with low compression set and of size and shape to provide a secondary seal, to control sealant depth, and to otherwise contribute to optimum sealant performance.

D. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.09 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - **EXECUTION**

3.01 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.

2. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:

a. Concrete.

b. Unglazed surfaces of ceramic tile.

3. Remove laitance and form-release agents from concrete.

4. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:

a. Metal.

b. Glass.

c. Porcelain enamel.

d. Glazed surfaces of ceramic tile.

B. Joint Priming: Prime joint substrates, where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.03 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Acoustical Sealant Application Standard: Comply with recommendations in ASTM C 919 for use of joint sealants in acoustical applications as applicable to materials, applications, and conditions indicated.

D. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of sealant backings.

2. Do not stretch, twist, puncture, or tear sealant backings.

3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

E. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

F. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.

2. Completely fill recesses in each joint configuration.

3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

G. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealant from surfaces adjacent to joints.

2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.

3. Provide concave joint configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.

a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

H. Installation of Preformed Foam Sealants: Install each length of sealant immediately after removing protective wrapping, taking care not to pull or stretch material, producing seal continuity at ends, turns, and intersections of joints. For applications at low ambient temperatures where expansion of sealant requires acceleration to produce seal, apply heat to sealant in compliance with sealant manufacturer's written instructions.

3.04 CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.05 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.06 JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application JS-1: Exterior vertical and horizontal nontraffic construction joints in cast-in-place concrete.

1. Joint Sealant: Single-component neutral-curing silicone sealant, ES-2.

2. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

B. Joint-Sealant Application JS-2: Exterior horizontal nontraffic and traffic isolation and contraction joints in cast-in-place concrete slabs. Joints between concrete sidewalks and building components.

1. Joint Sealant: Single-component pourable neutral-curing silicone sealant, ES-1.

2. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

C. Joint-Sealant Application JS-3: Exterior vertical and horizontal nontraffic joints between plant-precast architectural concrete units.

1. Joint Sealant: Single-component neutral-curing silicone sealant, ES-2.

2. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

D. Joint-Sealant Application JS-4: Exterior perimeter joints between materials above and walls and frames of doors, windows and louvers.

1. Joint Sealant: Single-component neutral-curing silicone sealant, ES-2.

2. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

E. Joint-Sealant Application JS-5: Interior perimeter joints of exterior openings.

1. Joint Sealant: Single-component neutral-curing silicone sealant, ES-2.

2. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

F. Joint-Sealant Application JS-6: Interior joints between plumbing fixtures and adjoining walls, floors, and counters.

1. Joint Sealant: Single-component mildew-resistant neutral-curing silicone sealant, ES-4.

2. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

G. Joint-Sealant Application JS-7: Vertical joints on exposed surfaces of interior unit masonry and precast concrete walls and partitions.

1. Joint Sealant: Latex sealant.

2. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

H. Joint-Sealant Application JS-8: Perimeter joints between interior wall surfaces and frames of interior doors, windows, and elevator entrances.

1. Joint Sealant: Latex sealant.

2. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

I. Joint-Sealant Application JS-9: Interior control, expansion, and isolation joints in horizontal traffic surfaces in horizontal traffic surfaces.

1. Joint Sealant: Single-component pourable neutral-curing silicone sealant, ES-1.

2. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

END OF SECTION 07 92 00

SECTION 08 11 13 – HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with all applicable requirements and standards.

1.03 QUALITY ASSURANCE

A. Provide doors, panels, and frames complying with the NAAMM Standard HMMA 861-87, “Guide Specifications for Commercial Hollow Metal Doors and Frames,” except as otherwise specified in this Section.

B. Provide custom steel doors and frames manufactured by a single firm specializing in the production of this type of work, unless otherwise acceptable to the Architect and Owner.

C. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252.

1. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide manufacturer’s certification that doors conform to all standard construction requirements of tested and labeled fire-rated door assemblies except for size.

2. Temperature Rise Rating: At stairwell enclosures, provide doors that have a temperature rise rating of 450 degrees F (232 degrees C) maximum in 30 minutes of fire exposure.

1.04 SUBMITTALS

A. Product Data:

1. Product data for each type of door and frame specified, including details of construction, materials, dimensions, hardware preparation, core, label compliance, sound ratings, profiles, and finishes.

B. Shop Drawings:

1. Submit drawings for fabrication and installation of custom steel doors and frames. Include details of each frame type, elevations of door design types, conditions at openings, details of construction, location and installation requirements of finish hardware and reinforcements, and details of joints and connections.

   a. Coordinate submittals with other doors, frames, and hardware and use the same "opening number identification" as given on the Contract Drawings and the Door Schedule.

      1) Submittals not using the numbering identification shown on Contract Drawings and Schedules will be rejected.

2. Label Construction Certification: For door assemblies required to be fire-rated and that exceed limitations of labeled assemblies, submit manufacturer's certification that each door and frame assembly has been constructed to conform to design, materials and construction equivalent to requirements for labeled construction.

C. Record Documents:

1. Provide record approved submittals and warranties.

1.05 DELIVERY, STORAGE AND HANDLING

A. Inspect doors and frames upon delivery for damage. Minor damages may be repaired provided refinished items are equal in all respects to new work and acceptable to the Architect; otherwise remove and replace damaged items as directed.

B. Store doors and frames at the building Site under cover. Place units on minimum 4-inch high wood blocking. Avoid the use of nonvented plastic or canvas shelters that could create a humidity chamber. If cardboard wrappers on doors become wet, remove cartons immediately. Provide ¼-inch spaces between stacked doors to promote air circulation.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.02 MANUFACTURERS

A. Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include:

1. Amweld Building Products, Inc.

2. Ceco Door Products.

3. Curries Manufacturing Inc.

4. Pearland Industries.

5. Fenestra Corp.

6. Tex-Steel Corp.

7. Pioneer Industries, Inc.

8. Steelcraft.

2.03 MATERIALS

A. Hot-Rolled Steel Sheets: ASTM A 569/A 569M, CS (Commercial Steel), Type B; free of scale, pitting or surface defects; pickled and oiled.

B. Cold-Rolled Steel Sheets: ASTM A 366/A 366M, CS (Commercial Steel), Type B.

C. Metallic-Coated (Galvanized) Steel Sheets: ASTM A 653/A 653M, CS (Commercial Steel), Type B; with G60 (Z180) zinc (galvanized) or A60 (AZ180) zinc-iron-alloy (galvannealed) coating.

D. Supports and Anchors: Fabricate of not less than 16-gage sheet metal. Galvanize after fabrication units to be built into exterior walls, complying with ASTM A 153, Class B.

E. Inserts, Bolts, and Fasteners: Manufacturer's standard units, except hot-dip galvanize items to be built into exterior walls, complying with ASTM A 153, Class C or D as applicable.

F. Shop-Applied Paint: Rust-inhibitive enamel or paint, either air-drying or baking, suitable as base for specified finish paints on steel surfaces.

2.04 FABRICATION, GENERAL

A. Fabricate hollow metal units to be rigid, neat in appearance, and free from defects, warp, or buckle. Accurately form metal to required sizes and profiles. Wherever practicable, fit and assemble units in the manufacturer's plant. Clearly identify work that cannot be permanently factory-assembled before shipment, to assure proper assembly at the Project Site. Weld exposed joints continuously; grind, fill, dress, and make smooth, flush, and invisible. Metallic filler to conceal manufacturing defects is not acceptable.

1. Interior Doors: Minimum 18-gage face sheets.

2. Exterior Doors: Minimum 16-gage face sheets.

B. Unless otherwise indicated, provide countersunk flat or oval heads for exposed screws and bolts.

C. Sound-Rated (Acoustical) Assemblies: Wherever shown or scheduled, provide door and frame assemblies that have been fabricated as sound-reducing type, tested in accordance with ASTM E 90, and classified in accordance with ASTM E 413.

1. Unless otherwise indicated, provide acoustical assemblies with sound ratings of STC 33 or better.

D. Prepare doors and frames to receive finish hardware, including cutouts, reinforcing, mortising, drilling, and tapping in accordance with final Finish Hardware Schedule and templates provided by hardware supplier. Comply with applicable requirements of ANSI A 115 series Specifications for door and frame preparation for hardware.

1. Reinforce doors and frames to receive surface-applied hardware. Drilling and tapping for surface-applied finish hardware may be done at Project Site.

2. Locate finish hardware as shown on final Shop Drawings, or if not shown, in accordance with "Recommended Locations for Builder's Hardware for Custom Steel Doors and Frames," published by Door and Hardware Institute.

E. Clean, treat, and paint exposed surfaces of steel doors and frames, including galvanized surfaces, but excluding stainless steel surfaces.

1. Clean steel surfaces of mill scale, rust, oil, grease, dirt, and other foreign materials before application of paint.

2. Apply pretreatment to cleaned metal surfaces, using cold phosphate solution (SSPC-PT2), hot phosphate solution (SSPC-PT4), or basic zinc chromate-vinyl butyryl solution (SSPC-PT3).

3. Apply shop coat of prime paint within time limits recommended by pretreatment manufacturer. Apply a smooth coat of even consistency to provide a uniform dry film thickness of not less than 0.7 mils.

F. Provide stops and moldings around solid, glazed, and louvered panels where indicated.

1. Form fixed stops and moldings integral with frame, unless otherwise indicated.

2. Provide removable stops and moldings where indicated or required, formed of not less than 20-gage steel sheets matching steel of frames. Secure with countersunk flat or oval head machine screws spaced uniformly not more than 12 inches on center. Form corners with butted hairline joints.

3. Coordinate width of rabbet between fixed and removable stops with type of glass or panel and type of installation indicated.

2.05 DOORS

A. Provide flush design doors, 1-¾ inches thick, seamless hollow construction.

1. For single-acting swing doors, bevel both vertical edges 1/8 inch in 2 inches. For double-acting swing doors, round vertical edges with 2-1/8 inch radius.

2. Unless otherwise required for acoustical or thermal doors, provide filler of fiberboard, mineral-wool board, or other insulating material solidly packed full door height to fill voids between inner core reinforcing members.

3. Reinforce doors with rigid tubular frame where stiles and rails are less than 8 inches wide. Form tubular frame with 16-gage steel, welded to outer sheets.

4. Provide internal core constructed of galvanized, stretcher-leveled steel sheets not less than 18-gage, vertically reinforced with galvanized sheet steel sections not less than 22 gage, spaced 6 inches on center, extending full height of door and spot welded to both face sheets at not more than 5 inches on center.

a. Continuous truss-form reinforcement of 28-gage galvanized steel may be provided in lieu of spaced steel sections. Spot weld truss-form reinforcement 3 inches on center vertically and horizontally over entire core surface on both sides.

5. Reinforce tops and bottoms of doors with galvanized, 18-gage, horizontal steel channels, welded continuously to core faces. For exterior stainless steel doors, close top and bottom edges to provide weather seal.

B. Painted Exterior Doors: Fabricate exterior doors of two outer, galvanized, stretcher-leveled steel sheets not less than 16-gage. Construct doors with smooth, flush surfaces without visible joints or seams on exposed faces or stile edges, except around glazed or louvered panel inserts. Provide weep-hole openings in the bottom of doors to permit escape of entrapped moisture.

1. Reinforce inside of doors with vertical galvanized sheet steel sections not less than 22-gage. Space vertical reinforcing 6 inches on center and extend full door height. Spot weld at not more than 5 inches on center to both face sheets.

a. Continuous truss-form inner core of 28-gage galvanized sheet steel reinforcing may be provided as inner reinforcement, in lieu of above. Spot weld truss-form reinforcement 3 inches on center vertically and horizontally over entire surface of both sides.

2. Reinforce tops and bottoms of doors with 16-gage horizontal galvanized sheet channels welded continuously to outer sheets. Close top and bottom edges to provide flush, waterproof weather seal, as integral part of door construction or by addition of inverted steel channels.

C. Painted Interior Doors: Fabricate interior doors of two (2) outer, cold-rolled, stretcher-leveled steel sheets not less than 18-gage. Construct doors with smooth, flush surfaces, without visible joints or seams on exposed faces or stile edges, except around glazed or louvered panel inserts.

1. Reinforce inside of doors with vertical, hot-rolled, not less than 22-gage steel sections. Space vertical reinforcing 6 inches on center and extend full door height. Spot weld at not more than 5 inches on center to both face sheets.

a. Continuous truss-form inner core of 28-gage sheet metal reinforcing may be provided as inner reinforcement in lieu of above. Spot weld truss-form reinforcement 3 inches on center vertically and horizontally over entire surface of both sides.

2. Reinforce tops and bottoms of doors with 18-gage, horizontal steel channels, welded continuously to outer sheets.

D. Finish Hardware Reinforcement: Minimum gages of steel reinforcing plates for the following hardware:

1. Hinges and Pivots: 7-gage thick by 1-½ inches wide by 6 inches longer than hinge, secured by not less than six (6) spot welds.

2. Lock Face, Flush Bolts, Closers, and Concealed Holders: 12-gage.

3. All Other Surface-Mounted Hardware: 16-gage.

2.06 FRAMES

A. Fabricate frames of full-welded unit construction, with corners mitered, reinforced, continuously welded full depth and width of frame. Knock-down type frames are not acceptable.

1. Form frames of minimum 14-gage galvanized steel sheets for exterior, and either cold or hot-rolled sheet steel of the following minimum gages for interior:

a. Openings up to and including 4 feet 0 inches wide: 16-gage.

b. Openings over 4 feet 0 inches wide: 14-gage.

B. Finish Hardware Reinforcement: Minimum gages of steel reinforcing plates for the following hardware:

1. Hinges and Pivots: 7-gage thick by 1-½ inches wide by 6 inches longer than hinge, secured by not less than six (6) spot welds.

2. Strikes, Flush Bolts, and Closers: 12-gage.

3. Surface-Mounted Hold-Open Arms and Panic Devices: 12-gage.

C. Jamb Anchors: Furnish jamb anchors as required to secure frames to adjacent construction, formed of not less than 18-gage galvanized steel.

1. Metal Stud Partitions: Insert type with notched clip to engage metal stud, welded to back of frames. Provide at least four (4) anchors for each jamb for frames up to 7 feet 6 inches height; five (5) anchors up to 8 feet 0 inches in jamb height; one (1) additional anchor each 24 inches or fraction thereof over 8 feet 0 inches in height.

2. In-Place Concrete or Masonry: Anchor frame jambs with minimum 3/8 inch concealed bolts into expansion shields or inserts at 6 inches from top and bottom and 26 inches on center, unless otherwise shown. Reinforce frames at anchor locations. Except for fire-rated openings, apply removable stop to cover anchor bolts unless otherwise indicated.

D. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, formed of not less than 14-gage galvanized steel sheet, as follows:

1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners, welded to bottom of jambs and mullions.

2. Separate Topping Concrete Slabs: Adjustable type with extension clips, allowing not less than 2-inch height adjustment. Terminate bottom of frames at finish floor surface.

E. Head Anchors: Provide two anchors at head of frames exceeding 42 inches wide for frames mounted in steel stud walls.

F. Head Strut Supports: Provide 3/8 inch by 2 inch vertical steel struts extending from top of frame at each jamb to supporting construction above, unless frame is anchored to masonry or to other structural support at each jamb. Bend top of struts to provide flush contact for securing to supporting construction above. Provide adjustable wedged or bolted anchorage to frame jamb members in compliance with UL 63.

G. Structural Reinforcing Members: Provide as part of frame assembly, where indicated at mullions, transoms, or other locations that are to be built into frame.

H. Spreader Bars: Provide removable spreader bar across bottom of frames, tack welded to jambs and mullions.

I. Rubber Door Silencers: Except on weather stripped doors, drill stop in strike jamb to receive three (3) silencers on single-door frames add drill head jamb stop to receive four (4) silencers on double-door frames. Install plastic plugs to keep holes clear during construction.

J. Plaster Guards: Provide 26-gage steel plaster guards or dust cover boxes, welded to frame, at back of finish hardware cutouts where mortar or other materials might obstruct hardware operation and to close off interior of openings.

2.07 STEEL FINISHES

A. Surface Preparation: Clean surfaces to comply with SSPC-SP1, “Solvent Cleaning”; remove dirt, oil, grease, or other contaminants that could impair paint bond. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 3, “Power Tool Cleaning,” or SSPC-SP 6/NACE No. 3, “Commercial Blast Cleaning.”

B. Factory Priming for Field-Painted Finish: Apply shop primer specified below immediately after surface preparation and pretreatment. Apply a smooth coat of even consistency to provide a uniform dry film thickness of not less than 0.7 mils (0.02 mm).

C. Galvanized Steel Surface Preparation: Clean surfaces with non-petroleum solvent so surfaces are free of oil and other contaminants. After cleaning, apply a conversion coating suited to the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas, and apply galvanizing repair paint specified below to comply with ASTM A 780.

1. Galvanizing Repair Paint: High-zinc dust content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.

D. Galvanized Steel Factory Priming for Field-Painted Finish: Apply shop primer specified below immediately after surface preparation and pretreatment. Apply a smooth coat of even consistency to provide a uniform dry film thickness of not less than 0.7 mils (0.02 mm).

E. Shop Primer: Manufacturer’s or fabricator’s standard, fast-curing, corrosion-inhibiting, lead and chromate-free, universal primer complying with ANSI A224.1 acceptance criteria; compatible with substrate and field-applied finish paint system indicated; and providing a sound foundation for field-applied topcoats despite prolonged exposure.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, and referenced standards, and conform to codes and ordinances of authorities having jurisdiction.

B. All installation shall be in accordance with manufacturer’s published recommendations.

C. Install frames and accessories in accordance with Shop Drawings, manufacturer's data, and as herein specified.

1. Setting Masonry Anchorage Devices: Provide masonry anchorage devices where required for securing frames to in-place concrete or masonry construction.

a. Set anchorage devices opposite each anchor location, in accordance with details on final Shop Drawings and anchorage device manufacturer's instructions. Leave drilled holes rough, not reamed, and free from dust and debris.

2. Floor anchors may be set with powder-actuated fasteners instead of masonry anchorage devices and machine screws, if so indicated on final Shop Drawings.

D. Placing Frames: Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces and spreaders, leaving surfaces smooth and undamaged.

1. At in-place concrete or masonry construction, set frames and secure in place with machine screws and masonry anchorage devices.

2. Place frames at fire-rated openings in accordance with NFPA Standard No. 80.

3. Make field splices in frames as detailed on final Shop Drawings, welded and finished to match factory work.

4. Remove spreader bars only after frames or bucks have been properly set and secured.

E. Install doors after adjacent work is completed and dry. Do not install doors until closers or stops and holders can be installed simultaneously for protection of doors.

F. Fit non-fire rated doors accurately in their respective frames, with the following clearances:

1. Jambs and Head: 3/32 inch.

2. Meeting Edges, Pairs of Doors: 1/8 inch.

3. Bottom: 3/8 inch, where no threshold or carpet.

4. Bottom: 1/8 inch, at threshold or carpet.

G. Place fire-rated doors with clearances as specified in NFPA Standard No. 80.

3.02 ADJUST AND CLEAN

A. Final Adjustments: Check and readjust operating hardware items just prior to final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including doors or frames that are warped, bowed or otherwise unacceptable.

B. Prime Coat Touch-Up: Immediately after erection, sand smooth any rusted or damaged areas of prime coat and apply touch-up of compatible air-drying primer.

1. Repair installed dented and damaged units to new condition by filling with automotive body putty.

2. Fill exposed countersunk anchor screws in countersunk screw holes with automotive body putty after units are installed in place.

3. Grind puttied areas smooth, true and even with surrounding surfaces. Repaint puttied areas with one additional coat of the specified primer before proceeding with field painting.

END OF SECTION 08 11 13

SECTION 08 14 16 – FLUSH WOOD DOORS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with all applicable requirements and standards.

1.03 QUALITY ASSURANCE

A. Quality Standards: Comply with the following standards:

1. WDMA Quality Standard: I.S.1A "Architectural Wood Flush Doors", of Window and Door Manufacturers Association (WDMA).

2. AWI Quality Standard: "Architectural Woodwork Quality Standards"; including Section 1300 "Architectural Flush Doors", of Architectural Woodwork Institute (AWI) for grade of door, core construction, finish and other requirements exceeding those of WDMA quality standard.

B. Obtain doors from a single manufacturer.

1.04 SUBMITTALS

A. Product Data:

1. Door manufacturer's technical data for each type of door, including details of core and edge construction, trim for openings and louvers, and factory-finishing Specifications.

B. Shop Drawings:

1. Submit Shop Drawings indicating location and size of each door, elevation of each kind of door, details of construction, location and extent of hardware blocking, fire ratings, requirements for factory finishing and other pertinent data.

2. Coordinate submittals with other doors, frames, and hardware and use the same "opening number identification" as given on the Drawings and the Door Schedule.

3. Submittals not using the numbering identification system shown on Drawings and Schedules will be rejected.

4. For factory-premachined doors, indicate dimensions and locations of cutouts for locksets and other cutouts adjacent to light and louver openings.

C. Samples:

1. Submit samples, 1-0" square or as indicated, for the following:

a. Doors for Transparent Finish: Door faces with solid wood edging representing typical range of color and grain for each species of veneer and solid lumber required.

b. Factory-Finished Doors: Each type of factory finish required.

c. -Metal Frames for Light Openings: Metal light frames in 6" lengths; for each material, type and finish required.

D. Record Documents:

1. Provide record approved shop drawings, samples, and warranties.

1.05 DELIVERY, STORAGE AND HANDLING

A. Protect doors during transit, storage and handling to prevent damage, soiling and deterioration. Comply with requirements of referenced standards and recommendations of WDMA pamphlet "How to Store, Handle, Finish, Install, and Maintain Wood Doors", as well as with manufacturer's instructions.

B. Identify each door with individual opening numbers which correlate with designation system used on Shop Drawings for door, frames, and hardware, using temporary, removable or concealed markings.

1.06 PROJECT CONDITIONS

A. Conditioning: Do not deliver or install doors until conditions for temperature and relative humidity have been stabilized and will be maintained in storage and installation areas during remainder of construction period to comply with the following requirements applicable to Project's geographical location:

1. Referenced AWI quality standard including Section 100-S-3 "Moisture Content".

1.07 WARRANTY

A. Warranties shall be in addition to, and not a limitation of, other rights the Owner may have under the Contract Documents.

B. Door Manufacturer's Warranty: Submit written agreement in door manufacturer's standard form signed by Manufacturer, Installer and Contractor, agreeing to repair or replace defective doors that have warped (bow, cup or twist) or that show telegraphing of core construction in face veneers, or do not conform to tolerance limitations of referenced quality standards.

1. Warranty shall be in effect during the life of the installation.

C. Contractor's Responsibilities: Replace or refinish doors where Contractor's Work contributed to rejection or to voiding of manufacturer's warranty.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.02 PLASTIC LAMINATE FACED DOORS, GENERAL

A. AWI grade: Custom

B. Bond: type II water resistant.

C. Plastic Laminate Face Panels: High pressure decorative laminates complying with NEMA LD3, Grade HGS, 0.048 inches (1.2mm) thick.

D. Colors, Patterns, and Finishes: As selected by Architect from laminate manufacturer’s full range of colors.

E. Stiles: 1 1/6 inch to 1 1/2 inch wide, one or two ply closed grain, solid hardwood; paint edge to match laminate faces. Provide fire retardant treated, UL approved, one or two ply hardwood stiles at fire-rated doors.

F. Rails:

1. Top Rail: 5 inch one to three ply closed grain, solid hardwood or Structural Composite Lumber.

2. Bottom Rail: Hardwood or Structural Composite Lumber. Provide 5 inch deep rail where concealed door seal or kick plate is scheduled.

3. Provide 5 inch fire retardant treated, UL approved hardwood or Structural Composite Lumber top rails at fire-rated doors.

4. Provide 5 inch fire retardant treated, UL approved hardwood or Structural Composite Lumber bottom rail at fire-rated doors where concealed door seal or kick plate is scheduled.

G. Blocking:

1. Provide lock block reinforcement where mortised hardware is scheduled.

2. Provide 5 inch hardwood or Structural Composite Lumber at intermediate-height where exit devices are scheduled.

3. Provide 5 inch fire retardant treated, UL approved hardwood or Structural Composite Lumber blocking at intermediate height at fire-rated doors

H. Low Emitting Materials: Provide doors made with adhesives and composite wood products that do not contain urea formaldehyde.

2.03 FLUSH SOLID CORE WOOD DOORS, PLASTIC LAMINATE FACED

A. Construction: Five plies. Mat formed wood particleboard core, complying with ANSI A 208.1, Grade LD-2.

1. Bonding: Stiles and rails bonded to core, with entire unit abrasive planed before faces and crossbands are applied.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Algoma Hardwoods, Inc.

2. Ampco, Inc.

3. Eggers Industries.

4. Haley Brothers, Inc.

5. Marshfield Door Systems, Inc.

6. Oshkosh Architectural Door Company.

7. Tex-Lam Manufacturing, Inc.

8. VT Industries, Inc.

2.04 FIRE RATED (20 MINUTE) FLUSH WOOD DOORS, PLASTIC LAMINATE FACED

A. Construction: Five plies. Mat formed wood particleboard core, complying with ANSI A 208.1, Grade LD-2.

1. Bonding: Stiles and rails bonded to core, with entire unit abrasive planed before faces and crossbands are applied.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Algoma Hardwoods, Inc.

2. Ampco, Inc.

3. Eggers Industries.

4. Haley Brothers, Inc.

5. Marshfield Door Systems, Inc.

6. Oshkosh Architectural Door Company.

7. Tex-Lam Manufacturing, Inc.

8. VT Industries, Inc.

2.05 FIRE RATED FLUSH WOOD DOORS, PLASTIC LAMINATE FACED

A. Construction: Incombustible non-asbestos mineral core.

1. Bonding: Stiles and rails bonded to core.

2. Treatment: Components shall be salt free.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Algoma Hardwoods, Inc.

2. Ampco, Inc.

3. Eggers Industries.

4. Haley Brothers, Inc.

5. Marshfield Door Systems, Inc.

6. Oshkosh Architectural Door Company.

7. Tex-Lam Manufacturing, Inc.

8. VT Industries, Inc.

2.06 LIGHT FRAMES

A. Metal Frames for Light Openings in Fire Doors: Manufacturer's standard frame formed of 18-gage cold-rolled steel, factory-primed, and approved for use in door of fire-rating indicated.

2.07 FABRICATION

A. Fabricate flush wood doors to produce doors complying with following requirements:

1. Factory pre-fit and pre-machine doors to fit frame opening sizes indicated with the following uniform clearances and bevels:

a. Comply with tolerance requirements of AWI for pre-fitting. Comply with final hardware schedules and door frame Shop Drawings and with hardware templates.

b. Coordinate measurements of hardware mortises in metal frames to verify dimensions and alignment before proceeding with factory pre-machining.

B. Metal Astragals: Pre-machine astragals and formed steel edges for hardware where required for pairs of fire rated doors.

C. Openings: Cut and trim openings through doors to comply with applicable requirements of referenced standards for kind(s) of doors required.

1. Light Openings: Trim openings with moldings of material and profile indicated.

D. Fire Rated Wood Doors: Provide wood doors which are identical in materials and construction to units tested in door and frame assemblies per ASTM E 152 and which are labeled and listed for ratings indicated by UL, Warnock Hersey or other testing and inspection agency acceptable to authorities having jurisdiction.

1. Provide UL approved 5 inches deep top rail reinforcement suitable to hold surface mounted closers with 1-½ inches x No. 12 fully threaded wood screws without the use of through-bolted fasteners.

2. At hinge stile, provide additional UL approved hardwood or high-density material to provide a minimum 5000 pound screw withdrawal resistance and minimum 300,000 slam cycles without failure of mortise hinges.

3. At lock stile, provide additional UL approved "Lock Block" blocking to provide solid anchorage for installation of locksets.

4. At mid-rail, provide 5 inches deep continuous blocking at doors indicated to have exit devices.

PART 3 - EXECUTION

3.01 PREPARATION

A. Examine installed door frames prior to hanging door:

1. Verify that frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with plumb jambs and level heads.

2. Reject doors with defects.

B. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. Manufacturer's Instructions: Install wood doors to comply with manufacturer's instructions and of referenced AWI standard and as indicated.

1. Install fire rated doors in corresponding fire rated frames in accordance with requirements of NFPA No. 80.

C. Pre-fit Doors: Fit to frames for uniform clearance at each edge.

D. Factory Finished Doors: Restore finish before installation, if fitting or machining is required at the Project Site.

3.03 ADJUSTING AND PROTECTION

A. Operation: Re-hang or replace doors which do not swing or operate freely.

B. Finished Doors: Refinish or replace doors damaged during installation.

C. Protect doors as recommended by door manufacturer to ensure that wood doors will be without damage or deterioration at time of Substantial Completion.

END OF SECTION 08 14 16

SECTION 08 31 13 – ACCESS DOORS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with all applicable requirements and standards.

1.03 QUALITY ASSURANCE

A. Single-source Responsibility: Obtain access doors for entire Project from one source from a single manufacturer.

B. Fire-Resistance Ratings: Wherever access doors are required in construction where a fire-resistance classification is indicated, provide access door assembly with panel door, frame, hinge, and latch from manufacturer listed in Underwriters Laboratories, Inc.'s "Building Materials Directory" for rating shown.

1. Provide UL label on each fire-rated access door.

C. Size Variations: Obtain Architect's acceptance of manufacturer's standard size units, which may vary slightly from sizes indicated.

D. Coordination: Furnish inserts and anchoring devices that must be built into other work for installation of access doors. Coordinate delivery with other work to avoid delay.

1.04 SUBMITTALS

A. Product Data:

1. Product data in form of manufacture's technical data and installation instructions for each type of access door assembly, including setting Drawings, templates, instructions, and directions for installation of anchorage devices.

a. Include complete schedule, including types, general locations, sizes, wall and ceiling construction details, finishes, latching or locking provisions, and other data pertinent to installation.

B. Samples:

1. Samples, 3 inches by 5 inches minimum size, of each panel face material showing factory-finished color and texture.

C. Shop Drawings:

1. Show fabrication and installation of customized access doors and frames, including details of each frame type, elevations of door design types, anchorage and accessory items.

D. Record Documents:

1. Provide record approved product data, shop drawings, and samples.

1.05 PROJECT CONDITIONS

A. Verification: Obtain specific locations and sizes for required access doors from trades requiring access to concealed equipment, and indicate on submittal schedule.

B. Special-Size Access Doors: Use where required or requested; indicate on schedule.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.02 MANUFACTURERS

A. To establish standards of manufacture, operation, performance, and appearance, Drawings and Specifications are based on products of J.L. Industries. Provided compliance with requirements, products of the following manufacturers will also be acceptable:

1. Bilco.

2. Cesco Products.

3. Karp Associates, Inc.

4. Larsen's Manufacturing Co.

5. Milcor.

6. Nystrom Inc.

7. The Williams Brothers Corp.

2.03 MATERIALS AND FABRICATION

A. General: Furnish each access door assembly manufactured as an integral unit, complete with all parts, and ready for installation.

B. Steel Access Doors and Frames: Fabricate units of continuous welded steel construction unless otherwise indicated. Grind welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access panels to types of support shown.

C. Frames: Fabricate from 16-gage steel.

1. Provide fully gasketed frames at all Vivarium locations.

D. Flush Panel Doors: Fabricate from not less than 14-gage sheet steel, with concealed spring hinges or concealed continuous piano hinge set to open 175 degrees. Finish with manufacturer's factory-applied prime paint.

E. Locking Devices: Furnish flush, screwdriver-operated cam locks of number required to hold door in flush, smooth plane when closed.

1. Provide one (1) cylinder lock per access door. Furnish two (2) keys per lock. Key all locks alike, unless otherwise scheduled.

F. Catwalk Access Hatch: At catwalk landing provide 30 x 36 inches roof hatch with the following features: Basis of Design Product; Bilco Type SM Surface Mount Access Door.

1. Cover and frame: 1/8 inch aluminum plate cover and 3/16 inch aluminum angle frame with integral mounting flange and 7/16 inch diameter anchor holes.

2. Gasket: Extruded EPDM rubber gasket permanently adhered to cover.

3. Hinges: Heavy-duty pintle hinges with 3/8" (9 mm) Type 316 stainless steel hinge pins.

4. Latch: 316 stainless steel slam latch with interior and exterior turn. Provide interior padlock hasp for secure locking from below.

5. Lift Assistance: Gas strut lifting mechanism with powder-coat finish. Automatic hold-open arm with grip handle release.

6. Hardware: 316 stainless steel unless otherwise specified.

7. Options: provide safety post and chains area fall protection.

8. Paint top of lid, perimeter frame, and safety posts "safety yellow" per Div 09 Painting.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. All installation shall be in accordance with manufacturer's published recommendations.

C. Coordinate installation with work of other trades.

D. Set frames accurately in position and securely attach to supports with face panels plumb or level in relation to adjacent finish surfaces.

3.02 ADJUST AND CLEAN

A. Adjust hardware and panels after installation for proper operation.

B. Remove and replace panels or frames that are warped, bowed, or otherwise damaged.

END OF SECTION 08 31 13

SECTION 08 71 11 – FINISH HARDWARE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 SUMMARY

A. This Section includes items known commercially as finish or door hardware that are required for swing, sliding, and folding doors, except special types of unique hardware specified in the same Sections as the doors and door frames on which they are installed.

1. Provide cylinders for operation of lock mechanisms furnished as part of the Work of other Sections such as entrance doors, rolling doors and grilles, etc.

a. Provide cylinders keyed to building system and with finish to match adjacent surfaces.

1.03 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with all applicable requirements and standards.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed door hardware installation similar in material, design, and extent to that indicated for this Project and whose Work has resulted in construction with a record of successful in-service performance.

B. Supplier Qualifications: A recognized architectural door hardware supplier, with warehousing facilities in the Project's vicinity, that has a record of successful in- service performance for supplying door hardware similar in quantity, type, and quality to that indicated for this Project and that employs an experienced architectural hardware consultant (AHC) who is available to Owner, Architect, and Contractor, at reasonable times during the course of the Work, for consultation.

C. Electrified Door Hardware Supplier Qualifications: An experienced door hardware supplier who has completed projects with electrified door hardware similar in material, design, and extent to that indicated for this Project, whose Work has resulted in construction with a record of successful in-service performance, and who is acceptable to manufacturer of primary materials.

1. Engineering Responsibility: Prepare data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

D. Fire Rated Openings: Provide door hardware for fire rated openings that comply with NFPA Standard No. 80 and requirements of authorities having jurisdiction. Provide only items of door hardware that are listed and are identical to products tested by UL, Warnock Hersey, FM, or other testing and inspecting organization acceptable to authorities having jurisdiction for use on types and sizes of doors indicated in compliance with requirements of fire rated door and door frame labels.

E. Source Limitations: Obtain each type and variety of door hardware from a single manufacturer, unless otherwise indicated.

1.05 SUBMITTALS

A. Product Data:

1. Include installation details, material descriptions, dimensions of individual components, profiles, and finishes.

B. Shop Drawings:

1. Details of electrified door hardware, indicating the following:

a. Wiring Diagrams: Detail wiring for power, signal, and control systems. Differentiate between manufacturer-installed and field-installed wiring. Include the following:

1) System schematic.

2) Point-to-point wiring diagram.

3) Riser diagram.

4) Elevation of each door.

2. Details of interface between electrified door hardware and fire alarm, access control, security, and building control system.

3. Door Hardware Schedule:

a. Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedules with doors, frames, and related Work to ensure proper size, thickness, hand, function, and finish of door hardware.

b. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the hardware schedule.

c. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door opening.

d. Use same identifying “set numbers” given in each Section. Coordinate submittal with doors and frames submittals and use same “opening number” identification as given on Drawings and in the Door Schedule.

e. Submittals not using numbering identification system shown on Drawings and Schedules will be rejected.

f. Content: include the following information:

1) Type, style, function, size, and finish of each hardware item.

2) Name and manufacturer of each item.

3) Fastenings and other pertinent information.

4) Location of each hardware set, cross referenced to indications on Drawings both on floor plans and in door and frame schedule.

5) Explanation of all abbreviations, symbols, and codes contained in schedule.

6) Mounting locations for hardware.

7) Door and frame sizes and materials.

8) Description of each electrified door hardware function, including location, sequence of operation, and interface with other building control systems.

g. Submittal Sequence: Submit final schedule at earliest possible date particularly where acceptance of hardware schedule must precede fabrication of other Work that is critical in the Project construction schedule. Include with schedule the product data, samples, Shop Drawings of other Work affected by door hardware, and other information essential to the coordinated review of schedule.

4. Templates for doors, frames, and other specified items to be factory prepared for the installation of door hardware. Check Shop Drawings of other Work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

C. Samples:

1. Samples of each type of exposed hardware unit in finish indicated and tagged with full description for coordination with schedule. Submit samples prior to submission of final hardware schedule.

2. Samples will be returned to the supplier. Units that are acceptable and remain undamaged through submittal, review, and field comparison process may, after final check of operation, be incorporated in the Work, within limitations of keying coordination requirements.

D. Record Documents:

1. Provide record approved product data, shop drawings, samples, and warranties.

1.06 COORDINATION

A. Coordinate the Work of this Section with Work of other sections that interface with hardware.

B. Furnish templates for doors, frames, and other Work specified to be factory prepared for the installation of door hardware to the appropriate trades. Check Shop Drawings of other Work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

1.07 PRODUCT HANDLING

A. Inventory door hardware jointly with representatives of hardware supplier and hardware installer until each is satisfied that count is correct.

B. Deliver individually packaged door hardware items promptly to place of installation (shop or Project Site).

1.08 MAINTENANCE

A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.02 SCHEDULED HARDWARE

A. Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of finish hardware are indicated in the "Hardware Schedule" at the end of Part 3 of this Section. Products are identified by using hardware designation numbers of the following:

1. Manufacturer's Product Designations: The product designation and name of one (1) manufacturer are listed for each hardware type required for the purpose of establishing minimum requirements. Provide either the product designated or, where more than one (1) manufacturer is specified for each hardware type, the comparable product of one (1) of the other manufacturers that complies with requirements.

2. ANSI/BHMA designations used elsewhere in this Section or in schedules to describe hardware items or to define quality or function are derived from the following standards. Provide products complying with these standards and requirements specified elsewhere in this Section.

a. Butts and Hinges: ANSI/BHMA A156.1.

b. Bored and Preassembled Locks and Latches: ANSI/BHMA A156.2.

c. Exit Devices: ANSI/BHMA A156.3.

d. Door Controls Closers: ANSI/BHMA A156.4.

e. Auxiliary Locks and Associated Products: ANSI/BHMA A156.5.

f. Architectural Door Trim: ANSI/BHMA A156.6.

g. Template Hinge Dimensions: ANSI/BHMA A156.7.

h. Door Controls Overhead Holders: ANSI/BHMA A156.8.

i. Interconnected Locks and Latches: ANSI/BHMA A156.12.

j. Mortise Locks and Latches: ANSI/BHMA A156.13.

k. Sliding and Folding Door Hardware: ANSI/BHMA A156.14.

l. Closer Holder Release Devices: ANSI/BHMA A156.15.

m. Auxiliary Hardware: ANSI/BHMA A156.16.

n. Self Closing Hinges and Pivots: ANSI/BHMA A156.17.

o. Materials and Finishes: ANSI/BHMA A156.18.

2.03 MATERIALS AND FABRICATION

A. Manufacturer's Name Plate: Do not use manufacturers' products that have manufacturer's name or trade name displayed in a visible location (omit removable nameplates) except in conjunction with required fire rated labels and as otherwise acceptable to Architect.

1. Manufacturer's identification will be permitted on rim of lock cylinders only.

B. Base Metals: Produce hardware units of base metal, fabricated by forming method indicated, using manufacturer’s standard alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18 for finishes. Do not furnish manufacturer’s standard materials or forming methods if different from specified standard.

C. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to commercially recognized industry standards for application intended. Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.

D. Provide concealed fasteners for hardware units that are exposed when door is closed except to the extent no standard units of type specified are available with concealed fasteners. Do not use thru bolts for installation where bolt head or nut on opposite face is exposed in other Work unless their use is the only means of reinforcing the Work adequately to fasten the hardware securely. Where thru bolts are used as a means of reinforcing the Work, provide sleeves for each thru bolt or use sex screw fasteners.

2.04 HINGES, BUTTS, AND PIVOTS

A. Templates: Except for hinges and pivots to be installed entirely (both leaves) into wood doors and frames, provide only template produced units.

B. Screws: Provide Phillips flat head screws complying with the following requirements:

1. For metal doors and frames install machine screws into drilled and tapped holes.

2. For wood doors and frames install wood screws.

3. For fire rated wood doors install #12 x 1 1/4 inch, threaded to the head steel wood screws.

4. Finish screw heads to match surface of hinges or pivots.

C. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:

1. Out Swing Exterior Doors: Non-removable pins.

2. Out Swing Corridor Doors with Locks: Non-removable pins.

3. Interior Doors: Non-rising pins.

4. Tips: Flat button and matching plug, finished to match leaves, except where hospital tip (HT) indicated.

D. Number of Hinges: Provide number of hinges indicated but not less than three (3) hinges per door leaf for doors 90 inches or less in height and one (1) additional hinge for each 30 inches of additional height.

1. Fire Rated Doors: Not less than three (3) hinges per door leaf for doors 90 inches or less in height with same rule for additional hinges.

E. Continuous Hinges:

1. Hinge to be manufactured of 6063-T6- aluminum alloy with anodized finishes (painted finishes available on entire hinge or gear cap only).

2. Door and frame leaves to be machined, anodized and assembled as a matched pair. Door and frame leaves to be anodized after all machining and drilling processes are complete.

3. All hinge profiles shall be manufactured to template screw locations, with standard duty and heavy duty hole patterns identical as to number and placement of holes. All hinge profiles to be manufactured to template bearing locations, with standard duty bearing configurations of 5-1/8 inch spacing with a minimum of sixteen (16) bearings; and heavy duty at 2-9/16 inch spacing with a minimum of thirty-two (32) bearings.

4. Hinge leaves to be extruded at a uniform 1/8 inch thickness from pivot point to outside edge of hinge leaf. Uncut hinges shall be non-handed and shall be paintless assembly of three (3) interlocking extrusions applied to the full height of the door and frame without mortising.

5. Vertical door loads shall be carried on chemically lubricated thermoplastic thrust bearings. The door and frame leaves shall be continuously geared together for the entire hinge length and this relationship secured with a full length cover channel so that the hinge will operate through a full 180 degrees.

6. All rotating areas of the gear cap and geared leaves shall have a permanent lubrication which is factory applied along the full length of the hinge, and the lubricant shall last the life of the hinge with no additional maintenance required. Fasteners supplied shall be 410 stainless steel, brite hardened and plated.

2.05 LOCK CYLINDERS AND KEYING

A. Masterkey and grand masterkey to the existing "Best" system. No Substitition.

B. Furnish six (6) masterkeys and three (3) change keys per key set. All keys and final cores are to be provided direct to Owner by this supplier. Do not permit best change key access by anyone other than Owner's personnel.

2.06 LOCKS, LATCHES, AND BOLTS

A. Strikes: Provide manufacturer's standard wrought box strike for each latch or lock bolt, with curved lip extended to protect frame, finished to match hardware set, unless otherwise indicated.

1. Provide flat lip strikes for locks with 3 piece, antifriction latchbolts as recommended by manufacturer.

2. Provide extra long strike lips for locks used on frames with applied wood casing trim.

3. Provide recess type top strikes for bolts locking into head frames, unless otherwise indicated.

4. Provide dust proof strikes for foot bolts, except where special threshold construction provides non recessed strike for bolt.

5. Provide roller type strikes where recommended by manufacturer of the latch and lock units.

B. Lock Throw: Provide 5/8 inch minimum throw of latch on pairs of doors. Comply with UL requirements for throw of bolts and latch bolts on rated fire openings.

1. Provide 1/2 inch minimum throw of latch for other bored and preassembled types of locks and 3/4 inch minimum throw of latch for mortise locks. Provide 1 inch minimum throw for all dead bolts.

C. Flush Bolt Heads: Minimum of 1/2 inch diameter rods of brass, bronze, or stainless steel with minimum 12 inch long rod for doors up to 7 feet 0 inches in height. Provide longer rods as necessary for doors exceeding 7 feet 0 inches in height.

D. Exit Device Dogging: Except on fire rated doors where closers are provided on doors equipped with exit devices, equip the units with keyed dogging device to keep the latch bolt retracted, when engaged.

E. Rabbeted Doors: Where rabbeted door stiles are indicated, provide special rabbeted front on lock and latch units and bolts.

2.07 PROGRAMMABLE/ELECTRIFIED LOCKING DEVICES

A. Programmable Locking Device:

1. Lock shall be heavy-duty cylindrical type, with a 2-¾ inches backset supplied with a ½ inch throw latchbolt as standard. Chassis shall accommodate standard 161 cylindrical lock prep for 1-¾ inch doors as standard, with 1-3/8 inches to 2-¾ inch thick doors in 1/8 inch increments available. Locksets shall be provided from the factory with the appropriate handing.

2. Outside and inside levers shall operate independently of each other. Lock shall use patented, clutch mechanism to deter vandalism and maximize durability. Disablement of secured levers shall not permit latchbolt retraction from secure side while allowing emergency egress.

3. The lock will be furnished with the Classroom and Storeroom function which is: The outside lever is normally locked. The inside lever is always free. The unit may be momentarily unlocked with an approved Normal access credential. The unit may be maintained unlocked by using a Toggle access credential.

4. Emergency mechanical key override utilizes a 1-¼ inch mortise cylinder with standard straight cam.

5. Outside escutcheon shall contain an integrated 6-button keypad.

6. Visual red and green LED indicators shall indicate activation, operational system status, system error conditions and low power conditions.

7. Device as manufactured by Best Access Systems. No substitution.

B. Electrified Locking Device: A security platform that combines mechanical hardware with the ability to monitor door openings with Owner's existing access control panel and software.

1. Complete monitoring of door from the lockset.

2. Panel interface board connects to third party access control panel.

3. Available in proximity or magnetic stripe.

4. Simplified request to exit component contained in the inside trim.

5. Industry standard HID Prox coordinates with Owner's existing credential.

6. UL tested for use on fire doors up to and including 3 hours. ANSI Grade 1.

2.08 EXIT DEVICES

A. Exit Devices shall be touchpad type, fabricated of bronze, brass, stainless steel, or aluminum, and plated to the standard architectural finishes to match the balance of door hardware.

B. All exit devices shall incorporate a fluid damper, which decelerates the touchpad on its return stroke and eliminates noise associated with exit device operation. Touchpad shall extend a minimum of one half of the door width. All latchbolts to be deadlatching type, with a self-lubrication coating to reduce wear. Mechanism case and end-cap will be 0.140-gauge attachment to door. Touchpad shall match exit device finish, and shall be stainless steel for US26, US26D, US28, US32, and US32D finishes. Only compression springs will be used in devices, latches, and outside trims or controls.

C. Exit devices shall be UL listed panic exit hardware. All exit devices for fire rated openings shall be UL labeled fire exit hardware.

D. Lever trim for exit devices shall be vandal-resistant type, which will travel to a 90-degree down position when more than 35 pounds of torque are applied, and which can easily be re-set.

E. All exit devices shall be of one manufacturer. No deviation will be considered.

F. All trim shall be thru-bolted to the lock stile case. Lever design to match locksets.

G. Surface vertical rod devices shall be UL labeled for fire door applications without the use of bottom rod assemblies. Where bottom rods are required for security applications, the devices shall be UL labeled for fire door applications with rod and latch guards by the device manufacturer.

2.09 CLOSERS AND DOOR CONTROL DEVICES

A. Access-Free Manual Closers: Where manual closers are indicated for doors required to be accessible to the physically handicapped, provide adjustable units complying with ADA and ANSI A-117.1 provisions for door opening force.

1. At interior doors, adjust closers for door opening force not to exceed 5 foot-pounds of force. If a door has a closer, then the sweep period of the closer shall be adjusted so that from an open position of 70 degrees, the door will take at least three (3) seconds to move to a point 3 inches (75 mm) from the latch measured to the leading edge of the door.

2. At exterior doors, adjust closers for door opening force not to exceed 8.5 foot-pounds of force.

3. Where parallel arms are indicated for closers, provide closer unit one (1) size larger than recommended for use with standard arms.

B. Door closers shall have fully hydraulic, full rack and pinion action with a high strength cast iron cylinder. All closers shall be of one (1) manufacturer. All closers shall utilize a stable fluid withstanding temperature range of 120 degrees F to –30 degrees F without seasonal adjustment of closer speed to properly close the door. Closers for fire-rated doors shall be provided with temperature stabilizing fluid that complies with standards UBC 7-2 (1997) and UL 10C.

C. Spring power shall be continuously adjustable over the full range of closer sizes, and allow for reduced opening force for the physically handicapped. Spring power adjustment allows for quick and accurate power adjustment and visually shows closer power size settings by way of dial adjustment gauge located on closer spring tube. Hydraulic regulation shall be by tamper-proof, non-critical valves. Closers shall have separate adjustment for latch speed, general speed and back check. Door closers with pressure relief valves are not acceptable.

D. All closers shall have solid forged steel main arms (and forearms for parallel arm closers) and where specified shall have a cast-in solid stop on the closer shoe.

E. All surface closers shall be certified to exceed ten million full load cycles by a recognized independent testing laboratory. All closers (overhead, surface and concealed shall be of one (1) manufacturer and carry manufacturer's ten (10) year warranty (electric closers to have two (2) year warranty).

F. Overhead concealed closers shall have spring power adjustable for 50 percent increase in closing power and fully mortised door tracks.

G. Closers to be installed to allow door swing as shown on plans. Doors swinging into exit corridors shall provide for corridor clear width as required by code. Where possible, mount closers on inside of rooms.

H. Provide brackets, mounting plates, and fastener types for closers as required for proper installation with door and frame conditions. Closers shall be attached to wood doors with sex bolts.

I. Powder coating finish to be certified to exceed 100 hours salt spray testing by ETL, an independent testing laboratory used by BHMA for ANSI certification.

J. Combination Door Closers and Holder: Provide units designed to hold door in open position under normal usage and to release and close door automatically under fire conditions. Incorporate an integral electromagnetic holder mechanism designed for use with UL listed fire detectors, provided with normally closed switching contacts.

K. Magnetic Door Holders to be heavy duty wall or floor mounted with metal housing and complete mounting hardware. Provide 24V holding coils unless otherwise scheduled.

L. Flush Floor Plates: Provide finished metal flush floor plates for floor closers except where thresholds are indicated and cover plate is specified to be an integral part of threshold. Finish floor plate to match hardware sets, unless otherwise indicated.

M. Provide grey resilient parts for exposed bumpers.

2.10 PUSH/PULL UNITS

A. Concealed Fasteners: Provide manufacturer's special concealed fastener system for installation, through bolted for matched pairs but not for single units.

2.11 DOOR TRIM UNITS

A. Fasteners: Provide manufacturer's standard exposed fasteners for door trim units consisting of either machine screws or self tapping screws.

B. Fabricate edge trim of stainless steel to fit door thickness in standard lengths or to match height of protection plates.

C. Fabricate protection plates not more than 1-1/2 inches less than door width on hinge side and not more than 1/2 inch less than door width on pull side by height indicated.

1. Metal Plates: Stainless steel, 0.050 inch (U.S. 18-gage).

2.12 WEATHERSTRIPPING AND SEALS

A. Provide continuous weatherstripping on exterior doors and smoke, light, or sound seals on interior doors where indicated or scheduled. Provide non-corrosive fasteners for exterior applications and elsewhere as indicated.

B. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strip is easily replaceable and readily available from stocks maintained by manufacturer.

C. Quality and type of materials are established herein and on the Drawings by catalogue numbers and descriptions from the catalogue of National Guard Products. Other acceptable manufacturers are: Zero International, Inc., Pemko Mfg., Co., Reese Enterprises, Inc.

1. Head/Jamb Seals: No. 2525.

2. Sweep Strip: No. 200N, mill finish.

3. Threshold: No. 425, mill finish.

4. Adjustable Head/Jamb Seals: No. 103N, mill finish.

5. Adjustable Door Bottoms: No. 222N, mill finish.

6. Threshold for Adjustable Seals: No. 950N, mill finish.

7. Rain Drip: No. 17, mill finish.

8. Top Protection: No. 16, mill finish.

2.13 HARDWARE FINISHES

A. Match items to the manufacturer's standard color and texture finish for the latch and lock sets (or push pull units if no latch or lock sets).

B. Provide finishes that match those established by ANSI/BHMA or, if none established, match the Architect's sample.

C. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware.

D. The designations used in schedules and elsewhere to indicate hardware finishes are those listed in ANSI/BHMA A156.18, "Materials and Finishes," including coordination with the traditional U.S. finishes shown by certain manufacturers for their products.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. All installation shall be in accordance with manufacturer’s published recommendations.

C. Mount hardware units at heights indicated in following applicable publications, except as specifically indicated or required to comply with governing regulations and except as otherwise directed by Architect.

1. "Recommended Locations for Builders Hardware for Standard Steel Doors and Frames" by the Door and Hardware Institute.

2. "Recommended Locations for Builders Hardware for Custom Steel Doors and Frames" by the Door and Hardware Institute.

3. NWWDA Industry Standard I.S.1.7, "Hardware Locations for Wood Flush Doors"; applicable for flush wood doors 1-3/8 and1-3/4 inches thick by 6 feet 8 inches and 7 feet 0 inches high.

D. Install each hardware item in compliance with the manufacturer's instructions and recommendations. Where cutting and fitting is required to install hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation or application of surface protection with finishing Work specified in the Division 09 Sections. Do not install surface mounted items until finishes have been completed on the substrates involved.

E. Set units level, plumb, and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.

F. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.

G. Set thresholds for exterior doors in full bed of butyl rubber or polyisobutylene mastic sealant complying with requirements specified in Division 07 Section "Joint Sealers."

H. Weatherstripping and Seals: Comply with manufacturer's instructions and recommendations to the extent installation requirements are not otherwise indicated.

1. Where adhesive applied items are indicated, abrade or otherwise prepare the substrate for complete adhesion to ensure the items will not delaminate.

3.02 ADJUSTING, CLEANING, AND DEMONSTRATING

A. Adjust and check each operating item of hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate freely and smoothly or as intended for the application made.

1. Where door hardware is installed more than one (1) month prior to acceptance or occupancy of a space or area, return to the installation during the week prior to acceptance or occupancy and make final check and adjustment of all hardware items in such space or area. Clean operating items as necessary to restore proper function and finish of hardware and doors. Adjust door control devices to compensate for final operation of heating and ventilating equipment.

B. Clean adjacent surfaces soiled by hardware installation.

C. Instruct Owner's personnel in the proper adjustment and maintenance of door hardware and hardware finishes.

3.03 HARDWARE APPLICATION SCHEDULE

HINGES – Hager Hinge Co., Ives

B 1 pr Butts BB1168 5.0 X 4.5	USP
B 2 pr Butts 1279 4.5 X 4.0	USP
B 3 pr Butts BB1279 4.5 X 4.0	USP
B 4 pr Butts BB1168 4.5 X 4.5	USP
B 5 pr Butts 1279 5.0 X 4.0	USP

B 6 pr Butts BB1279 5.0 X 4.0 USP
B 7 pr Butts 1279 5.0 X 4.0 US26D
B 8 pr Butts 1279 4.5 x 4.0 US26D
B 9 pr Butts BB1168 5.0 x 4.5 US26D
B 10 pr Butts1279 4.5 X 4.5 X NRP USP
B 11 ea Continuous Hinge Rotation 780-224 HD

DOOR CLOSERS – LCN, Norton Door Closer Company

C 1 ea Closers P4040SW x 4040SE-3210 689 (24VDC less than 90M current)
C 2 ea Closers 4110/4111 Series 689
C 3 ea Closers 4041 Series 689
C 4 ea Closers 4010/4011 Series 689
C 5 ea Closers 4041-EDA 689
C 6 ea Closers 4040SE x 4040se-3210 689 (24VDC less than 90MA current)
C 7 ea Closers 4010/4011 Series x DEL 689
C 8 ea Closers 4110/4111 Series x DEL 689
C 9 ea Closers 4111-H 689
C 10 ea Closers 4011-H 689

EXIT DEVICES – Von Duprin, Inc.

E 1 ea Exit Devices 3327 TL US 28 x Less Pull
E 2 ea Exit Devices 99L F US 28
E 3 ea Exit Devices 99L US 28
E 4 ea Exit Devices 3327 EO US 28

For functions other than listed above suffix the following:
a. NL Key retreacts latchbolt
b. LBR Less bottom rod
c. ALK Exit Alarm Kit

For electronic functions prefix the following:
a. CX Delay egress
b. EL Electronic latch retraction
c. E Electronic locking or unlocking of trim
d. RX Request to exit feature
e. LX Monitors exit device latch bolt
f. SS Indicates unauthorized use of opening

FLOOR CLOSERS – Rixson, Inc.
FC 1 sets D.A. Floor Closers 30 US26D

CYLINDERS – Best Access Systems
CL 1 ea Mortise Cylinders 1E 74 US10B x Required Cam
CL 2 ea Rim Cylinders 1E 72 US26D
CL 3 ea Mortise Cylinders 1E 74 US26D x Required Cam

MORTISED LOCKSETS, DEAD LOCKS, LATCHSETS – Best Access Systems (14H trim design) NO SUBSTITUTION
Provide all locksets in RM (Rosemont) trim design instead of MF.

LM – 4 ea Mortise Locksets 35H-7E-14H 626
LM – 5 ea Mortise Storeroom Locksets 35H-7EW-14H 626 x Outside Lever Knurled
LM – 6 ea Mortise Storeroom Locksets 35H-7EW-14H 626
LM – 7 ea Mortise Dbl Cylinder Office Locksets 35H-7G-14H 626
LM – 8 ea Mortise Classroom Locksets 35H-7J-14H 626
LM – 9 ea Mortise Privacy Locksets 35H-LF-14H 626
LM – 10 ea Mortise Dead Locks 35H-7T 626
LM – 11 ea Mortise Latchsets 35H-N-14H 626
LM – 12 ea Mortise Privacy Locksets 35H-LF-14H 626 X 2 Thumb Turns
LM – 13 ea Mortise Entrance Locksets 35H-7AW-14H 626
LM – 14 ea Mortise Communicating Locksets 35H-7C-14H 626
LM – 15 ea Ives Roller Latches RL30 US26D
LP – 1 ea Programmable Mortise Lock 35HZ7EV14KP 626
LP – 2 ea Programmable Mortise Lock 35HZ7FV14KP 626

CYLINDRICAL LOCKSETS, DEAD LOCKS, LATCHES – Best Access Systems (14C trim design) NO SUBSTITUTION

LC – 4 ea Cylindrical Entrance Locksets 93K-7AB-14C 626
LC – 5 ea Cylindrical Storeroom Locksets 93K-7D-14C 626 X Outside Knob Knurled
LC – 6 ea Cylindrical Storeroom Locksets 93K – 7D-14C 626
LC – 7 ea Cylindrical Corridor Locksets 93K-7C-14C 626
LC – 8 ea Cylindrical Classroom Locksets 93K-7R-14C 626
LC – 9 ea Cylindrical Privacy Locksets 93KOL-14C 626
LC – 10 ea Mortise Dead Locks 34H-7T 626
LC – 11 ea Cylindrical Latchsets 93K-N-14C 626
LC – 12 ea Cylindrical Privacy Locksets with 2 Thumb Turns (Not available)
LC – 13 ea Cylindrical Lockset with Dead Bolt (Not available)
LC – 14 ea Cylindrical Communicating Locksets 93K-7S-14C 626
LC – 15 ea Ives Roller Latches RL30 US26D
LP – 3 ea Programmable Cylindrical Lock 93KZ7DV14KP-S3 626

PULLS, PUSH PLATES, ARMOR PLATES, KICK PLATS & END CAPS – Ives, Rockwood, Trimco Hardware

P 1 ea Pulls Ives 8103EZ-0 US32D
P 2 ea Push Plates Ives 8200 – 6” X 16” US32D
P 3 ea Ives Pull Plate 8303EZ-0 – 6” X 16” US 32D
P 4 ea Offset Pulls Ives 8190-0 US32D
AP 1 ea Armor Plates Ives 8400. 36” x 1” L.W.D. x 0.50 US32D
AP 2 ea Armor Plates Ives 8400. 54” X 1 ½” L.W.D. x 0.50 US32D
AP 3 ea Armor Plates Ives 8400. 50” X 1 ½” L.W.D. x 0.50 US32D
AP 4 ea Armor Plates Ives 8400. 52” X 1” L.W.D. x 0.50 US32D
K 1 ea Kick Plates Ives 8400. 10” x 1 ½” L.W.D. x 0.50 US32D
EC 1 ea Edge Guards Rockwood 306 US32D Full Height of Door

SILENCERS, STOPS, HOLDERS, FLUSH BOLTS, DUST PROOF STRIKES, PUSH/PULL LATCHES & COORDINATORS – Ives, Rockwood, Trimco Hardware

S 1 ea Silencers Ives SR 64
S 2 ea Wall Stops Ives WS407CCV US32D
S 3 ea Floor Stops Ives FS13/R14 US26D
S 4 ea Floor Holders Ives FS40 US26D
S 5 ea Flush Bolts Ives FB458-12” US26D

S 6 ea Dust Proof Strikes Ives DP 2 US26D
S 7 ea Wall Stops Ives WS11X US26D
S 8 ea Push/Pull Latches GJ HL 6 US32D x 5” B.S.
S 9 ea Overhead Friction Holders GJ 410 Series US32D
S 10 ea Overhead Holders GJ 90H Series US32D
S 11 ea Automatic Flush Bolts Ives FB30 or FB40 x US32D
S 12 ea Coordinators Ives COR Series US P x Filler Bar

MISCELLANEOUS

M 2 sets Ives Center Hung Pivots 7255 US26D
M 3 ea Hagar Emg. Stop & Release 455/456 US26D

3.04 HARDWARE SETS

<3/14/13 - Under Development>

END OF SECTION 08 71 11

SECTION 08 81 00 – GLASS AND GLAZING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with all applicable federal, state, and local requirements, and conform to codes and ordinances of the authorities having jurisdiction.

1.03 DEFINITIONS

A. Manufacturer is used in this Section to refer to a firm that produces primary glass or fabricated glass as defined in the referenced glazing standard.

1.04 QUALITY ASSURANCE

A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, except where more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. FGMA Publications: "FGMA Glazing Manual."

B. Safety Glass: Products complying with ANSI Z97.1 and testing requirements of 16 CFR Part 1201 for Category II materials.

1. Subject to compliance with requirements, provide safety glass permanently marked with certification label of Safety Glazing Certification Council (SGCC) or other certification agency acceptable to authorities having jurisdiction.

C. Fire Resistive Glazing Products for Door and Window Assemblies: Products labeled and listed by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.

D. Glazier Qualifications: Engage an experienced glazier who has completed glazing similar in material, design, and extent to that indicated for Project with a record of successful in service performance.

E. Single Source Responsibility for Glass: Obtain glass from one source for each product indicated below:

1. Primary flat glass of each (ASTM C 1036) type and class indicated.

2. Heat treated flat glass of each (ASTM C 1048) condition indicated.

F. Single Source Responsibility for Glazing Accessories: Obtain glazing accessories from one source for each product and installation method indicated.

G. Preconstruction Compatibility and Adhesion Testing: Submit to sealant manufacturers, samples of each glass, gasket, glazing accessory, and glass framing member that will contact or affect glazing sealants for compatibility and adhesion testing as indicated below:

1. Use test methods standard with sealant manufacturer to determine if priming and other specific preparation techniques are required for rapid, optimum glazing sealants adhesion to glass and glazing channel substrates.

a. Perform tests under normal environmental conditions during installation.

2. Submit not less than nine pieces of each type and finish of glass framing members and each type, class, kind, condition, and form of glass (monolithic, ~~laminated, insulating~~ units) for adhesion testing, as well as one sample of each glazing accessory (gaskets, setting blocks and spacers) for compatibility testing.

3. Schedule sufficient time to test and analyze results to prevent delay in the Work.

4. Investigate materials failing compatibility or adhesion tests and get sealant manufacturer's written recommendations for corrective measures, including using special primers.

5. Testing is not required when glazing sealant manufacturer can submit required preparation data that is acceptable to Architect and is based on previous testing of current sealant products for adhesion to and compatibility with submitted glazing materials.

1.05 SUBMITTALS

A. Product Data: Submit manufacturer's technical data for each glazing material and fabricated glass product required, including installation and maintenance instructions.

B. Samples: Submit, for verification purposes, 12 inch square samples of each type of glass indicated except for clear single pane units, and 12 inch long samples of each color required (except black) for each type of sealant or gasket exposed to view. Install sealant or gasket sample between two strips of material representative of adjoining framing system in color.

C. Certificate: Submit certificates from respective manufacturers attesting that glass and glazing materials furnished for Project comply with requirements.

1. Separate certification will not be required for glazing materials bearing manufacturer's permanent labels designating type and thickness of glass, provided labels represent a quality control program involving a recognized certification agency or independent testing laboratory acceptable to authorities having jurisdiction.

D. Compatibility and Adhesion Test Report: Submit statement from sealant manufacturer indicating that glass and glazing materials have been tested for compatibility and adhesion with glazing sealants and interpreting test results relative to material performance, including recommendations for primers and substrate preparation needed to obtain adhesion.

E. Record Documents: Provide record approved product data, samples, reports, and certificates.

1.06 DELIVERY, STORAGE AND HANDLING

A. Protect glazing materials to comply with manufacturer's directions and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

1.07 SYSTEM PERFORMANCE REQUIREMENTS

A. Provide glazing systems that are produced, fabricated, and installed to withstand normal thermal movement, wind loading, and impact loading (where applicable), without failure including loss or glass breakage attributable to the following: defective manufacture, fabrication, and installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; and other defects in construction.

B. Glass Design: Glass thicknesses indicated on Drawings are for detailing only. Confirm glass thicknesses by analyzing Project loads and in service conditions. Provide glass lites for the various size openings in the thicknesses and strengths (annealed or heat treated) to meet or exceed the following criteria:

1. Minimum glass thickness, nominally, of lites in exterior walls is 6.0 mm (0.23 inch).

2. Minimum glass thicknesses of lites, whether composed of annealed or heat treated glass, are selected so the worst case probability of failure does not exceed the following:

a. 8 lites per 1000 for lites set vertically or not over 15 degrees off vertical and under wind action. Determine minimum thickness of monolithic annealed glass according to ASTM E 1300. For other than monolithic annealed glass, determine thickness per glass manufacturer's standard method of analysis including applying adjustment factors to ASTM E 1300 based on type of glass.

1.08 PROJECT CONDITIONS

A. Environmental Conditions: Do not proceed with glazing when ambient and substrate temperature conditions are outside the limits permitted by glazing materials manufacturer or when glazing channel substrates are wet from rain, frost, condensation, or other causes.

1. Install liquid sealants at ambient and substrate temperatures above 40 degrees F (4.4 degrees C).

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.02 PRIMARY GLASS PRODUCTS

A. Glass Type "2": Clear float glass conforming to ASTM C 1036, Type I, Class 1, Quality q3, which has been fully tempered by manufacturer's standard process (after cutting to final size), to achieve a flexural strength of 4 times normal glass strength, in accordance with ASTM C 1048, Condition A; ¼ inch thick.

2.03 MIRROR GLASS

A. Tempered Glass: Tempered float glass manufactured by horizontal (roller hearth) process with roll wave distortion parallel with bottom edge of glass as installed, unless otherwise indicated, complying with ASTM C 1048 for Kind FT (fully tempered), Condition A (uncoated surfaces), Type I (transparent, flat), Quality q3 (glazing select), and for class indicated below:

1. Clear Tempered Float Glass: Class 1 (clear).

2.04 MIRRORED GLASS PRODUCTION AND FABRICATION

A. Glass Coating: Coat second surface of glass with successive layers of chemically deposited silver, electrically or chemically deposited copper, and manufacturer's standard protective organic coating to produce coating system that complies with FS DD M 0041, except with salt spray test period extended to 300 hours and undercutting, discolorations, blackening, and silver impairment at mirror edges not greater than 1/8 inch.

B. Mirror Edge Treatment: Provide forms of edge treatment indicated below, with edges sealed after treatment to prevent chemical or atmospheric penetration of glass coating:

1. Flat polished edge.

2.05 ELASTOMERIC GLAZING SEALANTS

A. Provide products of type indicated, complying with the following requirements:

1. Compatibility: Select glazing sealants and tapes of proven compatibility with other materials they will contact, including glass products, seals of insulating glass units, and glazing channel substrates, under conditions of installation and service, as demonstrated by testing and field experience.

2. Suitability: Comply with sealant and glass manufacturer's recommendations for selecting glazing sealants and tapes that are suitable for applications indicated and conditions existing at time of installation.

3. Colors: Provide color of exposed joint sealants to comply with the following:

a. Provide selections made by Architect from manufacturer's full range of standard colors for products of type indicated.

B. Elastomeric Glazing Sealant Standard: Provide manufacturer's standard chemically curing, elastomeric sealants of base polymer indicated that comply with ASTM C 920 requirements for Type, Grade, Class and Uses.

C. Glazing Sealant for Fire Resistant Glazing Products: Identical to product used in test assembly to obtain fire resistive rating.

2.06 GLAZING TAPES

A. Back Bedding Mastic Glazing Tape: Preformed, butyl based elastomeric tape with a solids content of 100 percent, nonstaining and nonmigrating in contact with nonporous surfaces, with or without spacer rod as recommended by tape and glass manufacturers for application indicated, packaged on rolls with a release paper backing, and complying with AAMA 800.

B. Products: Subject to compliance with requirements, provide one of the following:

1. Back Bedding Mastic Glazing Tape Without Spacer Rod:

a. PTI 303 Glazing Tape (shimless), Protective Treatments, Inc.

b. S M 5700 Poly Glaze Tape Sealant, Schnee Morehead, Inc.

c. Tremco 440 Tape, Tremco Inc.

d. Extru Seal, Pecora Corp.

e. PTI 606 Architectural Sealant Tape, Protective Treatments, Inc.

f. Dyna Seal, Pecora Corp.

g. PTI 626 Architectural Sealant Tape, Protective Treatments, Inc.

h. SST 800 Tape, Tremco, Inc.

2. Back Bedding Mastic Glazing Tape With Spacer Rod:

a. PTI 303 Glazing Tape (with shim), Protective Treatments, Inc.

b. Pre shimmed Tremco 440 Tape, Tremco, Inc.

c. PTI 606 Architectural Sealant Tape, Protective Treatments, Inc.

2.07 MISCELLANEOUS GLAZING MATERIALS

A. Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials involved for glazing application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers and Sealers: Type recommended by sealant or gasket manufacturer.

C. Setting Blocks: Elastomeric material with a Shore A durometer hardness of 85 plus or minus 5.

D. Spacers: Elastomeric blocks or continuous extrusions with a Shore A durometer hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

F. Mirror Mastic: An adhesive setting compound, produced specifically for setting mirrors by spot application, certified as compatible with glass coating by organic protective coating manufacturer and approved by mirror manufacturer.

G. Mirror Hardware: Extruded aluminum mirror hardware, of size and profile indicated, in manufacturer's standard finish, complying with description below:

1. Clear anodized finish.

2.08 FABRICATION OF GLASS AND OTHER GLAZING PRODUCTS

A. Fabricate glass and other glazing products in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with recommendations of product manufacturer and referenced glazing standard as required to comply with system performance requirements.

PART 3 - EXECUTION

3.01 PREPARATION

A. Examine glass framing, with glazier present, for compliance with the following:

1. Manufacturing and installation tolerances, including those for size, squareness, offsets at corners.

2. Presence and functioning of weep system.

3. Minimum required face or edge clearances.

4. Effective sealing between joints of glass framing members.

B. Do not proceed with glazing until unsatisfactory conditions have been corrected.

C. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings that are not firmly bonded to substrates.

3.02 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. All installation shall be in accordance with manufacturer’s published recommendations.

C. Glazing – General:

1. Comply with combined recommendations of manufacturers of glass, sealants, gaskets, and other glazing materials, except where more stringent requirements are indicated, including those in referenced glazing publications.

2. Glazing channel dimensions as indicated on Drawings provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances. Adjust as required by Project conditions during installation.

3. Protect glass from edge damage during handling and installation as follows:

a. Use a rolling block in rotating glass units to prevent damage to glass corners. Do not impact glass with metal framing. Use suction cups to shift glass units within openings; do not raise or drift glass with a pry bar. Rotate glass lites with flares or bevels on bottom horizontal edges so edges are located at top of opening, unless otherwise indicated by manufacturer's label.

b. Remove damaged glass from Project Site and legally dispose of off Site. Damaged glass is glass with edge damage or other imperfections that, when installed, weaken glass and impair performance and appearance.

4. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction sealant substrate testing.

5. Install elastomeric setting blocks in sill rabbets, sized and located to comply with referenced glazing standard, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

6. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

7. Provide spacers for glass sizes larger than 50 united inches (length plus height) as follows:

   a. Locate spacers inside, outside, and directly opposite each other. Install correct size and spacing to preserve required face clearances, except where gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and comply with system performance requirements.

   b. Provide 1/8 inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

8. Provide edge blocking to comply with requirements of referenced glazing publications, unless otherwise required by glass manufacturer.

9. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

D. Tape Glazing:

1. Position tapes on fixed stops so that when compressed by glass their exposed edges are flush with or protrude slightly above sightline of stops.

2. Install tapes continuously but not in one continuous length. Do not stretch tapes to make them fit opening.

3. Where framing joints are vertical, cover these joints by applying tapes to heads and sills first and then to jambs. Where framing joints are horizontal, cover these joints by applying tapes to jambs and then to heads and sills.

4. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

5. Do not remove release paper from tape until just before each lite is installed.

6. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

E. Mirror Glazing:

1. Install mirrors to comply with printed directions of mirror manufacturer, and with referenced FGMA standard and NAMM document. Mount mirrors in place to avoid distorting reflected images and provide space for air circulation between back of mirror and face of mounting surface.

2. Mastic Spot Installation System: Install mirrors with mastic as follows:

   a. Identify and examine surfaces over which mirror is to be mounted. Comply with manufacturer's printed installation directions for preparation of mounting surfaces including coating surfaces with mastic manufacturer's special bond coating where applicable.

   b. Apply barrier coat to mirror backing where approved by manufacturers of mirror and backing material.

   c. Apply mastic in spots to comply with mastic manufacturer's printed directions for coverage and to allow air circulation between back of mirror and face of mounting surface.

   d. After mastic is applied, align mirror and press into place while maintaining a minimum air space of 3/16 inch between back of mirror and mounting surface.

   e. For wall mounted mirrors install permanent means of support at bottom and top edges with bottom support designed to withstand mirror weight and top support to prevent mirror from coming away from wall along top edges.

3.03 PROTECTION AND CLEANING

A. Protect exterior glass from breakage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels, and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations including weld splatter. If, despite such protection, contaminating substances do come into contact with glass, remove them immediately as recommended by glass manufacturer.

C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for build up of dirt, scum, alkali deposits, or stains, and remove as recommended by glass manufacturer.

D. Remove and replace glass that is broken, chipped, cracked, abraded, or damaged in any way, including natural causes, accidents and vandalism, during construction period.

E. Wash glass on both faces in each area of Project not more than four (4) days prior to date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended by glass manufacturer.

END OF SECTION 08 81 00

SECTION 09 22 16 – NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with all applicable requirements and standards.

1.03 QUALITY ASSURANCE

A. Fire Resistance Ratings: Where indicated, provide materials and construction which are identical to those of assemblies whose fire resistance rating has been determined per ASTM E 119 by a testing and inspecting organization acceptable to authorities having jurisdiction.

1. Provide fire resistance rated assemblies identical to those indicated by reference to GA File No's. in GA 600 "Fire Resistance Design Manual" or to design designations in U.L. "Fire Resistance Directory" or in listing of other testing agencies acceptable to authorities having jurisdiction.

1.04 SUBMITTALS

A. Product Data:

1. Submit product data consisting of manufacturer's product Specifications and installation instructions for each product, including data showing compliance with the requirements.

B. Record Documents:

1. Provide record approved product data.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.02 MANUFACTURERS

A. Subject to compliance with requirements, manufacturers offering products which may be incorporated in the Work include:

1. Dale/Incor Inc.

2. Dietrich Industries Inc.

3. Marino/Ware

4. Unimast Inc.

5. USG Corp.

2.03 STEEL FRAMING FOR WALLS AND PARTITIONS

A. Design Criteria: Design metal stud partitions to have deflection not to exceed l/240 under a 5 psf lateral load. Where height of stud required exceeds the deflection criteria shown in manufacturer's printed engineering charts, provide heavier gauge studs, or closer spacing, as required for actual span conditions.

B. Steel Studs and Runners: ASTM C 645, with flange edges of studs bent back 90 degrees and doubled over to form 3/16 inch minimum lip (return) and complying with the following requirements for minimum thickness and depth:

1. Thickness: 0.0270 inch (22 gauge), unless otherwise indicated.[

2. Thickness: 0.0329 inch (20 gauge) at walls to receive shelving and casework, at door jambs and where indicated.

3. Thickness: As indicated.

4. Depth: 3-5/8 inches, unless otherwise indicated.

5. Depth: 6 inches where indicated.

6. Depth: 2-1/2 inches where indicated.

7. Depth: As indicated.

C. Steel Rigid Furring Channels: ASTM C 645, hat shaped, depth and minimum thickness of base (uncoated) metal as follows:

1. Depth: 7/8 inch.

2. Depth: 1-1/2 inch.

3. Thickness: 0.0329 inch (20 gauge), unless otherwise indicated.

D. Furring Brackets: Serrated arm type, adjustable, fabricated from corrosion resistant steel sheet complying with ASTM C 645, minimum thickness of base (uncoated) metal of 0.0329 inch, designed for screw attachment to steel studs and steel rigid furring channels used for furring.

E. Steel Resilient Furring Channels: Manufacturer's standard product designed to reduce sound transmission, complying with ASTM C 645 for base metal, finish and widths of face and fastening flange, fabricated to form 1/2 inch deep channel of the following configuration:

1. Single Leg Configuration: Assymetric shaped channel with face connected to a single flange by a single slotted leg (web).

2. Double Leg Configuration: Hat shaped channel, with 1-1/2 inch wide face connected to flanges by double slotted or expanded metal legs (webs).

3. Configuration: Either one indicated above.

F. Z Furring Members: Manufacturer's standard zee shaped furring members with slotted or nonslotted web, fabricated from hot dip galvanized steel sheet complying with ASTM A 525, Coating Designation G60; with a minimum base metal (uncoated) thickness of 0.0179 inch, face flange of 1-1/4 inch, wall attachment flange of 7/8 inch, and of depth required to fit insulation thickness indicated.

G. Fasteners: Provide fasteners of type, material, size, corrosion resistance, holding power and other properties required to fasten steel framing and furring members securely to substrates involved; complying with the recommendations of gypsum drywall manufacturers for applications indicated.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. All installation shall be in accordance with manufacturer’s published recommendations.

3.02 INSTALLATION OF STEEL FRAMING, GENERAL

A. Steel Framing Installation Standard: Install steel framing to comply with ASTM C 754 and with ASTM C 840 requirements that apply to framing installation.

B. Install supplementary framing, blocking and bracing at terminations in the Work and for support of fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, and similar construction to comply with details indicated and with recommendations of gypsum board manufacturer, or if none available, with "Gypsum Construction Handbook" published by United States Gypsum Co.

C. Isolate steel framing from building structure to prevent transfer of loading imposed by structural movement, at locations indicated below to comply with details shown on Drawings:

1. Where edges of suspended ceilings abut building structure horizontally at ceiling perimeters or penetration of structural elements.

2. Where partition and wall framing abuts overhead structure.

a. Provide slip or cushioned type joints as detailed to attain lateral support, avoid axial loading, and maintain structural performance of partition.

b. Provide UL-listed components for use in fire resistance rated head of partition joint systems indicated.

D. Do not bridge building expansion and control joints with steel framing or furring members; independently frame both sides of joints with framing or furring members or as indicated.

3.03 INSTALLATION OF STEEL FRAMING FOR FURRED CEILINGS AND SOFFITS

A. Secure hangers to structural support by connecting directly to structure where possible, otherwise connect to cast in concrete inserts or other anchorage devices or fasteners as indicated.

B. Do not connect or suspend steel framing from ducts, pipes or conduit.

C. Keep hangers and braces two inches clear of ducts, pipes and conduits.

D. Sway brace suspended steel framing with hangers used for support.

E. Install suspended steel framing components in sizes and at spacings indicated but not less than that required by referenced steel framing installation standard.

3.04 INSTALLATION OF STEEL FRAMING FOR WALLS AND PARTITIONS

A. Install runners (tracks) at floors, ceilings and structural walls and columns where gypsum drywall stud system abuts other construction.

1. Where studs are installed directly against exterior walls, install asphalt felt strips between studs and wall.

B. Installation Tolerances: Install each steel framing and furring member so that fastening surface does not vary more than 1/8 inch from plane of faces of adjacent framing.

C. Extend partition framing, where indicated, full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing over frames for doors and openings and frame around ducts penetrating partitions above ceiling to provide support for gypsum board.

D. Terminate partition framing at suspended ceilings where indicated.

E. Install steel studs and furring in sizes and at spacings indicated but not less than that required by referenced steel framing installation standard.

1. For single layer construction: Unless otherwise indicated, 16 inches on center.

F. Install steel studs so that flanges point in the same direction and gypsum boards can be installed in the direction opposite to that of the flange.

G. Frame door openings to comply with details indicated, with GA 219 and with applicable published recommendations of gypsum board manufacturer. Attach vertical studs at jambs with screws either directly to frames or to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.

H. Frame openings other than door openings to comply with details indicated, or if none indicated, in same manner as required for door openings; and install framing below sills of openings to match framing required above door heads.

END OF SECTION 09 22 16

SECTION 09 29 00 - GYPSUM DRYWALL

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with all applicable requirements and standards.

1.03 DEFINITIONS

A. Gypsum Board Construction Terminology: Refer to ASTM C 11 and GA 505 for definitions of terms for gypsum board construction not otherwise defined in this section or other referenced standards.

1.04 QUALITY ASSURANCE

A. Fire Resistance Ratings: Where indicated, provide materials and construction which are identical to those of assemblies whose fire resistance rating has been determined per ASTM E 119 by a testing and inspecting organization acceptable to authorities having jurisdiction.

1. Provide fire resistance rated assemblies identical to those indicated by reference to GA File No's. in GA 600 "Fire Resistance Design Manual" or to design designations in U.L. "Fire Resistance Directory" or in listing of other testing and agencies acceptable to authorities having jurisdiction.

B. Perform gypsum board Work in accordance with recommendations of ASTM C 754 an GA 216 unless otherwise indicated or required by project conditions.

C. Keep a copy of GA 216 and GA 600 in field office for duration of project.

D. Single Source Responsibility: Obtain each type of gypsum board and related joint treatment materials from a single manufacturer.

1.05 SUBMITTALS

A. Product Data:

1. Submit product data indicating compliance with all specified requirements.

B. Record Documents:

1. Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections.

2. Design Data: Submit copies of each UL design selected for each required fire resistance rating for gypsum drywall assemblies including installer certification that each UL design selected will provide the scheduled fire resistance rating in accordance with local Codes.

3. Submit certification and test results that clearly state and indicate that each individual element and component of fire rated gypsum drywall assemblies are approved and appropriately rated for specific rated assembly for which it is to be used, and that the use of such individual element will in no way jeopardize the required rating of the assembly.

4. Submit Shop Drawings including complete details indicating location of all control and expansion joints in walls and ceilings.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver materials in original packages, containers or bundles bearing brand name and identification of manufacturer or supplier.

B. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic and other causes. Neatly stack gypsum boards flat to prevent sagging.

C. Handle gypsum boards to prevent damage to edges, ends, and surfaces. Do not bend or otherwise damage metal corner beads and trim.

1.07 PROJECT CONDITIONS

A. Environmental Conditions, General: Establish and maintain environmental conditions for application and finishing gypsum board to comply with ASTM C 840 and with gypsum board manufacturer's recommendations.

B. Minimum Room Temperatures: For nonadhesive attachment of gypsum board to framing, maintain not less than 40 degrees F (4 degrees C). For adhesive attachment and finishing of gypsum board maintain not less than 50 degrees F (10 degrees C) for 48 hours prior to application and continuously thereafter until drying is complete.

C. Ventilate building spaces to remove water not required for drying joint treatment materials. Avoid drafts during dry, hot weather to prevent materials form drying too rapidly.

1.08 ASSEMBLY PERFORMANCE REQUIREMENTS

A. Sound Transmission Characteristics: For gypsum board assemblies indicated to have STC ratings, provide materials and construction identical to those of assemblies whose STC ratings were determined per ASTM E 90 and classified per ASTM E 413 by a qualified independent testing agency.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.02 MANUFACTURERS

A. Subject to compliance with requirements, manufacturers offering products which may be incorporated in the Work include the following:

1. Gypsum Boards and Related Products:

a. Domtar Gypsum Co.

b. Georgia Pacific Corp.

c. Gold Bond Building Products Div., National Gypsum Co.

d. Temple-Inland

e. United States Gypsum Co.

2.03 STEEL FRAMING COMPONENTS FOR SUSPENDED AND FURRED CEILINGS

A. General: Provide components which comply with ASTM C 754 for materials and sizes, unless otherwise indicated.

B. Concrete Inserts: Inserts designed for attachment to concrete forms and for embedment in concrete, fabricated from corrosion resistant materials, with holes or loops for attachment of hanger wires and capability to sustain, without failure, a load equal to 5 times that imposed by ceiling construction, as determined from testing per ASTM E 488, conducted by an independent testing laboratory.

C. Wire for Hangers and Ties: ASTM A 641, Class 1 zinc coating, soft temper.

D. Hanger Rods: Mild steel, zinc coated or protected with rust inhibitive paint.

E. Flat Hangers: Mild steel, zinc coated or protected with rust inhibitive paint.

F. Angle Type Hangers: Angles with legs not less than 7/8 inch wide, formed from 0.0635 inch thick galvanized steel sheet complying with ASTM A 446, Coating Designation G90, with bolted connections and 5/16 inch diameter bolts.

G. Channels: Cold rolled steel, 0.0598 inch minimum thickness of base (uncoated) metal and 7/16 inch wide flanges, protected with rust inhibitive paint, and as follows:

1. Carrying Channels: 2 inches deep, 590 lbs per 1000 feet, unless otherwise indicated.

2. Carrying Channels: 1-1/2 inch deep, 475 lbs per 1000 feet, unless otherwise indicated.

3. Furring Channels: 3/4 inch deep, 300 lbs per 1000 feet, unless otherwise indicated.

2.04 GYPSUM BOARD

A. Provide gypsum board of types indicated in maximum lengths available to minimize end to end joints.

1. Provide gypsum board in thicknesses indicated, or if not otherwise indicated, in 5/8 inch thicknesses to comply with ASTM C 840 for application system and support spacing indicated.

B. Gypsum Wallboard: ASTM C 36, "Regular" for vertical surfaces, "Sag-Resistant for ceilings, and as follows:

1. Type: Type X where required for fire-resistant rated assemblies.

2. Edges: Tapered.

3. Thickness: 5/8 inch, unless otherwise indicated.

4. Subject to compliance with requirements, products which may be incorporated in the Work where "Type X" gypsum wallboard is indicated include:

a. "Gyprock Fireguard 'C' Gypsum Board"; Domtar Gypsum Co.

b. "Firestop Type C"; Georgia Pacific Corp.

c. "Fire Shield G"; Gold Bond Building Products Div., National Gypsum Co.

d. "SHEETROCK Brand FIRECODE 'C' Gypsum Panels"; United States Gypsum Co.

C. Gypsum Backing Board for Multi Layer Applications: ASTM C 442 or, where backing board is not available from manufacturer, gypsum wallboard, ASTM C 36, and as follows:

1. Type: Type X for fire resistance rated assemblies.

2. Edges: Manufacturer's standard.

D. Water Resistant Gypsum Backing Board: ASTM C 1396 / C 1396M, and as follows:

1. Type: Type X for fire resistance rated assemblies.

2. Thickness: 5/8 inch, unless otherwise indicated.

E. Exterior Gypsum Soffit Board: ASTM C 931, with manufacturer's standard edges, of type and thickness indicated below:

1. Type: Type X for fire resistance rated assemblies.

2. Thickness: 5/8 inch, unless otherwise indicated.

2.05 SHAFT-WALL SYSTEM DESCRIPTION

A. Performance Requirements, General: Provide gypsum board shaft wall systems complying with performance requirements specified, as demonstrated by pretesting manufacturer's corresponding stock systems.

B. Fire Resistance Ratings: Where indicated, provide materials and construction which are identical to those of assemblies, including those incorporating elevator door and other framing, whose fire resistance has been determined per ASTM E 119 by a testing and inspecting organization acceptable to authorities having jurisdiction.

1. Provide fire resistance rated assemblies identical to those indicated by reference to GA File No.'s in GA 600 "Fire Resistance Design Manual" or to design designations in UL "Fire Resistance Directory" or in listings of other testing and inspecting agencies acceptable to authorities having jurisdiction.

C. Steel Framing: ASTM C 645, of profile, size, and base metal thickness required to produce assemblies complying with structural performance requirements, with sectional properties computed to conform with AISI "Specification for Design of Cold Formed Steel Structural Members."

D. Gypsum Shaftwall Board: ASTM C 442, Type X liner panel or coreboard designed for shaft wall construction, with moisture resistant paper facings.

E. Structural Performance Characteristics: Provide gypsum board shaft wall systems engineered to withstand the following lateral design loadings (air pressures), applied transiently and cyclically, for maximum heights of partitions required, within the following deflection limits, verified by pretesting for deflection characteristics:

1. Lateral Loading: As indicated but not less than 10 per square foot

2. Deflection Limit: As indicated but not more than 1/240 of partition height

F. Sound Attenuation Performance: Provide gypsum board shaft wall systems designed and pretested to achieve the following minimum ratings for sound transmission class (STC) per ASTM E 90.

1. STC Rating: 47

G. Cavity Shaft Wall Systems: Provide assemblies consisting of gypsum shaft wall boards inserted between U or J shaped metal floor and ceiling tracks; with specially shaped studs engaged in tracks and fitted between shaftwall boards; and gypsum boards on finished side or sides applied to studs in number of layers, thicknesses and arrangement indicated.

1. Shaftwall Board Thickness: As indicated.

2. Stud Shape: I, C H or double E

3. Stud Thickness: 0.0179 inch min. thickness of base metal unless otherwise indicated or required.

4. Stud Depth: As indicated.

5. Room Side Finish: As indicated.

6. Shaft Side Finish: One layer of gypsum board; provide only where finish is indicated on shaft side as well as room side, otherwise leave exposed.

7. Cavity Insulation: Provide sound attenuation blankets in cavity formed by studs between shaftwall board and room side finish.

2.06 GLASS MESH MORTAR UNITS

A. Proprietary backing units with glass mesh fiber mesh reinforcing and water resistant coating on both faces, complying with the following requirements:

1. Coated Gypsum Panels: Gypsum core with glass fiber mesh surface mats and manufacturer's proprietary water and vapor retarding coating on both faces, fabricated in panels 1/2 inch thick by 48 inches wide by 96 inches long, and weighing 2.0 lbs per sq. ft.

2. Cement Coated Portland Cement Panels: High density portland cement surface coating on both faces and lightweight concrete core composed of portland cement and expanded ceramic aggregate; fabricated in panels 7/16 inch thick by 36 inches wide by 36, 48, or 60, 64, or 72 inches long; and weighing 3.2 3.8 lbs per sq. ft.

3. Vinyl Coated Portland Cement Panels: Core formed in a continuous process from aggregated portland cement slurry and reinforced with vinyl coated woven glass fiber mesh embedded in both surfaces, with one face smooth and other textured; fabricated in panels 1/2 inch thick and by 36 inches wide by 48, 60, and 72 inches long; and weighing 3 lbs per sq. ft.

B. Products: Subject to compliance with requirements, provide one of the following products:

1. "DomCrete"; Domtar Gypsum

2. "Durock"; USG Industries, Inc.

3. "Util-A-Crete"; FinPan Inc.

4. "Dens-Shield"; G-P Gypsum Corp.

5. "Util-A-Crete"; W. R. Bonsal Corp.

2.07 TRIM ACCESSORIES

A. Cornerbead and Edge Trim for Interior Installation: Provide corner beads, edge trim and control joints which comply with ASTM C 1047 and requirements indicated below:

1. Material: Formed metal, plastic or metal combined with paper, with metal complying with the following requirement:

a. Sheet steel zinc coated by hot dip process.

b. Sheet steel coated with zinc by hot dip or electrolytic processes, or with aluminum.

2. One Piece Control Joint: Formed with vee shaped slot per Fig. 1 in ASTM C 1047, with slot opening covered with removable strip.

B. Aluminum Edge Trim: Where indicated, provide manufacturer's standard extruded aluminum edge trim of profile shown or referenced by manufacturer's standard product designation, fabricated from aluminum alloy 6063 T5 complying with ASTM B 221, with clear anodized finish.

1. Manufacturer: Subject to compliance with requirements, provide aluminum accessories of one of the following:

a. Fry Reglet Corp.

b. Gordon, Inc.

c. MM Systems, Inc.

C. Metal Cornerbead and Edge Trim for Exterior Ceilings: Comply with ASTM C 1047, formed from rolled zinc.

2.08 GYPSUM BOARD JOINT TREATMENT MATERIALS

A. Provide materials complying with ASTM C 475, ASTM C 840, and recommendations of manufacturer of both gypsum board and joint treatment materials for the application indicated.

2.09 MISCELLANEOUS MATERIALS

A. Provide auxiliary materials for gypsum drywall construction which comply with referenced standards and the recommendations of the manufacturer of the gypsum board.

B. Laminating Adhesive: Special adhesive or joint compound recommended for laminating gypsum boards.

C. Spot Grout: ASTM C 475, setting type joint compound of type recommended for spot grouting hollow metal door frames.

D. Fastening Adhesive for Wood: ASTM C 557

E. Fastening Adhesive for Metal: Special adhesive recommended for laminating gypsum boards to steel framing.

F. Gypsum Board Screws: ASTM C 1002

G. Gypsum Board Nails: ASTM C 514

H. Asphalt Felt: ASTM D 226, Type I (No. 15)

I. Concealed Acoustical Sealant: Nondrying, nonhardening, nonskinning, nonstaining, nonbleeding, gunnable sealant complying with requirement specified in Division 07 section "Joint Sealers."

J. Sound Attenuation Blankets: Unfaced mineral fiber blanket insulation produced by combining mineral fibers of type described below with thermosetting resins to comply with ASTM C 665 for Type I (blankets without membrane facing); and as follows:

1. Mineral Fiber Type: Fibers manufactured from glass or slag.

a. Owens Corning Fiberglas "Firecore 60 Sound Attenuation Batts"

b. U. S. Gypsum Co. "Thermafiber Sound Attenuation Fire Blankets".

2. Provide blankets in thicknesses shown or, if not shown, in manufacturer's standard nominal thickness corresponding to the wall stud width.

K. Sound Pads: Flat sheets of heavy, mastic, flexible, non-hardening material such as "Sound Pad #68" manufactured by L. H. Dottie Compnay.

PART 3 - EXECUTION

3.01 PREPARATION

A. Examine substrates to which drywall construction attaches or abuts, preset hollow metal frames, cast in anchors, and structural framing, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of drywall construction. Do not proceed with installation until unsatisfactory conditions have been corrected.

B. Ceiling Anchorages: Coordinate installation of ceiling suspension system with installation of overhead structural systems to ensure that inserts and other structural anchorage provisions have been installed to receive ceiling anchors in a manner that will develop their full strength and at spacing required to support ceiling.

1. Furnish concrete inserts and other devices indicated, to other trades for installation well in advance of time needed for coordination with other construction.

C. Before sprayed on fireproofing is applied, attach offset anchor plates or ceiling runners (tracks) to surfaces indicated to receive sprayed on fireproofing. Where offset anchor plates are required provide continuous units fastened to building structure not more than 24 inches on center and to ceiling runners.

D. After sprayed on fireproofing has been applied, remove only as much fireproofing as needed to complete installation of drywall construction. Protect fireproofing that remains from damage.

3.02 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. All installation shall be in accordance with manufacturer's published recommendations.

3.03 INSTALLATION OF STEEL FRAMING FOR SUSPENDED CEILINGS

A. Install suspended steel framing components in sizes and at spacings indicated but not less than that required by referenced steel framing installation standard.

B. Suspend ceiling hangers from building structural members and as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or ceiling suspension system. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.

2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with the location of hangers required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.

3. Secure wire hangers by looping and wire tying, either directly to structures or to inserts, eyescrews, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause them to deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.

4. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eyescrews, or other devices and fasteners that are secure and appropriate for structure as well as for type of hanger involved, and in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.

5. Do not support ceilings directly from permanent metal forms. Furnish cast in place hanger inserts that extend through forms.

6. Do not attach hangers to steel deck tabs.

7. Do not attach hangers to steel roof deck. Attach hangers to structural members.

8. Do not connect or suspend steel framing from ducts, pipes or conduit.

C. Sway brace suspended steel framing with hangers used for support.

D. Installation Tolerances: Install steel framing components for suspended ceilings so that cross furring members or grid suspension members are level to within 1/8 inch in 12 feet as measured both lengthwise on each member and transversely between parallel members.

E. Wire tie or clip furring members to main runners and to other structural supports as indicated.

3.04 APPLICATION AND FINISHING OF GYPSUM BOARD, GENERAL

A. Gypsum Board Application and Finishing Standard: Install and finish gypsum board to comply with ASTM C 840 and GA 216.

B. Install sound attenuation blankets where indicated, prior to gypsum board unless readily installed after board has been installed.

1. Install sound pad sheets on the back of any device or accessory that is mounted in a drywall partition shown on Drawings to have an STC rating. Devices and accessories include: electrical receptacles, electrical outlet boxes, toilet accessories, and medical gas outlets.

C. Locate exposed end butt joints as far from center of walls and ceilings as possible, and stagger not less than 24 inches in alternate courses of board.

D. Install ceiling boards across framing in the manner which minimizes the number of end butt joints, and which avoids end joints in the central area of each ceiling. Stagger end joints at least 24 inches.

E. Install wall/partition boards in manner which minimizes the number of end butt joints or avoids them entirely where possible. At stairwells and similar high walls, install boards horizontally with end joints staggered over studs.

F. Install exposed gypsum board with face side out. Do not install imperfect, damaged or damp boards. Butt boards together for a light contact at edges and ends with not more than 1/16 inch open space between boards. Do not force into place.

G. Locate either edge or end joints over supports, except in horizontal applications where intermediate supports or gypsum board back blocking is provided behind end joints. Position boards so that like edges abut, tapered edges against tapered edges and mill cut or field cut ends against mill cut or field cut ends. Do not place tapered edges against cut edges or ends. Stagger vertical joints over different studs on opposite sides of partitions.

H. Attach gypsum board to steel studs so that leading edge or end of each board is attached to open (unsupported) edge of stud flange first.

I. Attach gypsum board to supplementary framing and blocking provided for additional support at openings and cutouts.

J. Spot grout hollow metal door frames for solid core wood doors, hollow metal doors and doors over 32 inches wide. Apply spot grout at each jamb anchor clip just before inserting board into frame.

K. Form control joints and expansion joints at locations indicated, with space between edges of boards, prepared to receive trim accessories.

L. Cover both faces of steel stud partition framing with gypsum board in concealed spaces (above ceilings, etc.), except in chase walls which are braced internally.

1. Except where concealed application is indicated or required for sound, fire, air or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. area, and may be limited to not less than 75 percent of full coverage.

2. Fit gypsum board around ducts, pipes, and conduits.

3. Where partitions intersect open concrete coffers, cut gypsum board to fit profile of coffers and allow 1/4 to 1/2 inch wide joint for sealant.

M. Isolate perimeter of non load bearing drywall partitions at structural abutments. Provide 1/4 inch to 1/2 inch space and trim edge with "U" bead edge trim. Seal joints with acoustical sealant.

N. Where sound rated drywall construction is indicated, seal construction at perimeters, control and expansion joints, openings and penetrations (including all conduits, pipes, etc) with a continuous bead of acoustical sealant including a bead at both faces of partitions. Comply with ASTM C 919 and manufacturer's recommendations for location of edge trim, and close off sound flanking paths around or through construction, including sealing of partitions above acoustical ceilings.

1. For double layer partition systems, construction above acoustical ceilings may be installed with base layer only.

O. At all non-rated smoke partitions and barriers, seal penetrations (including all conduits, pipes, etc) and holes. This is typical in Health Care corridor situations where the corridor must resist the passage of smoke.

P. For Rated smoke wall refer to Section 07 84 13 Penetration Firestopping.

Q. Space fasteners in gypsum boards in accordance with referenced gypsum board application and finishing standard and manufacturer's recommendations.

3.05 METHODS OF GYPSUM BOARD APPLICATION

A. Single Layer Application: Install gypsum wallboard as follows:

1. On ceilings apply gypsum board prior to wall/partition board application to the greatest extent possible.

2. On partitions/walls apply gypsum board vertically (parallel to framing), unless otherwise indicated, and provide sheet lengths which will minimize end joints.

3. On Z furring members apply gypsum board vertically (parallel to framing) with no end joints. Locate edge joints over furring members.

B. Wall Tile Base: Where drywall is base for thin set ceramic tile and similar rigid applied wall finishes, install gypsum backing board.

1. In "dry" areas install gypsum backing board or wallboard with tapered edges taped and finished to produce a flat surface.

C. At showers, tubs and similar "wet areas" install glass mesh mortar units and treat joints to comply with ANSI A108.11 and manufacturer's recommendations for type of application indicated.

D. Double Layer Application: Install gypsum backing board for base layer and gypsum wallboard for face layer.

1. On ceilings apply base layer prior to application of base layer on walls/partitions; apply face layers in same sequence. Offset joints between layers at least 10 inches. Apply base layers at right angles to supports unless otherwise indicated.

2. On partitions/walls apply base layer and face layers vertically (parallel to framing) with joints of base layer over supports and face layer joints offset at least 10 inches with base layer joints.

3. On Z furring members apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.

E. Acoustical Tile Base: Where drywall is base for adhesively applied acoustical tile, install gypsum backing board.

1. Provide either V joint type backing board or tape and finish joints to produce a flat surface.

F. Single Layer Fastening Methods: Apply gypsum boards to supports as follows:

1. Fasten with screws.

2. Fasten to wood supports with adhesive and supplementary nails or screws.

G. Double Layer Fastening Methods: Apply base layer of gypsum board and face layer to base layer as follows:

1. Fasten both base layers and face layers separately to supports with screws.

2. Fasten base layers to wood supports with nails and face layer with adhesive and supplementary fasteners.

H. Direct Bonding to Substrate: Where gypsum board is indicated to be directly adhered to a substrate (other than studs, joists, furring members or base layer of gypsum board), comply with gypsum board manufacturer's recommendations, and temporarily brace or fasten gypsum board until fastening adhesive has set.

3.06 INSTALLATION OF DRYWALL TRIM ACCESSORIES

A. General: Where feasible, use the same fasteners to anchor trim accessory flanges as required to fasten gypsum board to the supports. Otherwise, fasten flanges to comply with manufacturer's recommendations.

B. Install corner beads at external corners.

C. Install metal edge trim whenever edge of gypsum board would otherwise be exposed or semi exposed, and except where plastic trim is indicated. Provide type with face flange to receive joint compound except where "U" bead (semi finishing type) is indicated.

D. Install U bead where indicated, and where exterior gypsum board edges are not covered by applied moldings or indicated to receive edge trim with face flanges covered with joint compound.

E. Install control joints at locations indicated, or if not indicated, at spacings and locations required by referenced gypsum board application and finish standard, and approved by the Architect for visual effect.

1. Extend control joints for full height and width of gypsum board installation. Do not stop joints short of termination of gypsum board.

3.07 FINISHING OF DRYWALL

A. General: Apply joint treatment at gypsum board joints (both directions); flanges of corner bead, edge trim, and control joints; penetrations; fastener heads, surface defects and elsewhere as required to prepare Work for decoration.

B. Refer to Section 07 92 00 Joint Sealants for sealing of gypsum board installations in Vivarium Animal Holding and Procedure Rooms

C. Pre-fill open joints and rounded or beveled edges, if any, using setting type joint compound.

D. Apply joint tape at joints between gypsum boards, except where trim accessories are indicated.

E. Levels of Gypsum Board Finish: Provide the following levels of gypsum board finish per GA 214.

1. Level 1 for ceiling plenum areas, concealed areas, and where indicated, unless a higher level of finish is required for fire resistive rated assemblies and sound rated assemblies.

2. Level 2 where water resistant gypsum backing board panels form substrates for tile, and where indicated.

3. Level 3 for gypsum board surfaces indicated to receive medium or heavy textured finishes before painting.

4. Level 4 for gypsum board surfaces indicated to receive light textured finishes, wall coverings, and flat paints over light textures.

5. Level 5 for gypsum board surfaces indicated to receive gloss and semigloss enamels, non-textured flat paints, and where indicated.

F. Base for Acoustical Tile: Where gypsum board is indicated as a base for adhesively applied acoustical tile, install tape and 2 coat compound treatment, without sanding.

G. Water Resistant Gypsum Backing Board Base for Ceramic Tile: Comply with ASTM C 840 and manufacturer's recommendations for treatment of joints behind tile.

H. Water Resistant Backing Board Base for Ceramic Tile: Finish joints between water resistant backing board with tape and setting type joint compound to comply with gypsum board manufacturer's recommendations and installation standards referenced in Division 9 Section "Tile."

I. Partial Finishing: Omit third coat and sanding on concealed drywall construction which is indicated for drywall finishing or which requires finishing to achieve fire resistance rating, sound rating or to act as air or smoke barrier.

J. At all corridor partitions, smoke-stop partitions, horizontal exit enclosures, shafts and fire walls, permanently mark both sides of wall construction above ceilings to identify wall construction.

1. Label each wall with the words "(number) HOUR (FIRE) (SMOKE) Barrier - Do Not Penetrate".

2. Apply labeling to partition between 12 inches and 24 inches above ceiling line, located on surfaces that will not be concealed from view by subsequent construction.

3. Where a non-rated partition is constructed in front of a rated wall and extends more than12 inches above ceiling line, additional labeling shall be provided on the non-rated partion to identify the rated wall. [EXAMPLE: “2-Hour Fire Rated Barrier Behind This Partition - Do Not Penetrate.”].

4. Use stencils and paint letters at least 3 inches high in permanent red ink or sign paint.

5. For walls in excess of 20 feet long, label shall be repeated every 20 feet unless otherwise required by applicable code. For walls less than 20 feet in length, label each wall.

6. Use vertical bold black lines with arrows designating areas of individual walls that have different ratings.

3.08 INSTALLATION OF GYPSUM BOARD SHAFT WALL SYSTEMS

A. General: Install gypsum board shaft wall systems to comply with performance and other requirements indicated as well as with manufacturer's installation instructions and the following:

1. ASTM C 754 for installation of steel framing.

B. Do not bridge building expansion joints with shaft wall system, frame both sides of joints with furring and other support as indicated.

C. Install supplementary framing, blocking and bracing to support gravity and pullout loads of fixtures, equipment, services, heavy trim, furnishings and similar Work which cannot be adequately supported directly by regular framing of gypsum board shaft wall system.

1. Support elevator hoistway door frames independently of shaft wall framing system, or reinforce system in accordance with system manufacturer's instructions.

2. Where handrails are indicated for direct attachment to gypsum board shaft wall system, provide not less than a 0.0341 inch thick by 4 inch wide galvanized steel reinforcement strip, accurately positioned and secured behind not less than one gypsum board face layer of 1/2 inch or 5/8 inch thickness.

D. Coordinate gypsum board shaft wall construction with sprayed on fireproofing of the structure, so that both remain complete and undamaged. Patch or replace sprayed on fireproofing removed or damaged during the installation of the shaft wall system.

E. Integrate stair hanger rods with gypsum board shaft wall system where indicated (and where possible); by locating cavity of system as required to enclose rods.

F. At penetrations in shaft wall, maintain fire resistance rating of entire shaft wall assembly by installing supplementary fire protection behind boxes containing wiring devices, elevator call buttons, elevator floor indicators, and similar items.

G. Isolate shaft wall system from transfer of structural loading to system, both horizontally and vertically. Provide slip or cushioned type joints to attain lateral support and avoid axial loading. Comply with details shown and with manufacturer's instructions.

H. Seal gypsum board shaft walls at perimeter of each section which abuts other Work and at joints and penetrations within each section. Install acoustical sealant to withstand dislocation by air pressure differential between shaft and external spaces; comply with manufacturer's instructions and ASTM C 919.

I. In elevator shafts where gypsum board shaft wall system cannot be positioned within 2 inches of shaft face of structural beams, floor edges and similar projections into shaft, install 1/2 inch or 5/8 inch thick gypsum board cants covering tops of projections as follows:

1. Slope cant panels not more than 15 degrees from vertical. Set base edge of panels in gypsum board adhesive and secure top edges to shaft walls at 24 inches on center with screws fastened to shaft wall framing.

2. Where cants exceed 2 inches, support gypsum board with steel studs spaced 24 inches on center; extend studs from top of projection to shaft wall framing behind cant.

3.09 PROTECTION

A. Provide final protection and maintain conditions, in a manner suitable to Installer, which ensures gypsum drywall construction being without damage or deterioration at time of Substantial Completion.

END OF SECTION 09 29 00

SECTION 09 30 00 – TILE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with all applicable requirements and standards.

1.03 QUALITY ASSURANCE

A. Single Source Responsibility for Tile: Obtain each color, grade, finish, type, composition, and variety of tile from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work.

B. Single Source Responsibility for Setting and Grouting Materials: Obtain ingredients of a uniform quality from one manufacturer for each cementitious and admixture component and from one source or producer for each aggregate.

C. Installer Qualifications: Engage an experienced Installer who has successfully completed tile installations similar in material, design, and extent to that indicated for Project.

1.04 SUBMITTALS

1. Submit samples for verification purposes of each type, class, and color/ pattern of tile required, not less than 18 inches square on plywood or hardboard backing, and grouted as required. Architect's review will be for color, pattern and texture only. Compliance with all other requirements is the exclusive responsibility of the Contractor.

   a. Prepare and submit new samples, if requested, until appearance is acceptable to the Architect.

B. Product Data:

1. Submit manufacturer's product data and installation/maintenance instructions for all manufactured products and materials.

C. Shop Drawings:

1. Submit plans of all areas to receive tile Work showing location of expansion and control joints, layout of tile units, and other conditions affecting the Work.

   a. Include details showing setting methods, expansion joint constructions, and relationships to adjacent substrates.

   b. Locate precisely each joint and crack in tile substrates by measuring, record measurements on shop Drawings, and coordinate them with tile joint locations, in consultation with Architect.

   c. Provide manufacturer's Master Grade Certificate bearing TCA Certification mark and stating type, grade and location of material for all tile specified to be "Standard Grade".

D. Record Documents:

1. Provide record approved shop drawings, samples, and warranties.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirement of ANSI A137.1 for labeling sealed tile packages.

B. Prevent damage or contamination to materials by water, freezing, foreign matter, and other causes.

1.06 PROJECT CONDITIONS

A. Maintain environmental conditions and protect Work during and after installation to comply with referenced standards and manufacturer's printed recommendations.

B. Vent temporary heaters to exterior to prevent damage to tile Work from carbon dioxide buildup.

C. Maintain temperatures at 50 degrees F (10 degrees C) or more in tiled areas during installation and for seven (7) days after completion, unless higher temperatures are required by referenced installation standard or manufacturer's instructions.

1.07 EXTRA MATERIALS

A. Deliver extra materials to Owner. Furnish extra materials that match products installed as described below, packaged with protective covering for storage and identified with labels clearly describing contents.

1. Tile and Trim Units: Furnish quantity of full size units equal to 3 percent of amount installed, for each type, composition, color, pattern, and size.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.02 MANUFACTURERS

A. The notes and schedules on the Drawings establish manufacturer and model/design of tile products required for the Project. Provide the products listed unless Architect approves products of other manufacturer specifically for this Project.

2.03 PRODUCTS, GENERAL

A. ANSI Standard for Ceramic Tile: Comply with ANSI A137.1 "American National Standard Specifications for Ceramic Tile" for types, compositions, and grades of tile indicated.

1. Furnish tile complying with "Standard Grade" requirements unless otherwise indicated.

B. ANSI Standard for Tile Installation Materials: Comply with ANSI standard referenced with products and materials indicated for setting and grouting.

C. Colors, Textures, and Patterns: Where manufacturer's standard products are indicated for tile, grout, and other products requiring selection of colors, surface textures, patterns, and other appearance characteristics, provide specific products or materials complying with the following requirements:

1. Match color, texture, and pattern indicated by reference to manufacturer's standard designations for these characteristics.

2. Provide selections made by Architect from manufacturer's full range of standard colors, textures, and patterns for products of type indicated.

3. Provide tile trim and accessories that match color and finish of adjoining flat tile.

4. Where tile is indicated for installation in wet areas, do not use back or edge mounted tile assemblies unless tile manufacturer specifies that this type of mounting is suitable for these kinds of uses and has been successfully used on other projects.

D. Factory Blending: For tile exhibiting color variations within the ranges selected during sample submittals, blend tile in factory and package accordingly so that tile units taken from one package show the same range in colors as those taken from other packages and match approved samples.

1. Trim and Special Shapes: Rounded external corners, and trim shapes at head, jamb, and sills of opening, of same material and finish as tile, and as follows:

a. Base: At tiled walls, integral cove base; at vinyl fabric covered walls, integral cove, field tile and surface bullnose to form a base of height indicated.

b. External Corners: Surface bullnose shapes.

c. Internal Corners: Field butted square, except use square corner-combination angle and stretcher type cap.

E. For glazed wall tile, provide "Standard Grade" units, complying with ANSI A137.1. Provide units, trim and special shapes as indicated and required.

F. Accessories for Glazed Wall Tile: Provide vitreous china accessories of type and size indicated and in color and finish to match adjoining glazed wall tile.

2.04 ADHESIVE SETTING MATERIALS

A. For wall tile adhesive, provide factory mixed organic adhesive complying with ANSI A 136.1, Type I, with manufacturer's certification of conformance.

1. American Olean "AO 1700 Adhesive".

2. Laticrete "No. 15 Multi-Mastic".

3. Mapei "Ultra/Mastic 1".

4. C Cure Chemical Co. "Permabond 1002".

2.05 JOINT GROUT

A. For mosaic tile and glazed tile grout, provide manufactured joint grout conforming to ANSI A 118.6.

1. American Olean "Wall and Floor Grout".

2. Laticrete "Floor Grout" or "Wall Grout".

3. Mapei "Keracolor".

4. C Cure "MP Grout".

2.06 MIXING MORTARS AND GROUT

A. Mix mortars and grouts to comply with requirements of referenced standards and manufacturers including those for accurate proportioning of materials, water, or additive content; type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other procedures needed to produce mortars and grouts of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.01 PREPARATION

A. Examine substrates and areas where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.

1. Verify that substrates for setting tile are firm, dry, clean, and free from oil or waxy films and curing compounds.

2. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of Work, and similar items located in or behind tile has been completed before installing tile.

B. Do not proceed with installation until unsatisfactory conditions have been corrected.

C. Blending: For tile exhibiting color variations within the ranges selected during sample submittals, verify that tile has been blended in factory and packaged accordingly so that tile units taken from one package show the same range in colors as those taken from other packages and match approved samples. If not factory blended, either return to manufacturer or blend tiles at the Project Site before installing.

3.02 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. All installation shall be in accordance with manufacturer's published recommendations.

C. ANSI Tile Installation Standard: Comply with parts of ANSI 108 series of tile installation standards included under "American National Standard Specifications for the Installation of Ceramic Tile" that apply to type of setting and grouting materials and methods indicated.

1. Dry Set or latex cement set wall and floor tile: ANSI A 108.5.

2. Organic adhesive set wall and floor tile: ANSI A 108.4.

D. TCA Installation Guidelines: TCA "Handbook for Ceramic Tile Installation"; comply with TCA installation methods indicated.

E. Extend tile Work into recesses and under or behind equipment and fixtures to form a complete covering without interruptions except as otherwise shown. Terminate Work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

F. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so that plates, collars, or covers overlap tile.

G. Carefully lay out tile in an endeavor to center the tiles to space them evenly, and to avoid cutting them. If cutting is necessary, cutting shall be done by saw cut or drilling only, no tile cutters or snipped edges allowed; all cut ends shall be rubbed smooth and even. Unless otherwise shown, lay out tile so that no tile less than 1/2 size occurs. For height stated in feet and inches, maintain full courses to produce nearest attainable heights without cutting tile. Align joints in wall tile vertically and horizontally. No staggering of joints will be permitted. All cutting and drilling shall be done without marring surfaces and shall be done neatly to fit closely around pipes, fixtures, and fittings so that cover plates will overlap cuts.

H. Unless otherwise shown, lay tile in grid pattern. Align joints when adjoining tiles on floor, base, walls, and trim are same size. Lay out tile Work and center tile fields in both directions in each space or on each wall area. Adjust to minimize tile cutting. Provide uniform joint widths unless otherwise shown.

1. Confirm locations of joints in substrate will align with planned expansion joints in tile Work. Adjust layout of tile if necessary to align expansion joints with substrate conditions.

I. Lay out tile wainscots to next full tile beyond dimensions indicated.

J. Grout tile to comply with the requirements of the following installation standards:

1. For ceramic tile grouts (sand portland cement, dry set, commercial portland cement, and latex portland cement grouts), comply with ANSI A108.10.

3.03 WALL TILE INSTALLATION METHODS

A. Install types of tile designated for wall application to comply with requirements indicated below for setting bed methods, TCA installation methods related to subsurface wall conditions, and grout types:

B. Over gypsum board, use organic adhesive in accordance with TCA Method W242.

C. Over glass mesh mortar units, at typical locations, use latex portland cement mortar in accordance with TCA Method W244.

1. At Showers; TCA B415.

3.04 GROUT

A. Wall Joints (less than 1/8 inches wide): Unsanded Grout.

B. Floor and Wall Joints (1/8 inch to 5/8 inch wide): Sanded Grout.

3.05 CLEANING AND PROTECTION

A. Upon completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.

1. Remove latex portland cement grout residue from tile as soon as possible.

2. Unglazed tile may be cleaned with acid solutions only when permitted by tile and grout manufacturer's printed instructions, but no sooner than fourteen (14) calendar days after installation. Protect metal surfaces, cast iron, and vitreous plumbing fixtures from effects of acid cleaning. Flush surface with clean water before and after cleaning.

B. Leave finished installation clean and free of cracked, chipped, broken, unbonded, and otherwise defective tile Work.

C. Provide final protection and maintain conditions in a manner acceptable to manufacturer and installer that ensures tile is without damage or deterioration at time of Substantial Completion.

1. When recommended by tile manufacturer, apply a protective coat of neutral protective cleaner to completed tile walls and floors. Protect installed tile Work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear.

2. Prohibit foot and wheel traffic from tiled floors for at least seven (7) calendar days after grouting is completed.

D. Before final inspection, remove protective coverings and rinse neutral cleaner from tile surfaces.

END OF SECTION 09 30 00

SECTION 09 51 00 – ACOUSTICAL CEILINGS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with all applicable requirements and standards.

1.03 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced Installer who has successfully completed acoustical ceilings similar in material, design, and extent to those indicated for Project.

B. Fire Performance Characteristics: Provide acoustical ceilings that are identical to those tested for the following fire performance characteristics, per ASTM test method indicated below, by UL or other testing and inspecting organizations acceptable to authorities having jurisdiction. Identify acoustical ceiling components with appropriate markings of applicable testing and inspecting organization.

1. Surface Burning Characteristics: As follows, tested per ASTM E 84 and complying with ASTM E 1264 for Class A products.

a. Flame Spread: 25 or less.

b. Smoke Developed: 50 or less.

2. Fire Resistance Ratings: As indicated by reference to design designations in UL "Fire Resistance Directory," for types of assemblies in which acoustical ceilings function as a fire protective membrane and tested per ASTM E 119.

a. Protect lighting fixtures and air ducts to comply with requirements indicated for rated assembly.

C. Single Source Responsibility for Ceiling Units: Obtain each type of acoustical ceiling unit from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work.

D. Single Source Responsibility for Suspension System: Obtain each type of suspension system from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work.

E. Coordination of Work: Coordinate layout and installation of acoustical ceiling units and suspension system components with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire suppression system components (if any), and partition system (if any).

F. Preinstallation Conference: Conduct conference at Project Site.

1.04 SUBMITTALS

A. Coordination Drawings:

1. Reflected ceiling plans drawn accurately to scale and coordinating penetrations and ceiling mounted items. Show the following:

a. Ceiling suspension members.

b. Method of attaching hangers to building structure.

c. Ceiling mounted items including light fixtures; air outlets and inlets; speakers; sprinkler heads; and special moldings at walls, column penetrations, and other junctures with adjoining construction.

B. Samples:

1. Samples for initial selection purposes in form of manufacturer's color charts consisting of actual acoustical units or sections of units showing full range of colors, textures, and patterns available for each type of unit indicated.

2. Samples for verification purposes of each type of exposed finish required, prepared on samples of size indicated below and of same thickness and material indicated for final unit of Work. Where finishes involve normal color and texture variations, include sample sets showing full range of variations expected.

a. 6 inch square samples of each unit pattern and color required.

b. Set of 12 inch long samples of exposed suspension system members, including moldings, for each color and system type required.

C. Product Data:

1. Submit manufacturer's product data and installation/maintenance instructions for all manufactured products and materials.

D. Record Documents:

1. Provide record approved samples, product data, and coordination drawings.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver acoustical ceiling units to Project Site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical ceiling units, permit them to reach room temperature and stabilized moisture content.

C. Handle acoustical ceiling units carefully to avoid chipping edges or damaging units in any way.

1.06 EXTRA MATERIALS

A. Deliver extra materials to Owner. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with appropriate labels.

1. Acoustical Ceiling Units: Furnish quantity of full size units equal to 2.0 percent of amount installed.

2. Suspension System Components: Furnish quantity of each component equal to 2.0 percent of amount installed.

1.07 PROJECT CONDITIONS

A. Space Enclosure: Do not install interior acoustical ceilings until space is enclosed and weatherproof, wet Work in space is completed and nominally dry, Work above ceilings is complete, and ambient conditions of temperature and humidity will be continuously maintained at values near those indicated for final occupancy.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.02 METAL SUSPENSION SYSTEMS, GENERAL

A. Standard for Metal Suspension Systems: Provide manufacturer's standard metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable ASTM C 635 requirements.

B. Finishes and Colors: Provide manufacturer's standard factory applied finish for type of system indicated.

1. High Humidity Finish: Comply with ASTM C 635 requirements for "Coating Classification for Severe Environment Performance" where high humidity finishes are indicated.

C. Attachment Devices: Size for 5 times design load indicated in ASTM C 635, Table 1, Direct Hung unless otherwise indicated.

1. Cast In Place and Postinstalled Anchors in Concrete: Anchors of type indicated below, fabricated from corrosion resistant materials, with holes or loops for attachment of hangers of type indicated and with capability to sustain, without failure, a load equal to 5 times that imposed by ceiling construction, as determined by testing per ASTM E 488, conducted by a qualified independent testing laboratory.

    a. Cast in place anchors.

    b. Chemical anchors.

    c. Expansion anchors.

    d. Undercut anchors.

2. Powder Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion resistant materials, with clips or other accessory devices for attachment of hangers of type indicated, and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing per ASTM E 1190, conducted by a qualified testing laboratory.

D. Wire for Hangers and Ties: ASTM A 641, Class 1 zinc coating, soft temper.

1. Gage: Provide wire sized so that stress at 3 times hanger design load (ASTM C 635, Table 1, Direct Hung), will be less than yield stress of wire, but provide not less than 0.106 inch diameter (12 gage).

E. Hanger Rods: Mild steel, zinc coated, or protected with rust inhibitive paint.

F. Flat Hangers: Mild steel, zinc coated, or protected with rust inhibitive paint.

G. Angle Hangers: Angles with legs not less than 7/8 inch wide, formed with 0.0365 inch thick galvanized steel sheet complying with ASTM A 446, Coating Designation G90, with bolted connections and 5/16 inch diameter bolts.

H. Edge Moldings and Trim: Metal or extruded aluminum of types and profiles indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that fit type of edge detail and suspension system indicated. Provide trim with hemmed edges.

1. For lay in panels with reveal edge details, provide stepped edge molding that forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member.

2. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.

3. For narrow faced suspension systems, provide suspension system manufacturer's standard edge moldings that match width and configuration of exposed runners.

I. Hold Down Clips for Non Fire Resistance Rated Ceilings: For interior ceilings composed of lay in panels weighing less than 1 lb per sq. ft., provide hold down clips spaced 2' 0" on center on all cross tees.

J. Impact Clips: Where indicated, provide manufacturer's standard impact clip system designed to absorb impact forces against lay in panels.

K. Clean-Room Gasket System: Where indicated, provide manufacturer's standard system, including gasket and related adhesives, tapes, seals, and retention clips, designed to seal out foreign material from and maintain positive pressure in clean room.

2.03 EXPOSED GRID SYSTEM

A. Provide double web main and cross runners with 15/16 inch wide face, 1-1/2 inch deep nominally, with painted aluminum cap.

B. Provide "intermediate duty" structural classification per ASTM C 635.

C. Exposed Grid Suspension System for Ceiling Types ACT-1:

1. Armstrong "Prelude XL" hot dipped galvanized steel with baked polyester paint on aluminum capping.

a. Size: 15/16 inch

b. Color: White

2.04 ACOUSTIC UNIT MATERIALS

A. Provide units of configuration indicated which are prepared for mounting method designated and which comply with ASTM E 1264 requirements, including those indicated by reference to type, form, pattern, grade (NRC as applicable), light reflectance coefficient (LR), edge detail, and joint detail (if any).

B. Acoustic units are specified below by manufacturer and design to establish standards of appearance and performance. Equivalent products of other manufacturers may be incorporated into the Work if accepted by the Architect.

C. Provide the following lay-in acoustic panels where indicated. No substitutions will be considered.

1. Ceiling Panels Type ACT-1: Armstrong/ Cortega #770/ White/ Prelude Grid. 24 x 24 x 0.625 inches with square edges on all 4 sides.

PART 3 - EXECUTION

3.01 PREPARATION

A. Examine substrates and structural framing to which ceiling system attaches or abuts, with Installer present, for compliance with requirements specified in this and other sections that affect installation and anchorage of ceiling system. Do not proceed with installation until unsatisfactory conditions have been corrected.

B. Coordination: Furnish layouts for preset inserts, clips, and other ceiling anchors whose installation is specified in other sections.

1. Furnish concrete inserts and similar devices to other trades for installation well in advance of time needed for coordination of other Work.

C. Measure each ceiling area and establish layout of acoustical units to balance border widths at opposite edges of each ceiling. Avoid use of less than half width units at borders, and comply with reflected ceiling plans.

3.02 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. All installation shall be in accordance with manufacturer’s published recommendations.

C. Install acoustical ceiling systems to comply with installation standard referenced below, per manufacturer's instructions and CISCA "Ceiling Systems Handbook."

1. Standard for Installation of Ceiling Suspension Systems: Comply with ASTM C 636.

2. CISCA's Recommendations for Acoustical Ceilings: Comply with CISCA's "Recommendations for Direct-Hung Acoustical Tile and Lay-in Panel Ceilings--Seismic Zones 0-2."

3. U.B.C.'s "Metal Suspension Systems for Acoustical Tile and for Lay-in Panel Ceilings": U.B.C. Standard 25-2.

D. Arrange acoustical units and orient directionally patterned units (if any) in manner shown by reflected ceiling plans.

1. Install units with pattern running in one direction.

E. Suspend ceiling hangers from building structural members and as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or ceiling suspension system. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.

2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with the location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.

3. Secure wire hangers by looping and wire tying, either directly to structures or to inserts, eyescrews, or other devices that are secure and appropriate for substrate, and in a manner that will not cause them to deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.

4. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eyescrews, or other devices that are secure and appropriate for structure to which hangers are attached as well as for type of hanger involved, and in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.

5. Do not support ceilings directly from permanent metal forms; furnish cast in place hanger inserts that extend through forms.

6. Do not attach hangers to steel deck tabs.

7. Do not attach hangers to steel roof deck. Attach hangers to structural members.

8. Space hangers not more than 4' 0" on center along each member supported directly from hangers, unless otherwise shown, and provide hangers not more than 8 inches from ends of each member.

F. Install edge moldings of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical units.

1. Sealant Bed: Apply continuous ribbon of acoustical sealant, concealed on back of vertical leg before installing moldings.

2. Screw attach moldings to substrate at intervals not over 16 inches on center and not more than 3 inches from ends, leveling with ceiling suspension system to tolerance of 1/8 inch in 12' 0". Miter corners accurately and connect securely.

3. Do not use exposed fasteners, including pop rivets, on moldings and trim.

G. Install suspension system runners so they are squared and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

H. Install acoustical panels with undamaged edges and fitted accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.

I. Install acoustical units in coordination with suspension system, with edges concealed by support of suspension members. Scribe and cut panels to fit accurately at borders and at penetrations.

1. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension system runners and moldings.

2. Install hold down clips in areas indicated and in areas where required by governing regulations or for fire resistance ratings; space as recommended by panel manufacturer, unless otherwise indicated or required.

3.03 CLEANING

A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 09 51 00

SECTION 09 67 23 - RESINOUS FLOORING

PART 1 - GENERAL

1.1 SUMMARY

B. Section Includes:
1. High-performance resinous flooring and base systems.

C. Related Sections:
1. Division 07 Section "Joint Sealants" for sealants installed at joints in resinous flooring systems.

1.2 ACTION SUBMITTALS

B. Product Data: For each type of product indicated. Include manufacturer's technical data, application instructions, and recommendations for each resinous flooring component required.

C. Samples for Initial Selection: For each type of exposed finish required.

D. Samples for Verification: For each resinous flooring system required, 6 inches (150 mm) square, applied to a rigid backing by Installer for this Project.

E. Product Schedule: For resinous flooring. Use same designations indicated on Drawings.

1.3 INFORMATIONAL SUBMITTALS

B. Installer Certificates: Signed by manufacturer certifying that installers comply with specified requirements.

C. Material Certificates: For each resinous flooring component, from manufacturer.

D. Material Test Reports: For each resinous flooring system.

1.4 CLOSEOUT SUBMITTALS

B. Maintenance Data: For resinous flooring to include in maintenance manuals.

1.5 QUALITY ASSURANCE

B. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of flooring systems required for this Project.
   1. Engage an installer who is certified in writing by resinous flooring manufacturer as qualified to apply resinous flooring systems indicated.

C. Source Limitations: Obtain primary resinous flooring materials, including primers, resins, hardening agents, grouting coats, and topcoats, from single source from single manufacturer. Provide secondary materials, including patching and fill material, joint sealant, and repair materials, of type and from source recommended by manufacturer of primary materials.

D. Mockups: Apply mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
   1. Apply full-thickness mockups on 48-inch- (1200-mm-) square floor area selected by Architect.
      a. Include 48-inch (1200-mm) length of integral cove base with inside and outside corner.
   2. Simulate finished lighting conditions for Architect's review of mockups.
   3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

E. Preinstallation Conference: Conduct conference at Project site.

1.6 WARRANTY

B. Furnish manufacturer's written warranty on seamless flooring for period of two years after installation, warranting against loss of bond and wear through to concrete substrate (through normal wear and use) exclusive of substrate moisture related problems. Warranty shall be single source from the manufacturer, including material and labor.

1.7 DELIVERY, STORAGE, AND HANDLING

B. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storage and mixing with other components.

1.8 PROJECT CONDITIONS

B. Environmental Limitations: Comply with resinous flooring manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting resinous flooring application.

C. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring application.

D. Close spaces to traffic during resinous flooring application and for not less than 24 hours after application unless manufacturer recommends a longer period.

1.9 JOB SITE CONDITIONS

A. Pre-Installation conference shall be required with General Contractor, Owners Representative, Flooring Contractor and/or Manufacturer's Representative to review the following:
   1. Evaluate slab conditions and extent of repairs necessary for Contractor to begin normal preparation and installation of seamless flooring.
   2. Evaluate detail conditions at all penetrations, terminations, perimeter and drain locations. Detail problems shall be documented and resolved prior to floor installation.
   3. Test concrete sub-floors using the Calcium Chloride test method to verify that slab moisture vapor transmission rate does not exceed manufacturer’s recommendations.
   4. The Flooring Contractor shall provide an add option cost as part of the bid for the treatment of substrate moisture vapor transmission in the event the substrate exceeds manufacturers recommendations. Any slab developing readings of 3 pounds of water per 24 hours per 1000 square feet or greater shall receive Integral Concrete Waterproofing which shall be compatible with flooring and approved by the Flooring Manufacturer. Waterproofing shall be installed by a contractor that is certified by the manufacturer of the waterproofing material. The waterproofing system must have a materials and labor warranty of at least 5 years against the loss of bond due to substrate moisture vapor transmission if initial readings are above 3 pounds.
   5. The moisture proofing product shall be certified as compatible with the flooring material manufacturer.

B. Review job site conditions, including temperature, power, and lighting. Such problems shall be documented and resolved prior to floor installation

1.10 VIVARIUM EXPERIENCE REQUIREMENTS

A. Flooring System Application Experience: Resinous flooring system manufacturer must submit and prove that specified flooring product has been installed and in use for a minimum of 3 years in an existing vivarium facility and has not been found

unsafe or hazardous to research or animals. Flooring Contractors must submit facility name, location and installation date with their bid.

B. Flooring Contractor Experience: Installer must have prior experience installing specified flooring system in an existing vivarium facility. Flooring Contractor must submit facility name and location with their bid.

C. During the bidding review, the Owner will verify the following requirements:
   1. The floor system meets the performance criteria and physical properties
   2. Flooring contractor's vivarium experience
   3. Existing installation of flooring system at vivarium facilities

PART 2 - PRODUCTS

2.1 MANUFACTURERS

B. Manufacturers: Provide products by the following manufacturer:
   1. Life Sciences Product Seamtek N2 Type 1 Fiberglass Reinforced resinous composite floor system.
   2. Key Resin
   3. Chemfloors

2.2 MATERIALS

B. VOC Content of Liquid-Applied Flooring Components: Zero (0 g/L) when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

C. The resins shall be third party verified as being no-VOC and no-HAP (Hazardous Air Pollutants and the system shall be LEED compliant.

2.3 HIGH-PERFORMANCE RESINOUS FLOORING, RF-1

B. Resinous Flooring: Abrasion-, impact- and chemical-resistant, high-performance-flake-filled, resin-based, monolithic floor surfacing designed to produce a seamless floor and integral cove base.

C. System Characteristics:
   1. Color and Pattern: As indicated.
   2. Wearing Surface: Textured for slip resistance and easily cleanable by mopping. .
   3. Overall System Thickness: nominal 110 mils thick.
   4. Federal Agency Approvals: USDA approved for food-processing environments.

D. Primer As Recommended by manufacturer:

1. Resin: Vinyl ester

E. Fiberglass:
1. 8124 resin and MEKP activator @ 2%;
2. put dry glass on floor
3. wet with 8124 to saturate (roughly 9 gallons per 1000 sf)
4. 14 mils

F. Body coat and flake:
1. 4101 resin
2. CU90 activator @2% @!
3. Roughly 18-20 mils
4. Broadcast flakes: roughly 5 sq per pound

G. Lockout coat:
1. with 8050 resin and MEKP activator @ 2%
2. (130 sq ft / gallon or 12.3mils)

H. Seal Coat (top coat)
1. 1033 resin and UV light (no activator necessary)
2. (300 sq ft/gallon on 5 mils)

I. Physical Properties

Tensile Strength	ASTM D-638	13,000 psi
Flexural Strength	ASTM D-790	25,000 psi
Compressive Strength	ASTM D-695	17,000 psi
Bond Strength	ASTM D-4541	425 psi (100% concrete failure)
Flammability	ASTM D-635	Self-Extinguishing
Indentation	MIL D-3134F	None
Impact Resistance	MIL D-D-2794	16 ft-lbs without cracking chipping or delaminating

J. System Chemical Resistance: Refer to Chemical Resistance chart at the end of this Section.

2.4 ACCESSORIES

B. Primer: Type recommended by manufacturer for substrate and body coats indicated.
1. Formulation Description: High solids.

C. Waterproofing Membrane: In all wet areas type recommended by manufacturer for substrate and primer and body coats indicated.
   1. Formulation Description: 100 percent solids.

D. Reinforcing Membrane: Resinous product of or approved by Resinous Flooring Manufacturer. Flexible resin formulation that is recommended by manufacturer for substrate and primer and body coats indicated and that prevents substrate cracks from reflecting through resinous flooring.
   1. Formulation Description: 100 percent solids.
      a. Provide fiberglass scrim embedded in reinforcing membrane.

E. Patching and Fill Material: Resinous product of or approved by resinous flooring manufacturer and recommended by manufacturer for application indicated.

F. Termination Cap: Provide J-Bead stainless steel termination cap at top of coved base where indicated. Seal joint at wall with clear silicone sealant as specified in Div 07 - Joint Sealants.

PART 3 - EXECUTION

3.1 PREPARATION

B. General: Prepare and clean substrates according to resinous flooring manufacturer's written instructions for substrate indicated. Provide clean, dry substrate for resinous flooring application.

C. Concrete Substrates: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with resinous flooring.
   1. Roughen concrete substrates as follows:
      a. Shot-blast surfaces with an apparatus that abrades the concrete surface to CSP-4, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
   2. Repair damaged and deteriorated concrete according to resinous flooring manufacturer's written instructions.
   3. Verify that concrete substrates are dry and moisture-vapor emissions are within acceptable levels according to manufacturer's written instructions.
      a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with application of resinous flooring only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) of slab area in 24 hours.
      b. Perform plastic sheet test, ASTM D 4263. Proceed with application only after testing indicates absence of moisture in substrates.
      c. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.

4. Alkalinity and Adhesion Testing: Verify that concrete substrates have pH within acceptable range. Perform tests recommended by manufacturer. Proceed with application only after substrates pass testing.

D. Resinous Materials: Mix components and prepare materials according to resinous flooring manufacturer's written instructions.

E. Use patching and fill material to fill holes and depressions in substrates according to manufacturer's written instructions.

F. Treat control joints and other nonmoving substrate cracks to prevent cracks from reflecting through resinous flooring according to manufacturer's written instructions.

3.2 CLEANING AND PROTECTION

B. Cleaning: Remove all debris resulting from the flooring installation during the progress of the work.

C. Protection: General contractor shall provide floor protection from other trades prior to final acceptance by owner.

3.3 APPLICATION

B. General: Apply components of resinous flooring system according to manufacturer's written instructions to produce a uniform, monolithic wearing surface of thickness indicated.
1. Coordinate application of components to provide optimum adhesion of resinous flooring system to substrate, and optimum intercoat adhesion.
2. Cure resinous flooring components according to manufacturer's written instructions. Prevent contamination during application and curing processes.
3. At substrate isolation joints, refer to Drawings.

C. Apply primer over prepared substrate at manufacturer's recommended spreading rate.

D. Apply fiberglass reinforcing membrane to the floor area in a tight butt joint method.

E. Integral Cove Base: Apply cove base mix to wall surfaces before applying flooring. Apply according to manufacturer's written instructions and details including those for taping, mixing, priming, troweling, sanding, and topcoating of cove base. Round internal and external corners.
1. Integral Cove Base: 5 inches high.
2. Termination Caps: Install coved base termination caps secured to wall with self-tapping, stainless steel screws through gypsum wall board into each stud.

F. Apply self-leveling slurry body coats in thickness indicated for flooring system.

1. Broadcast aggregate flakes at rate recommended by manufacturer and, after resin is cured, remove excess aggregate flakes to provide surface texture indicated.

G. Apply topcoats in number indicated for flooring system and at spreading rates recommended in writing by manufacturer.

H. Cure final topcoats with UV machine at manufacturer's recommended exposure rate. *Final seal coat shall be a one part UV cured product allowing for immediate use after application and exposure to UV light*

3.4 FIELD QUALITY CONTROL

B. Core Sampling: At the direction of Owner and at locations designated by Owner, take one core sample per 1000 sq. ft. (92.9 sq. m) of resinous flooring, or portion of, to verify thickness. For each sample that fails to comply with requirements, take two additional samples. Repair damage caused by coring and correct deficiencies.

C. Material Sampling: Owner may at any time and any number of times during resinous flooring application require material samples for testing for compliance with requirements.
1. Owner will engage an independent testing agency to take samples of materials being used. Material samples will be taken, identified, sealed, and certified in presence of Contractor.
2. Testing agency will test samples for compliance with requirements, using applicable referenced testing procedures or, if not referenced, using testing procedures listed in manufacturer's product data.
3. If test results show applied materials do not comply with specified requirements, pay for testing, remove noncomplying materials, prepare surfaces coated with unacceptable materials, and reapply flooring materials to comply with requirements.

3.5 PROTECTION

B. Protect resinous flooring from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by resinous flooring manufacturer.

3.6 CHEMICAL RESISTANCE

B. System Chemical Resistance: Test specimens of cured resinous flooring system are unaffected when tested according to ASTM D 1308 for 50 percent immersion in the following reagents for no fewer than seven days:
1. The following is a list of reagents that the Government has determined are likely to contact resinous flooring during in-service use>.

LABORATORY DISINFECTANTS:

Liquids:

Sodium hypochlorite, maximum concentration - 10,000 ppm of available chlorine.
Ethanol, maximum concentration – 70%.
Phenol, maximum concentration - 5%.
Glutaraldehyde, maximum concentration - 2%.
A-33 (quaternary ammonium compound), maximum concentration - 3%.
Iodophores, maximum concentration - 2,000 ppm of iodine.
Liquid formalin, maximum concentration - 10%.
Lysol (phenolic), maximum concentration - 5%.
Peracetic acid, maximum concentration - 5%.
Sodium hydroxide, maximum concentration - 10%.
Hydrogen peroxide, maximum concentration - 6%.
"One Stroke Environ" - Active ingredients by weight are 11.3% sodium o-phenylphenate, 9.4% sodium o-benzyl-p-chlorophenate and 2.3% sodium p-tertiary amylphenate. A pH 12.6 concentrate is used in a 1:256.
"Germkill" - Active ingredients by weight are 18.76% nonylphenoxypoly (ethyleneoxy) ethanol iodine complex and 16.95% phosphoric acid. This is mixed to ratio of 1:100 for a pH in the acid range,
"Wescodyne" - Active ingredients, by weight are 9.1% polyethoxy polypropoxy polyethoxy ethanol - iodine complex and 8.74% nonyl phenoxypoly ethoxy ethanol-iodine complex. This is mixed at a ratio of 1:213 to a pH of 3.
“Micro-Chem” - a quaternary ammonia solution.
“Cavacide”: - a quaternary ammonium compound.
“Virkon S” - A balanced, stabilised blend of peroxygen compounds, surfactant, organic acids, and an inorganic buffer system. Diluted to a ratio of 1:100.
Clidox® -S: A chlorine dioxide based high level disinfectant missed at 1:5:1.

Gaseous:

Formaldehyde gas, maximum concentration - 0.3%/cubic foot at relative humidity in excess of 70%; Paraformaldehyde flakes are heated in 50% to 60% relative humidity to produce formaldehyde gas. Exposure for 12 hours and then neutralized with ammonium carbonate and washed with water at 140 to 176° F.
Vaporized hydrogen peroxide gas (VHP); vaporization of 35% liquid hydrogen peroxide at 25 deg. C, maximum concentration 3 mg/l, for a duration of 30 minutes.
Chlorine Dioxide – Concentration of 3 Sp (mg/L) for a duration of 10 minutes at 70% RH. Allow for aeration time of 35 minutes. Both duration and aeration times vary based on total chamber volume. Example is based on 2700 cu. Ft.

LABORATORY CHEMCIALS:

Acetone	Ammonium Hydroxide, 28%	Benzene
PART 4 - Beta-propiolactone	**PART 5 -** Carbon Tetrachloride	**PART 6 -** Chromic Acid, 40%
Citric Acid, 1%	Cottonseed Oil	Detergent Solution, .025%
PART 7 - Dichromate Cleaning Solution**	Diethyl Ether	Distilled Water
Ethyl Acetate	Ethyl Alcohol	Ethyl Ether
Formaldehyde, 37%	Heptane	Hydrochloric Acid, 37%
Hydrogen Peroxide, 28%	Isooctane	Kerosine
Methyl Alcohol	Methyl Ethyl Ketone	Methylene Chloride
Methyl mercury hydroxide	Methylethyl Ketone	Mineral Oil
Oleic Acid	Olive Oil	Perchloric Acid, 70%
Phenol, 5%	Soap Solution, 1%	Sodium Carbonate, 20%
Sodium Hydroxide, 50%	Sodium Hypochlorite, 5%	Sodium Hypochlorite, 5.25%
Toluene	Transformer Oil	Trizol
Turpentine	Xylene	

END OF SECTION 09 67 23

SECTION 09 91 00 – PAINTING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with all applicable requirements and standards.

1.03 DEFINITIONS

A. "Paint" includes coating systems materials; primers, emulsions, enamels, stains, sealers and fillers, and other applied materials whether used as prime, intermediate, or finish coats.

1. Substrate" as used herein means the surface to which paint is to be applied. In the case of previously painted existing surfaces, substrate means the surface to which the existing paint was applied.

1.04 QUALITY ASSURANCE

A. Single Source Responsibility: Provide primers and undercoat paint produced by the same manufacturer as the finish coats.

B. Coordination of Work: Review other sections in which primers are provided to ensure compatibility of the total systems for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.

C. Notify the Architect of problems anticipated using the materials specified.

D. Field Samples: On wall surfaces, other exterior, and interior components, duplicate finishes of prepared samples. Provide full coat finish samples on at least 100 sq. ft. of surface until required sheen, color and texture are obtained; simulate finished lighting conditions for review of in place Work.

1. Final acceptance of colors will be from job applied samples.

2. The Architect will select one room or surface to represent surfaces and conditions for each type of coating and substrate to be painted. Apply coatings in this room or surface in accordance with the schedule or as specified. After finishes are accepted, this room or surface will be used for evaluation of coating systems of a similar nature.

E. Material Quality: Provide the manufacturer's best quality trade sale paint material of the various coating types specified. Paint material containers not displaying manufacturer's product identification will not be acceptable.

1. Proprietary names used to designate colors or materials are not intended to imply that products named are required or to exclude equal products of other manufacturers.

2. Federal Specifications establish a minimum quality level for paint materials, except where other product identification is used. Provide written certification from the manufacturer that materials provided meet or exceed these criteria.

3. Products that comply with qualitative requirements of applicable Federal Specifications, yet differ in quantitative requirements, may be considered for use when acceptable to the Architect. Furnish material data and manufacturer's certificate of performance to Architect for proposed substitutions.

F. Odor Eliminating Additive: At all locations scheduled to receive solvent or alkyd-based coatings, provide an odor-eliminating additive to minimize the presence of odor from wet and drying paint films.

1. Provide additive recommended and approved by the primer/finish coat manufacturer for use with their paint. Benjamin Moore does not recommend an “odor eliminator additive” for Benjamin Moore Paints.

2. Provided compliance with above requirements, "Bio Zapp Paint Odor Eliminator" by Bio Zapp Laboratories, (800/776-7721) is acceptable.

1.05 SUBMITTALS

A. Samples:

1. Samples for initial color selection in the form of manufacturer's color charts.

a. After color selection, the Architect will furnish color chips for surfaces to be coated.

2. Samples for verification purposes:

a. Provide samples of each color and material to be applied, with texture to simulate actual conditions, on representative samples of the actual substrate.

b. Define each separate coat, including block fillers and primers.

c. Use representative colors when preparing samples for review

d. Resubmit until required sheen, color, and texture are achieved.

e. Provide a list of material and application for each coat of each sample. Label each sample as to location and application.

f. Submit samples on the following substrates for the Architect's review of color and texture only:

1) Ferrous Metal: Provide two 4 inch square samples of flat metal and two 8 inch long samples of solid metal for each color and finish.

2) Drywall: Provide two 12 by 12-inch samples of each color and finish.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to the Project Site in the manufacturer's original, unopened packages and containers bearing manufacturer's name and label and the following information:

1. Product name or title of material.

2. Product description (generic classification or binder type).

3. Federal Specification number, if applicable.

4. Manufacturer's stock number and date of manufacture.

5. Contents by volume, for pigment and vehicle constituents.

6. Thinning instructions.

7. Application instructions.

8. Color name and number.

B. Store materials not in use in tightly covered containers in a well ventilated area at a minimum ambient temperature of 45 degrees F (7 degrees C). Maintain containers used in storage in a clean condition, free of foreign materials and residue.

1. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily. Take necessary measures to ensure that workers and Work areas are protected from fire and health hazards resulting from handling, mixing, and application.

1.07 PROJECT CONDITIONS

A. Apply water based paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 50 degrees F (10 degrees C) and 90 degrees F (32 degrees C).

B. Apply solvent thinned paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 45 degrees F (7 degrees C) and 95 degrees F (35 degrees C).

C. Do not apply paint in snow, rain, fog, or mist, when the relative humidity exceeds 85 percent, at temperatures less than 5 degrees F (3 degrees C) above the dew point, or to damp or wet surfaces.

1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by the manufacturer during application and drying periods.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.02 PAINTING MANUFACTURES

A. PPG Industries, Inc.

1. Website: www.ppg.com

2. Address: One PPG Place, Pittsburgh, PA 15272

B. Benjamin Moore Paints

1. Website: www.benjaminmoore.com

2. Address: 51 Chestnut Ridge Road, Montvale, NJ 07645

C. ICI Paints – Imperial Chemical Industries

1. Website: www.icipaints.com

2. Address: 925 Euclid Avenue, Cleveland, Ohio 44115

2.03 PAINT SCHEDULE

A. Provide the following paint systems for the various substrates, as indicated. Provide only the listed prime and finish coat materials unless otherwise recommended in writing by the paint manufacturer for each specific substrate.

B. Where specific finish paint material is not indicated, refer to notes and finish schedules for finish paint material and gloss levels for each surface to be painted.

2.04 EXTERIOR PAINT SCHEDULE

A. Ferrous Metal; two (2) finish coats of water borne <semigloss><gloss> acrylic enamel over primer:

1. Rust Inhibiting Primer:

a. PPG: Pitt-Tech 100 percent Acrylic Primer 90-712

b. Benjamin Moore: M29 Direct to Metal Acrylic Semi-gloss Rust Inhibitive

c. ICI: Devoe Devflex 4020 PF Direct to Metal Primer and Flat Finish

2. Finish Coat:

a. PPG: Pitt-Tech 100 percent Acrylic Satin Direct to Metal 90-474

b. Benjamin Moore: M29 Direct to Metal Acrylic Semi-gloss Rust Inhibitive

c. ICI: Devflex 4206 Int/Ext Acrylic Latex Semi-gloss Enamel

B. Galvanized Metal; two (2) finish coats of water borne <semigloss><gloss> acrylic enamel over primer:

1. Galvanized Metal Primer:

a. PPG: Pitt-Tech 100 percent Acrylic Primer 90-712

b. Benjamin Moore: M29 Direct to Metal Acrylic Semi-gloss

c. ICI: Devoe Devflex 4020 PF Direct to Metal Primer and Flat Finish.

2. Finish Coat:

a. PPG: Pitt-Tech 100 percent Acrylic Satin Direct to Metal 90-474

b. Benjamin Moore: Moorlife 105 Flat Acrylic House Paint

c. ICI: Devoe Devflex 4206 Int/Ext Acrylic Latex Semi-gloss Enamel

C. Aluminum; two (2) finish coats of water borne <semigloss><gloss> acrylic enamel over primer:

1. Aluminum Metal Primer:

a. PPG: Pitt-Tech 100 percent Acrylic Primer 90-712

b. Benjamin Moore: M29 Direct to Metal Acrylic Semi-gloss

c. ICI: Devoe Devflex 4020 PF Direct to Metal Primer and Flat Finish

2. Finish Coat:

a. PPG: Pitt-Tech 100 percent Acrylic Satin Direct to Metal 90-474

b. Benjamin Moore: M29 Direct to Metal Acrylic Semi-gloss

c. ICI: Devflex 4206 Int/Ext Acrylic Latex Semi-gloss Enamel

D. Exhaust Hood: Two (2) Finish coats of Exterior Gloss Enamel over primer:

1. Provide the following color code:

a. Chemical Hood : safety red

b. Radioisotope: safety yellow

c. Clean Bench: safety green

d. Bio Safety Cabinet: safety blue

2. Exhaust Fan Hood Industrial Grade Rust-Inhibiting Primer:

a. PPG: Pitt-Tech 100 percent Acrylic Primer 90-712

b. Benjamin Moore: M29 Direct to Metal Acrylic Semi-gloss Rust Inhibitive

c. ICI: Devoe Devflex 4020 PF Direct to Metal Primer and Flat Finish

3. Exhaust Fan Hood Industrial Grade Finish Coat:

a. PPG: Pitt-Tech 100 percent Acrylic Satin Direct to Metal 90-474

b. Benjamin Moore: M29 Direct to Metal Acrylic Semi-gloss Rust Inhibitive

c. ICI: Devflex 4206 Int/Ext Acrylic Latex Semi-gloss Enamel

2.05 INTERIOR PAINTING SCHEDULE

A. Gypsum Drywall; two (2) finish coats over primer.

1. Primer:

a. PPG: Pure Performance Interior Latex Primer 9-2

b. Benjamin Moore: Eco Spec interior latex primer

c. ICI: LM 9116 Lifemaster 2000 interior primer-sealer

2. Finish Coat:

a. PPG: Pure Performance Interior Latex

b. Benjamin Moore: Eco Spec Interior Latex

c. ICI: LM 9300 Lifemaster 2000 Interior Eggshell

B. Ferrous Metal; two (2) finish coats of water borne semi-gloss acrylic latex enamel over primer:

1. Waterborne Acrylic Primer:

a. PPG: Pitt-Tech 100 percent Acrylic Primer 90-712

b. Benjamin Moore: M29 Direct to Metal Acrylic Semi-gloss

c. ICI: Devoe Devflex 4020 PF Direct to Metal Primer and Flat Finish

2. Finish Coat:

a. PPG: Pitt-Tech 100 percent Acrylic Satin Direct to Metal 90-474

b. Benjamin Moore: M29 Direct to Metal Acrylic Semi-gloss

c. ICI: Devoe Devflex 4206 Int/Ext Acrylic Latex Semi-gloss Enamel

C. Galvanized Metal; two (2) finish coats of water borne semi-gloss acrylic latex enamel over primer:

1. Waterborne Acrylic Galvanized Metal Primer

a. PPG: Pitt-Tech 100 percent Acrylic Primer 90-712

b. Benjamin Moore: M29 Direct to Metal Acrylic Semi-gloss

c. ICI: Devoe Devflex 4020 PF Direct to Metal Primer and Flat Finish

2. Finish Coat:

a. PPG: Pitt-Tech 100 percent Acrylic Satin Direct to Metal 90-474

b. Benjamin Moore: M29 Direct to Metal Acrylic Semi-gloss

c. ICI: Devoe Devflex 4206 Int/Ext Acrylic Latex Semi-gloss Enamel

D. Aluminum; two (2) finish coats of water borne acrylic latex enamel over primer:

1. Waterborne Acrylic Galvanized Metal Primer

a. PPG: Pitt-Tech 100 percent Acrylic Primer 90-712

b. Benjamin Moore: M29 Direct to Metal Acrylic Semi-gloss

c. ICI: Devoe Devflex 4020 PF Direct to Metal Primer and Flat Finish

2. Finish Coat:

a. PPG: Pitt-Tech 100 percent Acrylic Satin Direct to Metal 90-474

b. Benjamin Moore: M29 Direct to Metal Acrylic Semi-gloss

c. ICI: Devflex 4206 Int/Ext Acrylic Latex Semi-gloss Enamel

PART 3 - EXECUTION

3.01 PREPARATION

A. Examine substrates and conditions under which painting will be performed for compliance with requirements for application of paint. Do not begin paint application until unsatisfactory conditions have been corrected.

1. Start of painting will be construed as the Applicator's acceptance of surfaces and conditions within a particular area.

B. General Procedures: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items in place that are not to be painted, or provide surface applied protection prior to surface preparation and painting. Remove these items if necessary for complete painting of the items and adjacent surfaces. Following completion of painting operations in each space or area, have items reinstalled by workers skilled in the trades involved.

1. Clean surfaces before applying paint or surface treatments. Remove oil and grease prior to cleaning. Schedule cleaning and painting so that dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.

C. Surface Preparation: Clean and prepare surfaces to be painted in accordance with the manufacturer's instructions for each particular substrate condition and as specified.

1. Provide barrier coats over incompatible primers and existing surfaces, or remove and reprime. Notify Architect in writing of problems anticipated with using the specified finish coat material with substrates primed by others.

2. Cementitious Materials: Prepare concrete, concrete masonry block, cement plaster, and mineral fiber reinforced cement panel surfaces to be painted. Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.

   a. Use abrasive blast cleaning methods if recommended by the paint manufacturer.

   b. Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause blistering and burning of finish paint, correct this condition before application. Do not paint surfaces where moisture content exceeds that permitted in manufacturer's printed directions.

   c. Clean concrete floors to be painted with a 5 percent solution of muriatic acid or other etching cleaner. Flush the floor with clean water to remove acid, neutralize with ammonia, and rinse; allow to dry and vacuum before painting.

3. Wood: Clean surfaces of dirt, oil, and other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sand surfaces exposed to view smooth and dust off.

   a. Scrape and clean small, dry, seasoned knots and apply a thin coat of white shellac or other recommended knot sealer before application of primer. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sand smooth when dried.

   b. Prime, stain, or seal wood to be painted immediately upon delivery. Prime edges, ends, faces, undersides, and backsides of wood, including cabinets, counters, cases, and paneling.

   c. When transparent finish is required, backprime with spar varnish.

   d. Backprime paneling on interior partitions where masonry, plaster, or other wet wall construction occurs on backside.

   e. Seal tops, bottoms, and cutouts of unprimed wood doors with a heavy coat of varnish or sealer immediately upon delivery.

4. Ferrous Metals: Clean nongalvanized ferrous metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with recommendations of the Steel Structures Painting Council.

   a. Blast steel surfaces clean as recommended by the paint system manufacturer and in accordance with requirements of SSPC specification SSPC SP 10.

b. Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.

c. Touch up bare areas and shop applied prime coats that have been damaged. Wire brush, clean with solvents recommended by the paint manufacturer, and touch up with the same primer as the shop coat.

5. Galvanized Surfaces: Clean galvanized surfaces with non petroleum based solvents so that the surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.

D. Materials Preparation: Carefully mix and prepare paint materials in accordance with manufacturer's directions.

1. Maintain containers used in mixing and application of paint in a clean condition, free of foreign materials and residue.

2. Stir material before application to produce a mixture of uniform density; stir as required during application. Do not stir surface film into material. Remove film and, if necessary, strain material before using.

3. Use only thinners approved by the paint manufacturer, and only within recommended limits.

E. Tinting: Tint each undercoat a lighter shade to facilitate identification of each coat where multiple coats of the same material are applied. Tint undercoats to match the color of the finish coat, but provide sufficient differences in shade of undercoats to distinguish each separate coat.

3.02 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. All installation shall be in accordance with manufacturer’s published recommendations.

3.03 APPLICATION

A. Apply paint in accordance with manufacturer's directions. Use applicators and techniques best suited for substrate and type of material being applied.

B. Paint exposed surfaces whether or not colors are designated in "schedules," except where a surface or material is specifically indicated not to be painted or is to remain natural. Where an item or surface is not specifically mentioned, paint the same as similar adjacent materials or surfaces. If color or finish is not designated, the Architect will select from standard colors or finishes available.

1. Painting includes field painting exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron Work, primed surfaces of mechanical, electrical, and all other equipment, and prefinished surfaces of certain equipment including, but not limited to; electrical panel covers, equipment supports, and equipment exposed to view on the roof.

C. At "unoccupied" interior areas, painting is not required on prefinished items or finished metal surfaces.

1. Do not paint over Underwriter's Laboratories, Factory Mutual or other code required labels or equipment name, identification, performance rating, or nomenclature plates.

D. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.

1. Paint colors, surface treatments, and finishes are indicated in "schedules."

2. Provide finish coats that are compatible with primers used.

3. The number of coats and film thickness required is the same regardless of the application method. Do not apply succeeding coats until the previous coat has cured as recommended by the manufacturer. Sand between applications where sanding is required to produce an even smooth surface in accordance with the manufacturer's directions.

4. Apply additional coats when undercoats, stains, or other conditions show through final coat of paint until paint film is of uniform finish, color, and appearance. Give special attention to ensure that surfaces, including edges, corners, crevices, welds, and exposed fasteners, receive a dry film thickness equivalent to that of flat surfaces.

5. The term "exposed surfaces" includes areas visible when permanent or built in fixtures, convector covers, covers for finned tube radiation, grilles, and similar components are in place. Extend coatings in these areas as required to maintain the system integrity and provide desired protection.

6. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Paint surfaces behind permanently fixed equipment or furniture with prime coat only before final installation of equipment.

7. Paint interior surfaces of ducts, where visible through registers or grilles, with a flat, nonspecular black paint.

8. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.

9. Omit primer on metal surfaces that have been shop primed and touch up painted.

E. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.

1. Allow sufficient time between successive coats to permit proper drying. Do not recoat until paint has dried to where it feels firm, and does not deform or feel sticky under moderate thumb pressure and where application of another coat of paint does not cause lifting or loss of adhesion of the undercoat.

F. Minimum Coating Thickness: Apply materials at not less than the manufacturer's recommended spreading rate. Provide a total dry film thickness of the entire system as recommended by the manufacturer.

G. Mechanical and Electrical Work: Painting mechanical and electrical Work is limited to items exposed in mechanical equipment rooms and in occupied spaces.

H. Pigmented (Opaque) Finishes: Completely cover to provide an opaque, smooth surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.

I. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint Work not in compliance with specified requirements.

3.04 FIELD QUALITY CONTROL

A. The Owner reserves the right to invoke the following test procedure at any time and as often as the Owner deems necessary during the period when paint is being applied:

1. The Owner will engage the services of an independent testing laboratory to sample the paint material being used. Samples of material delivered to the project will be taken, identified, sealed, and certified in the presence of the Contractor.

2. The testing laboratory will perform appropriate tests for the following characteristics as required by the Owner:

a. Quantitative materials analysis

b. Abrasion resistance

c. Apparent reflectivity

d. Flexibility

e. Wash ability

f. Absorption

g. Accelerated yellowness

h. Recoating

i. Skinning

j. Color retention

k. Alkali and mildew resistance

3. If test results show material being used does not comply with specified requirements, the Contractor may be directed to stop painting, remove noncomplying paint, pay for testing, repaint surfaces coated with rejected paint, and remove rejected paint from previously painted surfaces if, upon repainting with specified paint, the two coatings are noncompatible.

3.05 CLEANING

A. At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from the Project Site.

B. Upon completion of painting, clean glass and paint spattered surfaces. Remove spattered paint by washing and scraping, using care not to scratch or damage adjacent finished surfaces.

3.06 PROTECTION

A. Protect Work of other trades, whether to be painted or not, against damage by painting. Correct damage by cleaning, repairing or replacing, and repainting, as acceptable to Architect.

B. Provide "wet paint" signs to protect newly painted finishes. Remove temporary protective wrappings provided by others for protection of their Work after completion of painting operations.

1. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

END OF SECTION 09 91 00

SECTION 09 97 00 – SPECIAL COATINGS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with all applicable requirements and standards.

1.03 QUALITY ASSURANCE

A. Applicator Qualifications: Engage an experienced applicator who has completed multicolored coating system applications similar in material and extent to that indicated for the Project that have resulted in a construction record of successful in service performance.

B. Single Source Responsibility: Provide primers and other undercoat material produced by the same manufacturer as the finish coats.

1. Notify the Architect about anticipated problems using coating systems specified.

C. Special Requirements of Regulatory Agencies: Submit certification that system complies with VOC (Volatile Organic Compounds) requirements and regulations of the Environmental Protection Agency (EPA), Occupational Safety and Health Administration (OSHA), State, County, City, and local Air Control District.

D. Fire Performance Characteristics: Provide coatings with the following surface burning characteristics as determined by testing identical products per ASTM E 84 by UL or other testing and inspecting agencies acceptable to authorities having jurisdiction. Identify coatings with appropriate markings of applicable testing and inspecting agency.

1. Flame Spread: 25 or less.

2. Smoke Developed: 450 or less.

E. Field Samples: The Architect will select one room or wall surface for each substrate to represent surfaces and conditions. Apply multicolored coatings to each surface according to the schedule, or as specified. Provide full coat samples on at least 100 sq. ft. of wall surface until the required color and texture are obtained. Simulate finished lighting conditions to review the field samples.

1. After finishes are accepted, these surfaces will be used to evaluate the coating system. Final acceptance of colors will be from job applied samples.

1.04 SUBMITTALS

A. Samples:

1. Samples for initial color selection in the form of manufacturer's color charts.

a. After color selection, the Architect will furnish color chips for surfaces to be coated.

2. Samples for Verification Purposes: Provide samples of each color and material to be applied with texture to simulate actual conditions on representative samples of the actual substrate.

a. Provide stepped samples, defining each separate coat, including primers. Use representative colors when preparing samples for review. Resubmit until the required sheen, color, and texture are achieved.

b. Provide a list of material and application for each coat of each sample. Label each sample as to location and application.

c. Submit samples on the following substrates for the Architect's review of color and texture only.

1) Gypsum Wallboard: Provide two 24 inch square samples of each color and material on gypsum wallboard.

2) Ferrous Metal: Provide two 4 inch square samples of flat metal and two 8 inch long samples of solid metal for each color and finish.

d. Resubmit samples as requested until the required sheen, color, and texture are achieved.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver multicolored coating materials to the Project Site in the manufacturer's new, original, unopened packages or containers bearing the manufacturer's name and label, and the following information:

1. Name or title of material

2. Manufacturer's name, stock number, and date of manufacture

3. Contents by volume

4. Thinning instructions, if permitted

5. Application instructions

6. Color name and number

7. Handling instructions and precautions

B. Store materials not in actual use in tightly closed, covered containers at a minimum ambient temperature of 45 degrees F (7 degrees C) in a well ventilated area. Keep containers used in storage in a clean condition, free of foreign materials and residue.

1. Protect coating materials from freezing. Keep the storage area neat and orderly. Remove oily rags and waste daily. Take necessary measures to ensure that workers and Work areas are protected from fire and health hazards resulting from handling, mixing, and application.

1.06 EXTRA MATERIALS

A. Extra Materials: Furnished from same production run as materials applied. Package materials with a protective covering and identify with labels describing contents. Deliver extra materials to Owner.

1. Multi Color Interior Coating: Furnish quantity equal to 2 percent of amount applied, but not less than one gallon, for each color and pattern installed.

1.07 PROJECT CONDITIONS

A. Environmental Conditions: Establish and maintain environmental conditions in spaces to receive multicolored coatings that comply with the manufacturer's recommendations. Provide adequate natural or induced ventilation, as necessary, for curing and as recommended by the manufacturer.

B. Temperature Conditions: Apply multicolored coatings only when the temperature of the surface to be coated, the ambient temperature, and the temperature of the materials to be used are above 50 degrees F (10 degrees C).

C. Weather Conditions: Do not apply coatings when the relative humidity exceeds 85 percent, or at temperatures less than 5 degrees F (3 degrees C) above the dew point, or to damp or wet surfaces.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.02 MULTICOLORED COATING MATERIALS, GENERAL

A. Material Compatibility: Provide primers, finish coat materials, and related materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by the manufacturer based on testing and field experience.

B. Material Quality: Provide the best quality grade of multicolored coatings. Materials not displaying manufacturer's identification as a best grade product will not be acceptable.

1. Proprietary Names: Using manufacturer's proprietary product names to designate colors or materials is not intended to imply that products of named manufacturers are required to be used to the exclusion of equivalent products of other manufacturers. Furnish the manufacturer's material data and certificate of performance for proposed substitutions.

C. Colors: Provide custom colors of the finished multicolored coating system to match the Architect's samples.

D. Colors: Match colors indicated by referring to manufacturer's standard color designations for multicolored coating systems.

E. Colors: Provide color selections made by the Architect from the manufacturer's full range of standard colors for multicolored coating systems.

2.03 MULITCOLOR COATING SCHEDULE

A. At locations indicated or scheduled, provide the following coating systems:

1. Coating System 1: "Polomyx" #6006-TB83

2. Coating System 2: "Polomyx" #6004-GA65

PART 3 - EXECUTION

3.01 PREPARATION

A. Examine substrates to receive multicolored coatings and conditions under which the coatings will be applied to conform to the manufacturer's application requirements. Do not begin coating application until unsatisfactory conditions have been corrected.

1. Start of coating application will be construed as the Applicator's acceptance of surfaces and conditions within a particular area.

B. General Procedures: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be coated. If such items cannot be removed, provide surface applied protection prior to surface preparation and coating. After coating operations have been completed in each space or area, reinstall the items removed using workers skilled in the trades involved.

C. Surface Preparation: Clean and prepare surfaces to be coated according to the manufacturer's instructions for each particular substrate condition, and as specified.

1. Cleaning: Clean surfaces to receive multicolored coatings. Remove oil and grease prior to cleaning. Schedule cleaning so that dust and other contaminants from the cleaning operations do not fall on wet, newly coated surfaces.

2. Provide barrier coats over incompatible primers or remove the primer and reprime. Notify the Architect in writing about anticipated problems if the multicolored coating system is applied over substrates primed by others.

3. Ferrous Metals: Prepare ferrous metal surfaces before beginning coating application. Clean nongalvanized ferrous metal surfaces that have not been shop coated. Remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with recommendations of the Steel Structures Painting Council (SSPC).

    a. Touch up bare areas and shop applied prime coats that have been damaged. Wire brush, clean with solvents recommended by the coating manufacturer, and touch up with the same primer as the shop coat.

4. Previously Painted Surfaces: Prepare previously painted or coated surfaces before beginning multicolored coating application. Remove flaking paint and other contaminants. Clean chalking and dusting surfaces that interfere with coating adhesion. Repair holes or cracks with an appropriate patching compound and spot prime. Sand surfaces smooth.

3.02 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. All installation shall be in accordance with manufacturer’s published recommendations.

3.03 APPLICATION

A. Apply multicolored coatings according to the manufacturer's directions. Use applicators and techniques best suited for the substrates and material being applied.

B. Do not apply coatings over dirt, rust, scale, grease, moisture, scuffed surfaces, or other conditions detrimental to the formation of a coating.

C. Prime Coats: Before applying multicolored coatings, apply a prime coat as recommended by the manufacturer to substrates required to be coated that have not received a prime coat by others. Reprime surfaces where evidence of suction spots or unsealed areas appears.

3.04 CLEANING

A. Cleanup: At the end of each Work day, remove empty cans, rags, rubbish, and other discarded coating materials from the Project Site.

B. Remove coatings from adjacent surfaces not intended to be coated.

3.05 PROTECTION

A. Protect Work of other trades, whether to be coated or not, against damage caused by multicolored coatings.

B. Provide temporary closure to confine spraying operation and to prevent polluting surrounding environment.

C. Provide "Wet Paint" signs to protect newly coated surfaces. Remove temporary protective wrappings provided by others to protect their Work after completing coating operations.

3.06 MULTICOLORED INTERIOR COATING SCHEDULE

A. General: Provide the following interior multicolored coating systems for substrates indicated.

B. Gypsum Drywall: One coat, flat, multicolored coating system over a primer.

1. Prime Coat: Latex primer sealer.

a.	Coronado:	Toll O Fect Primer/Sealer 120/11
b.	Multicolor Specialties:	Multispec 100 Primer
c.	Surface Protection Ind. Int.:	Polomyx 202 Basecoat
d.	Seagrave Coatings Corp.:	Seagrave Duramel X Primer
e.	California Products:	Aqua Fleck 80425
f.	Vitricon:	Vitricolor Primer
g.	Surface Protection Ind. Int.:	Zo Cryl Sealer 92

C. Ferrous Metal: One coat, flat, multicolored coating system over a metal primer.

1. Prime Coat: Water based acrylic primer

a.	Coronado:	Coronado Rust Inhibiting Primer 35 111
b.	Multicolor Specialties:	Multispec 101 Primer
c.	Surface Protection Ind. Int.:	Polomxy 210 Metal Basecoat
d.	Seagrave Coatings Corp.:	Universal Primer
e.	California Products:	Aqua Fleck 80461
f.	Vitricon:	Polyseal ZC Primer
g.	Surface Protection Ind. Int.:	Zo Ferro Primer 91

D. Finish Coats:

1. Water-based multi-colored finish coating:

a.	California Products:	Aqua Fleck
b.	Coronado Paint Co.:	Cor-O-Fect III
c.	Multicolor Specialties, Inc.:	MS 90 Water Bourne
d.	Surface Protection Ind. Int.:	Polomyx Waterbase N Series
e.	Surface Protection Ind. Int.:	Zolatone Waterbase 45 Series
f.	Vitricon Corp.:	Vitricolor Evoc

2. Solvent-based multi-colored finish coating:

a.	Coronado Paint Co.:	Toll-O-Fect
b.	Multicolor Specialties, Inc.:	Multispec 86 Fine Fleck
c.	Seagrave Coatings Corp.:	Plextone Multicolor System
d.	Surface Protection Ind. Int.:	Polomyx Multicolor Finish
e.	Surface Protection Ind. Int.:	Zolatone 43 Series
f.	Vitricon Corp.:	Vitricolor

END OF SECTION 09 97 00

SECTION 10 21 13 - TOILET COMPARTMENTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 SUMMARY

A. Section Includes:

1. Phenolic-core toilet compartments configured as toilet enclosures, entrance screens and urinal screens.

B. Related Sections:

1. Division 05 Section "Metal Fabrications" for supports that attach ceiling-hung compartments to overhead structural system.

2. Division 06 Section "Rough Carpentry" for blocking overhead support of floor-and-ceiling-anchored compartments.

3. Division 10 Section "Toilet and Bath Accessories" for toilet tissue dispensers, grab bars, purse shelves, and similar accessories.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For toilet compartments. Include plans, elevations, sections, details, and attachments to other work.

1. Show locations of cutouts for compartment-mounted toilet accessories.

2. Show locations of reinforcements for compartment-mounted grab bars.

3. Show locations of centerlines of toilet fixtures.

4. Show ceiling grid and overhead support or bracing locations.

C. Samples for Verification: For the following products, in manufacturer's standard sizes unless otherwise indicated:

1. Each type of material, color, and finish required for units, prepared on 6-inch- (152-mm-) square Samples of same thickness and material indicated for Work.

2. Each type of hardware and accessory.

1.04 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of toilet compartment, from manufacturer.

1.05 CLOSEOUT SUBMITTALS

A. Maintenance Data: For toilet compartments to include in maintenance manuals.

1.06 QUALITY ASSURANCE

A. Comply with requirements in GSA's CID-A-A-60003, "Partitions, Toilets, Complete."

B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84, or another standard acceptable to authorities having jurisdiction, by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.

2. Smoke-Developed Index: 450 or less.

C. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities" for toilet compartments designated as accessible.

1.07 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Stainless-Steel Castings: ASTM A 743/A 743M.

2.02 PHENOLIC-CORE UNITS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Accurate Partitions Corporation.

2. Ampco, Inc.

3. Global Steel Products Corp.

4. Partition Systems Incorporated of South Carolina.

B. Toilet-Enclosure Style: Ceiling hung.

C. Urinal-Screen Style: Wall hung.

D. Door, Panel, Screen, and Pilaster Construction: Ceiling hung, plastic laminate faced with black phenolic resin core. Urinal screens shall be supported from the wall, and be of the same construction as toilet partitions Provide minimum 3/4-inch- (19-mm-) thick doors and pilasters and minimum 1/2-inch- (13-mm-) thick panels.

E. Pilaster: shall be attached to the wall using continuous brackets. Brackets shall thru-bolt to pilaster, as well as provide a single ear (oriented to inside) for attachment to wall.

F. Brackets (Fittings):

1. Full-Height (Continuous) Type: Manufacturer's standard design; stainless steel.

G. Phenolic-Panel Finish:

1. Facing Sheet Finish: One color and pattern in each room.

2. Color and Pattern: Formica #744-58 Lacewood (matte) HGS plastic laminate, and exposed core edges shall be radiused and polished. Plastic laminate grain shall be oriented vertically.

2.03 ACCESSORIES

A. Hardware and Accessories: Manufacturer's standard design, heavy-duty operating hardware and accessories.

1. Material: Stainless steel.

2. Hinges: Manufacturer's standard paired, self-closing type that can be adjusted to hold doors open at any angle up to 90 degrees.

3. Latch and Keeper: Manufacturer's standard recessed latch unit designed for emergency access and with combination rubber-faced door strike and keeper. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible.

4. Coat Hook: Manufacturer's standard combination hook and rubber-tipped bumper, sized to prevent in-swinging door from hitting compartment-mounted accessories.

5. Door Bumper: Manufacturer's standard rubber-tipped bumper at out-swinging doors and entrance-screen doors.

6. Door Pull: Manufacturer's standard unit at out-swinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible.

B. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel or chrome-plated steel or brass, finished to match the items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless steel, hot-dip galvanized steel, or other rust-resistant, protective-coated steel.

2.04 FABRICATION

A. Ceiling-Hung Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at pilasters for connection to structural support above finished ceiling. Provide assemblies that support pilasters from structure without transmitting load to finished ceiling. Provide sleeves (caps) at tops of pilasters to conceal anchorage.

B. Door Size and Swings: Unless otherwise indicated, provide 24-inch- (610-mm-) wide, in-swinging doors for standard toilet compartments and 36-inch- (914-mm-) wide, out-swinging doors with a minimum 32-inch- (813-mm-) wide, clear opening for compartments designated as accessible.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.

1. Maximum Clearances:

a. Pilasters and Panels: 1/2 inch (13 mm).

b. Panels and Walls: 1 inch (25 mm).

B. Ceiling-Hung Units: Secure pilasters to supporting structure and level, plumb, and tighten. Hang doors and adjust so bottoms of doors are level with bottoms of pilasters when doors are in closed position.

C. Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb, rigid, and secured to resist lateral impact.

3.02 ADJUSTING

A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors and doors in entrance screens to return doors to fully closed position.

END OF SECTION 10 21 13

SECTION 10 22 26.13 – FOLDING PANEL PARTITIONS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with all applicable requirements and standards.

1.03 QUALITY ASSURANCE

A. Single Source Responsibility: Obtain folding panel partitions and mounting hardware from one source from a single manufacturer.

B. Testing Laboratory Qualifications: To qualify for acceptance, an independent testing laboratory must demonstrate to Architect's satisfaction, based on evaluation of laboratory submitted criteria conforming to ASTM E 699, that it has the experience and capability to conduct satisfactorily the testing indicated.

1.04 SUBMITTALS

A. Product Data:

1. Product data on physical characteristics, durability, resistance to fading, and flame spread characteristics for each type of folding panel partition and accessory specified.

2. Product certificates signed by manufacturers of folding panel partitions certifying that their products comply with specified requirements.

3. Acoustical Certification from an independent testing agency stating that product and materials furnished comply with specified requirements. Include certified laboratory testing data indicating that panels and materials meet specified test requirements. Include STC and NRC ratings and square foot weight of panel.

B. Samples:

1. Samples for initial selection purposes in form of manufacturer's standard color charts showing full range of colors, textures, and patterns available for each type of material exposed to view.

2. Samples for verification purposes of each type of material exposed to view. Include samples of each panel facing material selected.

C. Shop Drawings:

1. Shop Drawings showing location and extent of folding panel partitions. Include plans, elevations, large scale details of anchorages, and accessory items. Indicate unit conditions at openings, typical and special details, and location and installation requirements for hardware and operators. Indicate direction of travel and static and dynamic loading on the building structure.

2. Template drawings prepared by manufacturer showing location of items supported or anchored by permanent construction.

D. Record Documents: Record approved product data, samples, and shop drawings.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to Project Site in original factory wrappings and containers, clearly labeled with identification of manufacturer, brand name, quality or grade, fire performance characteristics, and lot number.

B. Store panels only on edge, blocked off ground to prevent sagging and warping, in original undamaged packages and containers, inside well ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

C. Comply with instructions and recommendations of manufacturer for special delivery, storage, and handling requirements.

1.06 SYSTEM PERFORMANCE REQUIREMENTS

A. Fire Performance Characteristics: Provide folding panel partitions with surface burning characteristics indicated below, as determined by testing assembled materials composed of surface coverings, backings, and other construction identical to those required in this section, per ASTM E 84, by a testing organization acceptable to authorities having jurisdiction.

1. Flame Spread: 25 or less

2. Smoke Developed: 450 or less

B. Acoustical Performance: Provide folding panel partitions tested by independent testing laboratory acceptable to authorities having jurisdiction, for the following acoustic properties, according to the test method indicated:

1. Sound Transmission Requirements: Folding panel partition assembly tested in a full scale opening (14 feet by 9 feet) for laboratory sound transmission loss performance in accordance with ASTM E 90, determined by ASTM E 413 and rated for a STC plus or minus 1 as indicated:

a. Sound Transmission Class (STC): Not less than 50 for the specified Model 931/932 Series panels.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.02 MANUFACTURERS

A. To establish standards of manufacture, operation, performance, and appearance, specifications are based on products of Modernfold Inc. "Acousti-Seal 900 Series", Model 932, Paired panels.

B. Subject to compliance with requirements, products of the following manufacturers will also be acceptable:

1. Foldoor/Holcomb & Hoke Mfg. Co.

2. Hufcor, Inc. (Hough Mfg. Corp.)

3. Panelfold, Inc.

2.03 PANEL CONSTRUCTION

A. Provide panel construction, 3 inches thick, consisting of minimum 24 gage steel face sheets welded to minimum 18 gage steel channel frame, factory-fabricated panels, free of joints in faces; panel hanging weight between 8 and 12 pounds per square foot depending upon panel finish. Top reinforcing as required to support hanging from suspension components; internal insulation, internal gasketed edge construction to achieve specified acoustical ratings.

1. Finish Surface: Vinyl fabric, factory-applied over steel face sheets.

B. Provide operable wall assembly that has been tested by an NSSEA accredited acoustical laboratory in a full-scale (14 feet x 9 feet opening) laboratory sound transmission loss performance test, and has been rated for an STC range of 50-52 (NSSEA Class G) when tested in accordance with ASTM E 90.

1. Vertical Seal: Deep nesting, interlocking astragals incorporating continuous vinyl acoustical seal.

2. Horizontal Top Seal: Continuous contact extruded vinyl.

3. Horizontal Bottom Seal: Retractable seal, extruded vinyl face, exerting positive pressure downward, assuring sealing and resisting panel movement. Minimum clearance between retracted seal and floor finish 1 inch.

a. Extension/retraction of bottom seals automatically actuated by movement of partition. Extended seal exerts nominal 20 lbs. pressure downwards.

C. Provide semi-concealed, butt-type hinges, finished to match other exposed hardware. Provide minimum three hinges per joint for heights up to 8' 0"; one additional hinge for each additional 4' 0" increase in height.

2.04 SUSPENSION SYSTEMS

A. Carriers: Four wheel at lead post and two wheel at intermediate spacing as required for size and weight of partition for ease of operation.

B. Suspension Tracks: Heavy duty steel or aluminum, with overhead supports of adjustable steel hanger rods; heavy duty, ball bearing, trolley system supports specifically designed for use with size and type folding panel partition assembly indicated. Track deflection independent of structural support system no more than 1/360th of opening width.

2.05 POSTS AND SEALS

A. Lead posts and jamb posts formed to provide rigidity for partition and light seal at adjacent construction.

1. Post Type: Intermediate post, one side.

B. Sound Seals: Perimeter sweep strips for each side, top, and bottom; providing continuous contact with head and sill surfaces for positive light and sound seal. Include manufacturer's standard male and female sound and light seal at lead post and jamb.

C. Vertical Seals: Deep nesting, interlocking astragals with continuous vinyl acoustical seal.

D. Horizontal Top Seals: Continuous contact extruded vinyl or mechanical retractable vinyl faced seal exerting positive pressure on track when extended.

[REVISE CLEARANCE DIMENSION BELOW AS REQUIRED TO ACCOMMODATE ANTICIPATED STRUCTURE AND FLOOR DEFLECTIONS AND IRREGULARITIES.]

E. Horizontal Bottom Seals: Retractable seal exerting positive pressure downward assuring horizontal and vertical sealing and resisting panel movement. Minimum clearance between retracted seal and floor finish shall be 1 inch.

1. Bottom seal shall be continuous contact extruded vinyl.

F. Final Closure: Positive mechanical closure expanding from panel edge to create positive acoustical seal.

1. Jamb hinged closure.

PART 3 - EXECUTION

3.01 PREPARATION

A. Examine flooring for compliance with requirements for installation tolerances and other conditions affecting performance of folding partitions. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. All installation shall be in accordance with manufacturer's published recommendations.

C. Install folding panel partitions and accessories in compliance with ASTM E 557 after other finishing operations including painting, have been completed.

D. Install folding panel partitions in conformance with drawings and approved shop drawings and in strict compliance with manufacturer's written installation instructions.

E. Match folding panel partitions for color and pattern by installing partitions from cartons in same sequence as manufactured and packaged, if so numbered. Broken, cracked, chipped, or deformed partitions are not acceptable.

F. Repair or replace folding panel partitions within areas where test results indicate partitions do not comply with requirements and retest partitions.

[NOTE: NOISE ISOLATION COEFFICIENT (NIC) IS AN IN PLACE FIELD TEST VALUE AND DOES NOT CORRELATE WITH LABORATORY STC VALUES. THIS TEST IS APPROPRIATE FOR PARTITIONS WITH STC RATING HIGHER THAN 48. FIELD TEST VALUE OF NIC IS GENERALLY 8 TO 10 POINTS LOWER THAN LAB NIC VALUE.]

[THE NIC VALUE SHOULD TAKE INTO ACCOUNT ALL PARTITIONS OF JOB SINCE WIDTH, HEIGHT, PERIMETER OF OPENING, AND FLOOR SURFACE AFFECT NIC. MFR AND/OR ACOUSTICAL CONSULTANT SHOULD BE CONSULTED TO ARRIVE AT A MUTUALLY AGREEABLE NIC VALUE FOR PROJECT.]

3.03 FIELD TESTS

A. Owner will engage an independent testing service to provide in-place tests of each operable partition for Noise Isolation Class (NIC). Tests for measurement of noise isolation between rooms will be performed in general conformance with ASTM E 336; NIC rating will be calculated in accordance with ASTM E 413.

B. If any operable partition does not initially meet NIC requirements stated above, installer will be responsible for modifying and adjusting partition assembly as required, after which partition will be retested until compliance is achieved.

1. Owner will pay cost of initial in-place field test for each operable partition. Cost of additional testing will be borne by the Contractor.

3.04 ADJUSTING

A. Lubricate bearings and sliding parts; adjust to ensure smooth, easy operation.

3.05 CLEANING

A. Clean all folding partition surfaces and clean adjacent surfaces soiled by Work of this section. Avoid use of abrasive cleaners or solutions containing corrosive solvents. Use cleaning materials recommended by manufacturer.

END OF SECTION 10 22 26.13

SECTION 10 26 00 – WALL AND CORNER GUARDS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with all applicable requirements and standards.

1.03 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firm (material producer) with not less than two years of production experience, whose published literature clearly indicates general compliance of products with requirements of this section.

B. Installer Qualifications: Firm specializing in installation of wall protection systems with not less than one year experience in installations similar to that required for this Project.

C. Single Source Responsibility: Provide material produced by a single manufacturer for each wall and corner guard type.

1.04 SUBMITTALS

A. Product Data:

1. Product data for each wall surface protection system component and installation accessory required, including installation methods for each type of substrate. Provide written data on each required component including physical characteristics, such as durability, resistance to fading, and flame resistance.

2. Manufacturer's printed instructions for maintenance of installed Work, including methods and frequency recommended for maintaining optimum condition under anticipated traffic and use conditions. Include precautions against materials and methods which may be detrimental to finishes and performance.

B. Samples:

1. Samples for Verification Purposes: Submit the following:

a. 12 inch long samples of each type of wall and corner guard required.

b. 6" x 6" square samples of each type wall protection required.

2. Prepare samples from same material to be used for the Work.

C. Shop Drawings:

1. Show locations, extent, and installation details of wall and corner guards, and other protection systems.

2. Show methods of attachment to adjoining construction.

D. Record Documents:

1. Provide record approved product data, samples, and shop drawings.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to the Project Site in original factory wrappings and containers, clearly labeled with identification of manufacturer, brand name, quality or grade, fire hazard classification, and lot number. Store materials in original undamaged packages and containers, inside well ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity; laid flat, blocked off ground to prevent sagging and warping.

B. Comply with instructions and recommendations of manufacturer for special delivery, storage, and handling requirements.

1.06 SEQUENCING AND SCHEDULING

A. Sequence wall and corner guard and wall and door protection system installation with other Work to minimize possibility of damage and soiling during remainder of construction period.

1.07 EXTRA MATERIALS:

A. After completion of Work, deliver to Owner not less than 2 percent of each type, color, and pattern of wall and corner guard, and wall protection material exclusive of material required to properly complete installation. Furnish accessory components as required. Furnish replacement materials from same production run as materials installed. Package replacement materials with protective covering, identified with appropriate labels.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.02 MANUFACTURERS

A. To establish standards of manufacture, operation, performance, and appearance, specifications are based on products of IPC Door and Wall Protection Systems, InPro Corporation.

B. Subject to compliance with requirements, products of the following manufacturers will also be acceptable:

1. Balco

2. Korogard Wall Protection Systems

3. IPC/InPro Door and Wall Protection Systems

4. Pawling Corporation

5. Tepromark, Inc.

2.03 MATERIALS

A. Provide wall and corner guards in materials as indicated. Fabricate units with tight seams and joints, with exposed edges rolled. Provide units with surfaces free of evidence of wrinkling, chipping, uneven coloration, dents and other imperfections.

B. Corner Guards: Provide wall and corner guards in dimensions, mounting, and profile details as indicated in configuration as shown on drawings. Provide material in 90 degree corners unless otherwise indicated, mounting holes 8 inches on center and formed edges.

1. Stainless Steel: Minimum 16 gage, Type 304, #4 satin finish. 3.5 x 3.5 inches x length as indicated.

a. CG-1: 90 degrees.

b. CG-2: C-channel to wrap around wall. Dimensions to be verified in the field.

C. Jamb Guards: 304 Stainless vertical steel rollers as manufactured by Life Science Products, Inc., 124 Speer Road, Chestertown, MD 21620, 1-800-638-9874.

1. Size: Four feet long.

2. Mounting: mounted to jamb opposite door side of jamb. Refer to Drawings for mounting height.

D. Crash Rails: Provide crash rails in dimensions, mounting and profile details as indicated in the drawings. Provide sheet metal blocking behind the gypsum board as required. Provide sealant at all joints. Seal joint between crash rail and the wall (top and bottom) at all locations.

1. WP-1: Basis of Design Nu Tree as manufactured by IPC Door and Wall Protection Systems, InPro Corporation, PO Box 406 Muskego, WI 53150 USA; Telephone: 800.222.5556, Fax: 888.715.8407, www.inprocorp.com

a. Provide crash rails designed to absorb shock without damage to adjacent wall in dimensions and finishes indicated.

b. Size; 1.5 x 5.5 inches,

2. WP-2: Match existing crash rail. Match dimensions, profile, mounting height and configuration.

2.04 FINISHES

A. Provide materials in colors as selected by Architect from manufacturer's standard colors and patterns.

B. Provide materials in colors as specified by Architect for custom color.

PART 3 - EXECUTION

3.01 PREPARATION

A. Examine areas and conditions in which wall and corner guards and wall protection systems will be installed. Do not proceed until unsatisfactory conditions have been corrected.

B. Prior to installation of wall and corner guards, clean substrate to remove dust, debris, and loose particles.

C. Ascertain that substrate is free of previous surface applied material. Prepare substrate surface to accept new material.

D. Illuminate areas of installation using building's permanent lighting system; temporary lighting alone will not be acceptable.

E. Verify that materials are those specified before installing.

3.02 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. All installation shall be in accordance with manufacturer’s published recommendations.

C. Install surface mounted wall and corner guards and wall and door protection systems and accessories after other finishing operations, including painting, have been completed.

D. Do not use material with chips, cracks, voids, stains, or other defects which might be visible in the finished Work.

E. Install material and assemblies to comply with drawings and final shop drawings in strict compliance with manufacturer's printed instructions. Adjust accessories for proper system alignment.

3.03 FIELD QUALITY CONTROL

A. Remove and replace material which is broken, chipped, stained or otherwise damaged and which does not match adjoining Work. Provide new matching units, installed as specified and in manner to eliminate evidence of replacement.

3.04 CLEANING

A. Immediately upon completion of installation, clean installed material.

B. Remove excess adhesive, using methods and materials recommended by manufacturer.

C. Remove surplus materials, rubbish, and debris resulting from installation upon completion of Work, and leave areas of installation in neat, clean condition.

END OF SECTION 10 26 00

SECTION 10 28 13 – TOILET AND BATH ACCESSORIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with all applicable requirements and standards.

1.03 QUALITY ASSURANCE

A. Inserts and Anchorages: Furnish accessory manufacturers' standard inserts and anchoring devices that must be set in concrete or built into masonry. Coordinate delivery with other Work to avoid delay.

B. Single Source Responsibility: Provide products of same manufacturer for each type of accessory unit and for units exposed to view in same areas, unless otherwise acceptable to Architect.

1.04 SUBMITTALS

A. Product Data:

1. Submit a complete listing of all manufacturers, products, model numbers, and designs proposed for use in the Work of this Section.

B. Record Documents:

1. Maintain two copies of all shop drawings, product data, and samples, manufacturer's specifications, recommendations, installation instructions, and maintenance data at the Project Site. At Project Closeout, turn over both copies to the Architect who will transmit one copy to the Owner.

1.05 PROJECT CONDITIONS

A. Coordination: Coordinate accessory locations, installation, and sequencing with other Work to avoid interference with and ensure proper installation, operation, adjustment, cleaning, and servicing of toilet accessory items.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.02 MANUFACTURERS

A. Product numbers scheduled below are products of the Bobrick Washroom Equipment, Inc. Subject to compliance with requirements, other manufacturers offering toilet accessories that may be incorporated in the Work include, but are not limited to, the following:

1. A & J Washroom Accessories
2. American Specialties, Inc.
3. Bradley Corporation
4. General Accessory Manufacturing Co.
5. McKinney/Parker
6. Bobrick Washroom Equipment, Inc.

2.03 ACCESSORY SCHEDULE

A. See Accessory Schedule Listed at the end of this Section.

2.04 MATERIALS, GENERAL

A. Stainless Steel: AISI Type 302/304, with polished No. 4 finish, 0.034 inch (22 gage) minimum thickness.

B. Brass: Leaded and unleaded, flat products, ASTM B 19; rods, shapes, forgings, and flat products with finished edges, ASTM B 16; Castings, ASTM B 30.

C. Sheet Steel: Cold rolled, commercial quality ASTM A 366, 0.04 inch (20 gage) minimum. Surface preparation and metal pretreatment as required for applied finish.

D. Galvanized Steel Sheet: ASTM A 527, G60.

E. Chromium Plating: Nickel and chromium electro deposited on base metal, ASTM B 456, Type SC 2.

F. Baked Enamel Finish: Factory applied, gloss white, baked acrylic enamel coating.

G. Stainless Steel Mirror Surfaces: Not less than 0.04 inch (20 gage) AISI Type 302/304 stainless steel sheet, stretcher leveled with No. 8 polished mirror finish. Bond to 1/4 inch minimum hardboard backing.

H. Galvanized Steel Mounting Devices: ASTM A 153, hot dip galvanized after fabrication.

I. Fasteners: Screws, bolts, and other devices of same material as accessory unit, or of galvanized steel where concealed.

2.05 FABRICATION

A. No names or labels are permitted on exposed faces of toilet and bath accessory units. On either interior surface not exposed to view or on back surface, provide identification of each accessory item either by a printed, waterproof label or a stamped nameplate indicating manufacturer's name and product model number.

B. Surface Mounted Toilet Accessories, General: Except where otherwise indicated, fabricate units with tight seams and joints, exposed edges rolled. Hang doors or access panels with continuous stainless steel piano hinge. Provide concealed anchorage wherever possible.

C. Recessed Toilet Accessories, General: Except where otherwise indicated, fabricate units of all welded construction, without mitered corners. Hang doors or access panels with full length, stainless steel piano hinge. Provide anchorage that is fully concealed when unit is closed.

D. Framed Mirror Units, General: Fabricate frames for glass mirror units to accommodate wood, felt, plastic, or other glass edge protection material. Provide mirror backing and support system that will permit rigid, tamperproof glass installation and prevent moisture accumulation, as follows:

1. Provide galvanized steel backing sheet, not less than 0.034 inch (22 gage) and full mirror size, with non absorptive filler material. Corrugated cardboard is not an acceptable filler material.

E. Mirror Unit Hangers: Provide system for mounting mirror units that will permit rigid, tamperproof, and theft proof installation, as follows:

1. One piece galvanized steel, wall hanger device with spring action locking mechanism to hold mirror unit in position with no exposed screws or bolts.

2. Heavy duty wall brackets of galvanized steel, equipped with concealed locking devices requiring a special tool to remove.

F. Keys: Provide universal keys for access to toilet accessory units requiring internal access for servicing, re-supply, etc. Provide minimum of six keys to Owner's representative.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. All installation shall be in accordance with manufacturer’s published recommendations.

C. Install toilet accessory units according to manufacturers' instructions, using fasteners appropriate to substrate as recommended by unit manufacturer. Install units plumb and level, firmly anchored in locations and at heights indicated.

D. Secure mirrors to walls in concealed, tamperproof manner with special hangers, toggle bolts, or screws. Set units plumb, level, and square at locations indicated, according to manufacturer's instructions for type of substrate involved.

E. Install grab bars to withstand a downward load of at least 250 lbf, complying with ASTM F 446.

3.02 ADJUSTING AND CLEANING

A. Adjust toilet accessories for proper operation and verify that mechanisms function smoothly. Replace damaged or defective items.

B. Clean and polish all exposed surfaces strictly according to manufacturer's recommendations after removing temporary labels and protective coatings.

3.03 PUBLIC-USE WASHROOM ACCESSORIES

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated in schedule below or comparable product by one of the following:

1. A & J Washroom Accessories, Inc.

2. American Specialties, Inc.

3. GAMCO Specialty Accessories; a division of Bobrick Washroom Equipment, Inc.

4. Tubular Specialties Manufacturing, Inc.

5. Georgia – Pacific.

B. TA-3 – Paper Towel Dispenser, Surface:

1. Material: plastic.

2. Construction: touchless dispensing using 4 D-cell batteries.

3. Mounting: Surface.

4. Capacity: 800 linear feet Georgia Pacific enMotion white high capacity EPA Roll Towel.

5. Basis of Design Products:

a. Georgia Pacific enMotion Impulse 10 #59487, color - splash blue.

b. Or equal product as determined by Owner.

C. TA-4 – Sanitary Napkin Disposal, Partition:

1. Material: Stainless steel, 22 gage door and flanges.

2. Construction: All-welded with continuous stainless steel piano hinge.

3. Door: Push type, self-closing.

4. Mounting: In toilet partition serving two compartments.

5. Receptacle: Leak proof, plastic, removable; capacity 1.2 gallons.

6. Basis of Design Products:

a. Bobrick B-354.

b. Bradley 4721-15.

D. TA-5 – Sanitary Napkin Disposal, Recessed in Wall:

1. Material: Stainless steel.

2. Construction: All-welded with continuous stainless steel piano hinge.

3. Door: Push type, self-closing.

4. Mounting: Recessed in wall.

5. Receptacle: Leak proof, plastic, removable; capacity 1.2 gallons.

6. Basis of Design Products:

a. Bobrick B-35303.

b. Bradley 4737.

E. TA-7 – Toilet Tissue Dispenser, Double Roll:

1. Material: Die cast aluminum with molded high-impact ABS spindles with concealed locking mechanism.

2. Capacity: Two standard core tissue rolls up to 6 inches diameter.

3. Mounting: Surface.

4. Basis of Design Products:

a. Bobrick B-2740.

b. Bradley 5241.

F. TA-8 – Soap Dispenser, Surface on Wall:

1. Material: 22 gage stainless steel, satin finish, front plunger.

2. Capacity: 40 fluid ounces.

3. Mounting: Surface; horizontal.

4. Basis of Design Products:

a. Bobrick B-2112.

b. Bradley 6542.

G. TA-9 – Grab Bars:

1. Sizes: Refer to Drawings.

2. Material: Stainless Steel, 18 gage, type 304, satin finish.

3. Construction: 1-1/2 inch clearance between grab bar and wall.

4. Mounting: Concealed plates with no exposed fasteners.

5. Basis of Design Products:

   a. Bobrick B-6206.

   b. Bradley 812.

H. TA-10 – Grab Bar, Two Wall:

1. Size: Refer to Drawings.

2. Material: Stainless steel.

3. Construction: 1-1/2 inch clearance between grab bar and wall.

4. Mounting: Concealed plates with no exposed fasteners.

5. Basis of Design Products:

   a. Bobrick B-62616.

   b. Bradley 8120-059.

I. TA-11 – Heavy-Duty Towel and Robe Hook:

1. Material: Chrome plated brass with satin finish.

2. Mounting: Surface, concealed.

3. Basis of Design Products:

   a. Bobrick B-2116.

   b. Bradley 9119.

J. TA-12s – Mirror, Framed with Shelf:

1. Material: No. 1 quality, 1/4 inch select float glass, 20 gage galvanized steel back and stainless steel retainer angle.

2. Size: 24 inches wide by 36 inches high.

3. Mounting: Surface with concealed hangers

4. Basis of Design Products:

   a. Bobrick B292.

   b. Bradley 7805.

K. TA-15 - Shelf / Broom and Mop Holder:

1. Sizes: 44 inches.

2. Material: Stainless steel, type 304, exposed surfaces satin finished.

3. Construction: 5 holders, 4 stainless steel hooks, stainless steel towel rod, brackets welded to shelf.

4. Mounting: Surface.

5. Basis of Design Products:

   a. Bobrick B-239.

   b. Bradley 9934.

L. TA-18 - Shower Rod:

1. Material: Stainless steel, 18 gage, type 304, satin finish.

2. Size: 1 inch diameter, lengths as detailed on Drawings.

3. Mounting: Surface with concealed mounting.

4. Basis of Design Products:

   a. Bobrick B-6107.

   b. Bradley 9065.

M. TA-19 - Soap Dish:

1. Material: Stainless steel, satin finish.

2. Mounting: Recessed.

3. Basis of Design Products:

   a. Bobrick B-6617.

   b. Bradley 9353.

N. TA-20 - Folding Shower Seat:

1. Materials: Plastic and stainless steel.

2. Basis of Design Products: Refer to Drawings for selection.

   a. Right-hand seat: Bobrick B-5171.

   b. Left-hand seat: Bobrick B-5181.

O. TA-28 - Toilet Seat Cover Dispenser:

1. Material: 22 gage stainless steel.

2. Mounting: Surface.

3. Construction:

   a. Surface Mounted: All welded; no hinge or lock.

4. Capacity:

   a. Surface Mounted 500 paper toilet seat covers.

5. Basis of Design Products:

   a. Surface Mounted: Bobrick B-221.

   b. Surface Mounted: Bradley 5831

P. TA-30 – Locker Room Bench; Refer Section 10 51 13 for requirements

Q. Notes:

1. Locate for accessibility as shown on Drawings.

2. Provide one TA-3 and one TA-8 at each hand wash sink, unless noted otherwise.

3. Provide one TA-15 at each Janitor Closet.

3.04 UNDERLAVATORY GUARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Plumberex Specialty Products, Inc.

2. Truebro by IPS Corporation.

B. Underlavatory Guard, ULG:

1. Description: Insulating pipe covering for supply and drain piping assemblies that prevent direct contact with and burns from piping; allow service access without removing coverings.

2. Material and Finish: Antimicrobial, molded plastic, white.

END OF SECTION 10 28 13

SECTION 10 44 00 – FIRE EXTINGUISHERS, CABINETS, AND ACCESSORIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with all applicable requirements and standards.

1.03 QUALITY ASSURANCE

A. Single Source Responsibility: Obtain extinguishers and cabinets from one source from a single manufacturer.

B. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Standard for Portable Fire Extinguishers."

C. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

1.04 SUBMITTALS

A. Product Data:

1. Product data for each type of product specified.

2. For fire extinguisher cabinets include rough-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type and materials, trim style, door construction, panel style, and materials.

B. Samples:

1. Samples for verification purposes of each type of metal finish required, prepared on metal samples of same thickness and alloy indicated for final unit of Work.

a. Where finishes involve normal color and texture variations, include sample sets showing full range of variations expected.

C. Record Documents:

1. Provide record approved product data and samples.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.02 FIRE EXTINGUISHERS

A. Provide fire extinguishers for each extinguisher cabinet and other locations indicated, in colors and finishes selected by Architect from manufacturer's standard, that comply with authorities having jurisdiction.

B. Extinguisher Drawing Schedule: Provide the following fire extinguishers, brackets, and cabinets at locations indicated:

1. In each cabinet provide 5-BC Carbon Dioxide extinguisher and 2 ½ lb water extinguisher.

2. Bracket mounted 10-BC Carbon Dioxide extinguisher.

2.03 MOUNTING BRACKETS

A. Brackets: Designed to prevent accidentally dislodging extinguisher, of sizes required for type and capacity of extinguisher indicated.

1. Provide manufacturer’s standard metal brackets for extinguishers not located in cabinets.

2.04 FIRE EXTINGUISHER CABINETS

A. Provide fire extinguisher cabinets where indicated and from the same manufacturer as the extinguishers. Provide sizes required for housing specified fire extinguishers, and as follows:

B. Construction: Manufacturer's standard enameled steel box, with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated. Weld joints and grind smooth. Miter and weld perimeter door frames.

C. Fire Rated Cabinets: UL listed with UL Listing Mark with rating of wall where it is installed.

D. Cabinet Type: Suitable for mounting conditions indicated of the following types:

1. Recessed: Cabinet box (tub) fully recessed in walls of sufficient depth to suit style of trim indicated.

a. Larsen’s Architectural Series 2720-R and FS 2720-R

b. J.L. Industries 4015 and 4015 FX

E. Trim Style: Match existing; fabricate trim in one piece with corners mitered, welded, and ground smooth.

1. Exposed Trim: One piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).

a. Square edge trim with 1/4 to 5/16 inch backbend depth.

b. Trim Metal: Of same metal and finish as door.

F. Door Material and Construction: Manufacturer's standard door construction, of material indicated, coordinated with cabinet types and trim styles selected.

1. Cold-Rolled Steel: Solid, white baked acrylic enamel, which can be used either as a finish or prime coat. Door shall include lettering.

G. Identify fire extinguisher in cabinet with FIRE EXTINGUISHER lettering applied to door vertically. Provide lettering to comply with authorities having jurisdiction for letter style, red in color, size, spacing, and location.

H. Identify bracket mounted extinguishers with FIRE EXTINGUISHER in red letter decals applied to wall surface. Use letter size, style, and location as selected by Architect.

I. Door Style: Manufacturer's standard design.

1. Solid Panel: Full flush opaque panel of material indicated.

J. Door Hardware:

1. Provide manufacturer's standard door operating hardware of proper type for cabinet type, trim style, and door material and style indicated. Provide concealed or continuous type hinge permitting door to open 180 deg.

2. Special Requirement: Provide recessed concealed handle with cam action latch.

2.05 FINISHES FOR FIRE EXTINGUISHER CABINETS, GENERAL

A. Comply with NAAMM "Metal Finishes Manual" for recommendations relative to applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying strippable, temporary protective covering prior to shipping.

C. Match existing color.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. All installation shall be in accordance with manufacturer’s published recommendations.

C. Install in locations and at mounting heights indicated or, if not indicated, at heights to comply with applicable regulations of governing authorities.

1. Prepare recesses in walls for fire extinguisher cabinets as required by type and size of cabinet and style of trim and to comply with manufacturer's instructions.

2. Fasten mounting brackets and fire extinguisher cabinets to structure, square and plumb.

D. Where fire rated walls are to receive recessed or semi-recessed cabinets, coordinate for proper installation of fire rated cabinets.

END OF SECTION 10 44 00

SECTION 10 51 13 – METAL LOCKERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with all applicable requirements and standards.

1.03 QUALITY ASSURANCE

A. Uniformity: Provide metal lockers that are standard products of single manufacturer, with interchangeable like parts. Include necessary mounting accessories, fittings, and fastenings.

1.04 SUBMITTALS

A. Product Data:

1. Product data and installation instructions for metal locker units.

B. Samples:

1. Samples for Verification: Manufacturer's standard sizes, showing the full range of color, texture, and pattern variations expected. Prepare Samples from the same material to be used for the Work.

C. Shop Drawings:

1. Show metal lockers in dimensioned relation to adjacent surfaces.

2. Show lockers in detail, method of installation, fillers, trim, base, and accessories. Include locker numbering sequence information.

D. Record Documents:

1. Provide record approved product data, samples, and shop drawings.

1.05 PROJECT CONDITIONS

A. Do not deliver metal lockers until building is enclosed and ready for locker installation. Protect from damage during delivery, handling, storage, and installation.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.02 MANUFACTURERS

A. Republic Storage Systems, LLC "Quiet" steel lockers are specified as the type, function, and quality required.

B. Products of the following manufacturers are acceptable, contingent upon providing products which are equivalent to or exceed the type, function, and quality specified, and are in compliance with the requirements of this Section:

1. De Bourgh Manufacturing Co.

2. Interior/Medart

3. List Industries Inc.

4. Lyon Metal Products

5. Penco Products Inc.

2.03 MATERIALS AND FABRICATION

A. Provide steel lockers with vented door panel as specified herein. Provide the following arrangements and sizes as indicated on the Drawings:

1. Locker Type 1: Double tier units; each locker 12 inches wide x 18 inches deep x 36 inches high.

2.04 MATERIALS

A. Sheet Steel: Mild cold rolled and leveled furniture steel, free from buckle, scale, and surface imperfections.

B. Expanded Metal: 3/4 inch mesh flattened carbon steel.

C. Fasteners: Cadmium, zinc, or nickel plated steel; exposed bolt heads, slotless type; self locking nuts or lock washers for nuts on moving parts.

D. Equipment: Hooks and hang rods of cadmium plated or zinc plated steel.

2.05 FABRICATION, GENERAL

A. Construction: Fabricate lockers square, rigid, and without warp, with metal faces flat and free of dents or distortion. Make exposed metal edges safe to touch. Weld frame members together to form rigid, one piece structure. Weld, bolt, or rivet other joints and connections. Grind exposed welds flush. Do not expose bolts or rivet heads on fronts of locker doors or frames.

2.06 FINISHES, GENERAL

A. Finish all steel surfaces and accessories, except prefinished stainless-steel and chrome-plated surfaces.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. Surface Preparation: Clean surfaces of dirt, oil, grease, mill scale, rust, and other contaminants that could impair paint bond. Use manufacturer's standard methods.

E. Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard baked-enamel finish consisting of a primer and a thermosetting topcoat. Comply with paint manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 1.4 mils (0.036 mm) on doors, frames, and legs, and 1.1 mils (0.028 mm) elsewhere.

1. Color: Provide locker units in color(s) selected by Architect from manufacturer's complete line (15 choices minimum) of available colors. Concealed parts may be manufacturer's standard neutral color.

2.07 WARDROBE LOCKERS

A. Body: Fabricate back and sides of minimum 24 gage steel, with double flanged connections extending full height. Form top and bottom of not less than 24 gage steel, with flanged edges.

1. Form exposed ends of non recessed lockers of minimum 16 gage steel.

B. Door: One piece, minimum 16 gage sheet steel, flanged at all edges, constructed to prevent springing when opening or closing. Fabricate to swing 180 degrees.

1. Ventilation: Provide slots at full perimeter of opening.

2. Ventilation: Provide stamped, louvered vents in door face, as follows:

a. Double tier lockers: Not fewer than 3 louver openings top and bottom.

3. Hinges: Steel, full loop, 5 knuckle, tight pin. Weld to inside of frame and secure to door with not fewer than 2 factory installed fasteners that are completely concealed and tamperproof when door is closed.

a. Provide at least 3 hinges for each door over 42 inches high; at least 2 hinges for each door 42 inches high or less.

C. Handle and Latch: Positive automatic, non-protruding, prelocking, pry resistant latch and pull; 14 gage plastic covered, heavy duty, vandalproof lift up handle, with strike and eye for padlock.

1. A 20 gage stainless steel recessed pocket containing the latch and handle shall be provided.

D. Acoustical Treatment: Provide construction treatment designed for significant reduction of noise of locker operation, including protected sound absorbing material; nylon or plastic coatings on operating components to prevent metal to metal contact, and latching mechanism designed to operate without rattling.

2.08 LOCKER ACCESSORIES

A. Equipment: Furnish each locker with the following items, unless otherwise shown:

1. Double Tier Units: One double prong rear hook and not fewer than 2 single prong side hooks.

2. Lockers 18 inches Deep: Provide hang rod in lieu of hook.

3. Multi-tier Lockers with space between Vertical Components: Provide chrome plated hang rod between verticals.

B. Number Plates: Manufacturer's standard etched, embossed, or stamped, nonferrous metal number plates with numerals not less than 1/2 inches high. Number lockers in sequence as directed by Architect. Attach plates to each locker door, in latch recess, with at least 2 fasteners of same finish as number plate.

C. Continuous Sloping Tops: Not less than 20 gage sheet steel, approximately 25 degrees pitch, in lengths as long as practicable but not less than 4 lockers. Provide closures at ends. Finish to match lockers.

D. Separators: Provide horizontal dividers of not less than 16 gage sheet steel between doors of multiple tier lockers to ensure rigidity.

E. Filler Panels: Provide filler panels where indicated, of not less than 18 gage steel sheet, factory fabricated and finished to match locker units.

F. Base: Where indicated, provide 4” high 16 gage metal base, factory fabricated and finished to match locker units. Recess base from front face of lockers.

G. Accessible Lockers: For lockers indicated to be accessible, provide shelf in locker located no lower than 9” above finished floor surface. Provide accessibility symbol graphics at exterior of locker door. Completed installation shall comply with requirements of the Americans with Disabilities Act (ADA).

2.09 BENCHES AND PEDESTALS

A. Description: Locker benches shall be laminated maple, 1-1/4" full finished thickness. All corners are to be rounded and sanded. Top and edges have two coats of a clear finish with one coat on the bottom.

1. Size Bench tops are to be ADA approved measuring 24 inches wide x 48 inches long.

2. Pedestals: Tops to be mounted on pedestals consisting of 1-1/4" O.D. tubing with 10 gauge steel flanges welded to each end. The overall height of bench assembly shall be 17-1/2". Pedestals shall be finished to match lockers. Four pedestals required.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. Install metal lockers at locations shown in accordance with manufacturer's instructions for plumb, level, rigid, and flush installation.

C. Assemble knocked-down lockers with standard fasteners, with no exposed fasteners on door faces and face frames.

D. Connect groups of all-welded lockers together with standard fasteners, with no exposed fasteners on face frames.

E. Anchor lockers to floors and walls at intervals recommended by manufacturer, but not more than 36 inches (910 mm) on center. Install anchors through back-up reinforcing plates where necessary to avoid metal distortion, using concealed fasteners.

F. Install trim, metal base, sloping top units, and metal filler panels and end panels, using concealed fasteners. Provide flush, hairline joints against adjacent surfaces.

3.02 ADJUST AND CLEAN

A. Adjust doors and latches to operate easily without binding. Verify that integral locking devices are operating properly.

B. Touch up marred finishes, but replace units that cannot be restored to factory finished appearance. Use only materials and procedures recommended or furnished by locker manufacturer.

END OF SECTION 10 51 13

SECTION 10 71 19 – FLOOD BARRIERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 SUMMARY

A. Provide labor, material, equipment, related services and supervision required, including, but not limited to, engineering, manufacturing, fabrication, and installation for flood barrier systems as required for the complete performance of the Work, and as shown on the Drawings and as specified herein.

B. This Section includes:

1. Sliding watertight flood barrier doors with inflatable seals.

1.03 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firm (material producer) with not less than five years of production experience, who's published literature clearly indicates general compliance of products with requirements of this section.

B. Single Source Responsibility: Obtain flood barriers and system components through one source from a single manufacturer.

1.05 SUBMITTALS

A. Product Data: For each type of flood barrier indicated. Include construction details relative to materials, individual components and profiles, and finishes.

B. Shop Drawings: Submit shop drawings for special door(s) including dimensioned plans and elevations, details of sections, connections and anchorage to other work, and parts list.

C. Delegated Design Submittal: For installed products indicated to comply with performance requirements and design criteria, include analysis data and calculations signed and sealed by the qualified professional engineer responsible for their preparation.

D. Certificates: Submit certification that the door(s) furnished, or a door of similar design, has been satisfactorily tested to verify that it will withstand the design hydrostatic pressure.

E. Qualification Date: For qualified professional engineer.

F. Operation and Maintenance Data: Submit instructions for maintaining flood barriers and for adjusting, repairing, and replacing components.

G. Warranty:

1. Manufacturer's warranty form in which manufacturer agrees to repair or replace components that fail in materials or workmanship within specified warranty period.

1.06 DELIVERY, STORAGE AND HANDLING

A. Do not deliver flood barriers until spaces to receive them are ready for flood barrier installation. Deliver in manufacturer’s undamaged protective cartons or packaging.

B. Protect flood barriers from damage during delivery, handling, storage and installation.

1.07 PERFORMANCE REQUIREMENTS

A. Design flood barriers, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Assembly shall be in accordance with the requirements of the national Flood insurance Program (NFIP) for the zone appropriate for the project location.

C. Hydrostatic Pressure Resistance: Resistance to lateral forces due to hydrostatic pressure from freestanding water in accordance with Federal Emergency Management Agency (FEMA) Technical Bulletin 3-93.

1. Watertight door(s) systems shall be designed and installed to resist a minimum of 15 feet (4.6 m) of hydrostatic pressure head at the installation location.

2. Watertight door(s) shall be designed with a minimum 2:1 factor of safety based on material yield strength, and shall provide an effective seal against the design pressure.

1.08 WARRANTY

A. Manufacturers standard form in which manufacturer agrees to repair or replace components of flood barriers that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including, but not limited to, excessive deflection.

b. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.

c. Delamination of exterior or interior facing materials.

2. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.02 MANUFACTURERS

A. Basis of Design: Design of watertight door systems is based on the D5B Sliding Watertight Door with Pneumatic Seals by Presray Corporation. Subject to compliance with requirements, provide the named product or a comparable product by one of the following:

1. Walz & Krenzer, Inc.

2. Other systems/manufacturers subject to approval of Architect.

2.03 MATERIALS

A. Structural Steel Plates and Shapes: ASTM A36.

B. Finish: Brush-off blast clean per SSPC-SP7, prime with one coat rust inhibitive, lead free, red primer.

C. Door Seals: Fabric reinforced high strength synthetic rubber. Basis of Design is Dual Presray type Pneuma-Seal inflatable gaskets.

D. Seal Controls: Control valve, pressure regulator, pressure gages, and mounting panel, for location on both interior and exterior wall to facilitate sealing of the door from either side. Valves shall be designed to ensure that, in the event of inadvertent damage to either seal, the other will remain sealed.

E. Door Hardware: Trolley track mounting brackets, ball bearing hangers and door pulls.

2.04 DESIGN

A. Door shall be designed for manual operation from either side.

B. Frame shall include suitable provisions for continuous support of all four edges of the door when the door is in the closed position. The frame at the sill shall form a trench to be recessed in the floor; the back wall of the trench shall provide a surface on which to mount the inflatable seal; the front wall shall act as a stop and provide a continuous support for the bottom edge of the door. Frame shall include suitable anchors for embedment in concrete.

2.05 SOURCE QUALITY CONTROL

A. All welds on steel assemblies that may be potential “leak path” shall be liquid penetrant inspected in accordance with ASME section VIII Div. of Appendix 8.

B. Finished assembly, or assembly similar in design shall be factory leak tested to verify that it will withstand the design hydrostatic pressure.

PART 3 - EXECUTION

3.01 PREPARATION

A. Advise installers of other work about specific requirements specific to watertight flood door installation

B. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, surface preparation, and other conditions affecting performance of work.

1. Surface contacting the inflatable seals shall be finished to 63 microinch to maximize sealing.

3.02 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. Installation shall be in accordance with manufacturer’s published recommendations:

3.03 ADJUSTING AND CLEANING

A. Adjust for proper operations

B. Remove and replace components that are warped, bowed, or otherwise damaged.

3.04 TRAINING

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain watertight flood doors.

END OF SECTION 10 71 19

SECTION 10 90 00 - ANIMAL MONITORING SYSTEM

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 SUMMARY

A. This is an expansion of the existing Edstrom Watchdog and Viewport Systems into the CRB Animal Area Renovation Project. A computer based data management, monitoring and control system specifically designed for laboratory animal facilities. The multi-tasking operating system allows simultaneous data collection, room task scheduling, alarm notification and report generation. Information is suitable to support reproducible studies employing good laboratory practices (GLP) and Association for Assessment and Accreditation of Laboratory Animal Care (AAALAC).

1.03 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Include dimensioned plan and elevation views of telecommunications equipment rooms, with each individual component labeled. Show equipment rack assemblies, method of field assembly, workspace requirements, and access for cable connections.

1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

1.05 COORDINATION

A. Coordinate layout and installation of cabling and conduit locations with Owner's equipment and service suppliers. Coordinate service arrangements with local telephone exchange carrier.

1. Meet jointly with access provider representatives and Owner to exchange information and agree on details of equipment arrangements and installation interfaces.

2. Obtain product data for specialized equipment Owner intends to contract separately or install later.

3. Record agreements reached in meetings and distribute to other participants.

4. Coordinate electrical and data conduit locations, control panel, back-boxes and electrical door hardware components with associated trades.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Animal Monitoring System: Edstrom Industries Watchdog System.

1. Edstrom Industries, Inc. 819 Bakke Avenue • Waterford WI 53185 • Tel: 262 534 5181 • Fax: 262 534 5184 • www.edstrom.com:

2.02 SYSTEM COMPONENTS

A. VLP Touchscreen Panel

1. The VLP Touchscreen features SAW (Surface Acoustic Wave) technology for fingertip touch sensing even through latex or nitrile gloves. The screen is water-resistant and chemical resistant. Both the surface mount and flush mount options feature a stainless steel front panel.

2. Enclosure Options

a. Surface mount stainless steel enclosure 18.75 in. W x 24 in. H x 2.75 in. D (476 mm W x 610 mm H x 70 mm D) - self contained (no back box)

b. Flush mount - stainless steel face 18 in. W x 18 in. H (457 mm W x 457 mm H)

1) Recessed galvanized steel back box 16 in. W x 16 in. H x 4.5 in. D (406 mm W x 406 mm H x 114 mm D)

c. Input power: 12VDC/24VDC 60Watts, plug in screw connectors

3. Touchscreen Panel

a. Display 12.1 in. (307 mm) SVGA TFT LCD

b. Resolutions: 800 x 600

c. Backlight: 2 CCFL

4. Hardware/software recovery monitor

5. Environmental parameter:

a. Temperature: 32-120oF (0-50oC)

b. Relative humidity: 10-95% @ 104°F (40oC), non-condensing

c. EMI: meets CE and FCC certifications

B. Embedded Software: The Edstrom Browser Shell provides a browser interface optimized for fingertip operation of the Edstrom system. The Edstrom Browser Shell includes support for an on-screen touch keyboard, and screen saver operations. The Edstrom Browser Shell is included and preinstalled from the factory on every VLP Touchscreen.

1. Edstrom Browser Shell Features

a. Provides full screen access

b. Provide popup on-screen keyboard programmatically when needed

c. Control Interface:

1) Screensaver after user-defined period (default 5 minutes)

2) Prevents unauthorized operating system access.

3) Power save mode turns off backlight after 15 minutes to reduce power consumption, heat emissions and extend backlight brightness life.

C. VLP Power Supply (Powers the VLP)

1. Enclosure - Surface Mounted

a. NEMA 12 painted steel 8 in. W x 10 in. H x 6 in. D (203 mm W x 254 mm H x 152 mm D)

2. Power input and output

a. Input power: 100/120/240 VAC, 50/60 Hz, 60 Watts

b. Output power: 12 VDC, 60Watts, 24VDC 60 Watts, Class 2 Energy limited

c. Terminal block screw connectors

d. One power supply per VLP touchscreen

D. SYSTEM COMMUNICATIONS AND CABLING

1. Uses industry standard TCP/IP over Ethernet for compatibility and flexibility in system layout. VLP Touchscreens are deployed on a private network connected to the Edstrom Watchdog system.

2. Communication Types

a. Ethernet cabling on private network

b. TCP/IP communication to web based facility management systems

1) Setup requires: static IP address, gateway address and subnet mask

3. Cabling - Refer to system layout drawings specific types, routings, and other networking components.

a. General Specifications (Cat-5e)

1) PVC jacketed standard (plenum rated optional)

2) Solid copper conductors

3) Shielded (when applicable)

b. Cable types - conductor quantity and sizes (use as applicable)

1) Power - 3 conductor, 8 to 18 gauge plenum rated depending on site

2) Ethernet: Cat5e specification plenum rated depending on site

E. Power Supply Unit (Powers Watchdog Panels And Network Sensor Devices)

1. Enclosure – surface mounted

    a. NEMA 12 painted steel 8 in. W x 10 in. H x 6 in. D (203 mm W x 254 mm H x 152 mm D)

2. Power input and output

    a. Input power: 120 VAC, 50/60Hz, 2 A Fused

    b. Output power: 26 VAC, 2 outputs fused at 5 amps each

    c. Plug in screw connectors requiring no tools for disassembly

3. Capacity

    a. The number of Panels and Network Modules supported by a single Power Supply Station is a function of the type of Panels, the type of Modules, and the distance these loads are from the Power Supply Station.

    b. For a typical installation that includes lighting, one Power Supply Station will support a single Panel and six rooms.

F. Power Supply Station (Powers Local Processors)

1. Enclosure – surface mounted

    a. NEMA 1 painted steel 10 in. W x 12 in. H x 6 in. D (254 mm W x 305 mm H x 152 mm D)

2. Power input and output

    a. Input power: 120 VAC, 50/60 Hz 1.5 Amp

    b. Output power: 8 VDC filtered and 24 VDC

    c. Plug in screw connectors requiring no tools for disassembly

3. Capacity

    a. Maximum of 4 processors or maximum of 4 door locks per Power Supply

4. Regulatory Compliance

    a. ETL listed, conforms to UL508, certified to CAN/CSA Std C22.2 no. 14

G. Power Supply Station (Powers Smart Box)

1. Enclosure – surface mounted

    a. NEMA 1 painted steel 10 in. W x 12 in. H x 6 in. D (254 mm W x 305 mm H x 152 mm D)

2. Power input and output

    a. Input power: 120 VAC, 50/60 Hz 1.0 Amp fused

    b. Output power: 24 VAC fused at 3 amps

    c. Screw terminal connectors

3. Capacity

   a. 1 Smart Box per power supply

4. Regulatory Compliance

   a. ETL listed, conforms to UL508, certified to CAN/CSA Std C22.2 no. 14

2.03 SMART BOX:

A. Interface between the Server and local processors. Collect and transmit local processor information to the Server. Receive and transmit Server commands to local processor.

B. Enclosure and Display

   1. Recessed galvanized enclosure with stainless steel flush mount panel

   2. Surface mounted low profile stainless steel enclosure and cover

   3. 5 key keypad with poly dome switches

   4. 16 x 2 liquid crystal display

C. Processor and Communications

   1. Nonvolatile memory

   2. Communicate with Server station via a RS422 serial protocol

   3. Communicate with local processors with DTMF communications circuit on 2 separate busses each supporting up to 32 local processors

   4. Poll local processors at least once per minute

   5. Identical, interchangeable circuit board with individual software assignable address

D. User Interface

   1. Provide communication interface between Server and local processors.

   2. Collect and transmit LP data to server at least once per minute.

   3. Receive and transmit Server commands to local processor

   4. Provide trouble-shooting capabilities with communication problems

2.04 LOCAL PROCESSOR (LP)

A. Interface between sensor and control components and smart box. Collect and transmit sensor data to smart box. Receive and transmit control commands to control components. Local user interface for data, display, input for lights, Automated Watering System, access control, and sensor calibration.

B. Enclosure and Display

   1. Recessed galvanized enclosure with stainless steel flush mount panel

   2. Surface mounted low profile stainless steel enclosure and cover

3. 13 key keypad with poly dome switches

4. 16 x 2 liquid crystal display

C. Processor and Communications

1. Non-volatile memory.

2. 7 digital input channels – 2 assignable

3. 4 assignable analog 4-20 mA input channels

4. 2-way communications circuit board with individual software assignable address

5. Store all parameter limits, set-up information and up to 750 PIN codes in non-volatile memory.

6. Special diagnostic programs for field calibration of connected sensors

7. Perform all control and local display functions during communication loss with smart box

8. Transmit data to smart box at least once per minute

D. Connections

1. Plug-in screw connectors requiring no tools for disassembly

E. User Interface

1. Access current conditions, limits and alarm status of all connected sensors

2. Activate connected control and access features after entering valid PIN

3. Allow calibration of connected sensors after entering valid PIN

4. Display current time

5. Display data in non-coded, direct reading numeric and English messages

6. Activate clean mode after entering valid PIN to suppress alarm notification process during a user defined time interval

2.05 ENVIRONMENTAL SENTRY PANEL (ESP)

A. Collect and process all data from sensors, provide user interface to view status, troubleshoot, set-up and calibrate, provide data interface for light control and generate calibration report via local connection of printer.

B. Enclosure and display

1. Surface mount stainless steel enclosure (14”W x 16”H x 6”D)

2. Recessed stainless steel back box and Flush Mount Panel - 16”W x 20”H x 6”D

3. 40x2 character liquid crystal display

4. 22 key keypad, all dome switches

5. Input power: 24vac, 1 amp fused input

C. Processor and Communications

1. Non-volatile user program memory

2. (32) 4-20ma., 0-20ma., 0-5V thermistor analog or multifunctional digital inputs

3. 1 network input/output to monitor up to 62 network sensors and/or light modules

4. Auxiliary form C dry remote alarm contact to signal loss of communication with Watchdog Server

5. (1) RS-485 communication port

6. Audible alarm

7. Alarm, service, power LED indicators

D. User Interface

1. Provide status screens to display time, date and panel status

2. Provide calibrate screens to allow user to calibrate individual analog sensors and generate calibration reports.

3. Provide install screens to allow users to troubleshoot monitoring devices after entry of PIN

2.06 ANIMAL WATERING SYSTEM CONTROLLER (AWSC)

A. Collect and process all data from sensors, provide user interface to view status, troubleshoot, set-up and activate control components. Store data in the event of communication loss with Watchdog server.

B. Enclosure and display – surface/recessed mounted

1. Surface mount stainless steel enclosure 14 in. W x 16 in. H x 6 in. D (356 mm W x 406 mm H x 152 mm D)

2. Recessed painted steel back box and Flush Mount Panel 16 in. W x 20 in. H x 6 in. D (406 mm W x 508 mm H x 152 mm D)

3. 40x2 character liquid crystal display

4. 16 key keypad, all poly dome switches

5. Input power: 24vac, 1 amp fused input

C. Communications

1. Non-volatile user program memory

2. (64) 24vdc, 3 amp fused outputs in banks of 16 to control solenoid valves for RDS and/or Waste Flush

3. Network input/output to a maximum of 30 Pressure Stations (PRS) to monitor for system pressure and leak and control flushing

4. Auxiliary form C dry remote alarm contact to signal loss of communication with Watchdog Server

5. (1) RS-485 communication port

6. Audible alarm

7. Alarm, service, power LED indicators

D. User Interface

1. Provide status screens to display time, date and panel status

2. Provide activate screens to allow the user to activate a flush sequence, flush an individual flush valve, pulse an individual flush valve or activate high pressure at a pressure reducing station

3. Provide install screens to allow user after entry of a valid PIN to troubleshoot problems

E. Regulatory Compliance

1. CE

2.07 SYSTEM COMMUNICATIONS AND CABLING

A. Applicable cabling required for specified communications to interconnect components of modular design system.

B. Communication Types

1. local processor to smart box

2. RS-422 – Smartbox to Server

3. Lon works – panels to network devices

4. RS-485 – panels to Server

C. Cabling

1. Provide system layout drawings showing types and routings

2. General Specifications

a. PVC jacketed plenum rated.

b. Stranded copper conductors

c. Shielded (when applicable)

3. Cable types – conductor quantity and sizes (use as applicable)

a. Standard – 2 to 7 conductors, 22 to 18 gauge

b. Shielded – 2 conductor, 18 gauge

c. Twisted pair- 1 or 2 pair, 22 gauge

d. Ethernet Cat5e specification

2.08 NETWORK MONITORING DEVICES

A. Network monitoring devices are used in conjunction with the Environmental Monitoring Panel. Network devices utilize a daisy chain wiring method with wiring going from monitoring device to monitoring device and then back to panel rather than using home run wiring for each device.

B. SENSOR MODULE

1. Type 4 (SM 4) temperature, humidity and light sensors in multiple combinations mounted on a single assembly

2. Temperature Sensor:

3. 100 OHM platinum thin-film RTD

4. Calibrated accuracy º F or º C ± 1º

5. Temperature range, 0 to 120ºF (-18 to 49ºC)

C. Humidity Sensor:

1. Interchangeable capacitive element with filter

2. Field Calibrated Accuracy ± 5% RH, 20% to 85% RH

D. Light Sensor:

a. Photo cell

E. Housing and Connections

a. 316 polished stainless steel housing for wall surface mount or mounting on standard switch box

b. Watertight, with sensor elements exposed behind stainless steel guard

c. Screw on, watertight cable connection

2.09 CONTROL DEVICES

A. PRESSURE REDUCING STATION MODULE (PRS)

1. Provides interface between control panel (AWSC or LP) and pressure station monitoring sensors and for control power to solenoid valves in the station and at terminal points of Distribution System and On-Line Rack Flush points.

a. Enclosure-ABS plastic water resistant

b. Processor and Communications

1) 8 bit microprocessor

2) 1 output: 24VAC to solenoid valve

3) Inputs: pressure transducer, flow switch

4) LED indicator lights: high and low pressure, flow, power and service

5) LED display indicates actual water pressure reading

6) Plug in screw connectors requiring no tools for disassembly

c. Solenoid capacity – (1) PRS Solenoid Only

B. ADVANCED LIGHT MODULE (ALM)

1. Works in conjunction with the ESP to control a maximum of 2 light levels and monitor the light “off”, “on” and “on high” status within a room with the following additional functionality

2. Advanced Functions

a. Detect and report of failed relays using feedback from pilots

b. Redundant relay configuration/control for continuous operation upon any relay failure

c. Explicit support for non-redundant paralleled relays

d. Explicit support for night lighting utilizing red or blue lights

e. Diagnostic features to aid in installation/wiring

f. Manual override capabilities

3. Processor and Communications

a. 8 bit microprocessor

b. Nonvolatile program memory

c. Real time clock

d. 7 relay driver outputs protected to 1 amp nominal, 3.5 Amps short circuit (24 VDC)

e. Beeper

f. Inputs

1) Light sensor (photo cell)

2) Manual tap switches (low and high)

g. Enclosure and Display

1) Input power: Operating voltage- 24-29 VAC or 12-40 VDC

2) Mountable inside a GE style lighting control panel

a) Up to 6 ALM’s can be mounted inside a 24 relay panel

b) Up to 12 ALM’s can be mounted inside a 48 relay panel

3) Communication, service and power LED indicators

4) 8 character, alphanumeric display

5) Single button interface for diagnostics mode

C. ALM TAP SWITCH

1. Activate light on/off

a. Momentarily contact push plate switch with Mylar label and aluminum push pad

1) Stainless steel plate assembly for wall surface or standard electrical switch box mounting

2) LED Indicator

2.10 CAPABILITIES AND FEATURES

A. Overall system operations offer the following capabilities based on hardware selected.

B. USER INTERFACE - system incorporates standard user interface options available both at the Server and remotely. User interface facilitates configuration of the system, daily interaction operations and reporting functions. These operations available to the user vary based on the interface selected and are summarized below:

1. Unless specifically indicated to the contrary, all features are supported in web client and web server user interface components.

2. User access to control or configuration interfaces requires login with assigned user login name and password.

a. All user login attempts (valid or invalid) are logged as an activity by the system

b. All user logouts are logged by the system

c. All user timeouts are logged by the system

3. Server – server applications allow the user to interact with the system using Microsoft Windows applications.

a. Configuration and Control interface allows users to set up and configure system

b. Reporting tool allows user to generate reports from multiple data sources including archive data sets

c. Number of simultaneously logged users controlled by license

d. Default idle time out on the web is 10 minutes but is user adjustable

e. Book marking of pages to subvert login is not allowed

4. Web Client – allows user remote from the Server to perform reporting, configuration and control operations using internet browser interfaces running over intranet backbone

a. Does not require any related software to be installed on the client machines

b. Client computer requirements

1) Internet browser Microsoft Internet Explorer Version 5 (or higher)

2) Internet browser JavaScript and cookie features must be enabled

3) Report download to PDF (portable document format) requires Adobe Acrobat Reader V5.05 or greater

C. INTEGRATION TO BUILDING AUTOMATION SYSTEMS VIA OPC

1. Watchdog OPC Client

a. Supports OPC XML-DA V1.0 standard

b. Supports reading Boolean, Integer and Floating Point values from a compatible system

c. External Points are mapped into the Watchdog system using Edstrom's OPC Client Configuration software program.

d. Integrated points are treated as Environmental Monitoring values and support Environmental Monitoring, Alarm Detection, Alarm Notification, and Configuration Management functions as defined herein

2. Watchdog OPC Server

a. Supports OPC XML-DA V1.0 standard

b. Hosts all available readings as String, Integer, Boolean, and Floating Point as appropriate

c. Each point value also supports point quality attributes

D. DATA COLLECTION

1. Collect data from connected hardware including panels, processors and sensors at least once per minute

2. Monitor communication between hardware and Server as an alarm condition. Utilize user defined alarm notification method to control system response to communication losses

3. Monitor computer supply power and record power deprivation events into Server database

4. Capture statistics on utilization of web user interface features

E. ANIMAL DRINKING WATER – AUTOMATED MONITORING AND FLUSH CONTROL

1. Allow user programmable room flush length ranging from 1 minute to 4 minutes

2. Allow user programmable rack flush length ranging from 15 seconds to 4 minutes

3. Allow user programmable rack fill length from 1 to 15 minutes

4. Control system flushing with up to 10 user defined start times

5. Allow establishment of up to 20 flush zones

6. Control flush sequences so no more than one point is flushing in each zone simultaneously

7. Allow control of individual room/rack solenoids locally or from Watchdog Server

8. Store flush events indicating flush success or failure of all flush operations at Watchdog Server

9. Begin alarm notification process when pressure/flow sensors indicate flush sequence has failed or when a high or low pressure or flow condition is detected

    a. Delay start of alarm notification on flow and pressure using alarm delays to accommodate normal animal drinking activity

    b. Allow delayed alarm clearing on flow and pressure using clear delays

10. Allow programmable bleed time on a per pressure station basis when used in conjunction with the AWSC

F. LIGHT CONTROL

1. Allow user defined setting of all lighting control parameters on an individual room basis including

    a. Light schedule

    b. Low level light extend time ranging from 0 to 255 minutes

    c. High level light extend time ranging from 0 to 255 minutes

    d. Alarm delay ranging from 0 to 255 minutes

    e. Alarm notification method

    f. Alarm check list

    g. (2) programmable light flash time ranging from 0 to 15 minutes

2. Control low level light in rooms using a user defined light schedule

3. Allow local override of current light state using user defined low level light extend time. Return lights to previous state after extend time expires

4. Allow local switch activation of high level lights for a user defined high level light extend time only when low-level lights are already on

5. Turn off high-level lights in conjunction with low-level lights

    a. Provide high-level light override capability of low-level light during flash period

6. Allow override of current light control state via the Server at any time

7. Begin alarm notification process when lights are in the incorrect state after user defined alarm delay period

    a. Allow user to disable lighting alarming on an individual room basis

8. Notify users of pending light transition from on to off via light blink

    a. Allow global operational preference for light blink on every on/off state transition or only override transitions

9. Log all light over-ride events

G. ACCESS CONTROL

1. Allow individual user access lists to be created for each room

2. Allow individual user access to be restricted to certain time ranges based on user classification group

3. Allow creation of 4 user defined classification groups to restrict access based on time and a universal classification group which has no time restrictions on access

4. Allow user defined setting of all access control parameters on an individual room basis including

   a. Alarm notification method for report of unauthorized entry

   b. Alarm notification method for report of door open conditions

   c. Schedule indicating when door is locked

   d. Alarm delay ranging from 0 to 255 minutes to prevent nuisance door open conditions

5. Report and store events at the Server

6. When a valid PIN or encoded card is entered

7. When an invalid PIN or invalid encoded card is entered

8. A door is opened without a valid PIN or encoded card being entered

9. Assign individual personal identification numbers (PIN) at the Server station

10. Enter PIN on local device to release lock

11. Release electric lock for a user defined maximum interval after a PIN or encoded card is entered

12. Release electric lock to exit when push-to-exit switch is activated – do not report exit – lock door after user defined interval

13. Lock electric lock immediately after door is opened or if operational menu selection is made

H. ENVIRONMENTAL MONITORING

1. Monitor analog parameters

   a. Trigger immediate alarm notification when current reading valves meet or exceed either high/low critical set points

   b. Trigger the alarm delay process when current reading values meet or exceed either high/low alarm set points

   c. Handle alarm and critical conditions as two distinct alarm conditions allowing re-notification as values transition between ranges

d. Provide alarm delays ranging from 0 to 255 minutes to delay the start of alarm notification when current readings are within the alarm range. Ignore alarm delays during critical range

e. Provide Clear Alarm delay ranging from 0 to 15 minutes to prevent the premature clearing of an alarm condition

f. Initiate user defined alarm notification method when an alarm is detected

g. Display user defined alarm check list when user acknowledges alarm condition

h. Perform Sample Point Logging at a user defined standard logging interval when the readings are within normal operating range

i. Perform Alarm Point Logging at a user defined alarm logging interval when the readings are outside normal operating range

j. Record sample point high value and time and sample point low value and time each day

k. Record average of sample points each day with an option to omit the points logged for alarm conditions

l. Record absolute high value and time and absolute low value and time each day

m. Allow a user defined clean interval ranging from 0 to 240 minutes to prevent report of alarm conditions during standard room cleaning procedures. Allow local activation of clean mode (LP and VLP only). Log when clean is activated along with name of user responsible for activation

2. Monitor digital parameters

a. Record changes in state at the Server

b. Log digital state at least once per day

c. Begin alarm notification after user defined alarm delay ranging from 0 to 255 minutes when parameter is not in correct state

d. Clear delay after user defined range

e. Allow user defined alarm notification method with user defined alarm check list

I. ALARM DETECTION AND NOTIFICATION

1. Handle all alarms generated by the system with a common alarm notification interface consisting of alarm notification methods and alarm checklists

2. Show current alarm conditions in centralized alarm folder from which user can acknowledge alarms and view current conditions

3. Allow system response to alarm conditions to be defined by alarm notification methods and user set-ups

a. Allow user defined label to identify alarm method throughout system

b. Allow force acknowledge, which when enabled, requires user acknowledgement of alarm prior to stopping alarm notification process

c. Allow user defined priority level ranging from 1 to 10 to distinguish alarms at the user interface

d. Provide e-mail notification

1) Send alarm start messages to designated e-mail address via SMTP

2) Send alarm clear messages to designated e-mail address via SMTP

3) Send alarm acknowledge messages to designated e-mail address via SMTP

4) Construct list of users to notify via e-mail from system user list and/or by direct entry of e-mail addresses

5) Provide message format to include location date, time, alarm condition and current reading. Acknowledge message format to include name of user acknowledging alarm and appropriate notes. Clear message format to indicate duration of alarm

6) Notes can be captured with acknowledgement of alarms

4. Provide pager notification

1) Send alarm start message to user on alpha-numeric pager via SMTP

2) Repeat alarm messages at a user defined interval range from 15 minutes to 8 hours

3) Send alarm clear message to user on alpha-numeric pager via SMTP

4) Send alarm acknowledge message to user on alpha-numeric pager via SMTP

5) Construct list of users to notify via pager from system user list and/or by direct entry of pager identifications

6) Provide message format to include location, time, alarm condition and current reading

5. Allow unlimited number of alarm notification methods to be defined

6. Allow alarm notification methods to be assigned to more than one alarm condition for standardized response

7. Allow changes in the configuration of the alarm notification method to automatically be propagated to all parameters utilizing the method with no requirement to re-apply the configuration

8. Provide acknowledgment provisions of alarm conditions

a. Stop the alarm notification process and record name of user taking responsibility for the alarm, and date/time of acknowledgement at the Server

b. Allows user to enter text note when acknowledging alarm condition

c. Allow alarm acknowledgement to expire after a user defined period ranging from 2 hours to 3 days

d. Forced note option to capture notes or info about alarm condition

9. Provide optional provision to require user to complete an alarm checklist prior to alarm acknowledgment. Failure to complete checklist will result in alarm not being acknowledged

   a. Allow user definition of any number of alarm checklists consisting of a label to identify checklist and an unlimited number of user defined questions

      1) Allow checklist to be assigned to more than one alarm condition for standardized response

10. Record and store information about alarm conditions as events including

    a. Alarm start

    b. Alarm clear

    c. Alarm re-report, report existing alarm conditions at least once per day

    d. Alarm acknowledge, include name of the user acknowledging the alarm as a user entered text note and user's responses to the alarm checklist

    e. Alarm acknowledge expire, reported when acknowledge period expires

    f. Alarm for analog parameter to include the current reading associated with the alarm condition as part of the alarm event

11. Alarm Bell – shows overall system status by displaying red (active alarms), yellow (acknowledged alarms) or green (no alarms) on a web page that automatically refreshes

J. CONFIGURATION MANAGEMENT

1. Allow customization of room status information in the rooms folder by allowing user to create room groups.

2. Show current status and alarm conditions based on each room in a rooms folder. In rooms folder provided color-coded display of current conditions where red indicates alarm condition, pink indicates acknowledged alarm condition and black indicates okay condition

3. Allow further customization of the room information through the use of user defined info fields. Allow unlimited number of info fields to be defined for the system

4. Allow creation of unlimited number of user defined schedules

   a. Allow schedules to be used for configuration of light control, alarm notification paging, access control and waste flushing

   b. Allow schedules to be assigned to multiple parameters

   c. Provide permanent pre-defined schedules for Always On, Never On, and Lighting Standard

   d. Allow schedule to consist of 4 "on times". Allow for variations based on day of week or holiday conditions

   e. Allow creation of user defined "holidays"

f. Allow changes in the configuration of the schedule to automatically be propagated to all parameters utilizing the schedule with no requirement to re-apply the configuration

5. Allow creation of unlimited number of user defined templates for use with the environmental, access control or watering related parameters

   a. Allow user defined label to identify the template

   b. Allow user to define a collection of settings for monitoring analog, digital, light, watering and access parameters

   c. Allow changes in the configuration of the template to automatically be propagated to all parameters utilizing the template with no requirement to re-apply the configuration

   d. Use templates as the primary mechanism for configuring the system allowing the user to perform drag/drop operations on the room name to perform configuration

   e. Provide user with pre-defined AAALAC templates for the following species: rodent, rabbit, dog, guinea pig and non-human primate

K. USER ACCOUNTS

1. Allow definition of user accounts to provide access to the system, where user account information must minimally contain a name, a PIN number and access level and may optionally contain

   a. Room access list

   b. Contact information including phone numbers, e-mail address, pager identification and schedules

   c. User photo

2. Provide 4 levels of user access to limit feature capabilities including Administrator, Super User, User and Keypad only. Allow Administrator level to control feature accessibility for other account levels

3. Enforce unique PIN numbers among active system users

4. Require minimum of USER level access to be able to gain access to the system configuration features

5. Require user login name and password in order to login to system configuration and status interface

6. Require unique login names

7. Allow configuration of user account expirations to automatically remove user accounts

8. Allow use of password expiration feature to force periodic change of account passwords

9. Record and store all attempts to login to

10. Allow drag/drop to make user accounts active or deleted

11. Capture of daily user login statistics including login, logout and timeout operation (Viewable on Web Interface Only)

L. ELECTRONIC RECORDS/ELECTRONIC SIGNATURE COMPLIANCE (21 CFR PART 11)

1. Disallow modifications of logged records

2. Create complete audit trails including date and time stamp as well as user identification on additions/deletions/changes to alarm methods, schedules, templates, user accounts, checklists, watering system configuration parameters, info fields and general system configuration parameters

3. Disallow disabling or modification of audit trails

4. Include before and after values when performing audit logs

5. Show name of active user on screen of Server user interface

6. Provide optional provisions to force users to change password at established intervals

7. Provide automatic user timeout if the Server or Web is left idle for 10 minutes

8. Provide optional mechanism to allow users to attach text notes when making changes/additions/deletions

9. Provide on-screen visual indication of changed parameters including changing the color and providing asterisk (server only)

10. Force notes to be captured on all changes

11. User can be locked out if user does not login correctly after a selectable number of attempts

M. REPORTING

1. System shall provide report data in interactive onscreen format

a. System shall allow attachment of notes provided data has not been archived

1) Entered notes will be date/time stamped and attributed to user.

2) Note can be free entry text or selected from user defined pick list.

a) Pick list notes supported in Web interface only.

2. System shall provide reports in printed hard copy format (Server Only)

3. System shall provide PDF formatted reports suitable for printing to hard copy printer (Web Only)

4. Provide standard reports including

a. Configuration Reports based on system data including alarm methods, Configuration History, Location, Template, and user configuration

b. Historical Reports including Daily Graph, combo, environmental, high/low/average, high/low/average graph, lighting, lighting graph, access, alarm notification, hardware, user activity, watering and equipment processing

c. Current status report

d. Hardware configuration and diagnostic reporting available through web client only

e. Report availability varies based on interface being used. Not all reports available on all platforms

5. Allow user to create macros that automate the report generation process to a daily, weekly or monthly event. (Server Only)

   a. Automatically generate required reports to hard copy format

   b. Automatically generate required reports PDF format available from the web

6. Allow user-defined data location or location groups for applicable report

7. Allow user defined report starting and ending dates for applicable report

8. Allow export of data to comma separated value format (limited support on web client)

9. Allow user selected report inclusions of activities, alarms, individual points, state changes, attached notes, checklist replies, and separate pages

10. Allow access to archived data

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examination of building and site shall be the responsibility of the Contractor. Examine surfaces, substrates and conditions for compliance with requirements of other sections in which that related work is specified, and determine if surfaces, substrates and conditions affecting performance of the work of this Section are satisfactory. Do not proceed with work of this Section until unsatisfactory conditions have been corrected in a manner acceptable to the Installer. Starting installation constitutes acceptance of surfaces, substrates and conditions. Remediation of installations in unacceptable condition shall be at the contractors expense..

3.02 INSTALLATION

A. Comply with BICSI RNCM.

3.03 IDENTIFICATION

A. In addition to requirements in this Article, comply with TIA/EIA-606-A and with applicable requirements in Division 16 Section "Electrical Identification."

3.04 FIELD QUALITY CONTROL

A. Manufacturer shall test all equipment and components for performance in accordance with these specifications.

3.05 DEMONSTRATION

A. Installer shall train Owner in capabilities of Animal Monitoring System. Refer to Division 1 Section "Demonstration and Training."

END OF SECTION 10 90 00

SECTION 10 90 10 - ANIMAL AUTOMATED DRINKING WATERING SYSTEM

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 SUMMARY

A. This is an expansion of the existing Edstrom Animal Automated Drinking Water System into the CRB Animal Area Renovation Project. A system specially built for the production, filtration and distribution of drinking water to animals.

1.03 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Include dimensioned plan and elevation views of equipment rooms, with each individual component labeled. Show equipment assemblies, method of field assembly and workspace requirements.

1.04 QUALITY ASSURANCE

A. Perform installation with factory certified technicians on the Clean Fitting system or prequalify/train on-site technicians with factory authorized personnel. Instruct on all aspects of cutting tube, deburring, tube bending and Clean Fitting assembly.

1.05 COORDINATION

A. Coordinate layout and installation of piping with other trades.

1. Meet with Owner to exchange information and agree on details of equipment arrangements and installation interfaces.

2. Record agreements reached in meetings and distribute to other participants.

3. Coordinate with Animal Room Monitoring System.

1.06 SCOPE

A. Equipment for the production and filtration shall be located in Mechanical Room as indicated.

B. Distribution of animal water shall include:

1. Animal Holding Room and Procedure Rooms as indicated.

1.07 GENERAL

A. Furnish all materials in accordance with this specification and manufacture in accordance with applicable codes and standards.

B. ANSI/ASTM Standard A450 stainless steel tubing.

C. Purchase the complete piping system from a single manufacturer. Factory cut and fabricate tubing to system designed lengths, electropolish and passivate and then cap and/or seal in a bag and suitably box for shipping protection. Individually bag each fitting and suitably box for shipping protection.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. The Basis of Design manufacturer for this system is Edstrom Industries.

B. Accepted Manufacturers include:

1. Edstrom Industries, Inc. 819 Bakke Avenue • Waterford WI 53185 • Tel: 262 534 5181 • Fax: 262 534 5184 • www.edstrom.com:

C. STORAGE AND REPRESSURIZATION EQUIPMENT

1. Provides atmospheric tank storage and pump system to accumulate the RO product water and repressurize for delivery through the supply header.

a. Storage Tank Assembly - Floor Standing (Standard)

1) Capacity: sized to application (90-1100 gallons) (341-4164 liters)

2) Material:

a) Tank and Gasket: polyethylene

b) Cover: polypropylene

c) Hardware: 316 stainless steel

d) Seal: bolt down cover with gasket

e) Level control: Level sensing pressure sensor/transducer

f) Back-up overflow float switch

g) Air vent filter: 0.2 micron

3) Approximate operational weight 720-8800 lbs. (327-3992 kg)

D. CAPABILITIES AND FEATURES

1. Automatic operation with a microprocessor controller to control the complete system.

2. SYSTEM PERFORMANCE

a. Specification based on designated operating parameters

b. Reject feedwater contaminants to listed levels for membrane

1) Salt rejection 95-98%

2) Organic rejection >150 MW

3) Bacteria rejection >99%

4) Particle rejection >99%

c. Produce permeate at designated rates based on 60ºF feed water temperature. For every 1ºF below 60ºF, expect a 2% reduction in the permeate production shown below.

1) Single Membrane Unit

a) 320 GPD @ 150 psi with 60 Hz Power Supply

b) 250 GPD @ 150 psi with 50 Hz Power Supply

2) Two Membrane Unit

a) 640 GPD @ 150 psi with 60 Hz Power Supply

b) 520 GPD @ 150 psi with 50 Hz Power Supply

3. Recover permeate at a 33% ratio of feedwater as a standard, but base actual recovery on analysis of supply water

2.02 FILTER BANK STATION

A. The Filter Bank Station is a panel-mount assembly with (3) filters to provide filtered water for animal drinking water systems.

1. Size: 22” W x 15” H x 5-3/4” D

B. PANEL

1. Stainless Steel, 16 gauge, 300 series, satin finish

2. Size: 8”H x 22” W

C. WETTED COMPONENTS

1. Piping: 1/2” O.D. Tubing – 316L stainless steel

2. Fittings: thread/clean joint compression – 316 stainless steel

3. Shut-Off Valve: 3/8” ball valve – 316 stainless steel

4. Injection Port: valved QD plug – 316 stainless steel

5. Inlet/Outlet Connection: clean joint compression fitting for 1/2” O.D. stainless steel tubing

6. Filter Housings – 10” long

a. Polypropylene with 3/8” FPT ports

b. Flow Rate: 5 gallons/minute @ 50 psi

7. Filter Cartridges – 9-3/4” long

a. 5 Micron – spun polypropylene

b. 1 Micron – cellulose polyester

c. 0.2 Micron – nylon 66 membrane

8. Pressure Gauge

a. 3.5” dial with 1/4” MPT connection, 316 stainless steel wetted parts

1) Range: 0-60 psi

2) Housing: 300 series stainless steel

D. CAPABILITIES AND FEATURES

1. The 0.2 micron absolute filtration provides capability to remove bacteria and microorganisms like cryptosporidium from the incoming supply

2. All wetter parts to be passive in tap water, 10 PPM chlorinated water or 2.5 pH acidified water

3. Filter Bank has 3 stage filtration to protect the 0.2 micron absolute rated final filter to extend its functional life

4. Injection port provided to allow chlorine sanitization of filter cartridges

2.03 PRESSURE REDUCING STATION

A. The Pressure Reducing Station is a panel assembly to provide animal drinking water at a normal operating pressure of 3-4 +/-1/2 psi with a minimum flow of one gallon per minute.

B. ENCLOSURE/PANEL

1. All parts shall be constructed of 18 gauge 300 Series Stainless Steel, except back panel of 16 gauge, with commercial satin finish on all exposed surfaces. The two gasketed doors shall have stainless hinges at each side to swing open and provide full access to all components

a. Surface Mount Cabinet: 16" H x 25.5" W x 6.5" D

b. Recessed Back Box: 16" H x 25" W x 6" D

c. Recessed Door Frame: 17.5" H x 26.5" W

C. DISPLAY/INTERFACE MODULE

1. Door mounted with digital readout of system pressure and LED Indicators for function status

a. Enclosure- ABS plastic, water resistant

b. 3-Character Display with pressure reading in psi, kPa/bar

c. Signal outputs for digital or network system connections

d. Output: 24vdc to solenoid valve

e. Inputs: Pressure transducer, flow switch

f. LED Indicators: High and low pressure, flow, solenoid power and service

g. Plug-in cable connectors

D. WETTED COMPONENTS

1. Piping, Fittings, Valves, etc.

a. Piping: 1/2" O.D. Tubing- 316L Stainless Steel

b. Fittings: Thread/Clean Joint Compression- 316L Stainless Steel

c. Shut-off Valve: Ball Valve- 316 Stainless Steel

d. Flexible Hose: Silicone Hose reinforced with polyester braid

e. Inlet Connection: Clean Joint Fitting- 1/2" Tube x 1/2" MPT

f. Outlet Connection: Flexible Hose with Clean Joint Fitting for 1/2" Tube

2. Water Filter- 5" Housing standard (other options available)

a. Housing: Polypropylene with 3/8" FPT ports

b. Replacement Cartridge: 5 micron spun polypropylene

c. Flow Rate: 5 GPM at 50 psi

d. Screen: 50 mesh Stainless Steel (Unfiltered models only)

3. Pressure Regulator- High flow design

a. Materials- wetted parts

1) 316 Stainless Steel

2) Diaphragm: Silicone, 6" diameter

3) Seat: Silicone

b. Ports: 1/2" MPT inlet, 3/4" MPT outlet

c. Pressure capacity: 75 psi (max) inlet

d. Low Pressure Unit:

1) Range: 2-8 psi adjustable outlet

2) Standard setting: 3 psi

3) Flow rate: 10 GPM @ 3 psi setting

e. High Pressure Unit

1) Range: 4-17 psi adjustable outlet

2) Standard setting: 15 psi

3) Flow rate: 14 GPM @ 10 psi setting

4. Pressure Transducer (CE Approved)

a. Range: 0-25 psi (0.5% accuracy)

b. 316 Stainless Steel wetted parts

5. Flow Switch - Non-Adjustable (UL Recognized)

a. Wetted materials: Ryton-R4 and 316 Stainless Steel

b. Flow rate actuation of Switch: 80 +/- 20ml/min.

c. Switch Function: N.O. (normally open with no flow)

d. Switch Rating: SPST .17 amp at 120 Volts AC

6. Solenoid Valve - Normally closed (UL Listed)

a. Wetted Materials: Electro-polished 316 Stainless Steel Body:

b. Ports: 3/8" FPT

c. Coil: Epoxy encapsulated one piece 24 vdc, .5 amps

2.04 STAINLESS STEEL ROOM DISTRIBUTION SYSTEM

A. The stainless steel room distribution system is a water delivery piping system designed specifically for an animal automated drinking water system. The system operates normally at a low pressure of 3-5 psi, but is subjected to flushing pressures up to 50 psi.

B. ROOM DISTRIBUTION PIPING AND FITTINGS

1. Distributes water from a pressure reducing station into and around each animal room and to flush drain points. Pressure rating is 200 psi minimum. Use piping/fitting design to allow mechanical dismantling for repair or replacement of individual components. Soldered, brazed or adhesive bonded joints are not permitted. Electropolish externally and passivate all water contact surfaces to attain a uniform oxide inactive surface film.

2. Stainless steel welded tubing

a. 50" OD x .035" wall

b. 316 L grade

3. Electropolish/passivation process
    a. Electropolish in 135°F solution of 65% phosphoric - 35% sulfuric acid
    b. Passivate in 105°F solution of 20% nitric - 80% water
    c. Final rinse with 125°F Reverse Osmosis water to remove all chemical residues
    d. Electropolish and passivate after all fabrication and welding
4. Coupling, elbow, tee fittings
    a. Clean Fitting or equivalent sanitary type
    b. 316 L grade stainless steel
    c. ID: .43" to exactly match tubing ID
    d. Electropolish both internally and externally and passivate in accordance with 2.1.2 to a finish of 32 RA or better on all water contact surfaces
    e. Joint Seal
        1) High grade FDA approved silicone
        2) Seal edge width: .05"
        3) ID: .43" for flush internal joint
    f. Ferrule: 316 Stainless Steel
    g. Retainer hex nut: 303 stainless steel
5. Interconnect Station (I/C) Assembly
    a. Prefabricated piping assembly with a Quick Disconnect (QD)/half coupling fitting welded to one end
    b. Clean Fitting connection or equivalent sanitary type
    c. QD Type: Industry Standard 1/4" universal style socket
    d. Design characteristics in accordance with 2.1.3 with base fitting of QD welded at branch port
    e. QD base fitting
        1) 316 L grade stainless steel
        2) Fitting length of 1.03" from tubing ID to QD seal
    f. QD components
        1) 316 grade stainless steel
        2) Electropolish both internally and externally and passivate in accordance with 2.1.2 to a finish of 32 RA or better on all machined water contact surfaces

3) QD Seal: High grade FDA approved silicone

g. Debur open end of pipe to make it Clean Fitting ready for field assembly

6. Pipe/Coupler Assembly

a. Prefabricated piping assembly with a half coupling fitting welded to one end

b. Clean Fitting connection or equivalent sanitary type

c. Design characteristics in accordance with 2.1.3

d. Debur open end of pipe to make it Clean Fitting ready for field assembly

C. INTERCONNECT STATION (I/C)

1. Located in each animal room as shown on drawings and/or to adequately accommodate manifold connection for mobile or stationary racks or kennel/pen arrangements.

a. I/C Connection: Edstrom I/C Assembly with universal style QD socket for hose connection

b. Use Pipe/Coupler assembly for all piping runs not requiring I/C connections

D. DETACHABLE KYNAR RECOIL HOSE

1. Animal rack water supply hose assembly which can be detached from the room piping for sanitization or during periods of non-use.

2. Tubing coil: Black PVDF (Kynar) [3/8 in. OD x 1/4 in. ID (9.53 mm OD x 6.35 mm ID), NSF standard 61, FDA grade, chlorine tolerance of 0.5 to 50 ppm]

3. Extended Reach: 6 feet (1829 mm)

4. Autoclavability: Maximum temperature of 250° F (121° C)

5. Quick disconnect couplings - Universal style

a. QD plug on upper end

b. QD socket on lower end

c. 316L grade stainless steel

d. Electropolish externally and passivate in accordance with 3.1.B to a finish of 64 RA or better on all machined water contact surfaces

e. QD Seal: High grade FDA approved silicone

f. Push lock barb connection

6. Stainless steel spring supports [3 in. (76 mm) long] both ends.

E. SOLENOID FLUSH VALVE

1. Solenoid valve located downstream from the water supply rack connection points at the terminating end of each room distribution piping run for Room Distribution Flushing or in the flush drain header at each rack location for On-Line Rack Flushing.

    a. Body Material: Electro-polished 316 stainless steel

    b. Input power: 24 VDC, 0.5 amp

    c. Watertight junction box connection with screw connectors

    d. Coil: Epoxy encapsulated one piece

    e. Ports: 3/8" FPT

    f. Diaphragm: Teflon

F. RACK FLUSH RECOIL HOSE

1. Animal rack flush hose/check valve/fitting assembly that connects the terminating point of the rack manifold to the drain header. QD plug on lower end of hose to plug into supply line/recoil hose QD socket when rack position is vacant.

2. Tubing coil: Black PVDF (Kynar) [3/8 in. OD x 1/4 in. ID (9.53 mm OD x 6.35 mm ID), NSF standard 61, FDA grade, chlorine tolerance of 0.5 to 50 ppm]

3. Extended Reach: 6 feet (1829 mm)

4. Autoclavability: Maximum temperature of 250° F (121° C)

5. Hose Fittings

    a. Swivel nut with o-ring seal on upper end

    b. QD plug on lower end – Universal style

    c. 316L grade stainless steel - wetted parts

    d. Electropolish externally and passivate in accordance with 3.1.B to a finish of 64 RA or better on all machined water contact surfaces

    e. Push lock barb connection

6. Stainless steel spring supports [3 in. (76 mm) long] both ends

7. Check Valve

    a. Polyproplene body

    b. Silicone O-ring seal

    c. Stainless steel spring

G. DISTRIBUTION HEADER PIPING

1. Supply water piping to pressure reducing station(s) and other equipment as required. All piping and fittings used shall be 316L stainless steel.

a. SS piping sized to handle flow rates

1) 1.25 in. OD x 0.049 in. wall (31.75 mm OD x 1.24 mm wall)

2) 1.0 in. OD x 0.065 in. wall (25.40 mm OD x 1.65 mm wall)

3) 0.75 in. OD x 0.035 in. wall (19.05 mm OD x 0.89 mm wall)

4) 0.5 in. OD x 0.035 in. wall (12.70 mm OD x 0.89 mm wall)

2. Fittings

a. Clean joint type - 0.5 in. (12.70 mm) and 0.75 in. (19.05 mm) OD

b. Compression type - 1 in. (25.40 mm) or larger OD

3. Installation and mounting

a. This piping shall be mounted to a suitable support structure with appropriate mounting hardware as required

b. Piping shall be installed at a uniform height to minimize rises and drops

H. CAPABILITIES AND FEATURES

1. Stainless steel tubing and fittings to be passive in tap water, 10 ppm chlorinated water or 2.5 pH acidified water.

a. Clean fitting design provides a consistent, smooth, inside diameter conduit for unobstructed water flow throughout the system piping.

b. Clean fitting seal design assures that no cracks or crevices exist between edge of tubing and mating fitting shoulder when fitting is fully assembled.

c. Pocket created by the QD port in the I/C assembly to be less than 2-1/2 tubing diameters long to allow for water exchange during flushing and to minimize the opportunity for microbial growth.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examination of building and site shall be the responsibility of the Contractor. Examine surfaces, substrates and conditions for compliance with requirements of other sections in which that related work is specified, and determine if surfaces, substrates and conditions affecting performance of the work of this Section are satisfactory. Do not proceed with work of this Section until unsatisfactory conditions have been corrected in a manner acceptable to the Installer. Starting installation constitutes acceptance of surfaces, substrates and conditions. Remediation of installations in unacceptable condition shall be at the contractors expense.

B. Inspect shipping cartons upon delivery for damage and material cleanliness. Report promptly to the manufacturer any damaged material.

3.02 INSTALLATION

A. Comply with BICSI RNCM.

3.03 FIELD QUALITY CONTROL

A. Manufacturer shall test all equipment and components for performance in accordance with these specifications.

B. Handle tubing to avoid bending or damage. Keep materials clean and free from grease and oil. Store all tubing and fittings in their original package until ready to use.

C. Store all system material in an area segregated from other construction material. Choose a location inside a building protected from any corrosive atmosphere. Limit access to protect against physical damage, loss and contamination.

3.04 FABRICATION

A. Factory debur ends of cut tubing so it is ready to assemble into the Clean Fitting

B. Make field cuts with a stainless steel tubing cutter supplied by the system manufacturer and used only on stainless steel and chamfer outside and inside edges per assembly instructions 4230-MI4160 to remove any burrs.

C. Make square cuts to accurate lengths and assemble joints tightly.

D. Use tube bending whenever possible for corners and offsets with a bender supplied by system manufacturer and used only on stainless steel.

3.05 INSTALLATION AND MOUNTING

A. Attach tubing to the wall, ceilings or other suitable support structure with 18 GA stainless steel clamps and other appropriate brackets. Use stainless steel mounting hardware.

B. Provide a 2-hole clamp at each I/C station within 2" of the QD fitting to provide adequate rigidity and support. Provide one-hole clamps at all other mounting points where suitable support can be attained. Space clamps not to exceed 36".

C. Provide plastic stand-off spacers under each clamp for wall mounting applications to mount piping off the wall by 1/2" with plastic screw anchors and stainless steel self tap screws (#10 x 1-1/4").

D. Install the entire piping system at a consistent level throughout at a height of 84" to 96" above the floor. Limit any rises and drops.

E. Provide a stainless steel wall plate on each side of the wall for wall break penetrations. Use silicone sealant to affix the plate to the wall and to make an air tight seal around the pipe. Avoid any mechanical joints inside walls. Do not use wall sleeves.

3.06 DEMONSTRATION

A. Installer shall train Owner in capabilities and operation of Animal Automated Drinking Water System. Refer to Division 1 Section "Demonstration and Training."

END OF SECTION 10 90 10

SECTION 11 06 00 - LABORATORY EQUIPMENT - OWNER FURNISHED OWNER INSTALLED

PART 1 - GENERAL

1.01 WORK INCLUDED

A. The scope of work included within this Section is Owner Furnished Owner Installed (OFOI); there is no work for the Contractor in this specification section. This is for information only.

B. The Owner is responsible for furnishing and installing all items listed on the list included at the end of this Section. This scope includes purchasing, shipping rigging into place and equipment utility connection to the facility. The Owner is responsible for coordinating the utilities with the various pieces of laboratory equipment. The laboratory equipment listed within the attachments were developed in the schematic design phase, any equipment modification and utility change is the responsibility of the Owner to coordinated with the design team.

C. The Owner is responsible for the removal of all debris, dirt, and rubbish accumulated as a result of this Work and leave premises clean and orderly. The Contractor will not be responsible for disposing of debris and rubbish.

D. The Owner will be responsible for insuring the laboratory equipment installed prior to the Contractor completing the construction.

PART 2 - PRODUCTS

2.01 MANUFACTURERS – REFER TO THE EQUIPMENT LIST AT THE END OF THIS SECTION.

PART 3 - EXECUTION

3.01 INSTALLATION

A. The Owner is to install the equipment without interfering with the Contractor's construction process. The Owner will coordinate and schedule the delivery and installation with the Contractor.

OWNER FURNISHED OWNER INSTALLED (OFOI) EQUIPMENT	
Mobile Laboratory Casework	A.T. Villa USA
Vented Table Top Enclosure	NuAire AbGuard Class I Vented Workstation, NU-819, 3 ft size
Table Top Downdraft Table	NuAire Downdraft Work Surface, 36” x 30” size
Biosafety Cabinets	NuAire Corporation Class II, Type A2 LabGard 602 Animal Cage Changing, 4 ft size.
Animal Caging System	Techniplast TouchSlim Line

END OF SECTION 11 06 00

SECTION 11 53 43 - LABORATORY SERVICE FITTINGS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 SUMMARY

A. Section includes the following:

1. Laboratory water and gas service fittings, valves, and related components.

2. Laboratory fixtures.

B. Related Sections include the following:

1. Division 11 Section “Biological Safety Cabinets”.

2. Division 12 Section “Laboratory Casework”.

3. Division 22 Sections for connecting service utilities at indicated point.

4. Division 26 for Electrical Service Fittings.

1.03 REFERENCES

A. Comply with all applicable trade standards ordinances, building codes and regulations including all standards and references noted herein.

B. Conform to the recommended practices for laboratory service fittings and fixtures published by the Scientific Equipment and Furniture Association, SEFA 7-1996.

1.04 DESCRIPTION

A. Work includes but not necessarily limited to furnishing to the project site for installation in accordance with applicable provisions of Division 15, all laboratory fixtures, fittings, and emergency plumbing fixtures described herein and shown on the Drawings.

B. Work in this Section requires close coordination with Work in electrical and mechanical Sections. Coordinate all Work to ensure an orderly progress in the Project, without removal of previously installed Work, and so as to prevent damage to finishes and products

1.05 ACTION SUBMITTALS

A. Material List/Product Data: Submit complete materials list, including catalogue data, of all materials, equipment and products for Work in this Section.

B. Shop Drawings: Submit complete shop fabrication and installation drawings, including plans, elevations. Sections, details and schedules. Show relationship to adjoining materials and construction. Shop drawings shall be in the form of reproducible or photocopies, not to exceed 11”x17” in size. Blue line prints are not acceptable.

C. Samples: Submit two (2) samples of each type of specified finish and color range available.

1.06 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Manuals: Submit under provisions of Section 01 77 00 complete operation and maintenance manuals that describe proper operating procedures, maintenance and replacement schedules, components parts lists, and nearest local factory representative for components and repairs.

1.07 QUALITY ASSURANCE

A. Installer shall have an established organization and production facility with five years documented experience specializing in the manufacture of the type of equipment specified, with an experienced Engineering Department. Each shall have demonstrate ability to produce the specified equipment of the required quality and quantity for complete installation in a project of this type an size within the required time limits.

B. Source Limitations for Laboratory Service Fittings: Obtain lab service fittings from one source from a single manufacturer, with resources to provide products of consistent quality in appearance and physical properties for the entire Project.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver all fittings and fixtures to job site in recommended packaging with each fitting individually packaged, marked, and scheduled for point use. Items shall be identified by same room number and assembly as indicated on Drawings.

B. Inventory fittings, at job site, verify that type and quantity are correct, and re-package until time of installation.

C. Store in a clean, dry location.

D. Replacements: In the event of damage, immediately make all repairs and replacement necessary for the approval of the Architect and at no additional cost to the Owner.

PART 2 - PRODUCTS

2.01 GENERAL

A. All service fittings and emergency plumbing fixtures shall be specifically designed for laboratory use.

B. Service fittings be furnished and delivered to point of use for installation as specified in other sections of the Specifications.

C. All service fittings shall be factory pre-assembled including the assembly of valves to turrets, mounting shanks to turrets, etc., ad individually factory used.

D. All laboratory service fittings shall be the product of one service-fitting manufacturer to assure ease of replacement and maintenance.

E. All service valves, fittings, and accessories shall be of cast brass with a minimum copper content of 85%, except for items which are to be brass forging or bar stock.

F. Provide fittings as shown in schedule at the end of this Section.

G. Assembly components and operating parts such as valve stems, renewable units, pacing nuts, outlet nozzles and straight serrated hose ends shall be made from solid brass stock.

H. Replaceable seats, needle cones, valve disc screws and other accessories shall be monel or stainless steel alloys especially selected for use intended.

I. Fittings shall be factory tested and shall be supplied with nipples, lock nuts, shanks, etc.

J. Serrated tip fittings shall have 3/8-inch IPS thread wit the hose end being tapered. Diameter of orifice in serrated tip shall be 1/8 inch, except where otherwise specified.

K. Turrets shall be brass drip forging of design indicated in details shown elsewhere in the Section and shall be one or two-way, as required, with 3/8 inch IPS female inlet thread for connections. Units shall be furnished with brass shanks, brass locknuts, and washers.

L. Fittings located on the same plane shall have their handles project the same distance from the pane of reference to present a uniform related appearance, regardless of valve type construction.

M. Flanges shall be brass forging of approved design with 3/8 inch IPS female inlet and outlet.

N. All goosenecks shall provide full thread for attachment of antisplash outlet fittings, serrated tips, and filter pumps.

O. Hot water/cold water gooseneck mixers and deck-mounted cold-water goosenecks shall swivel. Swivel point shall be at turret or at valve packings; “O” rings will not be permitted. Provide cold-water fittings including hand held drench hoses at emergency eyewash.

2.02 WATER AND GAS SERVICE FITTINGS

A. Manufacturers: Subject to compliance with requirements, as judged by the Architect, provide products by one of the following:

1. Water Saver Faucet Co., Chicago, IL; Tel: 312-666-5500.

2. Chicago Faucet Company, Des Plaines, IL; Tel: 847.803-5000.

3. Substitutions: Under provisions of Section 01 31 00.

B. Pattern: All service fittings shall have tapered body profiles.

C. Handles:

1. ADA faucets shall be fitted with “wrist-blade” handles.

2. Laboratory gas, air and vacuum valves at ADA accessible workstations shall be ball valves fitted with lever-type handles.

3. Other fittings shall be fitted with four arm handles.

D. Water Valves:

1. Water valves shall include a renewable unit containing all the working parts which are subject to wear, including stainless steel or monel screw and heavy duty seat disk and Teflon packing, and an integral or external adjustable volume control.

2. Unit shall be capable of being readily converted from compression to self-closing, and vice versa, without disturbing faucet body proper and shall also be capable of being readily converted from water construction to needle valve or steam valve construction having outside packing gland without disturbing faucet body.

3. Unit shall be sealed in valve body with special composition gasket. Metal-to-metal or ground joint type of sealing is not acceptable.

4. Water fixtures shall be fully assembled and factory tested at 80 psi water pressure.

E. Needle Valves: All needle valve assemblies shall be fully assembled and factory tested at 150 psi air pressure. Gas, air, vacuum and steam needle valve fittings shall have stainless steel replaceable floating cone that is precision ground and self-centering which shall seat against a stainless steel or monel renewable valve seat. Action of valve shall be slow compression for fine control under pressure up to 125 psi and shall have subject-to-wear parts easily replaceable.

F. Laboratory Ball Valves: All ball valves shall be suitable for laboratory gas, air, and vacuum and be supplied fully assembled and factory tested at 125 psi air pressure. Ball valves shall be of quarter-turn (closed t fully open) design, be fitted with lever handle requiring less than 5lbs pressure to operate, and shall have subject-to-wear parts easily replaceable. Ball valves shall be certified by AGA/CGA or CSA Standard Z21.15-1997/CGA9. 1-M97 for gas service.

G. High Purity Water Valves: High purity water valves shall be chromium plated cast brass with polypropylene liner. Valve stem and bonnet shall be brass. See fitting schedule on Drawings.

H. Service Fitting Color Index:

Service Name	Disc Color	Symbol	Letter Color
Lab Air	Orange	AIR	Black
GAS	Dark Blue	GAS	White
Vacuum	Yellow	VAC	Black
Cold Water	Dark Green	CW	White
Hot Water	Red	HW	White
High Purity	White	DI	Black
Nitrogen	Brown	N2	White
Carbon Dioxide	Pink	CO2	Black
Special Gas	Light Blue	Chemical	Black

2.03 FINISHES

A. Satin Chrome finish with clear, acid resistant coating.

1. All laboratory service fittings (except fittings inside fume hoods) and emergency plumbing fixtures shall be finished as follows: All exposed surfaces shall be polished and buffed, then electroplated with one layer of nickel and one layer of chrome. Each layer of plating shall completely cover all visible areas. Total plating thickness shall be not less than 0.4 mils. Chrome finish shall be treated to provide a satin finish.

a. Satin (AISI No. 6 brushed finish)

2. Clear epoxy coating: Following plating, clear epoxy coating shall be applied to all exposed surfaces and then baked to permit curing. Surfaces shall have a minimum coating thickness of 2 mils.

B. Fume hood service fittings shall be finished as follows:

1. Lever Handle: Satin Chrome as indicated above.

2. Outlet Fittings: colored epoxy, with clear, acid-resistant coating.

3. Epoxy Finish: Coating material shall be free-flowing epoxy powder with particle size of 35-7 microns. Surfaces to be coated shall be polished or sandblasted to produce a uniform fine-grained surface and immersed in a phosphoric acid cleaning solution to remove thoroughly all oil grease and other foreign substances. Following cleaning, coating material shall be electrostatic ally applied to all exposed surfaces. After applications, coating shall be fully baked to permit curing. Surfaces shall have a minimum coating thickness of 2 mils.

4. Color: Outlet fittings inside fume hoods shall have a colored finish color-coded to match the fitting service index color.

C. Performance Requirements for Coated Finishes:

1. Chemical resistance: Fume Test: Suspend coated samples in a container at least 6 cu. Ft. capacity, approximately 12 inches above open breakers, each containing 100 cc of 70% nitric acid, 94% sulfuric acid and 35% hydrochloric acid, respectively. After exposure to these fumes for 150 hours, the finish on the samples shall show no discoloration, disintegration or other effects.

2. Mar and abrasion resistance: Coating material shall have a pencil hardness of 2H-4H with adhesion substantial enough to withstand both direct and reverse impacts of 160 inch pounds. Coating shall have excellent mar resistance and be capable of withstanding scuffing, marring and other ordinary wear.

3. Reparability: Scratches and other localized surfaced damage shall be field-repairable.

2.04 ELECTRICAL SERVICE FITTINGS

A. Electrical Service Fittings: Refer to Division 26.

2.05 LABORATORY FIXTURES

A. Provide strainer, outlet and tailpiece for all cup sinks.

B. Refer to Division 22 for wall mounted sinks and service fittings.

C. Provide Stainless steel strainer, outlet, standpipe overflow and stopper for all casework sinks unless otherwise specified. Provide tailpieces compatible with waste piping system. See Division 22 for piping requirements.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Review conditions of installations, procedures and coordination with related Work.

B. Carefully inspect the installed Work of all other trades and verify that all such Work is complete and ready for the installation of this Work to properly commence.

C. Verify that all Work may be installed in complete accordance with the original design, reviewed submittals and manufacturer's recommendations.

3.02 PREPARATION

A. Prior to delivery of fittings, carefully inspect the installed Work of all other trades and verify that all such Work is complete to the point where this installation may properly commence.

B. Verify that all Work has been installed in complete accordance with the original design, approved submittals, and the manufacturer's recommendations.

C. Discrepancy: In the event of discrepancy, immediately notify the Architect. Do not proceed until unsatisfactory conditions have been corrected.

3.03 INSTALLATION OF SERVICE FITTINGS

A. Comply with requirements in Divisions 22 and 26 Sections for installing water and laboratory gas service fittings, piping, electrical devices, and wiring.

B. Install fittings according to Shop Drawings and manufacturer's written instructions. Set bases and flanges of sink- and countertop-mounted fittings in sealant recommended by manufacturer of sink or countertop material. Securely anchor fittings, piping, and conduit to laboratory casework, unless otherwise indicated.

3.04 CLEANING AND PROTECTING

A. Clean finished surfaces, touch up as required, and remove or refinish damaged or soiled areas to match original factory finish, as approved by Architect.

B. Protect countertop surfaces during construction with 6-mil (0.15-mm) plastic or other suitable water-resistant covering. Tape to underside of countertop at minimum of 48 inches (1200 mm) o.c.

3.05 SERVICE-FITTING SCHEDULE

A. Eyewash Fitting:

1. (EW): Deck mounted eyewash/drench hose unit. Basis of Design Manufacturer: WaterSaver EW1022 deck mounted. Refer to Drawings for locations.

B. Water Service-Fitting: Refer Sink Schedule in Drawings for sink size.

1. (HWCW): Basis of Design Manufacturer: WaterSaver L412VB-BH: vacuum breaker 6 inch swing gooseneck. Deck mount fitting with 4" wrist blade levers faucet mounted with color coded index discs. Provide assembled aerator on gooseneck.

C. Purified Water Fitting:

1. (PW): Basis of Design Manufacturer: WaterSaver L7611WSA: Deck mounted pure water fixture with all polypropylene internal construction with 6 inch rigid gooseneck. Provide white nylon four-arm handle with color coded index disc. Refer Drawings for right or left handing and provide correct model as indicated.

D. Emergency Shower Eyewash Combination:

1. (ESEW): Refer to Division 22.

E. Laboratory Gas Service-Fitting:

1. Vacuum Service Fitting Types:

a. V-1: L4200-147 WSA: Panel mounted flange with a single 45 degree angle pattern laboratory ball valve with removable straight serrated hose end and chrome plated lever handle with color coded index disc.

2. CO2 Service Fitting Type:

a. CO2-1: L4200-147 WSA: Panel mounted flange with a single 45 degree angle pattern laboratory ball valve with removable straight serrated hose end and chrome plated lever handle with color coded index disc.

3. O2 Service Fitting Type:

a. CO2-1: L4200-147 WSA: Panel mounted flange with a single 45 degree angle pattern laboratory ball valve with removable straight serrated hose end and chrome plated lever handle with color coded index disc.

F. Fume Hood Gas Fittings

1. Vacuum:

a. V-2: L4285RB-LR: Panel mounted guide plate with a single straight aluminum rod, brass coupling and pattern laboratory ball valve with removable straight serrated hose end.

2. Future use Fitting: Basis of Design Manufacturer – WaterSaver L4285LB-LR with panel mount guide plate with a single straight aluminum rod, brass coupling and pattern laboratory ball valve. Provide blank face caps

END OF SECTION 11 53 43

SECTION 11 53 53 – BIOLOGICAL SAFETY CABINETS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

C. Work of this Section requires close coordination with Work of Divisions 11, 22, 23 and 26, as well as installation of Owner furnished components and Work specified in other Sections.

1.02 SUMMARY

A. Furnish and install pre-piped and pre-wired biological safety cabinets, complete with accessories.

1.03 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All design tested performance, materials, installation, and workmanship shall comply with all applicable requirements and standards.

1. OSHA, Federal Register 29 CFR Part 1910 - Occupational Exposures to Hazardous Chemicals in Laboratories.

2. ANSI/AIHA Z9.5 - Laboratory Ventilation.

3. NFPA 45 - Standard on Fire Protection for Laboratories Using Chemicals.

4. Underwriters Laboratories, UL 1805 Laboratory Hoods and Cabinets

5. NSF (National Sanitation Foundation International)/ANSI Standard #49

6. Scientific Apparatus Makers Association Standard for Laboratory and Hospital Service Fittings.

1.04 QUALITY ASSURANCE

A. Coordinate work of the Section with Section 12 35 53 (Laboratory Casework).

B. Provide interface products of style, material finish and color in order to produce a homogenous installation.

C. Qualifications:

1. Work in this Section shall be performed by a firm having a minimum eight years documented experience, with an established organization and production facilities including all tools, equipment and special machinery necessary for specializing in the fabrication and installation of the type of equipment required, and with skilled personnel, factory trained workmen and an experienced engineering department. Each shall have the demonstrated knowledge, ability, and proven capability to produce the specified equipment of the required quality, as well as the proven capacity to complete an installation of this type within the required time limits.

1.05 SPECIAL APPROVAL

A. Prior to contract award, final Owner-approval must be obtained, based on Owner's risk assessment of his operations, the particular agents intended for use, and the selection of equipment.

1.06 SUBMITTALS

A. Submit as specified herein and under the provisions of Section 01 31 00.

B. Materials List/Product Data:

1. Complete materials list, including catalog data of all materials, equipment, fan curves, test designs, performance charts, and products for work specified in this Section.

2. Liner and work surface chemical resistance test data.

C. Samples: Submission of samples may be required, before fabrication has begun, to clearly show the following:

1. Each type of specified finish and color range available, or as identified in the Finish Schedule.

2. Each service fitting.

D. Shop Drawings:

1. Submit complete shop fabrication and installation drawings, including plans, elevations, sections, dimensions, materials and metal gauge sizes, details, fittings, duct connections, and schedules. Show relationship to adjoining materials and construction. Show all fastening types and locations for securing units in place. Identify and show locations, size, and details of filters. Identify connection points, locations, and sizes of building services and systems. Provide clear identification where equipment requirements deviate from the service/utility provisions in the Construction Documents. Shop Drawings shall be in electronic format, as well as in the form of reproducibles or photocopies, not to exceed 11 by 17 inch (A3) in size. Blue-line prints are not acceptable.

2. Coordinate shop drawing submittals of both this Section and Section 12 35 53 (Laboratory Casework) so that each recognizes and incorporates the other’s products.

E. Record Documents:

1. Provide record approved product data, shop drawings, samples, test reports, and certifications.

2. Operations/Maintenance Manuals:

a. Complete operating and maintenance manuals that describe proper operating procedures, maintenance and replacement schedules, component parts list, wiring diagrams, and closest factory representative for components and service.

3. Submit certification by an independent testing company stating the equipment is installed per applicable and referenced codes and standards, adjusted and balanced for design operations, and is complete and ready for intended function.

a. Certify that each type and size of biological safety cabinet meets requirements of NSF Standard #49

1.07 PRODUCT HANDLING

A. Contractor shall schedule the delivery of biological safety cabinets when spaces are sufficiently complete so materials can be installed immediately following delivery.

B. Protection: Use all means necessary to protect work of this section before, during and after installation including installed work and materials of other trades.

C. Replacement: Any damaged work shall be replaced, repaired, and restored to original condition to the approval of the Architect at no additional cost or inconvenience to the Owner.

1.08 MAINTENANCE SERVICE

A. Beginning at Substantial Completion, provide 12 months full maintenance service by skilled, competent employees of equipment installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required to maintain specified or normal operation. Use only parts and supplies as used in the manufacture and installation of the original equipment.

B. Perform maintenance, including emergency callback service during normal working hours.

1.09 WARRANTY

A. Warrant biological safety cabinets for three (3) years from Substantial Completion.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state, and local requirements and conform to codes and ordinances of authorities having jurisdiction.

2.02 SERVICE FITTINGS

A. Provide types of fittings necessary for the services and pressures indicated on Drawings.

B. Finish: Polished chrome on brass body with a clear acid and solvent resistant epoxy coating unless specified otherwise.

C. Equip valve handles with color coded plastic index buttons as follows:

Service	**Indexing**	**Button Color**	**Lettering Color**
Lab Air	AIR	Orange	Black
Vacuum	VAC	Yellow	Black

Carbon Dioxide	CO2	Pink	Black
Oxygen	O2	Lt. Green	Black
Nitrogen	N2	Brown	White
Argon	AR	Violet	White
Helium	HE	Black	White
Hydrogen	H2	Pink	Black
Specialty Gas	SG	Lt. Blue	Black

D. Manufacturers:

1. Chicago Faucets.

2. Watersaver Faucet Co., Inc.

3. Substitutions are not permitted.

4. All fittings supplied under this Section shall be by the same manufacturer.

2.03 ELECTRIC SERVICE FITTINGS

A. Provide types of fittings necessary for the services indicated on the Drawings.

2.04 BIOLOGICAL SAFETY CABINET – CLASS II, TYPE B2

A. Basis-of-Design Product: The design for ducted biological safety cabinets is based on Nuaire's Model NU-S430-600 with LabGard with ergonomic adjustable base, as provided by Biomedical Solutions, P.O. Box 1646, Sugar Land, TX 77487. Tel: 281-240-5893. Subject to compliance with requirements, provide the named product or a comparable product by one of the following:

1. The Baker Company: Scientific Resources Southwest, Inc., 13003 Southwest Freeway, Suite 125, Stafford, TX 77477. Tel: 281-980-2845

a. Model: e3 BCG401 and e3 BCG601 (both BioChemGARD e3 with ergonomic adjustable base)

2. Another manufacturer as approved by Owner and Architect able to meet the specifications set forth herein.

B. Air Flow (at maximum 2.0 inch water column negative static pressure):

1. Baker 4 foot cabinet: 664 CFM

2. Baker 6 foot cabinet: 993 CFM

3. NuAire 4 foot cabinet with 8 inch access opening: 785 CFM

4. NuAire 6 foot cabinet with 8 inch access opening: 1250CFM

C. Units shall meet or exceed requirements of NSF Standard #49.

D. Units shall be tested and certified as required in Section 1.06 Submittals of this document.

E. Units shall be console type, nominal 4 foot or 6 foot wide as indicated. Units shall be transportable through a 3'-0" x 6'-8" doorway.

F. Units shall be UL listed.

G. Exterior Material: Cold rolled steel with white baked enamel finish.

H. Interior Material: Type 304 stainless steel with No. 4 finish. All stainless steel shall be welded construction with radiused corners.

I. Blower Motors: Electronically Commutated Motor (ECM) ultra high efficiency type shall be used.

J. Unit Legs: Adjustable.

K. View-screen: Vertical sliding, slanted 10 degrees, counter-weighted, 1/4 inch safety glass – opens to 8-1/4 inch.

L. Air intake velocity through 8 inch front access shall be 100 fpm minimum.

M. Unit shall be designed to directly exhaust 100 percent of the total volume of air handled in the unit from the work surface area to an outside exhaust provided by others.

N. Units shall have zero-probed supply and exhaust HEPA filters, 99.99 percent efficient for 0.3 microns per DOP test. The HEPA filters shall be low resistance type achieving a low static pressure of 0.30 to 0.45 inches water column.

   1. Filters shall be front loading.

O. Stainless steel air diffuser(s) and filter protector(s) shall be provided in work area. A metal grille shall be provided to protect the supply filter.

P. Air-tight control valve or damper to shut-off for decontamination shall be provided.

Q. Units shall have a linear fluorescent fixture mounted outside cabinet providing minimum 80 foot-candle lighting within the hood. Lamps shall be 32w T8, medium bi-pin, 85CRI, with electronic ballast, and instant start per manufacturers listed in 26 51 00.

R. All electrical components shall be outside work zone and exhaust flow ducting.

S. Electrical Power Receptacles: Provide the following unless indicated otherwise on Drawings: GFI type, on separate circuit from fan motor and lights. Provide two (2) duplex receptacles, red in color to designate emergency power. For 4 foot units, provide one (1) duplex receptacle, red in color to designate emergency power. Cover plates shall be stainless steel.

T. Vacuum Service Fittings: Provide one (1) valve on the right side wall on a 4’ hood and two (2) valves, one each on left and right side walls, on a 6’ hood unless indicated otherwise on Drawings. Gas valves shall not be installed.

U. Spill Trough Drain Valve: Stainless steel ball valve.

V. Locate service fittings 6 inch minimum beyond cabinet face. All cabinets are to be pre-piped with no pipe less than or equal to 1/2 inch diameter in size. Make service connections to the cabinet through the top and toward the back of the cabinet. Connections through the back or sides of the cabinet are not acceptable. Connections shall extend 2 inches above the cabinet. Piping within units shall be as specified in Division 22 for respective system. Provide type K copper medical gas tubing for vacuum and air lines.

W. Units shall have an audible and visible alarm to indicate low exhaust air flow by monitoring air mass. Provide audible and visible alarm when sliding view screen is in an unsafe position.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Prior to installation of the Work of the Section, carefully inspect the installed Work specified in other sections and verify that all such Work is complete to the point where this installation may properly commence.

B. Verify that all Work has been installed in complete accordance with the original design, received and accepted submittals, and the manufacturer's recommendations.

C. In the event of discrepancy, immediately notify the Architect. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

3.02 INSTALLATION

A. Work in this Section requires close coordination with Work specified in Divisions 11, 22, 23, 25, and 26 as well as installation by Owner of Owner furnished components. Coordinate all Work to ensure an orderly process in the Project, without removal of previously installed Work, and so as to prevent damage to finishes and products.

B. Coordinate location and alignment of biological safety cabinets for proper connection of all piping and duct work.

C. Install all equipment in accordance with manufacturer's written instructions, applicable codes and regulations, accepted Shop Drawings, and as necessary for a complete operating system.

D. Floor Supported Work: Set in position, level and fasten to adjacent units as required. .

E. Provide and install transition section as required between cabinet and ductwork.

F. Connect electrical and mechanical services indicated on Drawings to devices furnished with cabinet.

3.03 FIELD TESTING

A. Provide two week advance notice of scheduled testing.

B. Field tests shall be performed by a qualified independent NSF-accredited testing company. Balancing of the system is in the scope of work of Division 23

1. Owner will approve testing firm.

2. Owner's representative shall witness tests.

3. Final approval of testing and acceptance of reports shall be by Owner's Environmental Health and Safety department.

C. Balance, test, and certify each Class II biological safety cabinet in accordance with Annex F Field Tests appended to National Sanitation Foundation International (NSF) Standard #49 "Class II (Laminar Flow) Biohazard Cabinetry".

D. Operate each item of equipment and test full range of functions over a continuous 48 hour period, recording physical data on operating equipment. Verify that equipment functions properly and safely. Field test each unit under normal operating conditions through its full cycle. Include tests of filters, intake and exhaust air velocities, airflow pattern evaluations and pressure tests where applicable.

E. Adjust and retest units that do not meet specified performance.

F. Replace units which do not meet standards after repetitive testing.

3.04 ADJUSTING AND CLEANING

A. Adjusting:

1. Repair or remove and replace defective Work as approved by the Architect upon completion of installation.

2. Adjust all moving or operating parts to function within their design parameters.

B. Cleaning: Remove debris from area of installation daily and at completion of Project.

3.05 PROTECTION

A. Protect all units before, during and after installation. Damaged materials due to improper protection shall be cause for rejection.

END OF SECTION 11 53 53

SECTION 12 35 53 - LABORATORY CASEWORK

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

a. Metal laboratory casework.

b. Utility-space framing at backs of base cabinets and between backs of base cabinets.

c. Filler and closure panels.

d. Laboratory countertops.

e. Laboratory sinks and troughs.

f. Flammable liquid/solvent storage cabinets for fume hood

g. Laboratory accessories.

B. Related Sections:

a. Division 06 Section "Rough Carpentry" for wood blocking for anchoring laboratory casework.

b. Division 09 Section "Non-Structural Metal Framing" for reinforcements in metal-framed partitions for anchoring laboratory casework.

c. Division 11 Section "Laboratory Fume Hoods"

d. Division 11 Section “Laboratory Service Fittings” for Laboratory Casework and for Fume Hoods.

e. Division 26 Section for Electrical Fittings.

1.02 PERFORMANCE REQUIREMENTS

A. System Structural Performance: Laboratory casework and support framing system shall withstand the effects of the following gravity loads and stresses without permanent deformation, excessive deflection, or binding of drawers and doors:

a. Support Framing System: 600 lb/ft. (900 kg/m).

b. Work Surfaces: 160 lb/ft. (240 kg/m).

c. Wall Cabinets (Upper Cabinets): 160 lb/ft. (240 kg/m).

d. Shelves: 40 lb/sq. ft. (200 kg/sq. m).

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For laboratory casework. Include plans, elevations, sections, details, and attachments to other work.

a. Indicate locations of hardware and keying of locks.

b. Indicate locations and types of service fittings.

c. Indicate locations of blocking and reinforcements required for installing laboratory casework.

d. Include details of utility spaces showing supports for conduits and piping.

e. Include details of support framing system.

f. Include details of exposed conduits, if required, for service fittings.

g. Indicate locations of and clearances from adjacent walls, doors, windows, other building components, and other laboratory equipment.

h. Include coordinated dimensions for laboratory equipment specified in other Sections.

C. Samples for Verification: For each type of cabinet finish and each type of countertop material indicated, in manufacturer's standard sizes.

D. Samples for Verification: Unless otherwise directed, approved full-size Samples may become part of the completed Work, if in an undisturbed condition at time of Substantial Completion. Notify Architect of their exact locations. If not incorporated into the Work, retain acceptable full-size Samples at Project site and remove when directed by Architect.

a. One full-size, finished base cabinet complete with hardware, doors, and drawers.

b. One full-size, finished wall cabinet complete with hardware, doors, and adjustable shelves.

c. One Sample each of hinged and sliding doors.

d. 6-inch- (150-mm-) square Samples for each type of countertop material.

e. One of each type of sink and accessory item specified.

f. One of each type of hardware item specified.

1.04 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified manufacturer.

B. Product Test Reports for Countertop Surface Material: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating compliance of laboratory countertop surface materials with requirements specified for chemical and physical resistance.

1.05 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish complete touchup kit for each type and color of metal laboratory casework provided. Include fillers, primers, paints, and other materials necessary to perform permanent repairs to damaged laboratory casework finish.

a. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

b. Cabinet Mounting Clips and Related Hardware: Quantity equal to 5 percent of amount installed, but no fewer than 20 of each type.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that produces casework of types indicated for this Project that has been tested for compliance with SEFA 8.

B. Source Limitations: Obtain laboratory casework from single source from single manufacturer unless otherwise indicated. Obtain countertops sinks accessories from casework manufacturer.

C. Casework Product Standard: Comply with SEFA 8, "Laboratory Furniture - Casework, Shelving and Tables - Recommended Practices."

D. Flammable Liquid Storage: Where cabinets are indicated for solvent or flammable liquid storage, provide units that are listed and labeled as complying with requirements in NFPA 30 by a testing and inspecting agency acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Protect finished surfaces during handling and installation with protective covering of polyethylene film or other suitable material.

1.08 COORDINATION

A. Coordinate layout and installation of framing and reinforcements for support of laboratory wall cabinets and shelving.

B. Coordinate installation of laboratory casework with installation of fume hoods and other laboratory equipment.

PART 2 - PRODUCTS

2.01 METAL CABINET MATERIALS

A. Metal: Cold-rolled, commercial steel (CS) sheet, complying with ASTM A 1008/A 1008M; matte finish; suitable for exposed applications.

2.02 AUXILIARY CABINET MATERIALS

A. Acid Storage-Cabinet Lining: 1/4-inch- (6-mm-) thick, polyethylene, polypropylene, epoxy, or phenolic-composite lining material.

B. Glass for Glazed Doors: Clear tempered glass complying with ASTM C 1048, Kind FT, Condition A, Type I, Class 1, Quality-Q3; not less than 5.0 mm thick.

2.03 COUNTERTOP, SHELF TROUGH AND SINK MATERIALS

A. Phenolic Composite: Solid, high-pressure decorative laminate, complying with NEMA LD 3, Grade CGS. Decorative urethane-acrylic surface and cellulose fibre reinforced phenolic resin core. Basis-of-Design Product: Subject to compliance with requirements, provide product; Trespa North America; “TopLab Plus” or comparable product by one of the following:

a. Epoxyn Products.

b. Nevamar Company, LLC.

c. NuLab Furniture Corporation.

B. Chemical Resistance: Composite countertop material has the following ratings when tested with indicated reagents according to NEMA LD 3, Test Procedure 3.4.5,Color: As selected by Architect from manufacturer's full range.

2.04 METAL CABINETS

A. Basis-of-Design Product: Subject to compliance with requirements, provide A.T. Villa USA, Inc – “Basic” or comparable product by one of the following:

a. Fisher Hamilton L.L.C.

b. Kewaunee Scientific Corporation; Laboratory Products Group.

c. Lab Crafters, Inc.

d. Mott Manufacturing Ltd.

B. Fabrication: Assemble and finish units at point of manufacture. Use precision dies for interchangeability of like-size drawers, doors, and similar parts. Perform assembly on precision jigs to provide units that are square. Reinforce units with angles, gussets, and channels. Except where otherwise specified, integrally frame and weld cabinet bodies to form dirt and vermin-resistant enclosures. Where applicable, reinforce base cabinets for sink support. Maintain uniform clearance around door and drawer fronts of 1/16 to 3/32 inch (1.5 to 2.4 mm).

C. Flush Doors: Outer and inner pans that nest into box formation, with full-height channel reinforcements at center of door. Fill doors with noncombustible, sound-deadening material.

D. Glazed Doors: Hollow-metal stiles and rails of similar construction as flush doors, with glass held in resilient channels or gasket material.

E. Hinged Doors: Mortise for hinges and reinforce with angles welded inside inner pans at hinge edge.

F. Drawers: Fronts made from outer and inner pans that nest into box formation, with no raw metal edges at top. Sides, back, and bottom fabricated in one piece with rolled or formed top of sides for stiffening and comfortable grasp for drawer removal.

G. Adjustable Shelves: Front, back, and ends formed down, with edges returned horizontally at front and back to form reinforcing channels.

H. Toe Space: Fully enclosed, 4 inches (100 mm) high by 3 inches (75 mm) deep, with no open gaps or pockets.

I. Tables: Welded tubing legs, not less than 2 inches (50 mm) square with channel stretchers as needed to comply with product standard. Weld or bolt stretchers to legs and cross-stretchers, and bolt legs to table aprons. Provide leveling device welded to bottom of each leg.

J. Utilities: Provide space, cutouts, and holes for pipes, conduits, and fittings in cabinet bodies to accommodate utility services and their support-strut assemblies. Provide base cabinets with removable backs for access to utility space.

K. Utility-Space Framing: Laboratory casework manufacturer's standard steel framing units consisting of 2 steel slotted channels complying with MFMA-4, not less than 1-5/8 inches (41 mm) square by 0.105-inch (2.66-mm) nominal thickness, and connected at top and bottom by U-shaped brackets made from 1-1/4-by-1/4-inch (32-by-6-mm) steel flat bars. Framing units may be made by welding specified channel material into rectangular frames instead of using U-shaped brackets.

L. Filler and Closure Panels: Provide where indicated and as needed to close spaces between cabinets and walls, ceilings, and indicated equipment. Fabricate from same material and with same finish as cabinets and with hemmed or flanged edges unless otherwise indicated.

a. Provide utility-space closure panels at all cabinets, spaces between base cabinets where utility space would otherwise be exposed, including spaces below countertops.

b. Provide closure panels at ends of utility spaces where utility space would otherwise be exposed.

c. Provide knee-space panels (modesty panels) at spaces between base cabinets, where cabinets are not installed against a wall or where space is not otherwise closed. Fabricate from back-to-back panels or of hollow construction to eliminate exposed hemmed or flanged edges.

2.05 METAL CABINET FINISH

A. General: Prepare, treat, and finish welded assemblies after assembling. Prepare, treat, and finish components that are to be assembled with mechanical fasteners before assembling. Prepare, treat, and finish concealed surfaces same as exposed surfaces.

B. Preparation: After assembly, clean surfaces of mill scale, rust, oil, and other contaminants. After cleaning, apply a conversion coating suited to the organic coating to be applied over it.

C. Chemical-Resistant Finish: Immediately after cleaning and pretreating, apply laboratory casework manufacturer's standard two-coat, chemical-resistant, baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils (0.05 mm).

a. Chemical and Physical Resistance of Finish System: Finish complies with acceptance levels of cabinet surface finish tests in SEFA 8. Acceptance level for chemical spot test shall be no more than four Level 3 conditions.

b. Colors for Metal Laboratory Casework Finish: As selected by Architect from manufacturer's full range.

2.06 HARDWARE

A. General: Provide laboratory casework manufacturer's standard, commercial-quality, heavy-duty hardware complying with requirements indicated for each type.

B. Hinges: , 5-knuckle hinges complying with BHMA A156.9, Grade 1, with antifriction bearings and rounded tips. Provide 2 for doors 48 inches (1200 mm) high or less and 3 for doors more than 48 inches (1200 mm) high.

C. Hinged Door and Drawer Pulls: back-mounted pulls. Provide 2 pulls for drawers more than 24 inches (600 mm) wide.

a. Design: Manufacturer’s standard recessed .

b. Overall Size: Match A.T. Villa existing casework recessed pulls.

D. Sliding Door Pulls: Stainless-steel or chrome-plated recessed flush pulls.

a. Design and Size: Oval, 1 by 3 inches (25 by 76 mm), 3/8 inch (10 mm) deep.

E. Door Catches: Nylon-roller spring catches. Provide 2 catches on doors more than 48 inches (1200 mm) high.

F. Drawer Slides: Side mounted, epoxy-coated steel, self-closing; designed to prevent rebound when drawers are closed; complying with BHMA A156.9, Type B05091.

a. Provide Grade 1HD-100; for drawers not more than 6 inches (150 mm) high and 24 inches (600 mm) wide.

b. Provide Grade 1HD-200; for drawers more than 6 inches (150 mm) high or 24 inches (600 mm) wide.

G. Locks for Metal Cabinets: Cam or half-mortise type with 5-pin tumbler, brass with chrome-plated finish; complying with BHMA A156.11, Type E07281, E07261, E07111, or E07021.

a. Provide a minimum of three keys per lock and two master keys.

b. Keying: Key each lock separately.

c. Master Key System: Key all locks to be operable by master key.

H. Sliding-Door Hardware Sets: Laboratory casework manufacturer's standard, to suit type and size of sliding-door units.

I. Adjustable Wall Shelf Supports: Surface-type steel standards and steel shelf brackets, with epoxy powder-coated finish, complying with BHMA A156.9, Types B04102 and B04112.

2.07 COUNTERTOPS , SHELVES , TROUGHS, AND SINKS

A. Countertops, General: Provide units with smooth surfaces in uniform plane free of defects. Make exposed edges and corners straight and uniformly beveled. Provide front and end overhang of 1 inch (25 mm), with continuous drip groove on underside 1/2 inch (13 mm) from edge.

B. Sinks, General: Provide sizes indicated or laboratory casework manufacturer's closest standard size of equal or greater volume, as approved by Architect.

a. Outlets: Provide with strainers and tailpieces, NPS 1-1/2 (DN 40), unless otherwise indicated.

b. Overflows: For each sink except cup sinks, provide overflow of standard beehive or open-top design with separate strainer. Height 2 inches (50 mm) less than sink depth. Provide in same material as strainer.

C. Phenolic-Composite Countertops:

a. Countertop Fabrication: Fabricate with cutouts for sinks, holes for service fittings and accessories, and with butt joints assembled with epoxy adhesive and concealed metal splines.

b. Countertop Configuration: Flat, 5/8 inch (16 mm) thick, with rounded edge and corners, and with drip groove and integral coved backsplash.

D. Stainless-Steel Sinks: Made from stainless-steel sheet, not less than 0.050-inch (1.27-mm) nominal thickness. Fabricate with corners rounded and coved to at least 5/8-inch (16-mm) radius. Slope sink bottoms to outlet. Provide double-wall construction for sink partitions with top edge rounded to at least 1/2-inch (13-mm) diameter. Provide continuous butt-welded joints. After fabricating and welding, grind surfaces smooth and polish as needed to produce uniform finish with no evidence of welds and free of cross scratches. Passivate and rinse surfaces; remove embedded foreign matter and leave surfaces clean.

a. Punch holes for fittings at factory.

b. Provide with stainless-steel strainers and tailpieces.

c. Provide with integral rims except where located in stainless-steel countertops.

d. Apply 1/8-inch- (3-mm-) thick coating of heat-resistant, sound-deadening mastic to undersink surfaces.

E. Troughs: Stainless steel. Pitch to drains not less than 1/8 inch/foot (10 mm/m). Except where troughs empty into sinks, provide NPS 1-1/2 (DN 40) outlets with strainers and tail-pieces.

a. Stainless-Steel Troughs: Made from stainless-steel sheet, not less than 0.062-inch (1.59-mm) nominal thickness. Fabricate with corners rounded and coved to at least 5/8-inch (16-mm) radius. Provide continuous butt-welded joints. After fabricating and welding, grind surfaces smooth and polish as needed to produce uniform finish with no evidence of welds and free of cross scratches. Passivate and rinse surfaces; remove embedded foreign matter and leave surfaces clean. Provide stainless-steel strainers and tailpieces.

2.08 FLAMMABLE LIQUID/SOLVENT STORAGE CABINETS FOR FUME HOOD

A. Metal cabinet with double-walled construction, designed for storage of flammable, combustible and solvent liquids.

B. Cabinets shall be designed to support concentrated loads of 400 lbs from lead brick gamma ray enclosure placed anywhere inside fume hood.

C. Doors: Cabinet doors shall have a three-point latch.

D. Shelf: One (1) adjustable height steel shelf.

E. Label: “FLAMMABLE KEEP FIRE AWAY” in conspicuous silk-screened lettering.

a. Stick-on decals not acceptable.

F. Venting: No ventilation required.

G. Standards: Cabinet shall be constructed in compliance with NFPA 30.

H. Doors to be self closing and latching.

2.09 LABORATORY ACCESSORIES

A. Reagent Shelves: Provide as indicated, fabricated from same material as adjacent countertop, unless otherwise indicated.

B. Pegboards: Stainless-steel pegboards with removable polypropylene pegs and stainless-steel drip troughs with drain outlet.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances, location of reinforcements, and other conditions affecting performance of laboratory casework.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION OF CABINETS

A. Comply with installation requirements in SEFA 2.3. Install level, plumb, and true; shim as required, using concealed shims. Where laboratory casework abuts other finished work, apply filler strips and scribe for accurate fit, with fasteners concealed where practical. Do not exceed the following tolerances:

a. Variation of Tops of Base Cabinets from Level: 1/16 inch in 10 feet (1.5 mm in 3 m).

b. Variation of Bottoms of Upper Cabinets from Level: 1/8 inch in 10 feet (3 mm in 3 m).

c. Variation of Faces of Cabinets from a True Plane: 1/8 inch in 10 feet (3 mm in 3 m).

d. Variation of Adjacent Surfaces from a True Plane (Lippage): 1/32 inch (0.8 mm).

e. Variation in Alignment of Adjacent Door and Drawer Edges: 1/16 inch (1.5 mm).

B. Utility-Space Framing: Secure to floor with two fasteners at each frame. Fasten to partition framing, wood blocking, or metal reinforcements in partitions and to base cabinets.

C. Base Cabinets: Fasten cabinets to utility-space framing, partition framing, wood blocking, or reinforcements in partitions with fasteners spaced not more than 24 inches (600 mm) o.c. Bolt adjacent cabinets together with joints flush, tight, and uniform.

a. Where base cabinets are installed away from walls, fasten to floor at toe space at not more than 24 inches (600 mm) o.c. and at sides of cabinets with not less than 2 fasteners per side.

D. Wall Cabinets: Fasten to hanging strips, masonry, partition framing, blocking, or reinforcements in partitions. Fasten each cabinet through back, near top, at not less than 24 inches (600 mm) o.c.

E. Install hardware uniformly and precisely. Set hinges snug and flat in mortises.

F. Adjust laboratory casework and hardware so doors and drawers align and operate smoothly without warp or bind and contact points meet accurately. Lubricate operating hardware as recommended by manufacturer.

3.03 INSTALLATION OF COUNTERTOPS

A. Comply with installation requirements in SEFA 2.3. Abut top and edge surfaces in one true plane with flush hairline joints and with internal supports placed to prevent deflection. Locate joints only where shown on Shop Drawings.

B. Field Jointing: Where possible, make in same manner as shop-made joints using dowels, splines, fasteners, adhesives, and sealants recommended by manufacturer. Prepare edges in shop for field-made joints.

C. Fastening: Secure countertops, except for epoxy countertops, to cabinets with Z-type fasteners or equivalent, using two or more fasteners at each cabinet front, end, and back.

D. Provide required holes and cutouts for service fittings.

E. Seal unfinished edges and cutouts in solid phenolic countertops as recommended by manufacturer.

F. Provide scribe moldings for closures at junctures of countertop, curb, and splash with walls as recommended by manufacturer for materials involved. Match materials and finish to adjacent laboratory casework. Use chemical-resistant, permanently elastic sealing compound where recommended by manufacturer.

G. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

3.04 INSTALLATION OF SINKS

A. Semiflush Installation of Stainless-Steel Sinks: Before setting, apply sink and countertop manufacturers' recommended sealant under rim lip and along top. Remove excess sealant while still wet and finish joint for neat appearance.

3.05 INSTALLATION OF LABORATORY ACCESSORIES

A. Install accessories according to Shop Drawings and manufacturer's written instructions.

B. Securely fasten adjustable shelving supports, stainless-steel shelves, and pegboards to partition framing, wood blocking, or reinforcements in partitions.

C. Install shelf standards plumb and at heights to align shelf brackets for level shelves. Install shelving level and straight, closely fitted to other work where indicated.

D. Securely fasten pegboards to partition framing, wood blocking, or reinforcements in partitions.

3.06 CLEANING AND PROTECTING

A. Clean finished surfaces, touch up as required, and remove or refinish damaged or soiled areas to match original factory finish, as approved by Architect.

B. Protect countertop surfaces during construction with 6-mil (0.15-mm) plastic or other suitable water-resistant covering. Tape to underside of countertop at a minimum of 48 inches (1200 mm) o.c.

END OF SECTION 12 35 53

SECTION 20 01 00 – BASIC FIRE SUPPRESSION, PLUMBING AND HVAC REQUIREMENTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 SUMMARY

A. Basic and supplemental requirements common to Fire Suppression, Plumbing and HVAC Work.

1.03 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the Contract Documents.

1.04 DEFINITIONS

A. These definitions are included to clarify the direction and intention of these Specifications. For further clarification, contact the Architect/Engineer.

1. Concealed / Exposed: "Concealed" areas are those areas that cannot be seen by the building occupants. "Exposed" areas are all areas, which are exposed to view by the building occupants, including under counters, inside cabinets and closets, plus all mechanical rooms. “Exterior” areas are those that are outside the building exterior envelope and exposed to the outdoors.

2. Furnish: The term "furnish" is used to mean "supply and deliver to the Project Site, ready for unloading, unpacking, assembly, installation, and similar operations.

3. Install: The term "install" is used to describe operations at Project Site including the actual "unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.

4. Provide: The term "provide" means "to furnish and install, complete and ready for the intended use.

1.05 QUALITY ASSURANCE

A. Fire Suppression, Plumbing and HVAC systems shall be coordinated with other systems and trades to include but not be limited to: Electrical systems, fire alarm, security systems, transport systems, telephone and data systems.

B. Verification of Dimensions: The Contractor shall be responsible for the coordination and proper relation of Contractor's Work to the building structure and to the Work of all trades. The Contractor shall visit the premises and become thoroughly familiar with all details of the Work and working conditions, to verify all dimensions in the field, and to advise the Architect/Engineer of any discrepancy before performing any Work. Adjustments to the Work required in order to facilitate a coordinated installation shall be made at no additional cost to the Owner or the Architect/Engineer.

C. All dimensional information related to new structures shall be taken from the appropriate Drawings. All dimensional information related to existing facilities shall be taken from actual measurements made by the Contractor on the Site.

D. The Drawings are subject to the requirements of Reference Standards, structural and architectural conditions. The Contractor shall carefully investigate structural and finish conditions and shall coordinate the separate trades in order to avoid interference between the various phases of Work. Work shall be organized and laid out so that it will be concealed in furred chases and suspended ceilings, etc., in finished portions of the building, unless specifically noted to be exposed. All exposed Work shall be installed parallel or perpendicular to the lines of the building unless otherwise noted.

E. When the Drawings do not give exact details as to the elevation of pipe and ducts, the Contractor shall physically arrange the systems to fit in the space available at the elevations intended with proper grades for the functioning of the system involved. Piping and duct systems are generally intended to be installed true and square to the building construction, and located as high as possible against the structure in a neat and workmanlike manner. The Drawings do not show all required offsets, control lines, pilot lines and other location details. Work shall be concealed in all finished areas.

F. Where core drilling of floor or wall penetrations is required, Work shall be performed in accordance with Division 03 Specifications. Where applicable Division 03 Specifications are not included in the Project, core drilling shall be in accordance with generally accepted standards, and be performed by licensed personnel where applicable.

G. Certify in writing that neither the Contractor nor any of Contractor's subcontractors or suppliers will supply any materials that contain any asbestos in any form for this Project.

1.06 DELIVERY, STORAGE AND HANDLING

A. All equipment, ductwork, and materials shall be delivered to the Project Site clean and sealed for protection.

B. Take particular care not to damage the existing construction in performing Work. All finished floors, step treads and finished surfaces shall be covered to prevent any damage by workers or their tools and equipment during the construction of the Project.

C. Equipment and materials shall be protected from rust and dust/debris both before and after installation. Any equipment or materials found in a rusty condition at the time of final inspection must be cleaned of rust and repainted as specified elsewhere in these Specifications.

D. All material affected by weather shall be covered and protected to keep the material free from damage while material is being transported to the Site and while stored at the Project Site.

E. During the execution of the Work, open ends of all piping and conduit, and all openings in equipment shall be closed when Work is not in progress, and shall be capped and sealed prior to completion of final connections, so as to prevent the entrance of foreign matter.

F. All equipment shall be protected during the execution of the Work. All ductwork and equipment shall be sealed with heavy plastic and tape to prevent build-up of dust and debris.

G. All ductwork and air handling equipment shall be wiped down with a damp cloth immediately before installation to ensure complete removal of accumulated dusts and foreign matter.

H. All plumbing fixtures shall be protected and covered to prohibit usage. All drains shall be covered until placed in service to prevent the entrance of foreign matter.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

B. All equipment installed shall have local representation, local factory authorized service, and a local stock of repair parts.

C. Responsibility for furnishing proper equipment and/or material and ensuring that equipment and/or material is installed as intended by the manufacturer, rests entirely upon the Contractor. Contractor shall request advice and supervisory assistance from the representative of specific manufacturers during the installation.

D. All materials, unless otherwise specified, shall be new, free from all defects, suitable for the intended use and of the best quality of their respective kinds. Materials and equipment shall be installed in accordance with the manufacturer's recommendations and the best standard practice for the type of Work involved. All Work shall be executed by mechanics skilled in their respective trades, and the installations shall provide a neat, precise appearance. Materials and/or equipment damaged in shipment or otherwise damaged prior to installation shall not be repaired at the job Site but shall be replaced with new materials and/or equipment.

E. Materials and equipment manufactured domestically are preferred when possible. Materials and equipment that are not available from a domestic manufacturer may be by a non-domestic manufacturer provided they fully comply with Contract Documents.

F. Prevention of Rust: Standard factory finish will be acceptable on equipment specified by model number; otherwise, surfaces of ferrous metal shall be given a rust inhibiting coating.

2.02 NAMEPLATES

A. Each major component of equipment shall have the manufacturer's name, address, and catalog number on a plate securely attached to the item of equipment. All data on nameplates shall be legible at the time of Final Inspection.

B. Nameplates shall be black laminated rigid phenolic with white core. Nameplate minimum size shall be 1 inch high by 3 inches long with 3/16-inch-high engraved white letters.

C. Nameplate Fasteners: Fasten nameplates to the front of equipment only by means of stainless steel self-tapping screws. Stick-ons or adhesives will not be allowed unless the NEMA enclosure rating is compromised, then only epoxy adhesive shall be used to attach nameplates.

D. Nameplate Information: In general, the following information is to be provided for the types of electrical components or enclosures supplied with equipment.

1. Individual Starters, Contactors, Disconnect Switches, and Similar Equipment: Identify the device, and voltage characteristics source and load served.

2.03 WALL, FLOOR AND CEILING PLATES (ESCUTCHEONS)

A. Except as otherwise noted, provide stainless steel or chrome plated brass floor and ceiling plates around all pipes, ducts, conduits, etc., passing exposed through walls, floors or ceilings, in any spaces except underfloor and plenum spaces.

B. Plates shall be sized to fit snugly against the outside of the pipe or against the insulation on lines that are insulated and positively secured to such pipe or insulation.

C. For finished ceiling installation, secure escutcheons to ceiling with escutcheon fasteners.

D. Plates will not be required for piping where pipe sleeves extend ¾-inch or more above finished floor.

E. Round and rectangular ducts shall have closure plates (not chrome plated) made to fit accurately at all floor, wall and ceiling penetrations.

2.04 ROOF PENETRATIONS AND FLASHING

A. Pipe, conduit and duct sleeves, pitch pockets and flashings compatible with the roofing installation shall be provided and installed for all roof penetrations by a contractor qualified in such Work. Installation shall comply with the Contract Documents and with FM General Data Sheets 1-28, 1-29, 1-31 & 1-49 along with the FM approval guide.

PART 3 - EXECUTION

3.01 PREPARATION

A. Cooperate with trades of adjacent, related or affected materials or operations, and with trades performing continuations of this Work in order to effect timely and accurate placing of Work and to coordinate, in proper and correct sequence, the Work of such trades.

B. The size of equipment indicated on the Drawings is based on the dimensions of a particular manufacturer. While other manufacturers may be acceptable, it is the responsibility of the Contractor to determine that the equipment proposed will fit in the space. Fabrication Drawings shall be prepared when required by the Architect/Engineer or Owner to indicate a suitable arrangement.

C. All equipment shall be installed in a manner to permit access to all surfaces. All valves, motors, drives, filters, and other accessory items shall be installed in a position to allow removal for service without disassembly of another part.

D. Space Requirements:

1. Consider space limitations imposed by contiguous Work in location of equipment and material. Do not provide equipment or material which is not suitable in this respect.

2. Make changes in material and equipment locations of up to five (5) feet, to allow for field conditions prior to actual installation, and as directed by the Architect/Engineer at no additional cost to the Owner.

E. Contractor shall note that the electrical design and Drawings are based on the equipment scheduled and indicated on the Drawings. Should any equipment be provided requiring changes to the electrical design, the required electrical changes shall be made at no cost to the Owner.

F. Connections for equipment other than Divisions 21, 22, 23:

1. Rough-in and provide all gas, air, water, steam, sewer, etc. connections to all fixtures, equipment, machinery, etc., furnished by the Owner and/or other trades in accordance with detailed rough-in Drawings provided by the equipment suppliers, by actual measurements of the equipment connections, or as detailed.

2. After the equipment is set in place, make all final connections and provide all required pipe, fittings, valves, traps, etc.

3. Provide all backflow preventers and air gap fittings required, using approved devices. In each service line connected to an item of equipment or piece of machinery, provide a shutoff valve. On each drain not provided with a trap, provide a suitable trap.

4. Provide all ductwork, transition pieces, etc., required for a complete installation of vent hoods, fume hoods, etc.

3.02 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. All installation shall be in accordance with manufacturer’s published recommendations.

C. Piping may be run exposed in rooms typically without ceilings such as mechanical rooms, janitor's closets, tight against pan soffits in exposed "tee" structures, or storage spaces, but only where necessary. Shutoff and isolation valves shall be easily accessible.

D. All pipe, conduits, etc., shall be cut accurately to measurements established at the building and shall be worked into place without springing or forcing. All ducts, pipes and conduits run exposed in machinery and equipment rooms shall be installed parallel to the building lines, except that piping shall be sloped to obtain the proper pitch. Piping and ducts run in furred ceilings, etc., shall be similarly installed, except as otherwise shown. All pipe openings shall be kept closed until the systems are closed with final connections.

E. Prior to the installation of any ceiling material, gypsum, plaster or acoustical board, the Contractor shall notify Owner's Project Manager so that arrangement can be made for an inspection of the above-ceiling area about to be "sealed" off. The Contractor shall provide written notification to the Owner at least five (5) calendar days prior to the inspection.

F. Precedence of Materials:

1. The Specifications determine the nature and setting of materials and equipment. The Drawings establish quantities, dimensions and details.

2. If interference is encountered, the following installation precedence of materials shall guide the Contractor to determine which trade shall be given the "Right of Way":

a. Building lines

b. Structural members

c. Structural support frames supporting ceiling equipment

d. Electric tracked vehicle system

e. Pneumatic trash and linen system

f. Pneumatic tube system

g. Soil and drain piping

h. Vent piping

i. Supply, return and outside air ductwork

j. Exhaust ductwork

k. HVAC water and steam piping

l. Condensate piping

m. Fire protection piping

n. Natural gas piping

o. Medical/Laboratory gases

p. Domestic water (cold and hot, softened, treated)

q. Refrigerant piping

r. Electrical conduit

3. Coordinate fire suppression, plumbing and HVAC systems with transport systems as required to maintain transport system right-of-way.

3.03 TESTING

A. When any piece of mechanical equipment is operable and it is to the advantage of the Contractor to operate the equipment, Contractor may do so, provided that Contractor properly supervises the operation, and has the Owner's written permission to do so. The warranty period shall, however, not commence until such time as the equipment is operated for the beneficial use of the Owner, or date of Substantial Completion, whichever occurs first.

B. Regardless of whether or not the equipment has or has not been operated, the Contractor shall properly clean the equipment, install clean filter media, properly adjust, and complete all deficiency list items before final acceptance by the Owner. The date of acceptance and performance certification will be the same date.

C. Before the Work is accepted, an authorized representative of the manufacturer of the installed materials and/or equipment shall personally inspect the installation and operation of manufacturer's materials and/or equipment to determine that materials and/or equipment are properly installed and in proper operating order. The qualifications of the manufacturer's representative shall be appropriate to the technical requirements of the installation. The qualifications of the manufacturer's representative shall be submitted to the Owner for approval. The decision of the Owner concerning the appropriateness of the manufacturer's representative shall be final. Testing and checking shall be accomplished during the course of the Work where required by Work being concealed, and at the completion of the Work. In addition, the Contractor shall submit to the Architect/Engineer a signed statement from each manufacturer's representative certifying as follows: **"I certify that the materials and/or equipment listed below have been personally inspected by the undersigned authorized manufacturer's representative and is properly installed and operating in accordance with the manufacturer's recommendations."**

D. Check inspections shall include piping, equipment, heating, air conditioning, insulation, ventilating equipment, controls, mechanical equipment and such other items hereinafter specified or specifically designated by the Architect/Engineer.

E. The Contractor shall execute, at no additional cost to the Owner, any tests required by the Owner or the National Fire Protection Association, ASTM, etc. Standards listed. The Contractor shall provide all equipment, materials and labor for making such tests. The Owner will pay reasonable amounts of fuel and electrical energy costs for system tests. Fuel and electrical energy costs for system adjustment and tests, which follow Substantial Completion by the Owner, will be borne by the Owner.

F. Notify the Owner's Project Manager and the Architect/Engineer in writing at least seven (7) calendar days prior to each test and prior to other Specification requirements requiring Owner and Architect/Engineer to observe and/or approve tests.

G. All tests shall have pertinent data logged by the Contractor at the time of testing. Data shall include date, time, personnel performing, observing and inspecting, description of the test and extent of system tested, test conditions, test results, specified results an other pertinent data. Data shall be delivered to the Architect/Engineer as specified under "Requirements for Final Acceptance." The Contractor or Contractor's authorized job superintendent shall legibly sign all Test Log entries.

H. Refer to Commissioning Specification Sections for additional Start-up, prefunctional and operational checkout, and for functional performance test procedures.

3.04 TRAINING

A. Operating and Maintenance Manuals and instruction shall be provided as specified under the Division 01 Section entitled "Project Closeout Procedures."

B. Specific training and operating instructions for individual equipment components shall be as specified in the individual Specification Sections.

END OF SECTION 20 01 00

SECTION 20 05 13 – MOTORS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 SUMMARY

A. Perform all Work required to provide and install high efficiency single- and three-phase electric motors required for equipment supplied under this division of Work as indicated by the Contract Documents, with supplementary items necessary for proper installation. Refer to Electrical Drawings for motor starter sizes. Disconnect switches to be furnished in Division 26.

B. The Fire Suppression, Plumbing and HVAC Subcontractor shall furnish starters for Fire Suppression, Plumbing and HVAC Work. Motor starters shall be provided in accordance with Division 26 Specifications. Some motors furnished in mechanical equipment rooms shall have starters furnished and installed as part of Division 26 (as per Specification Section 26 29 14, Motor Starters). Coordinate with Division 26.

C. Motors rated at less than 190 Watts and intended for intermittent operation need not conform to these Specifications.

D. ECM (Electronically Commutated Motor) motors on terminal units, fan-coil units, and computer room air conditioning units are except from specification requirements that can not apply due to different electrical design characteristics.

1.03 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and Workmanship shall comply with the applicable requirements and standards addressed within the following references:

1. AFBMA 9 – Load Ratings and Fatigue Life for Ball Bearings.

2. AFBMA 11 – Load Ratings and Fatigue Life for Roller Bearings.

3. EISA - The Energy Independence & Securities Act 2007.

4. ANSI/EEE 112 – Test Procedure for Polyphase Induction Motors and Generators.

5. ANSI/NEMA/ MG 1 – Motors and Generators Part 31.

6. NFPA 70 – National Electrical Code.

7. ANSI C19 – Industrial Control Apparatus.

8. NEMA ICS – Industrial Control and Systems.

9. NEMA RV 3 - Application and Installation Guidelines for Flexible and Liquidtight Flexible Metal and Nonmetallic Conduits

10. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable

11. NEMA FB 2.20 - Selection and Installation Guidelines For Fittings for Use With Flexible Electrical Conduit and Cable

12. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports

13. NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers, and Box Supports

14. NEMA OS 3 - Selection and Installation Guidelines for Electrical Outlet Boxes

15. UL 508 – Industrial Control Equipment.

16. ANSI/EEE 117 – Standard Test Procedure for Evaluation of Systems of Insulating Materials for Random Wound AC Electric Machinery.

17. ANSI/NEMA MG 2 – Safety Standard for Construction and Guide for Selection, Installation and Use of Electric Motors.

18. ANSI/UL 674 – Electric Motors and Generators for Use in Hazardous (Classified) Locations.

19. ANSI/UL 1004 – Electric Motors.

1.04 QUALITY ASSURANCE

A. Motors associated with variable frequency drives (VFD) shall be inverter-duty rated, and provided with grounded shaft or ceramic bearings to insulate shaft, and Class F 105 degrees C rise insulation. Ref. NEMA MG1 Part 31.

B. Conform to NFPA 70.

1.05 SUBMITTALS

A. All motors provided by the Contractor shall be of the same manufacturer unless they are an integral part of the piece of equipment to which they are attached.

B. Product Data: Provide the following information for each motor:

1. Manufacturer.

2. Rated full load horsepower.

3. Rated volts.

4. Number of Phases.

5. Insulation Class.

6. Frequency in Hertz.

7. Full load amperes (FLA).

8. Locked rotor amperes (LRA) at rated voltage or NEMA code letter.

9. Nominal speed at full load (rpm).

10. Service factor.

11. NEMA design letter.

12. NEMA machine type (ODP, WP-I, TEFC, etc.).

C. For motors one horsepower and larger, include the following additional information:

1. NEMA frame size.

2. NEMA insulation system classification. For motors required to be installed outdoors, include information showing compliance for outdoor application.

3. Maximum ambient temperature for which motor is designed.

4. Time rating.

5. Bearing size and type data.

6. Guaranteed efficiency and power factor at full load, 75% load, 50% load, 25% load and 0% load.

D. For motors 20 horsepower and larger, include the following additional information:

1. No load amperes.

2. Safe stall time.

3. Guaranteed efficiency and power factor at full load, 75% load, 50% load, 25% load and 0% load.

4. Motor manufacturer's recommended maximum power factor correction capacitor (kvar) that can safely be switched with the motor.

5. Expected value of corrected power factor at no load, 50 percent, 75 percent and full load.

6. Full load amperes with corrected power factor.

7. Maximum guaranteed slip at full load.

E. Operation and Maintenance Data:

1. Submit operation and maintenance data including assembly Drawings, bearing data including replacement sizes, and lubrication instructions.

F. Alternate Motors:

1. If a motor horsepower rating larger than indicated is offered as a substitute and accepted, provide required changes in size of conductors, conduits, motor controllers, overload relays, fuses, circuit breakers, switches and other related items at no change in the Contract price.

1.06 WARRANTY

A. Provide minimum one-year manufacturer's warranty including coverage for motors one horsepower and larger.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

B. Electrical Service: Refer to Drawing schedules for required electrical characteristics.

C. Design for continuous operation in 40 degrees C environment and for temperature rise in accordance with ANSI/NEMA MG 1 limits for insulation class, Service Factor and motor enclosure type.

1. Totally Enclosed Motors: Design for a service factor of 1.00 and an 80 degrees C maximum temperature rise in the same conditions.

2. Explosion-Proof Motors: UL approved and labeled for hazard classification, with over temperature protection.

D. Visible Stainless Steel Nameplate: Indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, Service Factor, Power Factor, efficiency.

E. Electrical Connection: Provide adequately sized metal electrical connection box for conduit connection. For fractional horsepower motors where connection is made directly, provide metal electrical box for conduit connection.

F. Motors shall be built in accordance with the latest ANSI, IEEE and NEMA Standards and shall be fully coordinated with the equipment served, shall be of sizes and electrical characteristics scheduled and of approved manufacturer as listed below or of the same manufacturer as the equipment which they serve. Nameplate rating of motors shall match the characteristics scheduled.

G. All motors shall be designed for normal starting torque unless the driven machine requires high starting torque and shall be selected for quiet operation, free from magnetic hum.

H. All motors shall be provided with adequately sized electrical connection box for attachment of flexible conduit. Paragraph 1.03 of this specification refers to the NEMA standards and publications relevant to applications and use of both metal and liquid tight flexible conduit. When motors are connected to driven equipment by the use of a V-belt drive, they shall be furnished with adjustable rails.

I. All air handling unit motor(s) with single and fan array arrangements, exhaust fan motors, chilled and hot water pump motors shall be compatible with variable frequency drive controllers. Equipment manufacturer shall coordinate with VFD manufacturer to ensure compatibility. Characteristics of motors furnished on equipment shall be furnished to VFD manufacturer for review, prior to installing motor on equipment. VFD's shall be furnished with driven equipment and shall be run tested as an equipment unit at factory prior to shipment. Submit run test report prior to shipping. F.O.B. of motors to factory shall be by the equipment manufacturer.

J. Motors shall be open drip-proof type, except where specified or noted otherwise on the construction drawing.

K. Motors ¼ to ¾ hp shall be Subtype II and meet the minimum requirements of EPAct92 for minimum NEMA nominal efficiency motors.

L. Motors 1 to 200 hp shall be Subtype I and meet the minimum requirements of NEMA Table 12-12 for NEMA premium efficiency motors.

2.02 MANUFACTURERS

A. Manufacturer: Company specializing in the manufacture of electric motors for HVAC and plumbing equipment use, and their accessories, with minimum three (3) years documented product development, testing and manufacturing experience.

1. Baldor - Super E – NEMA Premium Efficiency.

2. Marathon - NEMA Premium Efficiency.

3. Siemens – NEMA Premium EfficiencyU.S. Electrical – NEMA Premium Efficiency.

2.03 SINGLE PHASE POWER - SPLIT PHASE MOTORS

A. Starting Torque: Less than 150 percent of full load torque.

B. Starting Current: Up to seven times full load current.

C. Breakdown Torque: Approximately 200 percent of full load torque.

D. Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated sleeve or ball bearings.

E. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, prelubricated ball bearings.

F. Single phase motors, shall be less than 3/4 horsepower and shall be permanent split phase, capacitor start, induction run, 120 volt, 60 hertz motors with dripproof enclosures except as hereinafter specified. These motors shall have built-in thermal overload protection and shall be rated for temperature rise as hereinbefore specified for 3-phase motors.

2.04 SINGLE PHASE POWER - PERMANENT-SPLIT CAPACITOR MOTORS

A. Starting Torque: Exceeding one fourth of full load torque.

B. Starting Current: Up to six times full load current.

C. Multiple Speed: Through tapped windings.

D. Open Drip-proof or Enclosed Air Over Enclosure: Class A (50 degrees C temperature rise) insulation, minimum Service Factor as specified herein, prelubricated sleeve or ball bearings, automatic reset overload protector.

E. Single phase motors shall be less than 3/4 horsepower and shall be permanent split phase, capacitor start, induction run, 120 volt, 60 hertz motors. These motors shall have built-in thermal overload protection with automatic reset and shall be rated for temperature rise as hereinbefore specified for 3-phase motors.

2.05 SINGLE PHASE POWER - CAPACITOR START MOTORS

A. Starting Torque: Three times full load torque.

B. Starting Current: Less than five times full load current.

C. Pull-up Torque: Up to 350 percent of full load torque.

D. Breakdown Torque: Approximately 250 percent of full load torque.

E. Motors: Capacitor in series with starting winding; capacitor-start/capacitor-run motors shall have two capacitors in parallel with run capacitor remaining in circuit at operating speeds.

F. Enclosures shall be of the open dripproof type with a service factor as specified herein and Class B insulation rated at 90 degrees C temperature rise measured above 40 degrees C room ambient condition at full load, unless otherwise noted.

G. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, prelubricated ball bearings.

H. Single phase motors, in general, shall be less than 3/4 horsepower and shall be permanent split phase, capacitor start, induction run, 120 volt, 60 hertz motors. These motors shall have built-in thermal overload protection and shall be rated for temperature rise as hereinbefore specified for 3-phase motors.

2.06 THREE PHASE POWER - SQUIRREL CAGE MOTORS

A. Enclosures shall be of the open drip proof type with a service factor as specified herein and Class B insulation rated at 90 degrees C temperature rise measured above 40 degrees C room ambient condition at full load, unless otherwise noted.

B. All motors 3/4 horsepower and larger, unless smaller motors are indicated to be supplied as 3-phase, shall be 3-phase and shall be squirrel cage high efficiency induction type with standard NEMA frame sizes.

C. Three phase motors not connected to variable frequency drives are to be protected for phase loss and phase unbalance protection.

D. Motors 1 HP and larger shall have integral frames.

E. Starting Torque: Between one and one and one-half times full load torque.

F. Starting Current: Six times full load current.

G. Power Output, Locked Rotor Torque, Breakdown or Pullout Torque: NEMA Design B characteristics.

H. Design, Construction, Testing and Performance: Conform to ANSI/NEMA MG 1 for Design B motors.

I. Insulation System: NEMA Class B or better.

J. Testing Procedure: In accordance with ANSI/IEEE 112, Test Method B. Load test motors to determine freedom from electrical or mechanical defects and compliance with performance data.

K. Motor Frames: NEMA standard T-frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.

L. Bearings:

1. Ball or roller type, double shielded with continuous grease relief to accommodate excessive pressure caused by thermal expansion or over lubrication.

2. All motor bearings shall be factory prepacked with a nondetergent lubricant and shall be provided with lubrication fitting arranged to provide easy access when installed on the driven apparatus except as noted hereinafter.

3. Permanently lubricated factory-sealed motors may be provided in fractional horsepower sizes only where they are an integral part of a piece of approved apparatus.

4. All bearings shall be designed for L-10, 40,000 hour minimum life hours of continuous service. Calculate bearing load with NEMA minimum V-belt pulley with belt centerline at end of NEMA standard shaft extension. Direct driven fans may require specific bearings other then ball type, verify equipment specification where motor may be used where bearing life requirement may exceed L-10 rating. Stamp bearing sizes on nameplate.

M. Sound Power Levels: Refer to ANSI/NEMA MG 1.

N. Part Winding Start (Where Indicated): Epoxy seal windings using vacuum and pressure with rotor and starter surfaces protected with epoxy enamel. Bearings shall be double shielded with waterproof non-washing grease.

O. Nominal Efficiency and Power Factor: Meet or exceed values as scheduled at load and rated voltage when tested in accordance with ANSI/IEEE 112.

P. Motors one horsepower and larger shall be provided with a copper frame grounding lug of hydraulic compression design, for installation by the electrical subcontractor.

2.07 STARTING EQUIPMENT

A. Each motor shall be provided with proper starting equipment. Starting equipment shall be furnished by this Division.

B. Relays and equipment supplied by this Contractor shall be integral with electrical equipment supplied.

2.08 RATING

A. Speed and Size: Speed and approximate horsepower ratings are specified in equipment Specification Sections or are indicated on the Drawings. Furnish motors sufficiently sized for the particular application and with full-load rating not less than required by the driven equipment at specified capacity. Size motors so as not to overload at any point throughout the normal operating range.

B. Voltage:

1. Single phase: 115 volts for 120-volt nominal system voltage.

2. Three phase: 200 volts for 208-volt nominal system voltage.

3. Three phase: 230 volts for 240-volt nominal system voltage.

4. Three phase: 230/460 volts for 240/480-volt nominal system voltage.

5. Three phase: 460 volts for 480-volt nominal system voltage.

C. Frequency: 60 Hertz.

D. Efficiency: Provide energy-efficient motors meeting the requirements of NEMA MG1-12.55A, Table 12Y and MG 1.41.3. Efficiency to be determined by testing in accordance with NEMA MG 112.53 using IEEE 112A – Method B.

E. Service Factor: According to NEMA MG 1-12.47 but not less than those indicated per the Table below.

F. Table: NEMA Open Motor Service Factors:

Horsepower	3600 RPM	1800 RPM	1200 RPM	900 RPM
1/6 – 1/3	1.35	1.35	1.35	1.35
½	1.25	1.25	1.25	1.15
¾	1.25	1.25	1.15	1.15
1	1.25	1.15	1.15	1.15
1.5-150 and above	1.15	1.15	1.15	1.15
150				

Horsepower	3600 RPM	1800 RPM	1200 RPM	900 RPM

PART 3 - EXECUTION

3.01 APPLICATION

A. Single-phase motors for shaft mounted fans shall be split phase type.

B. Single-phase motors for shaft mounted fans or blowers shall be permanent split capacitor type.

C. Single-phase motors for fans shall be capacitor start, capacitor run type.

D. Motors located in exterior locations and in direct drive axial fans, roll filters, humidifiers and draw-through air units shall be totally enclosed weatherproof epoxy-sealed type.

3.02 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. All installation shall be in accordance with manufacturer's published recommendations.

C. Properly install and align motors after installation on the driven equipment.

D. Motor feeders shall be free of splices. In special cases when splice-free feeders are impractical, splices may be allowed given prior written approval from the Owner.

E. Use crimp-on, solderless copper terminals on the branch circuit conductors. For motors 20 horsepower and larger, use 5300 Series 3M motor lead splicing kit or approved equal.

F. When the motor and equipment are installed, the motor's nameplate must be in full view.

3.03 TESTING

A. General: Provide all necessary instruments, labor and personnel required to perform motor inspection and testing.

B. Inspection: Inspect all motors for damage, moisture absorption, alignment, freedom of rotation, proper lubrication, oil leaks, phase and rotation and cleanliness, and report any abnormalities to Owner before energizing.

C. Tests: Motor full load current and full load voltage shall be measured. Motor phase loss and phase unbalance protection shall be tested. Motor Test Report forms included at the end of this Section shall be completed and submitted prior to Substantial Completion.

D. Energizing: After installation has been thoroughly checked and found to be in proper condition, with thermal overloads in motor controllers properly sized and all controls in place, energize the equipment at system voltage for operational testing.

E. Motor Test Report Form:

DATE _____

SHEET ___ OF _____

PROJECT NAME _____

PROJECT NO. _____

MOTOR DESIGNATION _____, LOCATION _____

HP _____, FLA _____, LOCATION _____

PHASE LOSS AND PHASE UNBALANCE PROTECTION _____
INSULATION CLASS _____

SERVED FROM PANEL/MCC _____

MEASURED CONDITIONS

TEMPERATURE: _____ degrees F

RELATIVE HUMIDITY: _____ %

CURRENT (AMPS): ∅A _____, ∅B _____, ∅C _____

VOLTAGE (VOLTS): ∅B _____, ∅BC _____, ∅CA _____

∅AN _____, ∅BN _____, ∅CN _____

END OF SECTION 20 05 13

SECTION 20 05 16 – PIPING EXPANSION COMPENSATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 SUMMARY

A. Perform all Work required to provide and install the following piping expansion compensation equipment indicated by the Contract Documents with supplementary items necessary for their proper installation.

1. Flexible pipe connectors.

2. Expansion joints and compensators.

3. Pipe loops, offsets, and swing joints.

1.03 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:

1. MIL-E-17814E-Expansion Joints, Pipe, Slip-Type, Packed.

1.04 QUALITY ASSURANCE

A. Provide structural Work and equipment required to control expansion and contraction of piping. Verify that anchors, guides, and expansion joints provided, adequately protect system.

B. Expansion Calculations

1. Installation temperature: 50 degrees F.

2. Safety Factory: 30 percent.

3. Hot Water Heating, Domestic Hot Water, Chilled Water and Steam temperature shall be as per system design.

1.05 SUBMITTALS

A. Flexible Pipe Connectors: Indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per foot and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.

B. Expansion Joints: Indicate maximum temperature and pressure rating, and maximum expansion compensation. Indicate alignment, guide locations, quantities, spacing, etc.

C. Operation and Maintenance Data: Include adjustment instructions, warranty.

D. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this Section with minimum three (3) years documented experience.

1.06 EXTRA MATERIALS

A. Provide two (2) 12-ounce containers of packing coverage for leak-free performance of expansion joints.

1.07 WARRANTY

A. Provide a five (5) year warranty including coverage for leak-free performance of expansion joints.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.02 MANUFACTURERS

A. Flexible Pipe Connectors:

1. Hyspan Model Series 3505.

2. Pathway Model Xpress FF with anchor foot.

B. Expansion Joints – Steam:

1. Hyspan Model Series 3505.

2. Pathway Model Xpress FF with anchor foot.

C. Expansion Joints – Steel Piping:

1. Hyspan Model 3501 series.

2. Pathway Model Xpress FF with anchor foot.

D. Expansion Joints – External Ring:

1. Hyspan Model Series 5500.
2. Pathway Model Flexway CT.
3. Flexonics Model TCS-R.

E. Pipe Alignment Guides:

1. Anvil Model Fig. 255.
2. Piping Technology & Products Model Fig. 6.
3. Hyspan Model Series 9500.
4. AAA Technology Model Fig. 295.

2.03 FLEXIBLE PIPE CONNECTORS

A. Copper Piping - Domestic Water:

1. Pathway Model Xpress FF with anchor foot.
2. Exterior Sleeve: Braided bronze or stainless.
3. Pressure Rating: 200 psig WOG and 250 degrees F.
4. Joint: As specified for pipe joints.
5. Size: Use pipe-sized units.
6. Maximum offset: 3/4 inch on each side of installed centerline.

2.04 EXPANSION JOINTS

A. Steam - Stainless Steel Bellows (Externally Pressurized Guided Type):

1. Pressure Rating: 300 psig, maximum temperature 850 degrees F.
2. Maximum Compression: 4 inch.
3. Maximum Extension: 1 inch.
4. Joint: As specified for ANSI class.
5. Size: Use pipe-sized units.
6. Application: Steel piping 3 inches and under.

B. Steel Piping - 150 psig Chilled Water, 150 psig Heating Water, and Steam Condensate:

1. Annular Corrugated Inner Core: Steel laminated bellows meeting ASTM A 240.
2. Exterior Sleeve: Steel housing meeting ASTM A 53 GRB.

3. Pressure Rating: 150 psig and 300 psig at 750 degrees F. Refer to Drawings.

4. Joint: Flanged 150 and 300 raised face as required for piping system.

5. Size: Use pipe-sized units.

6. Axial Compression: 4 inches.

C. External Ring Stainless Steel Bellows Restrained (Chilled and Heating Water Pump Connectors) Type:

1. Pressure Rating: 350 psig at 400 degrees F.

2. Maximum Compression: 0.75 to 1.00 inches.

3. Maximum Extension: 0.25 inches.

4. Maximum Offset: 0.13 inches.

5. Joint: Flanged as required by ANSI class.

6. Size: Use pipe-sized units.

7. Bellows: Type 321 stainless steel.

8. Application: Steel piping over 3 inches.

2.05 ACCESSORIES

A. Pipe Alignment Guides:

1. Two (2) piece welded steel with enamel paint, bolted, with spider to fit standard pipe, frame with four mounting holes, clearance for minimum 1 inch thick insulation, minimum 3 inch travel.

2. Provide and install alignment guides at expansion joints per manufacturer's requirements.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. All installation shall be in accordance with manufacturer's published recommendations.

1. Accomplish structural Work and provide equipment required to control expansion and contraction of piping, loops, pipe offsets, and swing joints, and provide corrugated bellows type expansion joints where indicated on Drawings or required.

2. Provide pipe anchors as shown on the Drawings and/or as required to facilitate proper operation of pipe guides. Install anchors in compression. Weld anchors to pipe and to building structure

3. Provide pipe guides so that movement takes place along axis of pipe only. Guide sizes shall be the nominal pipe size with insulation. Guides shall not carry dead weight load on pipe and are not intended to take the place of the required pipe supports and rollers.

4. Construct spool pieces to exact size of flexible connection for future insertion.

5. Install flexible pipe connectors on pipes connected to equipment supported by vibration isolation. Provide line size flexible connectors.

6. Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor the other end. Install in a horizontal plane unless indicated otherwise.

7. Rigidly anchor pipe to building structure where shown or where necessary. Provide pipe guides so movement is directed along axis of pipe only. Erect piping such that strain and weight is not on cast connections or apparatus.

3.02 TESTING

A. Prepare and Start-up systems under provisions of Section 20 01 00 and Section 26 01 00.

B. Provide inspection services by flexible pipe manufacturer's representative for final installation.

C. Certify that installation is in accordance with manufacturer's recommendations and that connectors are performing satisfactorily. Notify Owner’s Project Manager at least five (5) calendar days prior to the inspection.

END OF SECTION 20 05 16

SECTION 20 05 29 – SUPPORTS AND SLEEVES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 SUMMARY

A. Perform all Work required to provide and install supports, hangers, anchors, sleeves and bases for all pipe, duct, equipment, system components and accessories, indicated by the Contract Documents with all supplementary items necessary for complete, code compliant and approved installation

1.03 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and Workmanship shall comply with the applicable requirements and standards addressed within the following references:

1. International Mechanical Code.

2. International Plumbing Code.

3. International Fuel Gas Code.

4. ASME B31.2 - Fuel Gas Piping.

5. ASME B31.9 - Building Services Piping.

6. ASTM F708 - Design and Installation of Rigid Pipe Hangers.

7. MSS SP58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.

8. MSS SP69 - Pipe Hangers and Supports - Selection and Application.

9. MSS SP89 - Pipe Hangers and Supports - Fabrication and Installation Practices.

10. MSS SP-90 - Guidelines on Terminology for Pipe Hangers and Supports.

11. NFPA 13 - Installation of Sprinkler Systems.

12. NFPA 14 - Installation of Standpipe and Hose Systems.

13. NFPA 99 - Standard for Health Care Facilities.

14. UL 203 - Pipe Hanger Equipment for Fire Protection Service.

15. SMACNA - HVAC Duct Construction Standards.

16. Underwriters Laboratories Standards and Listings.

1.04 QUALITY ASSURANCE

A. Materials and application of pipe hangers and supports shall be in accordance with MSS-SP-58 and SP-69 unless noted otherwise.

B. Support and sleeve materials and installation shall not interfere with the proper functioning of equipment.

C. Contractor shall be responsible for structural integrity of all hangers, supports, anchors, guides, inserts and sleeves. All structural hanging materials shall have a minimum safety factor of five.

D. Installer Qualifications: Utilize an installer experienced in performing Work of this Section who is experienced in installation of Work similar to that required for this Project and per the minimum requirements of MSS SP-89. Field welding of supports shall be by certified welders qualified in accordance with ASME Boiler and Pressure Vessel Code, Section IX using welding procedures per the minimum requirements of MSS SP-58.

1.05 SUBMITTALS

A. Product Data: Provide manufacturer’s catalog data including code compliance, load capacity, and intended application.

B. Manufacturer's Installation Instructions: Indicate special procedures and assembly of components.

C. Shop Drawings: Submit detailed Drawings of all shop or field fabricated supports, anchors and sleeves, signed and sealed by a qualified State of Texas registered professional engineer. Indicate size and characteristics of components and fabrication details and all loads exceeding 250 pounds imposed on the base building structure.

1.06 DELIVERY, STORAGE AND HANDLING

A. Comply with manufacturer’s ordering instructions and lead time requirements to avoid construction delays.

B. Deliver materials in manufacturer’s original, unopened, undamaged containers with identification labels intact. Maintain in place until installation.

C. Store materials protected from exposure to harmful weather conditions.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.02 MANUFACTURERS

A. Hangers and Supports:

1. Anvil International.

2. Kinder.

3. Cooper B-Line.

4. C & S Mfg. Corp.

5. Hubbard Enterprises/Holdrite

6. National Pipe Hanger Corporation.

7. Power Strut.

2.03 HANGERS AND SUPPORTS

A. General:

1. Refer to individual system and equipment Specification Sections for additional support requirements. Comply with MSS SP-69 for support selections and applications that are not addressed within these Specifications.

2. Utilize hangers and supports to support systems under all conditions of operation, allowing free expansion and contraction, and to prevent excessive stresses from being introduced into the structure, piping or connected equipment.

3. All pipe supports shall be of the type and arrangement to prevent excessive deflection, to avoid excessive bending stresses between supports, and to eliminate transmission of vibration.

4. Design hangers to impede disengagement by movement of supported pipe.

5. Install building attachments within concrete slabs or attach to structural steel. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, and expansion joints, and at changes in direction of piping.

6. Wire or perforated strap iron will not be acceptable as hanger material.

7. Hanger rods shall be threaded on both ends, threaded one end, or continuous threaded, complete with adjusting and lock nuts.

8. Fasteners requiring explosive powder (shooting) or pneumatic-driven actuation will not be acceptable under any circumstances.

9. Plastic anchors or plastic expansion shields will not be permitted under any circumstances.

10. Hangers and clamps supporting and contacting individual non-insulated brass or copper lines shall be copper or copper plated. Support individual non-insulated brass or copper lines 4 inches and smaller with adjustable swivel ring hangers. Where non-insulated brass or copper lines are supported on trapeze hangers or channels, the pipes shall be isolated from these supports with approved flexible elastomeric/thermoplastic isolation cushion material to completely encircle the piping and avoid contact with the channel or clamp. Plastic tape is not acceptable.

11. Hangers and clamps supporting and contacting glass piping shall be in accordance with the piping manufacturer's published recommendations and shall be fully lined with minimum 1/4 inch neoprene padding. The padding material and the configuration of its installation shall be submitted for approval.

12. Hangers and clamps supporting and contacting plastic piping shall be in accordance with the piping manufacturer's published recommendations and shall be factory coated or padded to prevent damage to piping.

13. Field fabricated supports shall be constructed from ASTM A36/A36M, steel shapes selected for loads being supported. Weld steel according to AWS D-1.1.

B. Finishes: All ferrous hangers, rods, inserts, clamps, stanchions, and brackets on piping within interior non-corrosive environments, shall be dipped in Zinc Chromate Primer before installation. Rods may be galvanized or cadmium plated after threading, in lieu of dipping zinc chromate. All hangers and supports exposed to the weather, including roofs and building crawl space areas, shall be galvanized or manufactured from materials that will not rust or corrode due to moisture. All hangers and supports located within corrosive environments shall be constructed from or coated with materials manufactured for installation within the particular environment.

C. Vertical Piping:

1. Supports for vertical riser piping in concealed areas shall utilize double bolt riser clamps, with each end having equal bearing on the building structure at each floor level.

2. Supports for vertical riser piping at floor levels in exposed areas (such as fire protection standpipe in stairwells) shall be attached to the underside of the penetrated structure utilizing drilled anchors, two hanger rods (sized as specified), and socket clamp with washers.

3. Two-hole rigid pipe clamps or four-hole socket clamps with washers may be used to support pipe directly from adequate structural members where floor-to-floor distance exceeds required vertical support spacing and lines are not subject to expansion and contraction.

D. Trapezes: Where multiple lines are run horizontally at the same elevation and grade, they may be supported on manufactured channel, suspended on rods or pipes. Trapeze members including suspension rods shall be properly sized for the quantity, diameters, and loaded weight of the lines they are to support.

E. Ductwork: All ductwork shall be supported in accordance with SMACNA recommendations for the service involved. Horizontal ducts supported using galvanized steel bands shall extend up both sides and onto the construction above, where they shall turn over and be secured with bolts and nuts fitted in inserts set in the concrete, bolted to angles secured to the construction above, or secured in another approved manner.

F. Terminal Units:

1. Terminal units weighing up to 150 pounds shall be supported by four (4) 1 inch wide sheet metal straps with ends turned under bottom of unit at corners.

2. Each band shall be secured by not over 3/4 inch in length, 1/4 inch diameter sheet metal screws – two (2) on bottom of unit and one (1) on each side.

3. The other strap end shall be attached to the structure by 1/4 inch diameter threaded bolt into the concrete insert or into drilled-hole threaded concrete expansion anchor.

4. Where interference occurs, overhead of the box, not allowing direct vertical support by straps, provide trapeze channels suspended by 1/4 inch diameter galvanized threaded rods providing such channels do not block access panels of units.

5. Terminal units weighing more than 150 pounds shall be supported per the terminal unit manufacturer's installation instructions using threaded rod and hanger brackets located per manufacturer's drawing.

G. Fixture and Equipment Service Piping:

1. Piping at local connections to plumbing fixtures and equipment shall be supported to prevent the weight of the piping from being transmitted to fixtures and equipment.

2. Makeshift, field-devised methods of plumbing pipe support, such as with the use of scrap framing materials, are not allowed. Support and positioning of piping shall be by means of engineered methods that comply with IAPMO PS 42-96. These shall be Hubbard Enterprises/Holdrite support systems, C & S Mfg. Corp. or Owner-approved equivalent.

3. Supports within chases and partitions shall be corrosion resistant metal plate, clamps, angles or channels, and aligned with structure in the vertical or horizontal position. Plastic supports are not allowed unless approved by Owner.

4. Horizontal supports within chases and partitions that are attached to studs shall be attached at both ends. Drywall shall not be relied upon to support the piping.

5. Supports for plumbing fixture water service piping within chases and partitions may be attached to cast iron drain and vent pipe with approved brackets and pipe clamps.

6. Piping exposed on the face of drywall shall be supported with corrosion resistant metal channels that are attached to wall studs. Drywall shall not be relied upon to support the piping.

7. Piping supported from the floor shall utilize corrosion resistant metal channels or brackets that are anchored to the floor slab.

8. All water piping shall be isolated from building components to prevent the transmission of sound.

9. All copper or brass lines shall be isolated from ferrous metals with dielectric materials to prevent electrolytic action. Plastic tape is not an acceptable isolation material.

H. Fire Protection Piping: All hangers and supports for fire standpipe systems and fire sprinkler systems shall be Factory Mutual and Underwriters' Laboratories, Inc. listed and labeled.

I. Inserts:

1. Cast-in-place concrete inserts shall comply with MSS-SP-69, U.L. and F.M. approved, and sized to suit threaded hanger rods.

2. Inserts shall have malleable iron case with galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods. Suitable concrete inserts for pipe and equipment hangers shall be set and properly located for all pipe and equipment to be suspended from concrete construction. If the inserts are later found not to be in the proper location for the placement of hangers, then drilled anchors shall be installed. Drilled anchors in concrete or masonry shall be submitted for the approval.

3. Manufactured inserts for metal deck construction shall have legs custom fit to rest in form valleys.

4. Shop fabricated inserts shall be submitted and approved by Owner prior to installation.

5. Inserts shall be of a type that will not interfere with structural reinforcing and that will not displace excessive amounts of structural concrete.

J. Pipe Shields: Provide pipe shields in accordance with insulation manufacturer’s published recommendations. Install MSS SP-58, Type 39 protection saddles, if insulation without vapor barrier is indicated. Install MSS SP-58, Type 40 protective shields on cold piping with vapor barrier.

K. Housekeeping Pads:

1. Provide minimum 4 inch reinforced concrete pads with chamfered corners and equipment bases for all outdoor equipment on grade, floor mounted equipment in main central plant area, mechanical rooms, areas with floors below grade, penthouse equipment rooms, floor mounted air handling units, and where shown on Drawings.

2. Housekeeping pads shall extend minimum of 4 inch on all sides beyond the limits of the mounted equipment unless otherwise noted.

3. Provide galvanized anchor bolts for all equipment placed on concrete pads or on concrete slabs of the size and number recommended by the equipment manufacturer.

2.04 PIPE AND DUCT PENETRATIONS

A. General:

1. Seal penetrations through all rated partitions, walls and floors with U.L. tested assemblies to provide and maintain a rating equal to or greater than the partition, wall or floor.

2. Inside diameter of all sleeves or cored holes shall provide sufficient annular space between outside diameter of pipe, duct or insulation to allow proper installation of required fire and water proofing materials and allow for movement due to expansion and contraction.

3. Exposed ceiling, floor and wall pipe penetrations within finished areas (including exterior wall faces) shall be provided with chrome plated, brass or stamped steel, hinged, split-ring escutcheon with set screw or snap-on type. Inside diameter shall closely fit pipe outside diameter or outside of pipe insulation where pipe is insulated. Outside diameter shall completely cover the opening in floors, walls, or ceilings. In exterior, damp, or corrosive environments, use Type 302 stainless steel escutcheons.

B. Floor Pipe Penetrations:

1. Seal penetrations through all floors to provide and maintain a watertight installation.

2. Sleeves cast in the slab for pipe penetrations shall be Schedule 40 steel, ASTM A53, with 2 inch wide annular fin water-stop continuously welded at midpoint of slab. Entire assembly shall be hot-dipped galvanized after fabrication. Water-stop shall be same thickness as sleeve.

3. Cored holes in the slab for pipe penetrations shall be provided with a Schedule 40 steel, ASTM A53 sleeve, with 2 inch wide annular fin water-stop continuously welded at point on sleeve to allow countersinking into slab and waterproofing. Entire sleeve assembly shall be hot-dipped galvanized after fabrication. Water-stop shall be same thickness as sleeve.

4. All sleeves shall extend a minimum of two inches above finished floor.

5. Where job conditions prevent the use of a sleeve that extends two inches above the slab, Link-Seal mechanical casing seals manufactured by Thunderline Corporation may be installed to provide a watertight penetration. Mechanical casing seals can be used only for relatively small diameter pipe penetrations. Verify that slab thickness allows proper installation of the link-seal assembly and the required fire stopping prior to applying this exception.

C. Wall Penetrations:

1. Where piping or ductwork passes through non-rated partition, close off space between pipe or duct and construction with gypsum wallboard and repair plaster smoothed and finished to match adjacent wall area.

2. Pipe penetrations through interior rated partitions shall be provided with adjustable prefabricated U.L. listed fire rated galvanized sheet metal sleeves having gauge thickness as required by wall fire rating, 20 gauge minimum. EXCEPTION: When U.L. Listed assembly does not require a sleeve,

3. Pipe penetrations through exterior walls and walls below grade shall be provided with “Link-Seal” mechanical casing seal manufactured by Thunderline Corporation.

4. Ductwork penetrations through rated partitions, walls and floors shall be provided with sleeves that are manufactured integral with the damper assembly installed.

D. Flashing:

1. Coordinate flashing material and installation required for pipe and duct roof penetrations with Owner and roofing Contractor.

2. Provide flexible flashing and metal counter-flashing where ductwork penetrates exterior walls. Seal penetration water and air tight.

3. Provide acoustical flashing around ducts and pipes penetrating equipment rooms, with materials and installation in accordance with manufacturer's instructions for sound control.

E. Roof Curbs: Coordinate roof curb material and installation with Owner and roofing Contractor.

PART 3 - EXECUTION

3.01 PREPARATION

A. Conduct a pre-installation meeting prior to commencing Work of this Section to verify Project requirements, coordinate with other trades, establish condition and completeness of substrate, review manufacturer’s installation instructions and manufacturer’s warranty requirements.

3.02 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. Application, sizing and installation of piping, supports, anchors and sleeves shall be in accordance with manufacturer's printed installation instructions.

C. Provide for vertical adjustments after erection and during commissioning, where feasible, to ensure pipe is at design elevation and slope.

D. Install hangers and supports to allow controlled thermal movement of piping systems, permitting freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

E. Install hanger so that rod is vertical under operating conditions.

F. Supports, hangers, anchors, and guides shall be fastened to the structure only at such points where the structure is capable of restraining the forces in the piping system.

G. The load and spacing on each hanger and/or insert shall not exceed the safe allowable load for any component of the support system, including the concrete that holds the inserts. Reinforcement at inserts shall be provided as required to develop the strength required. Contractor shall be responsible for engaging a structural engineer as required for design and review at support systems.

H. Do not hang pipe, duct or any mechanical/plumbing item directly from a metal deck or locate on the bottom chord of any truss or joist unless approved by the Structural Engineer of Record.

I. All supports shall be designed and installed to avoid interference with other piping, hangers, ducts, electrical conduit, supports, building structures, equipment, etc.

J. Piping supports shall be independent from ductwork supports. Combining supports is not permitted.

K. Provide all supporting steel required for the installation of mechanical equipment and materials, including angles, channels, beams, etc. to suspended or floor supported tanks and equipment. All of this steel may not be specifically indicated on the Drawings.

L. All piping and ductwork supports shall be designed and installed to allow the insulation to be continuous through the hangers.

M. Adjustable clevis hangers shall be supported at rods with a nut above and below the hanger.

N. All hanger rods shall be trimmed neatly so that 1 inch of excess hanger rod protrudes beyond the hanger nut. In the event a rod is intentionally but temporarily left excessively long (for sloped or insulated lines for example), the Contractor shall take appropriate measures to protect the pipe or other materials from damage.

O. Install hangers to provide minimum ½ inch space between finished covering and adjacent structures, materials, etc.

P. Horizontal and vertical piping in chases and partitions shall be supported to prevent movement and isolated from the supports to prevent transmission of sound.

Q. Locate hangers within 12 inches of each horizontal elbow.

R. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.

S. Support riser piping independently of connected horizontal piping. Riser piping is defined as vertical piping extending through more than one floor level.

T. Support riser piping at each floor level and provide additional supports where floor-to-floor distance exceeds required vertical support spacing. Installation of riser clamps and welded steel riser supports shall not allow weight of piping to be transmitted to floor sleeves.

U. Steel Bar Joists: Hanger rods shall be secured to angle irons of adequate size; each angle shall span across two or more joists as required to distribute the weight properly and shall be welded or otherwise permanently fixed to the top of joists.

V. Steel Beams: Where pipes and loads are supported under steel beams, approved type beam clamps shall be used.

W. Pre-Cast Tee Structural Concrete: Hanger supports, anchors, etc. attached to the precast, double tee, structural concrete system shall be installed in accordance with approved Shop Drawings only. Holes required for hanger rods shall be core drilled in the "flange" of the double tee only; impact type tools are not allowed under any circumstances. Core drilling in the "stem" portions of the double tee is not allowed. Holes core drilled through the "flange" for hanger rods shall be no greater than 1/4 inch larger than the diameter of the hanger rod. Hanger rods shall supported by means of bearing plates of size and shape acceptable to the Architect/Engineer, with welded double nuts on the hanger rod above the bearing plate. Cinch anchors, lead shields, expansion bolts, and studs driven by explosion charges are not allowed under any circumstances in the lower 15 inches of each stem and in the "shadow" of the stem on the top side of the "double tees".

X. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

Y. Inserts:

1. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

2. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

3. Install anchors in concrete after concrete is placed and completely cured. Install anchors according to manufacturer's written instructions..

Z. Flashing:

1. Coordinate all roof flashing with requirements of Division 07.

AA. Pipe Shields:

1. Provide shields at each hanger supporting insulated pipe.

2. Provide shields of the proper length to distribute weight evenly and to prevent compression of insulation at hanger.

3. Install shield so that hanger is located at the center of the shield.

4. Attach shield to insulation with adhesive to prevent slippage or movement.

BB. Equipment Anchor Bolts:

1. Foundation bolts shall be placed in the forms when the concrete is poured, the bolts being correctly located by means of templates. Each bolt shall be set in a sleeve of sufficient size to provide ½ inch clearance around bolt.

END OF SECTION 20 05 29

SECTION 20 05 48 – VIBRATION ISOLATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 SUMMARY

A. Perform all Work required to provide and install inertia bases and vibration isolation indicated by the Contract Documents with supplementary items necessary for their proper installation.

1.03 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and Workmanship shall comply with the applicable requirements and standards addressed within the following references:

1. ASHRAE - Guide to Average Noise Criteria Curves.

1.04 QUALITY ASSURANCE

A. Provide for vibration isolation supports for all equipment, piping and ductwork indicated herein. The transmission of perceptible vibration, structural borne noise or objectionable air borne noise to occupied areas by equipment installed under this Contract will not be permitted. Install vibration isolators as specified herein or shown on the Drawings or otherwise required to prevent the transmission of vibration which would create objectionable noise levels in occupied areas.

B. The vibration isolation supplier must be a firm capable of dealing effectively with vibration and noise characteristics effects and criteria; and one that can provide facilities and capabilities for measuring and evaluating the aforementioned disturbances.

C. Maintain ASHRAE criteria for average noise criteria curves for all equipment at full load condition.

D. Provide vibration isolation devices, from a single manufacturer or supplier who will be responsible for complete coordination of all phases of this Work.

1.05 SUBMITTALS

A. Product Data:

1. Submit Shop Drawings, installation instructions, and product data.

2. Indicate vibration isolator locations, with static and dynamic load on each, on Shop Drawings and described on product data.

3. Contractor shall furnish complete submittal data, including Shop Drawings, which shall indicate the size, type and deflection of each isolator; and the supported weight, disturbing frequency and efficiency of each isolator proposed; and any calculations and other information as may be required for the Architect/Engineer to check the isolator selection for compliance with the specification.

B. Record Documents:

1. Indicate inertia bases on Shop Drawings, including dimensions.

2. All steel bases and concrete inertia bases shall be completely detailed, and shall show completely any reinforcing steel that may be required to provide a rigid base for the isolated equipment. Further, the submittal data shall clearly indicate outlined procedures for installing and adjusting the isolators and bases mentioned above.

3. Submittals on riser isolation system shall show initial and final loads on the structure at each support point, initial and final deflection of each isolator, amount and direction of each deflection change, total expansion and contraction of each riser and operating temperature of 180 degrees F in the riser.

4. Riser diagrams shall be prepared by the vibration isolation manufacturer and submitted for approval. These diagrams shall show initial and final spring deflections, amount and direction of deflection changes, overall expansion and contraction of the riser, and operating temperature of the medium.

5. Submittal data shall include certification that the riser system has been examined for excessive stresses and that none will exist in the design proposed when installed in accordance with submittal and these Specifications.

C. Operation and Maintenance Data:

1. Provide manufacturer's recommended maintenance procedures.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

B. All vibration isolators and bases shall be designed for and treated for resistance to corrosion.

C. Steel components shall be PVC coated or phosphated and painted with industrial grade enamel. All nuts, bolts and washers shall be zinc-electroplated or cadmium plated.

D. All isolators exposed to the weather shall have steel parts hot-dip galvanized or zinc-electroplated plus coating of Neoprene or Bitumastic paint. Aluminum components for outdoor installation shall be etched and painted with industrial grade enamel.

E. Required spring deflections for isolators supporting various items of equipment are shown on the Drawings or tabulated elsewhere in these Specifications, but in no case shall be less than one inch. Springs shall be capable of 30 percent over-travel before becoming solid.

F. Where height-saving brackets for side mounting of isolators are required, the height-saving brackets shall be designed to provide for an operating clearance of 2 inches under the isolated structure and designed so that the isolators can be installed and removed when the operating clearance is 2 inches or less. When used with spring isolators having a deflection of 2-1/2 inches or more, the height-saving brackets shall be of the pre-compression type to limit exposed bolt length between the top of the isolator and the underneath side of the bracket.

G. All isolators supporting a given piece of equipment shall limit the length of the exposed adjustment bolt between the top and base to a maximum range of 1 inch to 2 inches.

H. All isolators supporting a given piece of equipment shall be selected for approximately equal spring deflection.

I. Isolators for equipment installed outdoors shall be designed to provide adequate restraint due to normal wind conditions and to withstand wind load of 55 pounds per square foot applied to any exposed surface of the equipment without failure.

2.02 MANUFACTURERS

A. Amber Booth.

B. Korfund Dynamics.

C. Consolidated Kinetics.

D. Mason Industries.

2.03 ISOLATION BASES

A. Type SFB: A structural steel fan and motor base with NEMA standard motor side rails and holes drilled to receive the fan and motor. The steel members shall be adequately sized to prevent distortion and misalignment of the drive.

B. Type CPF: Concrete inertia base, consisting of full depth perimeter steel pouring form, 3000 psi concrete reinforcing bars welded in place, bolting templates with anchor bolts and height-saving brackets for side mounting of the isolators. The base shall be sized with a minimum overlap of 4 inches around the base of the equipment. Fan bases are to be supplied with NEMA standard motor slide rails.

C. The bases for pumps shall be sized to support the suction elbow of end suction pumps and both the suction and discharge elbows of horizontal split-case pumps. The bases shall be T-shaped where necessary to conserve space.

D. Structural bases shall be thoroughly cleaned of welding slag and primed with zinc-chromate or metal etching primer. A finish coat of industrial grade enamel shall be applied over the primer.

2.04 ISOLATOR TYPES

A. Isolator types and required deflections are specified under "Application." Isolator type designations are Amber Booth designators. The isolators shall comply with the following descriptions for each type required on the Project:

1. Type XL: Aluminum-housed, adjustable, spring mounting having telescoping top and bottom sections separated by resilient inserts of Neoprene or other suitable material to limit horizontal motion. The inserts shall be permanently lubricated to minimize vertical friction. Steel or cast iron housings may be used if they are hot-dip galvanized after fabrication. A Neoprene pad having a minimum thickness of ¼ inch shall be bonded to the baseplate.

2. Type SW: Adjustable, freestanding, open-spring mounting with combination leveling bolt and equipment fastening bolt. The spring mounting to baseplate and compression plate must be rigid. The neoprene pad with a minimum thickness of ¼ inch is bonded to the baseplate. A minimum horizontal-to-vertical spring rate of 1.0 is required.

3. Type BS: Spring hanger consisting of a rectangular steel box, coil spring, spring retainers, neoprene-impregnated fabric washer and steel washer.

4. Type BSA: Spring hanger consisting of a rectangular steel box capable of 200 percent minimum overload without visible deformation, coil spring, spring retainers, neoprene impregnated fabric washer and steel washer. Incorporate a 30 degree angularity feature that will permit up to a 15 degree misalignment of the hanger rod from the vertical without shorting out to the hanger box.

5. Type BSR: Combination spring and rubber hanger consisting of a rectangular steel box, coil spring, spring retainers and elastomeric mounting designed for ½ inch deflection.

6. Type BSRA: Combination spring and elastomeric hanger consisting of a rectangular steel box capable of 200 percent minimum overload without visible deformation, coil spring, spring retainers and elastomeric element. Incorporate a 30 degree angularity feature that will permit up to a 15 degree misalignment of the hanger rod from the vertical without shorting out to the hanger box.

7. Type RSW: Adjustable spring isolator as describe for Type SW with the addition of a fabricated steel housing suitable for recessing into a concrete inertia block. The housing has a side access.

8. Type PBS: Spring hanger as described for Type BS with the addition of a load transfer plate to hold the equipment or piping at a fixed elevation during installation and to permit transferring the load to the spring after installation.

9. Type PBSA: Spring hanger consisting of a rectangular steel box capable of 200 percent minimum overload without visible deformation, with the addition of a load transfer plate to hold the equipment or piping at a fixed elevation during installation, and to permit transferring the load to the spring after installation, a coil spring, spring retainers, neoprene impregnated fabric washer and steel washer. Incorporate a 30 degree angularity feature that will permit up to a 15 degree misalignment of the hanger rod from the vertical without shorting out to the hanger box.

10. PBSR: Combination spring and elastomeric hanger as described for Type BSR with the addition of a load transfer plate to hold the equipment or piping at a fixed elevation during installation and to permit transferring the load to the spring after installation.

11. Type PBSRA: Combination spring and elastomeric hanger consisting of a rectangular steel box capable of 200 percent minimum overload without visible deformation, with the addition of a load transfer plate to hold the equipment or piping at a fixed elevation during installation, a coil spring, spring retainers and elastomeric element. Incorporate a 30 degree angularity feature that will permit up to a 15 degree misalignment of the hanger rod from the vertical without shorting out to the hanger box.

12. Type CT: Adjustable, open-spring isolator having one or more coil springs attached to a top compression plate and a base plate. A neoprene pad with a minimum thickness of ¼ inch is bonded to the base plate. The spring assembly must fit within a welded steel enclosure consisting of a top plate and rigid lower housing, which serves as a blocking device during installation. The isolator includes restraining bolts for connecting the top plate and lower housing to prevent the isolated equipment from rising when drained of water.

13. Type SP-NRE: Pad-type mounting consisting of two layers of 3/8 inch thick ribbed or waffled neoprene pads bonded to a 16 gauge galvanized steel separator plate. Size pads for approximately 20 to 40 psi load and a deflection of 0.12 to 0.16 inch.

14. Type BRD: Elastomeric hanger consisting of a rectangular steel box and an elastomeric isolation element of neoprene. A high-quality synthetic rubber may be used if it contains antiozone and antioxidant additives. The elements are designed for approximately ½ inch deflection and loaded so that the deflection does not exceed 15 percent of the free height of the element.

15. Type TRK: For static pressure of 3 inch water or greater, provide a set of spring-loaded thrust resistors (two or more) installed across the flexible duct connection on the fan discharge, designed to limit the movement of the fan. Coil spring static deflection capabilities of thrust resistors shall equal those of the isolators supporting the equipment up to a maximum of 2 inches.

16. Type RVD: An elastomeric mounting having a steel baseplate with mounting holes and a threaded insert at top of the mounting for attaching equipment. All metal parts shall be completely embedded in the elastomeric material. Mountings shall be designed for approximately ½ inch deflection.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. All installation shall be in accordance with manufacturer's published recommendations.

C. Install motor driven equipment with vibration isolators.

D. Set steel bases for one-inch clearance between housekeeping pad and base. Set concrete inertia bases for 2 inch clearance. Adjust equipment level.

E. Isolate pumped water-piping systems with spring-type vibration isolators to produce a floating mechanical system. Provide spring isolators on piping connected to isolated equipment as follows: Static deflection for the two supports closest to equipment on each pipe connected to the equipment shall be equal to the deflection of isolated equipment. All other supports for horizontal piping shall have a minimum operating deflection of ¾ inch with a capability of an additional 50 percent travel to solid.

F. All open-type spring isolators shall be restrained as recommended by the manufacturer.

G. Pumps:

1. Each centrifugal pump and its driving motor shall be mounted on a common inertia base and the base, in turn, shall be mounted on the scheduled vibration isolator type to prevent transmission of vibration and noise to the building structure.

2. In general, all inertia bases shall be formed and poured in place onto a hard, flat surface from which the base can be separated when cured. The base shall be shimmed, using flat material, to the intended final height prior to equipment mounting and piping connection.

3. After piping connections are made and the system filled with water and ready to put into service, the isolator adjustment bolts shall be extended until the shim blocks can be removed. Isolators may then be backed down slightly to restore the intended height. The locknuts should then be tightened on the isolators. Jack bolts shall be trimmed to a length that will allow no more than 1 inch of additional height adjustment. After final adjustment, the inertia base shall not support any piping load. All springs supporting piping that is connected to a piece of isolated equipment shall be sized for static deflection equal to that of the isolated equipment.

H. Piping (Including Generator Piping):

1. Floor mounted supports shall have the same type of isolator or media as is used for the nearest isolated equipment connected to the piping.

2. The pipe hanger system shall have provisions for all piping to be shimmed or blocked in place until all connections are made and the system filled with water; then, the isolators adjusted to support the weights and the shim blocks removed.

3. The first three support points from a piece of isolated equipment shall be of the positioning type and provide not less than the static deflection of the equipment isolators.

4. All springs supporting piping shall be capable of an additional ½ inch deflection prior to complete compression and springs supporting vertical risers shall have provisions for limit stops.

5. Support risers up through 16 inches at every third floor, and risers 18 inches and over at every second floor. All supports for risers must have a deflection capability at least four times the anticipated expansion and contraction. Install temporary anchors as required to permit preadjustment of springs in the risers. Furnish permanent limit stops to prevent excessive vertical motion of risers in the event risers are drained. Wall sleeves for takeoffs from risers shall be sized for insulation outside diameter plus two times the calculated thermal movement to prevent binding.

6. System operating temperatures (degrees F) are as follows:

Service	Supply	Return
Chilled Water	42-45	56-59
Heating Water	180	160
25-pound Steam and Condensate	318	318
70-pound Steam and Condensate	318	318

I. Resilient Sleeves: Resilient sleeves shall be provided at all points where equipment room walls, floors or ceilings are penetrated by ducts, piping or refrigerant line, etc.

J. Fans and Air Handling Units: Such units shall have electrical flexible connections not less than 36 inches long and the flexible duct connections with a free length of not less than 8 inches.

K. Ductwork: Isolate all high pressure ductwork within each equipment room and to a minimum of 50 feet from fan with Type BS hangers or Type SW floor supports, sized for ¾ inch deflection.

L. To prevent excessive transfer of piping load from floor to floor, all water riser support springs shall have a deflection capability of four times the expansion or contraction to be accommodated by the support with the additional runout capability to absorb the movement. Isolators supporting steam and diesel engine exhaust risers shall be selected for deflections equal to two times the anticipated thermal movement at the support point. Riser isolation system shall be designed such that it supports the riser in tension, eliminating the need for guides; requires no anchors; and has a zero movement point at or near the center to divide thermal movement approximately in half, thus reducing vertical movement of horizontal pipe takeoffs.

3.02 APPLICATION

A. The following is a schedule of equipment on a typical project that requires vibration isolation and base isolators of the types specified. Refer to Drawings for equipment scheduled for the Project. Any equipment, system or condition that may be altered, added, or changed; or that is not specifically described in the Contract Documents shall be isolated in a manner specified for similar equipment, system or condition in order to comply with these Specifications.

Equipment Type	Isolator Type/ Minimum Deflection (Inches)	Base Type
Air Handling Units Floor Mounted – Up to 15 HP	SW 2”	N/A
Floor Mounted – 15 HP and Over	SW2.4”	N/A
Suspended – Up to 15 HP	PBSRA 2”	SFB
Suspended – 15 HP and Over	PBSRA 3.5”	SFB
High pressure Fan Sections	SW 2” with TRK 3.5	CPF
Fan Coil Units – Suspended	PBSRA 1”	N/A
Fan Powered Terminal Units Not Internally Isolated	PBSRA 1”	N/A
Centrifugal Fans Class I and II – Up to 54-¼ inch Diameter Up to 15 HP	SW 2”	SFB (If required)
Class I and II – 60-inch Diameter and Over, 15 HP and Over	SW 4.5”	SFB (If required)

Equipment Type	Isolator Type/ Minimum Deflection (Inches)	Base Type
Class III – All sizes	SW 3.5” with TRK 2”	CPF
Arrangement # 3 Fans	SW 4.5”	SFB
Vane Axial Fans	SW 4.5” with TRK 2”	SFB
Vent Sets:		
Floor Mounted – Up to 15 HP	SW 1.5”	SFB (If required)
Suspended – Up to 15 HP	PBSRA 1.5”	SFB (If required)
Unit Substations	RVD 0.5”	N/A
Compressors	CT 1.5”	N/A
Engine Driven Generators: Skid Mounted	CT 3”	N/A
Exhaust Pipe	PBSRA 3”	N/A
Pumps: Up to 5 HP	RSW 0.5”	CPF
5 HP to 10 HP	RSW 1”	CPF
10 HP and Over	RSW 2”	CPF
Vacuum Pumps	RSW 1”	CPF

B. Piping Application:

1. Type PBSRA for hangers in all horizontal piping at equipment; except at connections to risers use BS.

2. Type SW for all floor supports of floor supported piping at equipment or stanchion.

END OF SECTION 20 05 48

SECTION 20 05 53 – PIPING AND EQUIPMENT IDENTIFICATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 SUMMARY

A. Perform all Work required to provide and install Owner's equipment tags, fire damper tags, valve tags, stencils, and pipe markers indicated by the Contract Documents with supplementary items necessary for proper installation.

B. Contractor shall make it possible for Owner's personnel that will operate and maintain the equipment and systems in this Project to readily identify the various pieces of equipment, valves, piping, ductwork, fire dampers etc., by marking them.

C. All items of equipment such as fans, pumps, fire dampers etc., shall be clearly marked using equipment tags as hereinafter specified. The tagged item of equipment shall correspond to the same number as shown on the Drawings.

1.03 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and Workmanship shall comply with the applicable requirements and standards addressed within the following references:

1. ASME A13.1 - Scheme for the Identification of Piping Systems.

2. NFPA 99 – Standard for Health Care Facilities.

3. NFPA 13 – Installation of Sprinkler Systems.

4. NFPA 14 – Installation of standpipe and Hose Systems.

5. International Plumbing Code.

1.04 SUBMITTALS

A. Product Data:

1. Provide manufacturer's catalog literature for each product.

B. Record Documents:

1. Submit valve schedule complete with asset number, building number, room number, valve tag numbering system, valve function, valve type, area served, year installed, manufacturer, model number, size, rated pressure, temperature rating and normal position.

2. Valve schedule shall be developed utilizing Owner's valve schedule template, refer to Attachment "A". Provide Owner with electronic version (Microsoft Excel) of the final approved valve schedule at or before Project Closeout.

3. Submit fire damper schedule complete asset number, building number, room number, FD, FSD, SD equipment tag numbering system, system, function, damper type, area served, date installed, manufacturer, model number, damper size, temperature rating and damper blade type.

4. Fire damper schedule shall be developed utilizing Owner's fire damper schedule template, refer to Attachment "E". Provide Owner with electronic version (Microsoft Excel) of the final approved fire damper schedule at or before Project Closeout.

C. Operation and Maintenance Data:

1. Manufacturer's Installation Instructions: Indicate special procedures and installation.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.02 MANUFACTURERS

A. Equipment Tags, Valve Tags, and Markers:

1. Marking Systems, Inc.

2. Seton Name Plate Company.

3. W.H. Brady Company.

4. Graphic Products, Inc.

2.03 EQUIPMENT TAGS

A. Description: 3" x 4" vinyl label, 3.0 Mil self adhesive vinyl similar to DuraLabel Pro. Label color shall be black text on a white background. The label shall contain the following information per the template, described in Attachment "C":

1. Equipment name: Per Owner's Equipment Naming convention and as listed in Contractor's Equipment Matrix.

2. Function

3. Area served

4. Asset number: Number provided by MDACC Property Manager upon request.

5. Asset number bar code

B. All scheduled equipment shall be identified with an Equipment Tag.

C. Refer to Specification Section 01 91 00, General Commissioning Requirements for a detailed description of Equipment Matrix information.

2.04 VALVE TAGS

A. Valve tags shall conform to ANSI A13.1-1981 "Scheme for the Identification of Piping Systems", refer to Attachment “B” for abbreviation and label color designations.

B. Valve tags shall be ABS plastic tags: Injected molded ABS plastic, 3.375” X 4.75” with self adhesive vinyl label, similar to DuraLabel Pro, affixed to valve tag. Each tag shall be attached to its valve with one tie strap.

C. Vinyl Label: 3.0 Mil self adhesive vinyl similar to DuraLabel Pro. Label color shall be as per the standard designated colors listed in the attachment to this specification. The label shall contain the following information as per template, refer to Attachment “C”:

1. Valve name: refer to Attachment “D” for valve tag naming convention

2. Function

3. Area served

4. Asset number: Number provided by MDACC Property Manager upon request.

5. Asset number bar code

D. Each valve shall be named as per attached valve tag naming convention, refer to Attachment “D”.

E. In addition to valve tags, valves at water headers and steam PRV stations, valves associated with condensate, gas, water meters, and other valves as specified shall be tagged with standardized color coded plastic tags. Each tag shall be attached to its valve with one tie strap. These tags shall be 2-½ inches wide by 1-½ inches high with these color codings:

1. Red = normally closed.

2. Green = normally open.

3. Blue = open in winter, closed in summer.

4. Yellow = closed in winter, open in summer.

F. Valve Tag Fasteners: Single ABS plastic tie strap.

2.05 PIPE AND DUCT MARKERS

A. Round Pipe and Duct Markers shall conform to ANSI A13.1-2007 "Scheme for the Identification of Piping Systems", refer to Attachment “B” for abbreviation and label color designations. Arrow markers must have same ANSI background colors as their companion pipe markers, or be incorporated into the pipe identification marker.

B. Rectangular Duct Stencils shall conform to ANSI A13.1-2007 "Scheme for the Identification of Piping Systems", refer to Attachment “B” for abbreviation and label color designations. Letter height shall be a minimum of 1-1/4”. Stencil material shall be fiber board; Stencil paint shall be exterior, gloss, acrylic enamel. The following rectangular duct systems shall be stenciled:

1. Chemical Fume Hood Exhaust.

2. Biosafety Cabinet Exhaust.

3. Radioisotope Exhaust.

4. ETO Exhaust.

C. Plastic Pipe Markers: Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.

D. Plastic Tape Pipe Markers: Heat sealed or heat shrink, spring fasteners, clips or snap-on, are acceptable.

E. Underground Plastic Pipe markers: Bright colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service.

F. All medical gas piping shall have minimum information per NFPA 99, plus operating pressure.

G. Pipe markers and arrow markers also shall be provided for all piping systems.

H. Use Seton Setmark Type SNA or Brady snap-on type identification for all piping systems, up through 6 inch. For piping systems larger than 6 inches, use Seton or Brady strap-on markers or similar by Marking Services, Inc.

2.06 CEILING GRID TAG FOR EQUIPMENT LOCATED ABOVE LAY-IN CEILING

A. Description: 3/4” x 3” vinyl label, 3.0 Mil self adhesive vinyl similar to DuraLabel Pro. Label color shall be black text on a white background. The label shall contain the following information per the template, described in Attachment “C”:

1. Equipment name: Per Owner’s Equipment Naming convention and as listed in Contractor’s Equipment Matrix.

2. Asset number: Number provided by MDACC Property Manager upon request.

3. Asset number bar code

B. All scheduled equipment above finish lay-in ceiling shall be identified with an Equipment Tag.

C. Refer to Specification Section 01 91 00, General Commissioning Requirements for a detailed description of Equipment Matrix information.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. All installation shall be in accordance with manufacturer's published recommendations.

C. Install plastic tape, and pipe markers completely around pipe in accordance with manufacturer's instructions.

D. Locate markers on the two (2) lower quarters of the pipe where view is unobstructed.

3.02 VALVE TAGS

A. Contractor(s) shall provide and install valve tags on all valves installed within this Project, except check valves; valves within fabricated equipment units; faucets; hose connections; needle valves; gauge cocks; HVAC terminal devices and similar roughing-in connections of end-use fixtures and units.

B. Existing valve tags shall not be attached to new valves. When removing and/or replacing existing tagged valves, give the Owner all existing tags that are attached to the valves that are removed. New tags with new asset numbers shall be provided for new valves.

3.03 APPLICATION OF MARKERS AND STENCILS

A. Piping runs throughout the Project including those above lift-out ceilings, under floor and those exposed to view when access doors or access panels are opened shall be identified by means of pipe markers and/or stencils. Concealed areas, for purposes of this identification section, are those areas that cannot be seen except by demolition of the building elements. In addition to pipe markers and/or stencils, arrow markers shall be used to indicate direction of flow.

B. As a minimum, locate pipe markers and/or stencils as follows:

1. Provide a pipe marker at each valve to indicate proper identification of pipe contents. Where several valves exist on one (1) header, it is necessary to mark only the header.

2. Every 20 feet in exposed and concealed areas on all piping systems. Provide at least one (1) pipe marker in each room on all piping systems.

3. At each branch or riser take off on piping systems, excluding short takeoffs for fixtures and terminal units.

4. Provide a pipe marker or stencil and an arrow marker at every point of pipe entry or exit where the pipe penetrates a wall, floor, service column or enclosure.

5. At access doors, manholes and similar access points that permit view of concealed piping.

6. Near major equipment items and other points of origination and termination.

C. Provide an arrow marker with each pipe marker pointing away from the pipe marker to indicate direction of flow.

D. Provide a double-ended arrow marker when flow can be in either or both directions.

E. Indicate delivered water temperature on domestic hot water supply and return lines.

F. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.

G. Identify control panels and major control components outside panels with plastic nameplates.

H. Identify valves in main and branch piping with tags.

I. Tag automatic controls, instruments and relays. Key to control schematic.

J. Provide ceiling grid tags to locate valves, fan coil units, dampers or other concealed equipment above T-bar type panel ceilings. Locate in corner of grid closest to equipment.

K. Identify pipe utilizing copper press fittings with markers stating, “Press-Fit” adjacent to each content identification marker.

L. Identify medium pressure gas piping (14 inches water column to 5psi) with the statement, “WARNING – ½ to 5psi NATURAL GAS”.

M. Identify right and left nipple and coupling union assemblies with the statement “Right/Left Nipple/Coupling”.

ATTACHMENTS:

“A” - Valve Schedule
“B” - Label Abbreviations, Background and Text colors
“C” – Label examples with dimensions, font type and height
“D” – Valve tag naming convention
“E” - Fire, Fire/Smoke and Smoke Damper Schedule

END OF SECTION 20 05 53

ATTACHMENT "A"

Download an electronic version of this schedule to use as a template for submittal purposes at:
HTTP://WWW2.MDANDERSON.ORG/DEPTS/CPM/STANDARDS/SUPP.HTML

CONTRACTOR : _____

MDACC PROJECT NO. : _____

DATE SUBMITTED : _____

VALVE SCHEDULE

Asset Number	Building Number	Room Number	Valve Tag Number	System	Function *(i.e.) Bypass, Drain, Shut-off, etc.*	Valve Type *(i.e.) Ball, Gate, etc.*	Area Served	Date Installed	Manufacturer	Model No.	Valve Size (in.)	Valve Press/Temp Rating (psig/Deg F)	Normal Position (NO or NC)
311208	100B	BB.4600	CHWS-100B-9	Chilled Water Supply	Isolation Valve	Butterfly Valve	Anderson C/E/W	10/30/2008	Nibco	LD2000	14"	150 psig / 210° F.	NO

Column Explanations:

Asset Number - Seven digit number provided by MDACC Property Manager upon request.
Building Number - Number provided by MDACC Project Manager upon request.
Room Number - Number provided by MDACC Project Manager upon request.
Valve Tag Number - Assigned by contractor using MDACC valve tag naming convention.
System - The piping system the valve is installed in i.e. chilled water supply, hot water return, etc.
Function - Valve use, i.e. isolation, shut off, bypass, etc.
Area Served - Building area effected if the valve is opened or closed.
Normal Position - Valve position during normal operation. (NO = Normally Open, NC = Normally Closed)

ATTACHMENT "B"

Mechanical/Plumbing Piping System Abbreviations and Letter/Label Coloring

Pipe Contents	Label Abbreviation	Label Colors (Background/Text)
Acid Waste	ACID	Orange/Black
Biosafety Cabinet Exhaust	BCE	Purple/white
Brine Water	BR	Orange/Black
Carbon dioxide	CO_2	Gray/white
Chemical Fume Hood Exhaust	CFHE	Purple/white
Chilled Water Return	CHWR	Green/White
Chilled Water Supply	CHWS	Green/White
Condenser Water Return	CWR	Green/White
Condenser Water Supply	CWS	Green/White
ETO Exhaust	ETOE	Purple/white
Fire Suppression Water	FIRE	Red/White
Fuel Oil Return	FOR	Yellow/Black
Fuel Oil Supply	FOS	Yellow/Black
Gray Water	-	Green/White
Hazardous Waste	HAZ	Orange/Black
Helium	He	Brown/white
High Pressure Condensate	HPC	Blue/White
High Pressure Steam (above 125#)	HPS	Blue/White
High Purity Water	DI or RO	Green/White
Hot Water Heating Return	HWR	Green/White
Hot Water Heating Supply	HWS	Green/White
Instrument air	IA	Red/white
Laboratory air	Lab Air	Yellow and white checkerboard/black
Laboratory vacuum	Lab Vac	White and black checkerboard/black boxed
Low Pressure Condensate	LPC	Blue/White
Low Pressure Steam (below 25#)	LPS	Blue/White
Medical air	Med Air	Yellow/black
Medical–surgical vacuum	Med Vac	White/black
Medium Pressure Condensate	MPC	Blue/White
Medium Pressure Steam (above 25# - below 125#)	MPS	Blue/White
Natural Gas	NG	Yellow/Black
Nitrogen	N_2	Black/white
Nitrogen (liquid)	LN2	Black/White
Nitrous oxide	N_2O	Blue/white
Non-Potable Water	-	Green/White

ATTACHMENT "B"

Oxygen	O_2	Green/white
Potable Cold Water	DCW	Green/White
Potable Hot Water Return	DHWR	Green/White
Potable Hot Water Supply	DHW	Green/White
Pumped Condensate Return	PCR	Blue/White
Radioisotope Exhaust	RE	Yellow/magenta
Waste anesthetic gas disposal	WAGD	Violet/white

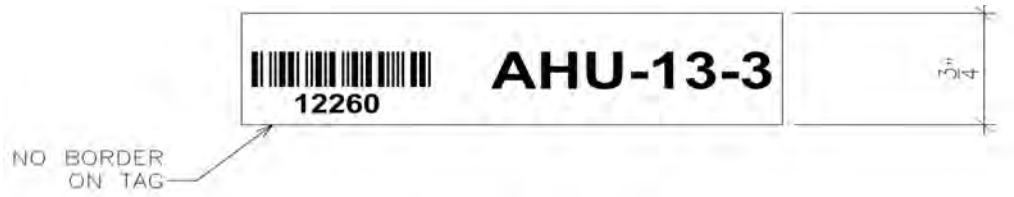
ATTACHMENT "C"

Equipment Tag Layout

FACILITIES MANAGEMENT TAG	Arial	9
AHU-13-4	**Arial Bold**	**18**
Function: Air Handling Unit 13-4	Arial	14
Area Served: G15.3531	Arial	16
Mainsaver Asset # FM11261	Arial	16
FM11261	BC C39 3 to 1 Medium	28
This is not an Institutional Tag	Arial	9

3"h X 4"w TAG **Font Description** **Height**

Ceiling Grid Tag Layout



FONT

BC C39 3 to 1 Medium	Arial 28

ATTACHMENT "D"

Valve Tag Naming Convention

- The first set of characters are system type designators. (Number of letters will vary per system type)

X	**X**	**X**	**X**	**X**	**-**	X	X	X	X	-	X	X	X

System Type Abbreviation (See Attachment "B" for abbreviations)

- A dash shall separate each set of characters.

X	X	X	X	X	**-**	X	X	X	X	-	X	X	X

Placeholder

- The middle set of characters are the building designator.

X	X	X	X	X	**-**	**X**	**X**	**X**	**X**	-	X	X	X

Building Designator (Contact Owner's Project Manager for building number)

- A dash shall separate each set of characters.

X	X	X	X	X	-	X	X	X	X	**-**	X	X	X

Placeholder

- The last set of characters are sequential valve tag numbers.

X	X	X	X	X	-	X	X	X	X	-	**X**	**X**	**X**

Sequential Valve Tag Number
(Number of digits will vary based on quantity of valves installed)

Below is an Example for a Chilled Water Supply Valve Located in Anderson Central:

	C	**H**	**W**	**S**	**-**	**1**	**0**	**0**	**B**	**-**	**9**

NOTE: No two valve tags shall have the same name or asset number. Obtain valve tag names from Owner's Property Manager when installing valves within existing systems.

ATTACHMENT "E"

Download an electronic version of this schedule to use as a template for submittal purposes at:
HTTP://WWW2.MDANDERSON.ORG/DEPTS/CPM/STANDARDS/SUPP.HTML

Complete and Submit FD, FSD & SD Schedule in Accordance with Project Specification 20 05 53. Please Direct Questions Regarding This Form to the Owner's Project Manager.

CONTRACTOR : _____
MDACC PROJECT NO. : _____
DATE SUBMITTED : _____

FIRE DAMPER (FD), FIRE SMOKE DAMPER (FSD) and SMOKE DAMPER (SD) SCHEDULE

Asset Number	Building Number	Room Number	FD, FSD & SD Tag Number	System	Function	Damper Type	Date Installed	Next Test Date	Manufacturer	Model No.	Damper Size (in.)	Damper Temp. Rating (Deg F)	Damper Description

Column Explanations:

Asset Number - Seven digit number provided by MDACC Property Manager upon request.
Building Number - Number provided by MDACC Project Manager upon request.
Room Number - Number provided by MDACC Project Manager upon request.
FD,FSD and SD Tag Number - Assigned by contractor using MDACC equipment naming convention.
System - The HVAC system the damper is installed in i.e. AHU, OAHU, EF, Transfer Duct, etc.
Function - Supply, Return or Exhaust
Damper Type - Stainless side seal (s), Blade lip seal (l), Motorized operation (M), Pneumatic operation (P), Hand operation (H)
Next Test Date - Always one year from install date.
Damper Size - Round, Square, Rectangular size in inches
Damper Temperature Rating -
Damper Description - Opposed blade (O), Parallel Blade (P)

Row/Column Explanations:

Row Number 8 (Hidden) - For MDACC use only.
Columns P & T (Hidden) - For MDACC use only.

Template Version: 060211

SECTION 20 07 19 – PIPING INSULATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 SUMMARY

A. Perform all Work required to provide and install piping insulation, jackets and accessories indicated by the Contract Documents with supplementary items necessary for proper installation.

1.03 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and Workmanship shall comply with the applicable requirements and standards addressed within the following references:

1. ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate.

2. ASTM C168 - Terminology Relating to Thermal Insulation Materials.

3. ASTM C177 - Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded- Hot-Plate Apparatus.

4. ASTM C195 - Mineral Fiber Thermal Insulating Cement.

5. ASTM C335 - Steady-State Heat Transfer Properties of Horizontal Pipe Insulation.

6. ASTM C449 - Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.

7. ASTM C518 - Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.

8. ASTM C534 - Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.

9. ASTM C547 - Mineral Fiber Pipe Insulation.

10. ASTM C552 - Cellular Glass Thermal Insulation.

11. ASTM C578 - Rigid, Cellular Polystyrene Thermal Insulation.

12. ASTM C585 - Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System).

13. ASTM C591 - Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation.

14. ASTM C610 - Molded Expanded Perlite Block and Pipe Thermal Insulation.

15. ASTM C921 - Jackets for Thermal Insulation.

16. ASTM C1126 - Faced or Unfaced Rigid Celluar Phenolic Thermal Insulation.

17. ASTM D1056 - Flexible Cellular Materials - Sponge or Expanded Rubber.

18. ASTM D1667 - Flexible Cellular Materials - Vinyl Chloride Polymers and Copolymers (Closed Cell Foam).

19. ASTM D2842 - Water Absorption of Rigid Cellular Plastics.

20. ASTM C795 - Insulation For Use Over Austenitic Steel.

21. ASTM E84 - Surface Burning Characteristics of Building Materials.

22. ASTM E96 - Water Vapor Transmission of Materials.

23. NFPA 255 - Surface Burning Characteristics of Building Materials.

24. UL 723 - Surface Burning Characteristics of Building Materials.

25. ASTM D5590 - Standard Test Method for Determining the Resistance of Paint Films and Related Coatings to Fungal Defacement by Accelerated Four-Week Agar Plate Assay

1.04 DEFINITIONS

A. Concealed: Areas that cannot be seen by the building occupants.

B. Interior Exposed: Areas that are exposed to view by the building occupants, including underneath countertops, inside cabinets and closets, and all equipment rooms.

C. Interior: Areas inside the building exterior envelope that are not exposed to the outdoors.

D. Exterior: Areas outside the building exterior envelope that are exposed to the outdoors, including building crawl spaces and loading dock areas.

1.05 QUALITY ASSURANCE

A. All piping requiring insulation shall be insulated as specified herein and as required for a complete system. In each case, the insulation shall be equivalent to that specified and materials applied and finished as described in these Specifications.

B. All insulation, jacket, adhesives, mastics, sealers, etc., utilized in the fabrication of these systems shall meet NFPA for fire resistant ratings (maximum of 25 flame spread and 50 smoke developed ratings) and shall be approved by the insulation manufacturer for guaranteed performances when incorporated into their insulation system, unless a specific product is specified for a specific application and is stated as an exception to this requirement.

1. Certificates to this effect shall be submitted along with Contractor's submittal data for this Section of the Specifications.

2. No material shall be used that, when tested by the ASTM E84-89 test method, is found to melt, drip or delaminate to such a degree that the continuity of the flame front is destroyed, thereby resulting in an artificially low flame spread rating.

C. Application Company Qualifications: Company performing the Work of this Section shall have minimum three (3) years experience specializing in the trade.

D. All insulation shall be applied by mechanics skilled in this particular Work and regularly engaged in such occupation.

E. All insulation shall be applied in strict accordance with these Specifications and with factory printed recommendations on items not herein mentioned. Unsightly, inadequate, or sloppy Work will not be acceptable.

1.06 SUBMITTALS

A. Product Data:

1. Provide product description, list of materials, "k" value, "R" value, mean temperature range, and thickness for each service and location.

2. Samples: When requested, submit three (3) samples of any representative size illustrating each insulation type

B. Operation and Maintenance Data:

1. Indicate procedures that ensure acceptable standards will be achieved. Submit certificates to this effect.

1.07 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to the Project Site in original factory packaging, labeled with manufacturer's identification including product thermal ratings and thickness.

B. Store insulation in original wrapping and protect from weather and construction traffic. Protect insulation against dirt, water, chemical, and mechanical damage.

C. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics and insulation cements.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.02 MANUFACTURERS

A. Insulation:

1. Owens-Corning (Type P1).
2. Certainteed Corporation (Type P1).
3. Johns Manville Corporation (Type P1).
4. Knauf Corporation (Type P1).
5. Dow Chemical Company (Type P2).
6. Armstrong/Armacell (Armaflex) (Type P3).
7. RBX Industries/Rubatex (Type P3).
8. Industrial Insulation Group, LLC (Type P4).
9. Resolco International by (Insul-Phen) (Type P5).
10. FOAMGLAS (Cellular Glass) by Pittsburgh Corning (Type P6).

B. Jackets:

1. Childers Products Company
2. PABCO
3. RPR Products, Inc.
4. Venture Clad Corporation
5. Foster Vapor Fas 62-05
6. Foamglas

C. Coatings, Sealants, and Adhesives:

1. Foster
2. Childers

2.03 INSULATION

A. Type P1: Fiberglass preformed insulation; ASTM C 547; minimum 3.0 lb/cu ft density, ASTM C335,'k' value of 0.23 at 75 degrees F; noncombustible.

B. Type P2: Molded closed cell polyisocyanurate insulation; ASTM E96, maximum water vapor transmission rating of 0.005 Perm-In; ASTM C518, 'k' value of 0.20 at 75 degrees F; ASTM D2842, water absorption value of 0.05 lb/ft2.

C. Type P3: Closed cell elastomeric, flexible, insulation; ASTM E96; maximum vapor transmission rating of 0.20 perms; ASTM C 518; 'k' value of 0.27 at 75 degrees F.

D. Type P4: Mineral Wool; ASTM C 547; preformed, high temperature insulation; 'k' value of 0.35 at 300 degrees F.

E. Type P5: Phenolic closed cell, ASTM C1126 rigid foam, 2.2 lbs. nominal density, CFC free; ASTM C518, 'k' value of 0.13 at 75 degrees F. (Note material thickness limit is 3 inches as tested in accordance with ASTM E84).

F. Type P5A: Phenolic closed cell insulation; ASTM E96, maximum water vapor transmission rating of 0.02 Perm-In; ASTM C1126 rigid foam, 3.75 lbs. nominal density, CFC free; ASTM C518, 'k' value of 0.16 at 75 degrees F. (Note material thickness limit is 3 inches as tested in accordance with ASTM E84).

G. Type P5B: Phenolic closed cell insulation; ASTM E96, maximum water vapor transmission rating of 0.02 Perm-In; ASTM C1126 rigid foam, 5.0 lbs. nominal density, CFC free; ASTM C518, ‘k’ value of 0.21 at 75 degrees F. (Note material thickness limit is 3 inches as tested in accordance with ASTM E84).

H. Type P6: Cellular Glass, ASTM C552, 7.5 lbs./cu.ft, density, ASTM E96 (Wet Cup Method) 0.00 water vapor perm , ASTM C518 ‘k’ value of 0.29 at 75 degrees F.

2.04 JACKETS

A. Factory Applied Jackets:

1. White kraft bonded to reinforced foil vapor barrier with self-sealing adhesive joints.

2. ASJ White, triple-ply laminate polypropylene, mold resistant, metalized polyester vapor barrier film backing: Venture 1555U or Insulrap 30 Vapor Barrier I-30.

B. Field Applied Jackets:

1. PVC Jackets: UL listed 25/50 rated per ASTM E 84, UV resistant, minimum insulation thickness 0.020 inches for pipe outside diameters up to 18 inches and 0.030 inches for pipe outside diameters 18 inches and above. Standard manufactured PVC cover fittings cover system consisting of one-piece, pre-molded, PVC covers with fiberglass inserts manufactured from 20-mils thick, high-impact, ultraviolet-resistant. Use ultraviolet resistant adhesive as recommended by the manufacturer.

2. Reinforcing Mesh: Glass Fiber Childers Chil-Glas #10 or synthetic 9X8 mesh with minimum weight of 0.9 ounces per square yard.

3. Aluminum Jackets: ASTM B 209; 0.020 inch thick; smooth finish with factory applied moisture barrier.

4. Stainless Steel Jackets: Type 304 stainless steel; 0.010 inch thick; smooth finish.

5. VentureClad 1577CW or Foster Vapor Fas 62-05, zero permeability and mold resistant jacket material, 5-ply laminate with 5-6 mil film with adhesive on one side. Jacketing laminated film must have UV coating for additional exterior protection. Product shall be used with phenolic closed cell insulation where Type 5A and 5B insulation is installed on existing chilled water piping being repaired or being modified.

2.05 COATINGS, SEALANTS, AND ADHESIVES

A. Insulating Cement: ASTM C 195; hydraulic setting mineral wool; Ryder One-Coat.

B. Sealants: Foster 95-50; Childers CP-70 or CP-76

1. Apply at valves, fittings and where insulation is terminated. Brush-apply sealant to end of insulation and continue along pipe surface.

2. Below-ambient closed cell pipe insulation (Type P5, P5A, P5B): apply sealant on all longitudinal and butt insulation joints to prevent moisture transmission.

C. Adhesives: Use to adhere the longitudinal lap seam of vapor barrier jackets and at butt joints between insulation or fitting covers. Provide Childers CP-82 or Foster 85-20/85-60 as general purpose adhesive. For use with calcium silicate or expanded perlite insulation, use Childers CP-97 or Foster 81-27 fibrous adhesive when adhering pipe saddles and shields to the insulation.

D. Primers: For proper bonding with lagging adhesive/canvas provide light coat of Childers CP-50 AMV1 or Foster 30-36 diluted 50 percent with water over insulation or Pittcoat 300 primer thinned with mineral spirits to cover insulating cements prior to finish coating.

E. Coatings and Mastics:

1. Vapor barrier coating for indoor, below-ambient applications: Foster 30-80 or Childers CP-38 on all elbows, fittings, and valves. Coating shall adhere to MIL-C-19565C, Type II and shall be QPL listed.

2. Weather barrier/breather mastics for above-ambient piping applications: Childers CP-10/CP-11 or Foster 46-50.

3. High humidity applications: Foster 30-80 AF or Childers CP-137 AF fungus/mold resistant coating that meets ASTM D 5590 with zero growth rating.

4. Exterior applications: Childers CP 30LO (must be covered by metal jacketing), Childers CP-45 Encacel V, or Foster 60-95 Monolar for insulated elbows/fittings, longitudinal seams, and butt joints of vapor barrier jackets or glass cloth jackets.

5. Finish coat over closed cell elastomeric: Foster 30-64 or Armstrong "Finish" acrylic finish.

6. Canvas Finishes:

a. Apply lagging adhesive to prevent mildew for securing canvas. Apply anti-fungal lagging adhesive that adheres to ASTM D 5590 with zero growth rating. (Foster 30-36AF, Childers CP-137AF) Do not use wheat paste.

b. Exterior Applications: cover all canvas insulation with a fire-retardant weather barrier mastic. On canvas jacketed systems where seam joints at fittings are rough, cover with an application of insulating cement and smooth with a trowel before the canvas is applied with adhesive. Canvas shall be free of wrinkles and have a smooth, neat appearance.

F. Reinforcing Mesh: Childers Chil-Glas #10 or Foster Mast-a-Fab 9x8 reinforcing mesh with coatings and mastics.

G. Lagging Adhesives/Coatings: Childers CP-50A HV2 or Foster 30-36 for adhering canvas and glass cloths over thermal insulation installed indoors. Adhesive shall adhere to MIL-A-3316C Class I, Grade A.

a. High humidity applications (unconditioned space): Foster 30-36 AF or Childers CP-137 AF fungus/mold resistant coating that meets ASTM D 5590 with zero growth rating. Coating shall adhere to MIL-C-19565C, Type II and must be QPL listed.

2.06 APPLICATIONS

A. Interior Concealed Applications (Plenums, Chases):

1. Type P1 Insulation: Provide factory applied ASJ white kraft foil vapor barrier.

a. Below-ambient piping: Coat all ASJ seams with Foster 30-80 or Childers CP-38 vapor barrier coating. Coat all elbows, fittings, and valves with same vapor barrier coating and Foster Mast-a-Fab or Childers Chil-Glas #10 reinforcing mesh.

b. High humidity applications: Foster 30-36 AF.

2. Type P3 Insulation: Finish coat is not required.

3. Type P4 Insulation: Lightly coat insulation with lagging adhesive diluted 50% with water for proper bonding with canvas/lagging adhesive. Cover with a canvas jacket and non-diluted Childers CP-50A HV2 or Foster 30-36 lagging adhesive.

a. High humidity applications (unconditioned space): Foster 30-36 AF or Childers CP-137 AF fungus/mold resistant coating.

4. Type P5 and P5A, 5B Insulation: VentureClad jacket on piping where condensation can occur or where installed on existing chilled water piping, chilled water condensate drain piping, and roof storm drain piping that transports cold rain water from the building roof.

5. Type P5 Jacket not required when insulation is used on hot water piping.

6. Type P6 Insulation:

a. Above-ambient piping: Pittcoat 404, Foster 46-50, or Childers CP-10/11 pre-molded PVC covers per manufacturer's recommendations. Jacket is not required when this type of piping insulation is concealed within a piping chase.

b. Below-ambient piping: Coat all ASJ seams with Foster 30-80 or Childers CP-38 vapor barrier coating. Coat all elbows, fittings, and valves with same vapor barrier coating and Foster Mast-a-Fab or Childers Chil-Glas #10 reinforcing mesh.

c. High humidity applications (unconditioned space): Foster 30-36 AF or Childers CP-137 AF fungus/mold resistant coating.

B. Interior Exposed Applications (Equipment Rooms):

1. Type P1 and P2 Insulation: Factory applied ASJ white kraft foil vapor barrier. Finish with canvas jacket or Childers Chil-Glas #10 glass membrane with Childers CP-50A HV2 or Foster 30-36. Verify jacket is suitable for applications.

a. High humidity applications (unconditioned space): Foster 30-36 AF or Childers CP-137 AF fungus/mold resistant coating. Finish coat is not required.

2. Type P3 Insulation: Finish coat is not required.

3. Type P4 Insulation: Lightly coat insulation with lagging adhesive diluted 50% with water for proper bonding with canvas/lagging adhesive. Cover with a canvas jacket and non-diluted Childers CP-50A HV2 or Foster 30-60 lagging adhesive.

a. High humidity applications (unconditioned space): Foster 30-36 AF or Childers CP-137 AF fungus/mold resistant coating. Finish coat is not required.

4. Type P5 Insulation: Factory applied ASJ white kraft foil vapor barrier.

5. Type P5 and P5A Insulation: VentureClad jacket on piping where condensation can occur or where installed on existing chilled water piping, chilled water condensate drain piping, and roof storm drain piping that transports cold rain water from the building roof.

6. Type P6 Insulation: Provide triple-ply laminate polypropylene, mold resistant with a metal foil and polyester vapor barrier film backing.

a. Below-ambient piping: Coat all ASJ seams with Foster 30-80 or Childers CP-38 vapor barrier coating. Coat all elbows, fittings, and valves with same vapor barrier coating and Foster Mast-a-Fab or Childers Chil-Glas #10 reinforcing mesh.

b. Above-ambient piping: Provide Pittcoat 404, Foster 46-50, or Childers CP-10/11 or pre-molded PVC covers per manufacturer's recommendations.

c. High humidity applications (unconditioned space): Foster 30-36 AF or Childers CP-137 AF fungus/mold resistant coating.

7. All exposed insulated piping within six (6) feet of the floor shall be protected with aluminum or stainless steel jacket to protect insulation from being torn or punctured.

C. Exterior Applications:

1. Insulate piping system as indicated under Interior Exposed Applications, prior to final jacket installation.

2. Provide electric heat tracing for all exterior small bore piping 2 inches and smaller where water may be susceptible to freezing due to intermittent flow conditions.

[EDITOR'S NOTE: ENGINEER SHALL INDICATE LOCATION OF HEAT TRACING ON PIPING PLANS AND ELECTRICAL REQUIREMENTS ON ELECTRICAL DRAWINGS]

3. Final jacket cover shall be aluminum or stainless steel having integral moisture barrier with seams located at 2 or 10 o'clock position of horizontal piping. All laps shall be minimum 2 inches. Apply Foster 95-44 or Childers CP-76 metal jacketing sealant on all laps to prevent water transmission.

4. Type P1 Insulation: For above-ambient piping, finish with Childers Chil-Glas #10 or 9X8 reinforcing mesh and Childers CP-10/CP-11, or Foster 46-50 weather barrier/breather mastic, prior to final jacket installation.

5. P6 Insulation Above-ground: Provide (50 mil thickness) self-sealing non- metallic, bituminous compound reinforced with glass fiber membrane with 1 mil aluminum top film jacketing for both chilled water and hot water piping (PITTWRAP CW Plus). Provide metal jacketi where material is exposed to ultraviolet rays.

6. P6 Insulation Underground: Provide factory applied (50 mil thicknesses) self-sealing membrane bituminous compound reinforce with glass fiber for chilled water piping (PITTWRAP IW 50 or Foster C.I. Wrap 50mil). Metal jacket not required for buried pipe.

2.07 INSERTS, SUPPORTS AND SHIELDS

A. Application: Piping ½ inch diameter or larger for all systems except direct buried.

B. Shields shall be made of galvanized steel or made of black iron painted on both sides with a minimum two coats of aluminum paint. Required metal shield sizes are as follows:

Nominal IPS (inches)	Metal Thickness (gage)	Minimum Lengths of Shield (inches)
½ to 1½	18	12
2	14	12
2-½ to 6	12	16
8 and above	10	20

C. Inserts for shields shall be manufactured of 7.5 lb/cu. ft. density cellular glass or 5.0 lb/cu. ft. density cellular, phenolic insulating material suitable for the planned temperature range. Provide factory fabricated inserts with integral galvanized pipe saddles. Inserts shall be the same thickness as the adjacent insulation.

D. Depending on the type of pipe support design, stainless steel bands or aluminum bands may be required to keep shield material next to the jacketing material.

1. Insulation Bands: 3/4 inch wide; 0.007 inch thick galvanized steel when exposed to interior environment, 0.010 inch thick stainless steel or 0.015 inch thick aluminum when exposed to humid interior environment or outside environment.

2. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum or 0.010 inch thick stainless steel to match jacket.

PART 3 - EXECUTION

3.01 PREPARATION

A. Verify that piping has been inspected at the welds and pressure tested before applying paint and insulation materials.

B. Thoroughly clean all surfaces to be insulated as required to remove all oil, grease, loose scale, rust, and foreign matter. Piping shall be completely dry at the time of application of primer paint. Painting on piping where condensation is occurring on the pipe surface is strictly prohibited.

C. Provide primer coat on all steel piping field welds. Painting shall be completed and approved prior to installation of insulation. Paint shall be applied in accordance with the paint manufacturer's instructions, environment, and pipe surface temperatures.

3.02 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. Installation of insulation and jacket materials shall be in accordance with manufacturer's published instructions.

C. Handle and install materials in accordance with manufacturer's instructions in the absence of specific instructions herein.

D. On exposed piping, locate insulation cover seams with the ridge of the lap joint is directed down.

E. Exposed Insulated piping within six feet of the floor shall be protected with an aluminum or stainless jacket material to protect the insulation.

F. Insulate fittings, joints and valves with molded insulation of the same material and thickness as adjoining pipe. Open voids and cracks insulation shall be kept at a minimum when placing insulation on abnormal or irregular shapes. Use closed cell or recommended fill material as instructed by the insulation manufacturer to close openings. Fiberglass insulation shall not be used as a fill material on chilled water piping or fittings. Vapor seal all cold piping ASJ seams and elbows/fittings with vapor barrier coating and reinforcing mesh.

G. Continue insulation through walls, sleeves, pipe hangers, floors, and other pipe penetrations.

H. Provide dams in insulation at intervals not to exceed 20 feet on cold piping systems to prevent migration of condensation or fluid leaks. Indicate visually where the dams are located for maintenance personnel to identify and also provide dams at butt joints of insulation at fittings, flanges, valves, and hangers.

I. Insulate entire system including fittings, valves, flanges and strainers. Use closed cell insulation on cold piping system flexible connections, expansion joints and unions, bevel and seal ends of insulation and continue sealant or coating a minimum of 4 inches along the piping, unless stated otherwise. On all closed-cell insulation, cold piping, use insulation joint sealant on all longitudinal and butt joints.

J. For hot piping conveying fluids 180 degrees F or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation. Continue sealant or coating a minimum of 4 inches along the piping.

K. On heating piping systems conveying fluids over 180 degrees F with unions, flanges, valves, strainers and equipment that are anticipated to be removed for maintenance, the insulation shall terminate (beveled to pipe) just prior to the flange or union with vapor barrier sealed to pipe. The tapered segment of insulation shall not interfere with the removal of unions flange bolts or equipment. The unions, flanges, valves and strainers shall be insulated with removable insulated covers with toggle catches or Velcro straps

L. All sections of molded pipe covering shall be firmly butted together. Where an insulation covering is applied, it shall lap the adjoining section of insulation by at least three inches (3 inches). Where insulation terminates, it shall be neatly beveled and finished. All materials used shall be fire retardant or nonflammable.

M. Where vapor barriers are required, the vapor barrier shall be on the outside. Extreme care shall be taken that the vapor barrier is unbroken. Joints, etc., shall be sealed with vapor barrier coating. Where insulation with a vapor barrier terminates, seal off with vapor barrier continuous to the surface being insulated. Ends shall not be left raw.

N. Where pipe chases are tight, adequate provision shall be made at the rough-in stage using offset fittings or other means (except springing the pipe) to ensure that insulation can be applied throughout the length of the pipe.

O. When installing phenolic insulation provide a 5 lb. density insert of same thickness and contour as adjoining 3.75 lb. density insulation, between the support shield and piping, and under the finish jacket, on piping 1½ inch diameter or larger, to prevent insulation from sagging at support points. Provide inserts for 180-degree arc and not less than 2 inches more than the length of the pipe support shield or minimum 12 inches long (whichever is greater). Pipe support shield shall be adhered to insulation with a UL approved adhesive that meets E-84 requirements.

P. Seal all insulation at supports, protrusions and interruptions. Maintain vapor barrier with finish coat.

Q. Shields:

1. Install between pipe hangers or pipe hanger rolls and inserts. Curved metal shields shall be used between the hangers or support points and at the bottom of insulated pipe.

2. Hangers shall support the load of the insulated pipe section on the outside of the insulation and shall not be in direct contact with the pipe.

3. Manufacturer shall be responsible to size the length of shield required to prevent insulation from breaking.

4. Provide rigid insulation at each support point, a minimum of 2 inches longer than shield length.

5. Curved metal shields shall be designed to limit the bearing stress on the insulation to 35 psi and shall be curved to fit up to mid-perimeter of the insulated pipe.

3.03 EXISTING CHILLED WATER PIPING INSULATED WITH PHENOLIC FOAM INSULATION

A. Re-insulate existing piping systems after repairs have been performed in the same manner as the original installation unless:

1. The nature of damage to the insulation indicates that the system was not insulated properly, and that installation of flashing will be necessary where leaks occur.

a. Increasing the thickness of the insulation may be required when condensation occurs.

b. Provide insulation expansion joints where large cracks or gaps occur.

B. Materials:

1. When possible carefully remove existing insulation material so it can be reapplied, and provide temporary protection to adjacent insulation material to prevent damage while repairs are underway.

2. When performing a hot tap, maintenance to a strainer, or adding a mechanical component or similar to an operating chilled water system, apply temporary insulation to prevent moisture damage to exposed insulation material. Qualified insulation subcontractor personnel shall assist in the following:

a. Strainers; dry the strainer body prior to installing the insulating cap. Ensure that the exposed insulation and insulating cap is dry and free of any contamination. Tape in place then finish with reinforcing mesh and vapor barrier coating.

b. Hot tap: to eliminate the possibility of moisture migration into the existing insulation, remove the complete section of the pipe covering where the operation will occur. Apply duct wrap on the raw ends of the adjacent insulation in both directions at a 12 inch length. Use FSK tape to secure the wrap. After completion of the hot tap, remove the temporary insulation and inspect the protected sections to ensure the sections are dry and free from contaminates. Re-insulate and seal the circumferential and longitudinal joints with Foster 30-45 or Childers CP-70. Apply FSK tape at the seams to match the existing facing system.

c. Use freezing blankets to install new mechanical components to an existing chilled water piping section. Remove enough insulation to install the freezing blankets plus one additional section in either direction. To eliminate the possibility of moisture migration, remove the complete section of the pipe covering where the operation will occur. Apply duct wrap on the raw ends of the adjacent insulation in both directions at a 12 inch length. Use FSK tape to secure the wrap. After completion of the procedure, remove the temporary insulation and inspect the protected sections to ensure that the insulation sections are dry and free from contaminates. Re-insulate and seal the circumferential and longitudinal joints with a Foster 30-45 or Childers CP-70 or equivalent. Apply tape at the seams to match the existing facing system.

C. Maintenance and Inspection Methods:

1. Conduct periodic inspections as determined by the Owner, to address the following:

a. Replace missing insulation and protect adjacent insulation which can become burned or wet after maintenance has been performed to the system.

b. Repair leaks or spills and remove and replace damaged insulation.

c. Repair breaks, tears, cracks, or punctures of the vapor barrier or protective covering. Verify that the existing insulation is dry and if wet replace the entire affected section as described in this section.

d. On piping exposed to the outdoor environment, replace the affected section of insulation as described in this section and use galvanized steel, aluminum or stainless steel to protect the insulation from being crushed due to foot traffic or maintenance equipment. PVC is appropriate for interior areas not subject to foot traffic.

3.04 PIPING INSULATION APPLICATION AND THICKNESS SCHEDULE

A. In no case shall installed piping insulation have insulation thicknesses that are less than what is required by local energy codes and ASHRAE 90.1 (whichever is more stringent), based on comparable insulation conductivity values at the specified mean rating temperature.

B. Type 5A and 5B insulation is only used where it is being replaced on existing pipe and thickness of the replacement insulation shall match the existing insulation thickness.

Piping Systems	Location	Type	Pipe Size	Insulation Thickness
Domestic Cold Water, Soft Water, Make-Up Water	Interior Concealed	P1	1-1/2" & Smaller	1/2”
			2" to 4"	1/2”
			6" & Larger	1/2”
	Interior Exposed	P5	1-1/2" & Smaller	3/4”
			2” to 4”	3/4”
			6” & Larger	1”
	Interior Exposed	P6	1-1/2” & Smaller	1”
			2” to 4	1”
			6” & Larger	1-1/2”
	Exterior	P5	All Sizes	1”
		P6	4” & Smaller	1”
			6” & Larger	1-1/2”
Domestic Hot Water, Tempered Water (Maximum 200 Degrees F)	Interior Concealed	P1	2” & Smaller	1"
			2-1/2”& Larger	1-1/2”
	Interior Exposed	P5	1-1/2” & Smaller	3/4”
			2” to 4”	1”
		P6	6” & Larger	1-1/2”
			4” & Smaller	1”

Piping Systems	Location	Type	Pipe Size	Insulation Thickness
			6” & Larger	1-1/2”
	Exterior	P5	All Sizes	1-1/2”
		P6	All Sizes	1-1/2”
Fire Protection Water (40 Degrees F – Nominal)	Exterior	P5	4” and Smaller	3/4”
			6” and Larger	1”
		P6	4” and Smaller	1-1/2”
			6“ and Larger	3
Underside of all Roof / Overflow Drain Bodies and related horizontal roof drain lines to vertical leader	Interior Exposed	P5	2” to 4”	3/4”
			6” and Larger	1”
		P6	2” to 4”	1”
			6” and Larger	1-1/2”
	Interior Concealed	P1	2" to 4”	1/2"
			6” and Larger	1/2”
Floor Drain Bodies and related horizontal Sanitary Drain Lines above floor that receive cold condensate drainage.	Interior Exposed	P5	2” to 4”	3/4"
			6” and Larger	1"
		P6	2” to 4”	1”
			6” and Larger	1-1/2”
	Interior Concealed	P1	2” to 4”	1/2”
			6” and Larger	1/2
Cold Condensate Drain Lines	Interior	P5	All Sizes	3/4”
		P6	4” and Smaller	1”
			6” & Larger	1-1/2”
	Interior Concealed	P3	All Sizes	3/4”
		P6	All Sizes	1"
Building Heating Hot Water (Maximum 160 Degrees F)	Interior Exposed	P5	2-1/2” and Smaller	1"
			3" and Larger	1-1/2”
		P5	2-1/2” and Smaller	1-1/2”
			3" and Larger	3”
	Interior Concealed	P1	2-1/2” and Smaller	1-1/2”
			3" and Larger	2-1/2”
		P5	2-1/2” and Smaller	1"
			3" and Larger	1-1/2”
		P6	2-1/2” and Smaller	1-1/2”
			3" and Larger	2”
	Exterior	P2	2-1/2” and Smaller	1"
			3" and Larger	1-1/2”
		P5	2-1/2” and Smaller	1-1/2”
			3" and Larger	2”
Chilled Water	Interior	P6	4" and Smaller	1-1/2”
			6" and Larger	2"

Piping Systems	Location	Type	Pipe Size	Insulation Thickness
	Exterior	P6	4” and Smaller	2”
			6” and Larger	3-1/2”
Refrigerant Suction Piping (35 Degrees F – Nominal)	All	P3	2-1/2” and Smaller	3/4"
Non Tempered Domestic Hot Water (Maximum 180 Degrees F)	All	P1	1" and Smaller	1"
			1-1/2" to 2-1/2"	1-1/2"
			3" to 6"	2“
			8" and Larger	2-1/2”
Engine Exhaust	All	P4	Less then 1"	2-1/2"
			1" to 3"	3"
			4" and Larger	4"
Low Pressure Steam, Boiler Feedwater, Steam Condensate Return, Compresses Air Discharge, Boiler Blowdown (201 Degrees F to 250 Degrees F)	All	P1	2-1/2" and Smaller	2"
			3” to 6"	3”
			8" and Larger	3-1/2"
		P4	Less than 1-1/2”	1-1/2"
			1-1/2” & Larger	2"
Medium Temp. Hot Water and Steam (251 Degrees F to 350 Degrees F)	All	P4	Less than 1”	1-1/2"
			1" to 1-1/2"	2-1/2"
			1-1/2" and Larger	3"
High Temp. Hot Water (351 Degrees F to 400 Degrees F) and Steam (351 Degrees F to 600 Degrees F)	All	P4	Less then 1”	2-1/2"
			1” to 4"	3"
			4" and Larger	4”
Brine Systems, Cryogenics (Minus 30 Degrees F to 0 Degrees F)	All	P5	3” and Smaller	2”
			4” and Larger	3”
		P6	4” and Smaller	2-1/2”
			6” and Larger	4”
Brine Systems, Cryogenics (0 Degrees F to 34 Degrees F) Brine Systems, Cryogenics (0 Degrees F to 34 Degrees F)	All	P5	4” and Smaller	1”
			6” and Larger	1-1/2”
		P6	4” and Smaller	1-1/2”
			6” and Larger	2”

END OF SECTION 20 07 19

SECTION 20 08 00 – FIRE SUPRESSION/PLUMBING/HVAC SYSTEMS COMMISSIONING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 SUMMARY

A. The purpose of this Section is to define responsibilities in the Commissioning process. Additional system testing is required within individual Specification Sections.

B. Ensure that all systems are operating in a manner consistent with the Contract Documents. General Commissioning requirements and coordination are detailed in Division 01. Execute all Commissioning responsibilities assigned and include the cost of Commissioning in the Contract price.

C. HVAC systems to be commissioned include the following: [Edit or add to the following scope as appropriate to the Project.]

1. Chilled Water Systems
2. Cooling Tower
3. Hot Water and Steam PRV Station
4. Steam Boiler System
5. Pumps
6. Heat Exchangers
7. Air Handling Units
8. Fans
9. Piping Systems
10. Ductwork Systems
11. Fire, Fire/Smoke and Volume Dampers
12. Chemical Treatment
13. Roof Top Packaged DX Units

14. Split Systems
15. Fan Coil Units
16. Terminal Units
17. Unit Heaters
18. Building Automation System

D. Plumbing Systems to be commissioned include the following:

1. Sanitary Waste and Vent
2. Roof and Storm Drainage
3. Laboratory (Chemical) Waste and Vent
4. Grease/Oil Laden Waste and Vent
5. Sump/Ejector Pumps
6. Domestic Water Booster Pumps
7. Domestic Water Storage/Break Tank
8. Water Softeners
9. Pure Water Production Equipment (R.O., D.I., etc.)
10. Domestic Water Heaters
11. Domestic Hot Water Circulating Pumps
12. Domestic Cold Water Distribution
13. Domestic Hot Water Distribution
14. Natural Gas Distribution
15. Medical Air Compressors and Vacuum Pumps
16. Laboratory Air Compressors And Vacuum Pumps
17. Medical Compressed Gas Cylinder Manifolds
18. Laboratory Compressed Gas Manifolds
19. Medical Gas and Vacuum System Alarms
20. Laboratory Gas and Vacuum System Alarms
21. Medical Gas and Vacuum Distribution

22. Laboratory Gas and Vacuum Distribution

23. Plumbing Fixtures

24. Plumbing Systems/Emergency Power Source Integration

25. Plumbing Systems/Building Automation System Integration

E. Fire Protection Systems to be commissioned include the following:

1. Fire Pump

2. Wet Standpipe

3. Wet Fire Sprinkler

4. Dry Fire Sprinkler

5. Pre-Action Fire Sprinkler

6. Chemical Fire Suppression

7. Fire Protection Water Storage/Break Tank

8. Fire Protection Systems/Emergency Power Source Integration

9. Fire Protection Systems/Fire Alarm System Integration

10. Fire Water Tank and piping system including valves, high/low level, over flow, metering, basin and circulation loop.

1.03 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with all applicable requirements and standards.

1.04 DEFINITIONS

A. Commissioning: A systematic process confirming that building systems have been installed, properly started, and consistently operated in strict accordance with the Contract Documents, that all systems are complete and functioning in accordance with the Contract Documents at Substantial Completion, and that Contractor has provided Owner adequate system documentation and training. Commissioning includes deferred and/or seasonal tests as approved by Owner.

B. Commissioning Plan: Document prepared by Contractor and approved by Owner that provides the structure, schedule, and coordination plan for the Commissioning process from the construction phase through the warranty period. The Commissioning Plan must satisfy the Owner's test requirements.

C. Commissioning Team: Working group made up of representative(s) from the Architect/Engineer (A/E), Contractor, Test, Adjust, and Balance (TAB) Firm, Building Automation System (BAS) provider, specialty manufacturers and suppliers, and Owner. Contractor will provide ad-hoc representation of subcontractors on the Commissioning Team as required for implementation of the Commissioning Plan.

D. Deferred Tests: Functional Performance or Integrated System Tests performed after Substantial Completion due to partial occupancy, partial equipment acceptance, seasonal requirements, design, or other Site conditions that prohibit the test from being performed prior to Substantial Completion.

E. Deficiency: Condition of a component, piece of equipment or system that is not in compliance with Contract Documents.

F. Factory Testing: Testing of equipment at the factory, by factory personnel with an Owner's representative present if deemed necessary by Owner.

G. Functional Performance Test Procedures: Commissioning protocols and detailed test procedures and instructions in tabular and script-type format that fully describe system configuration and steps required to determine if the system is performing and functioning properly. Contractor prepares these procedures to document Functional Performance Tests.

H. Functional Performance Test (FPT): Test of dynamic function and operation of equipment and systems executed by Contractor. Systems are tested under various modes, such as during low cooling or heating loads, high loads, component failures, unoccupied, varying outside air temperatures, life safety conditions, power failure, etc. Systems are run through all specified sequences of operation. Components are verified to be responding in accordance with Contract Documents. Functional Performance Tests are executed after Start-ups and Prefunctional Checklists are complete.

I. Integrated System Test: Test of dynamic interactive function and operation of multiple systems. Integrated System Tests are tested under various modes, such as fire alarm and emergency situations, life safety conditions, power failure, etc. Systems are integrally operated through all specified sequences of operation. Components are verified to be responding in accordance with Contract Documents. Integrated System Tests are executed after Functional Performance Tests are complete and prior to Substantial Completion. Integrated System Tests provide verification that the integrated systems will properly function according to the Contract Documents.

J. Integrated System Test Procedures: Commissioning protocols and detailed test procedures and instructions in tabular and script-type format fully describe system configurations and steps required to determine if the interacting systems are performing and functioning properly. Contractor prepares these procedures to document Integrated System Tests.

K. Prefunctional Checklist: A list of static inspections and material or component tests that verify proper installation of equipment (e.g., belt tension, oil levels, labels affixed, gages in place, sensors calibrated, etc.). The word Prefunctional refers to before Functional tests. Prefunctional Checklists must include the manufacturer's Start-up checklist(s). Contractor shall sign Prefunctional Checklists as complete and submit with the Request for Start-up/Functional Performance Test Form.

L. Start-up: The activities where equipment is initially energized, tested, and operated. Start-up is completed prior to Functional Performance Tests.

M. Test Requirements: Requirements specifying what systems, modes and functions, etc. must be tested. Test requirements are not detailed test procedures. Test requirements and acceptance criteria are specified in the Contract Documents.

1.05 SUBMITTALS

A. Contractor shall prepare Prefunctional Checklists and Functional Performance Test (FPT) procedures and execute and document results. All Prefunctional Checklists and tests must be documented using specific, procedural forms in Microsoft Word or Excel software developed for that purpose. Prior to testing, Contractor shall submit those forms to the Owner for review and approval.

B. Contractor shall provide Owner with documentation required for Commissioning Work. At minimum, documentation shall include: Detailed Start-up procedures, full sequences of operation, Operating and Maintenance data, performance data, Functional Performance Test Procedures, control drawings, and details of Owner-contracted tests.

C. Contractor shall submit to Owner installation and checkout materials actually shipped inside equipment and actual field checkout sheet forms used by factory or field technicians.

D. Contractor shall review and approve other relative documentation for impact on FPT's of the systems:

1. Shop drawings and product submittal data related to systems or equipment to be commissioned. The Subcontractor responsible for the FPT shall review and incorporate comments from the Owner and A/E via the Contractor.

2. Incorporate manufacturer's Start-up procedures with Prefunctional checklists.

3. Draft Test, Adjust and Balance (TAB) Reports: Review and provide comments to Owner.

4. Factory Performance Test Reports: Review and compile all factory performance data to assure that the data is complete prior to executing the FPT's.

5. Completed equipment Start-up certification forms along with the manufacturer's field or factory performance and Start-up test documentation: Subcontractor performing the test will review the documentation prior to commencing with the scheduled FPT's. Owner may require that system one-line diagrams and applicable Specification Section(s) be attached to the FPT documentation.

6. Final TAB Reports: Subcontractor performing the test will review the documentation prior to commencing with the scheduled FPT's.

7. Operating and Maintenance (O&M) information per requirements of the Technical Specifications and Division 01 requirements: To validate adequacy and completeness of the FPT, the Contractor shall ensure that the O&M manual content, marked-up record Drawings and Specifications, component submittal drawings, and other pertinent documents are available at the Project Site for review.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.02 TEST EQUIPMENT

A. Provide all specialized tools, test equipment and instruments required to execute Start-up, checkout, and testing of equipment.

B. All specialized tools, test equipment, and instruments required to execute Start-up, checkout, and testing of equipment shall be of sufficient quality and accuracy to test and/or measure system performance within specified tolerances. A testing laboratory must have calibrated test equipment within the previous twelve (12) months. Calibration shall be NIST traceable. Contractor must calibrate test equipment and instruments according to manufacturer's recommended intervals and whenever the test equipment is dropped or damaged. Calibration tags must be affixed to the test equipment or certificates readily available.

PART 3 - EXECUTION

3.01 PREPARATION

A. Construction Phase:

1. In each purchase order or subcontract that is written for changes in scope, include the following requirements for submittal data, Commissioning documentation, testing assistance, Operating and Maintenance (O&M) data, and training, as a minimum.

2. Attend Pre-Commissioning Meeting(s), Pre-Installation Meeting(s), and other Project meetings scheduled by the Contractor to facilitate the Commissioning process.

3. Provide manufacturer's data sheets and shop drawing submittals of equipment.

4. Provide additional requested documentation to the Contractor, prior to O&M manual submittals, for development of Prefunctional Checklist and Functional Performance Tests procedures.

    a. Typically, this will include detailed manufacturer's installation and Start-up, operating, troubleshooting and maintenance procedures, full details of any Owner-contracted tests, full factory testing reports, if any, and full warranty information, including all responsibilities of the Owner to keep the warranty in force clearly identified.

    b. In addition, the installation, Start-up, and checkout materials that are actually shipped inside the equipment and the actual field checkout sheet forms to be used by the factory or field technicians shall be submitted to the Contractor.

    c. This information and data request may be made prior to normal submittals.

5. With input from the BAS Provider and A/E, Clarify the operation and control of commissioned equipment in areas where the Specifications, BAS control drawings, or equipment documentation are not sufficient for writing detailed test procedures.

6. Prepare the specific Functional Performance Test procedures specified in Section 20 08 16. Ensure that Functional Performance Test procedures address feasibility, safety, and equipment protection and provide necessary written alarm limits to be used during the tests.

7. Develop the Commissioning Plan using manufacturer's Start-up procedures and the Prefunctional Checklists. Submit manufacturer's detailed Start-up procedures and the Commissioning Plan and procedures and other requested equipment documentation to Owner for review.

8. During the Start-up and initial checkout process, execute and document related portions of the Prefunctional Checklists for all commissioned equipment.

9. Perform and clearly document all completed Prefunctional Checklists and Start-up procedures. Provide a copy to the Owner prior to the Functional Performance Test.

10. Address current A/E and Owner punch list items before Functional Performance Tests. Air and water test, adjust and balance shall be completed with discrepancies and problems remedied before Functional Performance Tests of the respective air or water related systems are executed.

11. Provide skilled technicians to execute starting of equipment and to assist in execution of Functional Performance Tests. Ensure that they are available and present during the agreed-upon schedules and for a sufficient duration to complete the necessary tests, adjustments, and problem solving.

12. Correct deficiencies (differences between specified and observed performance) as interpreted by the Owner's Project Manager and A/E and retest the system and equipment.

13. Compile all Commissioning records and documentation to be included in a Commissioning and Closeout Manual.

14. Prepare O&M manuals according to the Contract Documents, including clarifying and updating the original sequences of operation to as-built conditions.

15. During construction, maintain as-built marked-up Drawings and Specifications of all Contract Documents and Contractor-generated coordination Drawings. Update after completion of Commissioning activities (include deferred tests). The as-built drawings and specifications shall be delivered to the Owner both in electronic format and hard copies as required by the Owner.

16. Provide training of the Owner's operating personnel as specified.

17. Coordinate with equipment manufacturers to determine specific requirements to maintain the validity of the warranty.

B. Warranty Phase:

1. Execute seasonal or deferred tests, witnessed by the Owner, according to the Specifications.

a. Complete deferred tests as part of this Contract during the Warranty Period. Schedule this activity with Owner. Perform tests and document and correct deficiencies. Owner may observe the tests and review and approve test documentation and deficiency corrections.

b. If any check or test cannot be completed prior to Substantial Completion due to the building structure, required occupancy condition, or other condition, execution of such test may be delayed to later in the Warranty Period, upon approval of the Owner. Contractor shall reschedule and conduct these unforeseen deferred tests in the same manner as deferred tests.

2. Correct deficiencies and make necessary adjustments to O&M manuals, Commissioning documentation, and as-built drawings for applicable issues identified in any seasonal testing.

3.02 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. All installation shall be in accordance with manufacturer's published recommendations.

3.03 TESTING

A. Prefunctional Checklists and Start-up:

1. Follow the Start-up and initial checkout procedures listed in this Section and in Division 01. Start-up and complete systems and sub-systems so they are fully functional, meeting the requirements of the Contract Documents.

2. Prefunctional Checklists shall be complete prior to commencement of a Functional Performance test.

B. Functional Performance Tests:

1. Functional Performance Tests are conducted after system Start-up and checkout is satisfactorily completed. Air balancing and water balancing shall be completed before Functional Performance Tests.

C. Coordination Between Testing Parties:

1. Factory Start-ups: Factory Start-ups are specified for certain equipment. Factory Start-ups generally are Start-up related activities that will be reviewed and checked prior to Functional Performance Tests. All costs associated with factory Start-ups shall be included with the contract price unless otherwise noted. Notify the Commissioning Team of the factory Start-up schedule and coordinate these factory Start-ups with witnessing parties. The Commissioning Team members may witness these Start-ups at their discretion.

2. Independent Testing Agencies: For systems that specify testing by an independent testing agency, the cost of the test shall be included in the Contract price unless otherwise noted. Testing performed by independent agencies may cover aspects required in the Prefunctional Checklists, Start-ups, and Functional Performance Tests. Coordinate with the independent testing agency so that Owner and/or A/E can witness the test to ensure that applicable aspects of the test meet requirements.

3.04 TRAINING

A. Submit a written training plan to the Owner and Architect/Engineer for review and approval. Contractor's training plan shall cover the following elements:

1. Equipment included in training.

2. Intended audience.

3. Location of training.

4. Objectives.

5. Subjects covered.

6. Duration of training on each subject.

7. Instructor for each subject.

8. Methods (classroom lecture, video, Site walk-through, actual operational demonstrations, written handouts, etc.).

9. Instructors and qualifications.

B. Contractor shall have the following training responsibilities:

1. Provide a training plan ten (10) calendar days prior to the scheduled training, in accordance with Division 01.

2. Provide Owner personnel with comprehensive training in the understanding of the systems and the operation and maintenance of each major piece of commissioned mechanical equipment or system.

3. Training shall start with classroom sessions, if necessary, followed by hands-on training on each piece of equipment, which shall illustrate the various modes of operation, including Start-up, shutdown, fire/smoke alarm, power failure, etc.

4. During any demonstration, should the system fail to perform in accordance with the requirements of the O&M manual or sequence of operations, the system will be repaired or adjusted as necessary and the demonstration repeated.

5. The appropriate trade or manufacturer's representative shall provide the instructions on each major piece of equipment. This representative may be the Start-up technician for the piece of equipment, the installing contractor, or manufacturer’s representative. Practical building operating expertise as well as in-depth knowledge of all modes of operation of the specific piece of equipment are required. More than one party may be required to execute the training.

6. The training sessions shall follow the outline in the Table of Contents of the O&M manual and illustrate whenever possible the use of the O&M manuals for reference.

7. Training shall include:

   a. Usage of the printed installation, operation and maintenance instruction material included in the O&M manuals.

   b. Review of the written O&M instructions emphasizing safe and proper operating requirements, preventative maintenance, special tools needed and spare parts inventory suggestions. The training shall include Start-up, operation in all modes possible, shutdown, seasonal changeover and any emergency procedures.

   c. Discussion of relevant health and safety issues and concerns.

   d. Discussion of warranties and guarantees.

   e. Common troubleshooting problems and solutions.

   f. Explanation of information included in the O&M manuals and the location of all plans and manuals in the facility.

   g. Discussion of any peculiarities of equipment installation or operation.

8. Hands-on training shall include Start-up, operation in all modes possible, including manual, shutdown, and any emergency procedures and maintenance of all pieces of equipment

9. Training shall occur after Functional Performance Tests are complete and shall be scheduled with the Owner's Project Manager.

C. Contractor shall cooperate with Owner and Owner's Test, Adjust, and Balance Firm for verification testing and final adjustments and balancing as may be indicated in the Contract Documents or as directed by Owner.

D. Provide training on each system/piece of equipment according to the following schedule: [Edit the following as appropriate for the Project].

Hours	System
_____	Chillers and System
_____	Cooling Towers
_____	Boilers and Heating System and PRV Station
_____	HVAC Piping Systems
_____	HVAC Chemical Water Treatment
_____	Air Compressors and dryers
_____	Air Handler Units
_____	Variable Speed Drives
_____	Supplementary Supply Fans
_____	Return Fan/Relief Fan
_____	Air Terminal Units
_____	Air Handler Units
_____	Packaged Rooftop Units
_____	Computer Room AC Units
_____	Split System AC or Heat Pumps
_____	Elevator Shaft Fans
_____	Stairwell Fans
_____	Specialty Exhaust Fans
_____	Restroom Central Exhaust Fans
_____	Garage Exhaust Fans
_____	Emergency Generator
_____	Domestic Water Heaters
_____	Domestic Hot Water Circulating System
_____	Domestic Water Booster Pumps
_____	Domestic Water Storage/Break Tank
_____	Water Softeners
_____	Pure Water Production Equipment (R.O., D.I., etc.)
_____	Medical Air Compressors and Vacuum Pumps
_____	Laboratory Air Compressors and Vacuum Pumps
_____	Medical Compressed Gas Cylinder Manifolds
_____	Laboratory Compressed Gas Manifolds
_____	Medical Gas and Vacuum System Alarms
_____	Laboratory Gas and Vacuum System Alarms
_____	Sump Pumps
_____	Sewage Ejector
_____	Fire Pump System
_____	Wet Standpipe/Sprinkler Fire Protection System
_____	Dry Fire Sprinkler System

_____ Pre-Action Fire Sprinkler System
_____ Chemical Fire Suppression System
_____ Irrigation System
_____ Ornamental Fountain System

END OF SECTION 20 08 00

SECTION 20 08 16 – HVAC/ PLUMBING/FIRE SUPRESSION SYSTEMS FUNCTIONAL PERFORMANCE TESTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 SUMMARY

A. This Section expands on and defines responsibilities of the Contractor in regards to Functional Performance Tests (FPT's) of the Commissioning process.

B. Contractor shall oversee the Commissioning activities with the Contractor's Subcontractors and the Architect/Engineer (A/E).

C. Prefunctional Checklists, tests and Start-ups are to be completed and documented for the record prior to commencing with FPT's. Refer to Section 20 08 00 and 20 08 13 for additional requirements.

D. Completed FPT Forms for all pieces of equipment and systems shall be submitted to the Owner prior to Substantial Completion.

E. Refer to Attachments A and B at the end of this Section for example forms that indicate level of documentation required for the Commissioning process.

1.03 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with all applicable requirements and standards.

1.04 SUBMITTALS

A. Maintain and use an action item tracking system, "Action Item List," that indicates as a minimum, required information, identified deficiencies, work required, etc.). Each item shall be tracked with the initiator, the parties responsible, due date, the date of closure, and a description of the resolution. Each item shall be categorized for sorting and tracking and for documentation on applicable forms. Action Item List shall be distributed and documented using Microsoft Excel or a database format approved by Owner.

B. Disseminate this list as appropriate to keep all parties involved with the FPT informed.

C. Functional Performance Test procedure forms must include the following:

1. System and equipment or component name(s).

2. Equipment location and identification number as identified in the Equipment Matrix described in Division 01.

3. Unique test identification number and reference to unique Prefunctional Checklist and Start-up Documentation Identification Numbers for the equipment.

4. Date and time of test.

5. Project name.

6. Participating parties.

7. Specific sequence of operation or other specified parameters, including performance data being verified.

8. Instructions for setting up a Functional Performance Test.

9. Specific script-type, step-by-step procedures to perform a Functional Performance Test, in a clear, sequential and repeatable format that is customized for the system being tested.

10. A Yes/No checkbox (or data entry box as appropriate) for clearly indicating whether or not proper performance of each part of a Functional Performance Test was achieved with space for actual readings.

11. Section for comments.

12. Signatures and date block for participants and Owner approvals.

D. Refer to Division 01 and 20 08 00 for additional documentation requirements.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.02 TEST EQUIPMENT

A. Refer to Section 20 08 00 – HVAC/Plumbing/Fire Suppression System Commissioning.

PART 3 - EXECUTION

3.01 PREPARATION

A. The objective of FPT's is to demonstrate that each system operates according to the Contract Documents through all specified modes of operation.

B. Contractor shall operate each system through all modes of operation (occupied, unoccupied, warm-up, cool-down, etc.) where there is a specified system response. Verification of each sequence in the sequences of operation is required.

C. All equipment, components and devices applicable to the FPT must be started and this Start-up must be documented. This documentation includes completion of the Prefunctional Checklists, pressure testing of equipment, duct, pipe, etc., flushing/cleaning of applicable systems, completed labeling and identification, completed insulation of applicable systems, etc. Refer to Section 20 08 13 for additional Prefunctional Checklist and Start-up requirements.

D. Unless specifically agreed to by the Commissioning Team, all support systems shall be complete prior to FPT.

1. The electrical system serving it is completed and tested.

2. The hydronic systems serving it have been balanced and FPT completed.

3. Balancing has been accomplished on the air and water sides.

4. The building automation system (BAS) has been started and calibrated.

E. Commissioning Team members shall assist in development and review of the optimal sequence of testing.

3.02 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. All installation shall be in accordance with manufacturer's published recommendations.

3.03 FUNCTIONAL PERFORMANCE TEST PROCEDURES

A. The purpose of a Functional Performance Test is to verify and document compliance with the stated criteria of acceptance. Contractor shall develop specific script-type test procedures and associated test forms to verify and document proper operation of each piece of equipment and system.

B. Contractor shall operate, or cause to be operated, each system, device, or equipment item, both intermittently and continuously, for a duration period as indicated in the Specification Section(s) for such item and/or in accordance with the manufacturer's written recommendations, the Contract Documents, and the Commissioning Plan.

C. Contractor shall operate each component device and each building system to the full extent of its capability, from minimum to maximum, and under automatic control and manual control.

D. Contractor and manufacturer's representatives shall supervise and coordinate adjustments and balancing of all devices and systems for proper operation prior to requesting the Functional Performance Test(s).

E. Where final balancing of a system is to be performed by Owner or Owner's consultants, such as final air balancing, Contractor shall provide all services indicated in the applicable Technical Sections and under this Section, including the following prior to Owner's final balancing:

1. Operational verification of all component devices and the total system, including automatic controls when applicable. Operational verification includes verification that all motors, fans, dampers, and other operable devices are performing in compliance with Specifications throughout their operable range and that all devices are controlled as described in the specified sequence of operation.

2. All tabulated data, motor amperage readings, valve tag verifications, and other data required by Technical Specifications.

F. Where final balancing of a system or particular components of a system are not specifically indicated to be performed by Owner or Owner's consultants, Contractor shall provide final balancing and adjustments for operation within specified tolerances prior to Functional Performance Test of such system.

G. Sampling: Some types of identical equipment (such as terminal devices) will be tested using a sampling strategy. The sample percentage is indicated below. [Insert equipment list and sampling percentage.]

H. Failure Limit on Sample Tests: With the sampling percentages is listed a failure limit. This limit indicates the maximum percentage of the tested devices that may have any test that fails before an entirely new sample must be tested. When the maximum number of failures is reached, testing on that sample will be terminated and re-testing will be scheduled.

1. Where sample tests involve multiple systems (i.e.: Checking strainers on different hydronic systems) the maximum failure limit will apply per system.

I. Deferred Tests: Contractor shall schedule with the Owner and complete Deferred Tests as part of this Contract during the Warranty Period. Testing procedures shall be repeated and/or conducted as necessary during appropriate seasons. Deferred or "Opposite season" tests will be required where scheduling prohibits thorough testing in all modes of operation. Air Handler and central heating system testing for heating related modes of operation and control loops shall be tested during outside air temperatures below 50 degrees F. Air handler and central cooling system testing for cooling related modes of operation and control loops shall be tested during outside air temperatures above 85 degrees F.

J. Provide and deliver the required submitted documentation convenient to testing area. Validate that all required documentation has been submitted to the Owner and is per the Contract Document requirements.

K. Review the Start-up documentation at the start of FPT's. Ensure that any items indicated as outstanding in the Prefunctional Checklist is entered as an Action Item and enter one if it is not. The Prefunctional Checklists and Start-up tests/measurements shall be spot checked at the beginning of FPT's to ensure accuracy. Complete a test that indicates Contractor has reviewed the Prefunctional Checklists and finds the Prefunctional Checklists acceptable and notes any outstanding items.

L. Check for and as applicable direct the Subcontractor to demonstrate that access is sufficient to perform required maintenance.

M. Validate that all prerequisite work is complete and confirm this validation via a test record for documentation.

N. Specifically check labeling and ensure conformance to the Contract Documents.

O. Analyze trends of the system operating parameters to evaluate normal system functionality. The trending requirements are specified in the BAS Commissioning Specification, however all systems must be trended and reviewed prior to and as part of functional performance trending. Subcontractor shall establish these trends, ensure they are being stored properly, and forward the data in electronic format to the Contractor. Analyzed trends shall be organized and/or grouped in a manner that clearly demonstrates the individual components of a piece of equipment is under total control and display this information together. The trend group data shall be labeled with the system name or the purpose of the trend group or data and submitted in a Microsoft Excel spreadsheet.

P. Check proof indication, alarming on failure and restart/acknowledgement as applicable.

Q. Observe operating conditions encountered at the start of the FPT. Contractor shall examine for normal functionality and record parameters as a test.

R. All dynamic systems powered by electricity shall be tested to simulate a power outage to ensure proper sequencing. Those on emergency power or uninterruptible power shall be tested on all sources. This test shall generally be coordinated with electrical power systems testing addressed in the Contract Documents.

1. Emergency power tests for mechanical systems will be conducted in concert with the testing of the emergency power systems. Testing Contractor shall be available for the power outage test to test their systems under a power outage. This is in addition to the requirement specified by system.

S. Inspect the installation and compare it to the Contract Documents. Record the inspection as a test.

T. Capacities and adjusted and balanced conditions as applicable will generally be checked.

U. Verify all sequence modes and sequences of operation. Contractor must initiate all modes and may not refer to or rely on a Prefunctional Test done by the building automation system. Some examples of generic modes that apply to most systems include:

1. Off mode.

2. Failed mode: Proof, safeties, power outage etc. See below for crash testing.

3. Start sequence in various modes.

4. Stop sequences in various modes.

V. All adjusted, balanced, controlled systems shall be assessed to determine the optimal setting for the system as applicable. The optimal settings should be determined to establish reliable, efficient, safe and stable operation. The Contractor is responsible for placing systems in optimal condition for occupancy and not simply relying on initial design estimated settings.

W. Dynamic Graphics: The graphic for all components, systems, and areas sampled and required to be represented by a graphic shall be checked for adequacy and accuracy. Furthermore, when setpoints are required to be adjustable, verify that they can be adjusted directly from the graphic screen.

X. All interfaces between two systems or equipment of different manufacturers must be checked for accuracy and functionality.

Y. Contractor shall to the extent possible, load the heating and cooling systems during initial FPT's to check the capacity of the building central systems and initially optimize system settings. This will typically be done using the preheat system to false load the cooling system. This test will incorporate varying the load to check central systems response.

Z. "Crash Testing": Contractor shall analyze systems to identify possible conditions where functionality may be compromised. Contractor shall design non-destructive tests that will demonstrate either the automated response to the conditions or so that team can identify the best method for responding or fixing the condition. All tests and their findings shall be documented in a Microsoft Excel spreadsheet.

3.04 PARTICIPATION

A. Required participating parties are indicated with the individual tests. Typically, multiple parties are required for any given test, yet participation for any given party is only required for the respective portion of the test for which the party is responsible. In many cases, the maximum required time in hours is indicated in parenthesis for any given test. The time is typically per unit system unless indicated otherwise. If no time is indicated, participation is required throughout the entire test.

B. Frequently, on multiple samples where a given party does not directly conduct the test, the participation of that party will only be required for an initial quantity of systems/equipment. It is required that the parties be available on-site throughout the testing of any given system for which they are required participants. Therefore time for which they are not directly involved can be spent performing other work (typically addressing identified punch list items or failed test).

C. No party involved with the Project is prohibited from participation in or witnessing of any tests. Any Subcontractor may elect to witness all tests on their systems even if their involvement is not directly required.

D. Coordinate effectively with the individual Subcontractors throughout the development and execution of FPT's and maximize Subcontractors' involvement.

3.05 NON-CONFORMANCE

A. Record results of Functional Performance Tests. Contractor shall report all deficiencies and non-conformance issues to Owner on the Functional Performance Test report form and in a Commissioning deficiency report.

B. At the sole discretion of Owner, Owner may permit the Contractor to make corrections of minor deficiencies observed during a Functional Performance Test. However, the Contractor must document the deficiency and resolution on the appropriate report form.

C. Contractor and Owner will attempt to resolve deficiencies in the following manner:

1. When there is no dispute about a deficiency and Contractor accepts responsibility for correction.

a. Contractor documents the deficiency and the corrective actions, and then proceeds to another test or sequence. Contractor submits a deficiency report to Owner. Contractor corrects the deficiency, completes the statement of correction form certifying that the equipment or system is ready for retesting, and sends the certification to Owner.

b. Contractor reschedules test with Owner.

2. When there is a dispute about whether or not the test indicates a Deficiency, or the Contractor's responsibility for the correction of the apparent Deficiency.

a. Contractor documents the apparent Deficiency and proceeds to another test or sequence. Contractor submits a Deficiency report to Owner, including the apparent Deficiency.

b. Contractor facilitates resolution of Deficiency and provides recommendations to the Owner. Contractor and Owner may bring other parties into the discussions as needed. Final technical interpretive authority is with the Architect/Engineer. Final acceptance authority is with the Owner.

c. Contractor documents resolution process.

d. If Owner agrees with Contractor's interpretation and proposed resolution, Contractor forwards response to Owner. Contractor reschedules test with Owner. Contractor must repeat this process until satisfactory performance and Owner's approval is obtained.

3.06 ACCEPTANCE CRITERIA

A. Acceptance criteria for tests are indicated in the Specification Sections applicable to the systems being tested. Unless indicated otherwise, acceptance criteria will be specified with the individual system, equipment, component, or device.

END OF SECTION 20 08 16

EXAMPLE – FUNCTIONAL PERFORMANCE TEST
HVAC Pumps

Project: _____ **Project** #:_____

Identification of Equipment or System:

_____

Location of Equipment or System:

_____

Specification Section: _____ Detail/Drawing Number: _____

Manufacturer / Supplier:

_____

This Date: _____ ***Time of Test:*** _____

═══

FUNCTIONAL PERFORMANCE TEST PROCEDURE NUMBER: _____

PREFUNCTIONAL CHECKLIST NUMBER: _____

Components Included:
___ VFD for pump, ___ Heat Exchanger, ___ Other _____

Other Related Functional Performance Tests: _____

1. General:

   a. This Functional Performance Test is submitted for approval and is subject to the attached list of outstanding items not completed successfully. Submit a Commissioning Deficiency Report upon completion of any outstanding or deficient items. None of the outstanding items preclude safe and reliable functional tests being performed.

   b. ___ Commissioning Deficiency Report attached.

2. Participants:

Name	Company	Role/Participation

Name	Company	Role/Participation

3. Functional Performance Test Prerequisites:

Specified Requirement		Yes	No	Date to be Submitted
a)	The Prefunctional Checklist for this system is complete and approved			
b)	The Prefunctional Checklist for the pump variable frequency drive system is complete and approved			
c)	The Prefunctional Checklfor the air handling unit related to this pump variable frequency drive system is complete and approved			
d)	All Architect/Engineer punchlist items for this system and related equipment have been addressed and corrected			
e)	Sequence of operation is attached			
f)	Test, adjust, and balance (TAB) completed and approved for the associated systems			
g)	TAB report provided			
h)	Design setpoint information included on forms			
	Controls:			
	i) DDC loops operational, temperature/pressure setpoints met without hunting			
	ii) Master transmission diagram is updated on device graph			
	iii) Graphic programming is complete and operational			
	iv) System communicates with main controller			
	v) Pump is set to design/final setpoints			
	vi) Local reading of setpoints agree with remote readings			
i)	These Functional Performance Test procedures have been reviewed and approved by installing contractor and applicable subcontractors			

4. Functional Performance Test Procedure:

Step	Mode	Test Procedure	Expected Response	Pass	
				Yes	No
1	Pump Off	Standby check. HOA in Auto position. Unit commanded Off by BAS.	Verify by visual inspection that: a) Discharge gauge pressure equals suction gauge pressure. b) No rotation of pump shaft. c) Pump light indication shows pump is off. Pump indication shows pump as being Off at the BAS.		
2	Pump Start-up	HOA in Auto position. Unit commanded On by BAS.	Verify by visual inspection that: a) Discharge gauge pressure greater than suction gauge pressure. b) Rotation of pump shaft. c) Pump light indication shows pump is On. Pump indication shows pump as		

Step	Mode	Test Procedure	Expected Response	Pass	
				Yes	No
			being On at the BAS.		

3	Pump Operation	HOA in Auto position. Test results are recorded in table.	Verify by local and remote reading that test results correspond with TAB report and sequence of operation as described in the Contract Documents.		
4	Simulate Pump Overload Trip	HOA in Auto position. Test results are recorded in table.	BAS indicates an alarm for Pump Trip condition.		
5	Simulate Loss of Pump Flow	HOA in Auto position. Test results are recorded in table. Isolate DP switch across suction and discharge of pump and open sensing line vent valves to relieve pressure across DP switch.	BAS indicates an alarm condition for Loss of Pump condition.		

5. Comments:

FINAL SIGN-OFF

Contractors attest that the above items have been verified and meet the requirements of the Contract Documents except as noted on the attached Commissioning Deficiency Report.

General Contractor: Print Name:

Signature:

Title:

Date:

Mechanical Subcontractor Print Name:

Signature:

Title:

Date:

Other Subcontractor: Print Name:

Signature:

Title:

Date:

Functional Performance Test procedure received and reviewed for completeness by MD ANDERSON representatives. Integrated System Test can proceed.

MD ANDERSON: Print Name:

Signature:

Title:

Date:

MD ANDERSON: Print Name:

Signature:

Title:

Date:

EXAMPLE – FUNCTIONAL PERFORMANCE TEST
Air Handling Units - Modular

Project: _____ **Project #:**_____

Identification of Equipment or System:

_____

Location of Equipment or System:

_____

Specification Section: _____ Detail/Drawing Number: _____

Manufacturer / Supplier:

_____

This Date: _____ ***Time of Test:*** _____

═══

FUNCTIONAL PERFORMANCE TEST PROCEDURE NUMBER: _____

PREFUNCTIONAL CHECKLIST NUMBER: _____

Components Included:
___ VFD for AHU, ___ Return Fans (RF), ___ Outside Air Handling Unit, AHU _____,
Other _____

Other Related Functional Performance Tests: _____

1. General:

   a. This Functional Performance Test is submitted for approval and is subject to the attached list of outstanding items not completed successfully. Submit a Commissioning Deficiency Report upon completion of any outstanding or deficient items. None of the outstanding items preclude safe and reliable functional tests being performed.

   b. ___ Commissioning Deficiency Report attached.

2. Participants:

Name	Company	Role/Participation

Name	Company	Role/Participation

3. Functional Performance Test Prerequisites:

	Specified Requirement	Yes	No	Date to be Submitted
a)	The Prefunctional Checklist for this system is complete and approved			
b)	The Prefunctional Checklist for the following systems and components are complete and approved:			
	i) Chilled water system			
	ii) Chilled water piping and valves			
	iii) Condenser water pumps			
	iv) Cooling towers			
	iii) Associated terminal units			
	iv) Variable frequency drives for associated pumps			
c)	All control system functions for this and all interlocking systems are programmed and operable per the Contract Documents including final setpoints and schedules with debugging, loop tuning, and sensor calibrations completed.			
d)	Piping system flushing complete and required test reports approved			
e)	Water treatment system complete and operational			
f)	Vibration control report approved			
g)	Test, adjust, and balance (TAB) completed and approved for the hydronic systems and associated terminal units.			
h)	TAB report provided			
i)	All Architect/Engineer punchlist items for this system and related equipment have been addressed and corrected			
j)	Safeties and operating ranges reviewed			
k)	Sequences of operation is attached			
l)	Schedules and setpoints attached			
m)	False loading equipment, system, and procedures ready (boilers, preheat or reheat coils, control loops, override on outside air (OSA) dampers, etc.)			
n)	Have all energy savings control strategies, setpoints, and schedules been incorporated that this equipment and control system are capable of? If not, list recommendations below:			
o)	Control Program Review: Review the software control program(s) for this equipment. Parameters, setpoints, and logic sequences appear to follow the specified written sequences.			
p)	These Functional Performance Test procedures have been reviewed and approved by installing contractor and applicable subcontractors			

4. Current Setpoints for Functional Performance Test Procedure:

c. Record all values for current setpoints (SP), control parameters, limits, delays, lockouts, schedules, etc., changed to accommodate testing.

Parameter	Pre-Test Values	Returned to Pre-Test Values √
Discharge air static pressure (SP)		
Discharge air temp.		
Static P. reset schedule		
Discharge air reset schedule		

Parameter	Pre-Test Values	Returned to Pre-Test Values √
Building static pressure		
Dirty filter D.P.		
OSA CFM		

5. Sensor Calibration Checks:

d. Check the sensors listed below for calibration and adequate location. This is a sampling check of calibrations done during Prefunctional Checklist.

e. "In calibration" means making a reading with a calibrated test instrument within 6 inches of the site sensor. Verify that the sensor reading (via the permanent thermostat, gage, or building automation system (BAS)) compared to the test instrument-measured value is within the tolerances specified in the Prefunctional Checklist requirements (_____). If not, install offset in BAS, calibrate or replace sensor. Use the same test instruments as used for the original calibration, if possible.

Sensor & Location	Loc-ation OK[1]	1st Gage or BAS Value	Instr. Meas'd Value	Final Gage or BAS Value	Pass Y/N?
DAT					
RAT					
OSAT					

Sensor & Locatio n	Loc-ation OK[1]	1st Gage or BAS Value	Instr. Meas'd Value	Final Gage or BAS Value	Pass Y/N?
Dis-charge SP					

[1]Sensor location is appropriate and away from causes of erratic operation.

6. Device Calibration Checks:

f. The actuators or devices listed below checked for calibration. This is a spot check on a sample of calibrations done during Prefunctional Checklist and start-up.

g. "In calibration" means observing a readout in the BAS and going to the actuator or controlled device and verifying that the BAS reading is correct. Fix items out of calibration or adjustment, via an offset in the BAS, or a mechanical fix.

Device or Actuator & Location	Procedure / State	1st BAS Value	Site Observation	Final BAS Reading	Pass Y/N
Cooling coil valve (CCV) position or command and stroke*	1. Intermediate positions				
	2. Full open				
	3. Increase pressure (open)				
	4. Closed				
	5. Remove power or air (closed)				
Relief damper position **	1. Closed				
	2. Full open				
Mixed air damper position **	1. Closed				
	2. Full open				
Main OSA damper position**	1. Closed				
	2. Full open				
Min. OSA damper position**	1. Closed				
	2. Full open				
Variable frequency drive speed (VFD)***	1. Min.: _____%				
	2. Max.: _____%				

* Set pumps to normal mode. Procedure 1. Command valve to a few intermediate positions. Verify that readings in BAS reasonably correspond to the actual positions. For cooling coil valves (NO): Procedure 2. Lower space setpoint to 20 deg. F. below space temperature. Verify BAS reading says CCV is 100% open. Visually verify valve is 100% open. Procedure 3. For pneumatic actuators, by override in the BAS, increase pressure to valve by ____ psi (do not exceed actuator rating). Verify valve stem and actuator position does not change. Restore to normal. Procedure 4. Set space setpoint to 20F above space temperature. Verify BAS reading says CCV is closed. Visually verify valve is closed. Procedure 5. Remove control air or electricity from the valve and verify that the valve stem and actuator position do not change.

** 1. Command damper closed and verify that damper is shut and BAS reads shut.
2. Do the same, commanding damper fully open.

*** VFD: Procedure 1. Lower the controlling static pressure setpoint (duct or discharge) to be 1/4 of its current value. Verify that the vanes are shut, or fan speed is at minimum for VFD and packaged controller reads the same. Return the static pressure setpoint to normal. Procedure 2. Lower the space temperature setpoint to be 20F below space temperature and cause TU dampers to go to full cooling. Raise the static pressure setpoint as necessary to cause the setpoint to not be met. Verify that the inlet vanes are fully open or the fan speed is at its maximum and verify that the packaged controller reads the same. Return all to normal.

Notes:

7. Functional Performance Test Procedure:

Step[1]	Mode[2]	Test Procedure[3]	Expected Response[4]	Pass	
				Yes	No
1	Fan Off	Standby check with units commanded Off by BAS.	Verify by visual inspection that: 1. Return Air Dampers to AHU- are Open. 2. Outside Air Dampers in AHU- are Closed. 3. Isolation Dampers on AHU- are Closed. 4. Relief Dampers in RF- are Closed. 5. Cooling Coil Valve on Cooling Coil of AHU- is Closed.		
2	Unit Start-up	With units commanded on by BAS.	1. Supply Fan Isolation Dampers Open in AHU- 2. Supply Fan start through VFDs 3. Supply Fan Isolation Dampers in AHU- Open 4. AHU- Fans Start 5. RF- Isolation Dampers Open 6. RF- Fans start through VFDs 7. Exhaust Fans EF- start.		
3	RF Volume Control	1. Verify RF Volume, utilizing airflow meters in Return Fans RF____, Supply Fans in AHU-____ and Garage Exhaust Fan EF-1, and TAB established CFMs for Exhaust Fans EF-	Verify that RF airflow meter readings correspond to calculation.		

Step[1]	Mode[2]	Test Procedure[3]	Expected Response[4]	Pass	
				Yes	No
		__, and ___, TAB established Fixed Differential, make the following calculation: (Return Air Flow=Supply Air Flow, -EF-1and2 Flow, -SF1 Flow-Fixed Differential} 2. Trend Log RF____, AHU ____, and SF-1 airflow rates at 5 min. intervals. Command off EF-1 and 2 sequentially at 5 min. Intervals.	Verify that RF airflow meter readings continue to correspond to calculation		
4	Duct Static Pressure Control	Disable Duct Static Pressure Reset utilizing BAS Software. Adjust space temperature setpoint on significant quantity of zones to be well below observed reading.	Verify that VFD's modulate as required to maintain SP setpoint without hunting or overshooting setpoint.		
5	High Static Pressure Alarm and Shutdown	With units running at low flow condition, utilizing a squeeze bulb, simulate an increase in discharge air static pressure.	Verify that BAS indicates an alarm condition at ___" WG and shuts fans down at ___"WG		
6	Static Pressure Reset	1. For Perimeter Terminal Units on floors 9-16, Reset space temperature setpoints to be below space temperatures. Utilizing BAS trend logging capabilities, Record at 5 min. intervals, Discharge Air SP Spt, Perimeter TU Units in saturation. 2. Reset space temperature setpoints to be above space temperatures. Utilizing the same Trending as above, Record the same data points.	Verify that DA SP Spts increase by ___" WG at __ min intervals until only one Perimeter TU remains in saturation. Verify that setpoints are met and maintained without excessive hunting. Verify that DA SP Spt decreases by ___"WG at __ min intervals until one Perimeter TU reaches saturation.		
7	Discharge Temp. Reset	1. For Perimeter Terminal Units Floors 1-2, Reset space sensor setpoints to be above space temperatures. Utilizing BAS Trend Logging, at 6 min intervals, record DAT setpoint, DAT, and perimeter TU cooling Flow rates. 2. For Perimeter Terminal Units Floors 1-2, Reset space sensor setpoints to be below space temperatures. Utilizing BAS Trend Logging, at 6 min intervals, record DAT setpoint, DAT, and perimeter TU	Verify that Discharge Air Temperature Setpoint is reset upwards at 2 deg increments every 6 min to maintain design cooling CFM at 5 perimeter TU's to maintain design cooling CFM Verify that Discharge Air Temperature Setpoint is reset downwards at 2 deg increments every 6 min to reach design cooling CFM at only 5 perimeter TU's. Both should happen		

Step[1]	Mode[2]	Test Procedure[3]	Expected Response[4]	Pass	
				Yes	No
		cooling Flow rates.	without excessive hunting.		
8	Smoke Conditions	Interfacing with EC, simulate a fire mode with the Fire Alarm System.	Verify that AHU System returns to FAN OFF Status, with OSA and Relief Dampers in a Closed Position.		
9	Warm-up Control	Place Unit's BAS Control Mode into Warmup. Overwrite RAT Sensor Reading to be 65 Deg. F.	Verify that dampers assume a 100% Return Air Mode.		
10	Warm-up Control	Place Unit's BAS Control Mode in Warmup. Overwrite RAT Sensor Reading to be ___ Deg. F.	Verify that unit returns to Normal Operation Mode.		
11	Freeze Condition	Overwrite Low Limit Detection Thermostat reading to be __ Deg. F.	Verify that system alarms, fans stop, OSA Dampers close, Relief Dampers Close, and RA dampers open.		
12	Return Fan Static Pressure	With AHU Unit __ running at low air flow condition, Overwrite RF __ return air fan inlet SP to a reading below -___" W.G.	Verify that system alarms and that all Fans are shut down.		
13	Manual Smoke Pressuriz. System	With Fire Alarm System in alarm, utilizing control panel in Fireman Control Center, select a floor and place floor into purge mode.	Verify that Single Fan operates, Isolation dampers open only on selected Fans, Return Fans are off, Outside Air Handling Units are off, OSA dampers open, and return air dampers close.		
14	Minimum OSA Unit Fan Off	Command AHU-1&2 System off.	Verify that AHU ___ isolation dampers are closed, and if OSA temperature is above __ Deg. F, heating coil control valve is closed.		
15	Minimum OSA Unit Fan Off	Simulate a OSA temperature below 35 Deg. F.	Verify that heating coil control valve opens.		
16	Minimum OSA Unit Temp. Control	Utilizing BAS software, reset discharge air setpoint to 80 Deg. F.	Verify that Face and Bypass Dampers and Heating Coil Control Valves modulate in sequence to maintain __ Deg. F. Setpoint.		
17	Minimum OSA Unit Freeze Condition	Simulate a condition at low limit detection thermostat of below 40 Deg. F.	Verify that BAS system goes into alarm, AHU- __ Fans Shut Down, AHU-___ Isolation Dampers Close, and Heating Valve Opens.		
18	On-Floor Return Fan Operation	Place AHU-____ in normal operating mode.	Verify that RAF __-__ Start and Run.		
19	Building	Trend log the supply fan	Observe in the trends that the		

Step[1]	Mode[2]	Test Procedure[3]	Expected Response[4]	Pass	
				Yes	No
	Static Pressure	speed, the relief fan speed, relief damper position and the building static pressure for 12 hrs at 20 min. intervals. During the trend, force, if necessary, the economizer damper to be full open and at minimum. Document these times.	building static pressure is maintained within +/- 0.05" of setpoint without excessive hunting. Carefully examine during the extreme economizer damper positions. Observe that any relief dampers modulate as expected relative to relief fan operation and static pressure.		
20	AHU Filter Drop	Reset the Filter Differential Pressure to exceed the setting recommended by the filter manufacturer.	Verify that the BAS reports an alarm.		
21	Chilled Water Valve Closing Efficiency	1. Utilizing BAS, place AHU Units in WARMUP Mode. 2. Manually close isolation Valve in Chilled Water Supply to AHU Coil. 3. Place thermometer in Chilled Water Return Piping adjacent to AHU. Record temp. at 1 min. intervals for 15 min. 4. Manually open isolation Valve in Chilled Water Supply to AHU Coil. 5. Repeat Step 3. 6. Graph Results on Temperature-Time Basis.	Chilled Water Return Temperature should approach RAT. If significant divergence is noted, review specified performance requirements of Chilled Water Control Valves.		
22	Supply Fan Isolation Damper	Utilizing BAS, Command AHU-1, SF-1 into the off position.	Verify that AHU-1, SF-1 Isolation Dampers Close.		
23	Review	Review schedules, current setpoints and sequences with Specification Section 15___ and Control Drawings prepared by BAS Provider.	Submit approved differences to be incorporated into as-built record documentation.		

Record Footnotes:
[1]Sequences of operation specified in Contract Documents (attached).
[2]Mode or function ID being tested from testing requirements of the Contract Documents.
[3]Step-by-step procedures for manual testing, trend logging, or data-logger monitoring.
[4]Include tolerances for a passing condition.
[5]Record any permanently changed parameter values and submit to Owner.

8. Comments:

FINAL SIGN-OFF

Contractors attest that the above items have been verified and meet the requirements of the Contract Documents except as noted on the attached Commissioning Deficiency Report.

General Contractor:	Print Name:	
	Signature:	
	Title:	
	Date:	
Mechanical Subcontractor	Print Name:	
	Signature:	
	Title:	
	Date:	
Other Subcontractor:	Print Name:	
	Signature:	
	Title:	
	Date:	

Functional Performance Test procedure received and reviewed for completeness by MD ANDERSON representatives. Integrated System Test can proceed.

MD ANDERSON:	Print Name:	
	Signature:	
	Title:	
	Date:	
MD ANDERSON:	Print Name:	
	Signature:	
	Title:	
	Date:	

SECTION 21 10 13 – WET STANDPIPES AND SPRINKLER SYSTEMS – [FOR NEW INSTALLATIONS AND RECONFIGURATION FOR EXPANSION OF EXISTING SYSTEMS]

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 SUMMARY

A. Perform all Work required to provide and install pipe, fittings, valves, connections, hangers, supports, sleeves and appurtenances for new, rework and/or expansion of existing wet combination sprinkler and standpipe systems with supplementary items necessary for complete, code compliant and approved installation.

B. Contractor shall include within his bid all materials and Work to provide standpipe and 100% sprinkler protection for all areas in new construction or for the entire smoke compartment affected by renovation work.

C. Size all branches and mains by hydraulic calculations. Contractor shall conduct a water flow test to obtain water supply information to determine actual available volume and pressures as a design basis for the system, including storage tank replenishment on new systems. Provide a 10 psi cushion for all hydraulic designs. This Contractor shall verify that the affected existing systems are configured and functioning properly according to NFPA 13. Hazard classifications for fire protection system design, installation and water supplies shall be in accordance with NFPA Standards. EXCEPTION: All pipe sizes and water flow demand for Light Hazard Occupancies shall be based upon Ordinary Hazard (Group 1) as the minimum system design. Sprinkler head locations and spacing for Light Hazard Occupancies shall be in accordance with NFPA 13 requirements.

D. Interface all new flow and valve supervisory switches with building fire and smoke alarm systems.

E. Provide temporary fire protection during the construction phase of Project. Inform and obtain approval from the Owner and General Contractor for any interruptions of existing fire protection, domestic water or fire alarm systems. Adhere to ADM1131 Facilities Planned Utility Outages Policy for outage and shutdown requests.

F. The Environmental Health and Safety Department (EH&S) of UTMD ANDERSON is the Local Authority Having Jurisdiction (AHJ) for fire protection system equipment, materials, installation and applicable code interpretations.

1.03 REFERENCE STANDARDS

A. All materials, installation and workmanship shall comply with the applicable requirements and standards identified in Element Z2005 of UTMD Anderson Owner Design Guidelines.

1.04 QUALITY ASSURANCE

A. Standpipe and sprinkler system design, testing; cleaning, certification, materials, equipment and installation shall meet the requirements of standards identified in Element Z2005 of UTMD Anderson Owner Design Guidelines.

B. Obtain and become familiar with requirements of Owner's insurance underwriter and incorporate all applicable provisions for compliance.

C. Thoroughly and clearly document all Project related communications with code and regulatory agents and expediently forward communication documentation to the MD ANDERSON Project Manager.

D. Equipment and components shall bear FM label or UL marking. Provide manufacturer's name and pressure rating marked on valve body.

E. All hose threads, coupling types, etc., utilized in the fire protection systems shall conform to the standards and requirements of the City of Houston, Texas Fire Department.

F. Maintain at least one copy of all system related documents on Site.

G. Design sprinkler system under direct supervision of a R.M.E.'s (Responsible Managing Employee) experienced in design of this Work and licensed in the State of Texas. All design submittal documents and Shop Drawings shall bear the R.M.E.'s signed and dated registrations number. The system shall be installed by a firm having minimum three years experience regularly engaged in the design and installation of automatic fire protection systems in accordance with requirements of the National Fire Protection Association and the State of Texas Fire Marshal's office. Evidence to support the above requirements shall be submitted with Shop Drawings. Working plans, material submittals and hydraulic calculations shall be reviewed by a fire protection engineering firm chosen by the owner for compliance with project specification and all applicable codes identified in Element Z2005 of UTMD Anderson Owner Design Guidelines. UTMD Anderson shall receive a report from the fire protection engineering firm identifying any discrepancies. If working drawings, material submittals and hydraulic calculations meet all applicable codes as identified in Element Z2005 of UTMD Anderson Owner Design Guidelines, the fire protection engineering firm shall submit a letter of approval to UTMD Anderson project manager and UTMD Anderson's Fire and Life Safety group for final approval. NO WORK shall begin until UTMD Anderson project manager and UTMD Anderson Fire & Life Safety group grant final approval. The Contractor is solely liable for any and all work performed or material purchases made prior to UTMD Anderson final approval

1.05 SUBMITTALS

A. General:

1. All new applications employing six (6) or more sprinklers and all rework applications employing twenty (20) or more sprinklers shall be submitted for approval as described herein. Product data shall be submitted for all size Projects as described herein.

B. Product Data:

1. Provide data on sprinkler heads, piping materials, joining methods, supports, valves, flow switches, tamper switches and all other components and accessories intended to be installed. Include manufacturers' catalog information, Code and Standards compliance, performance ratings, rough-in details, weights, finishes, support and connection requirements.

2. Submit one of each style of sprinkler head proposed.

C. Record Documents:

1. Submit preliminary layout showing head locations within coordinated ceiling grid and inspector's test station locations for review by Architect/Engineer, MD ANDERSON Project Manager, EH&S and owner designated fire protection engineering firm.

2. Submit verification of Contractor's design and installation qualifications.

3. Provide full written description of manufacturer's warranty.

4. Provide certificate of compliance from authority having jurisdiction indicating approval of field acceptance tests. Refer to paragraph 3.04 B, within this specification section.

5. Shop Drawings:

a. Submit detailed and accurate Shop Drawings electronically of entire systems prior to fabrication. Indicate system controls, hydraulic reference points, detailed pipe layout, valves, hangers and supports, components and accessories.

b. Hydraulic calculations: Submit flow test results and comprehensive hydraulic data sheets complying with NFPA 13. Verification of the adequacy of water pressure and other pertinent water supply data shall be the responsibility of the design engineer.

c. Where expanding existing systems, the submitted design drawings shall show a sufficient amount of the existing system as required, the minimum shall show back to cross main or feed main to clearly identifying how the new work connects to the existing system.

6. As-Built Drawings and Closeout Documentation:

a. All electronic as-built or as-constructed building must meet requirements of 1.8.3.1.2 of section 01 77 00 of MD Anderson's Master Construction Specifications.

b. Provide three sets of as-built record drawings electronically indicating actual installed locations, sizes and types of sprinkler heads, piping, valves, supports, equipment and all other system components. Identify all deviations from approved submittal drawings.

c. Provide two sets of final hydraulic calculations.

d. Submit certification letter by engineer of record stating that the fire protection systems design complies with Referenced Standards.

e. Submit verification of Contractor's design and installation qualifications.

f. Provide full written description of manufacturer's warranty.

g. Provide certificate of compliance from authority having jurisdiction indicating approval of field acceptance tests. Refer to paragraph 3.04 B, within this specification section.

h. Provide all written exception and authorizations for deviations from this specification.

D. Operation and Maintenance Data:

1. Include components of system, servicing requirements, inspection data, replacement part numbers, location and numbers of service depot. Provide a preventive maintenance schedule for all applicable equipment and systems.

1.06 DELIVERY, STORAGE AND HANDLING

A. All materials shall be new, undamaged, and free of rust. Protect installed piping, valves and associated materials during progression of the construction period to avoid clogging with dirt, and debris and to prevent damage, rust, etc.

B. Accept valves on-site in shipping containers and maintain in place until installation. Provide temporary protective coating and end plugs on valves not packaged within containers. Maintain in place until installation.

C. Protect all materials that are to be installed within this Project from exposure to rain, freezing temperatures and direct sunlight. EXCEPTION: Materials manufactured for exterior locations.

1.07 EXTRA MATERIALS

A. The Contractor shall provide supply of spare heads of each type installed under the Contract in quantities as required by National Fire Protection Association Standard No. 13. The heads shall be packed in a suitable wall mounted sprinkler cabinet and shall be representative of and in proportion to, the number of each type and temperature rating installed. In addition to the spare heads, the Contractor shall provide not less than three special sprinkler head wrenches for each type of head. The cabinet shall be permanently affixed to a wall near the fire pump controller.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

B. All piping, materials and equipment used in the installation of sprinkler and standpipe systems shall be new and listed as approved by the Underwriters' Laboratories, Inc., List of Inspected Fire Protection Equipment and Materials and the Factory Mutual Testing Laboratories List of Approved Equipment, Fire Protection Devices and Devices Involving Fire Hazard and shall be the latest design of the manufacturer.

C. Pressure ratings of pipe, fittings, valves, gauges and all other water carrying appurtenances shall be suitable for the designed system pressures in which they are installed.

D. The installing Contractor shall identify piping, fire department connections, valves and hydraulic design information in accordance with applicable NFPA Standards.

2.02 MANUFACTURER

A. Sprinkler Heads: Reliable, Grinnell, Viking, Flexhead.

B. Flow Switches: Notifier, Potter-Roemer, System Sensor.

C. Tamper Switches: Notifier, Potter-Roemer, System Sensor.

D. Gate Valves: Mueller, Nibco, Stockham, Kennedy.

E. Butterfly Valves: Milwaukee, Nibco, Grinnell, Victaulic, Kennedy.

F. Ball Valves: Milwaukee, Nibco, Stockham, Victaulic.

G. Check Valves: Mueller, Nibco, Stockham, Grinnell, Victaulic.

H. Grooved Fittings and Couplings: Grinnell, Anvil, Victaulic.

~~I. Hose Valves: Elkhart, Larsen, Potter-Roemer.~~

~~J. Fire Department Connections: Elkhart, Larsen, Potter-Roemer.~~

~~K. Electric or Water Motor Alarm Bells: Potter-Roemer, Reliable, Victaulic, Grinnell, and Viking.~~

~~L. In-Building Water Supply Riser: Ames.~~

2.03 SPRINKLER HEADS

A. Unless otherwise specified or indicated on the drawings, sprinkler heads shall be regular automatic closed type spray heads with temperature ratings as required by National Fire Protection Association Standard No. 13.

~~1. Heads within smoke compartments containing patient sleeping rooms shall be quick-response type.~~

~~2.~~**1.** The installing contractor is to verify the existing type of sprinkler head installed in area of renovation projects to ensure the response type is the same. Standard response and quick heads are not to be mixed in a project.

~~3.~~**2.** Finished Ceilings: Provide concealed ceiling sprinklers with factory finished (no field painting) cover plate, color to match ceiling finish. [Exception: Provide chrome plated or alternate color cover plates where directed by Architect].

~~4.~~**3.** Unfinished Areas without Ceilings: Provide bronze upright. Protect sprinkler heads against mechanical injury with standard guards where required.

~~5.~~**4.** Cold Rooms (≤ 42°F.) and Areas below Heated Ceiling/Soffit Spaces Susceptible to Freezing: Provide dry pendant type with chrome finish and two-piece escutcheon. (Areas include but not limited to; walk-in freezers, exterior overhangs, canopies…).

~~6.~~**5.** Elevator Equipment Rooms: Provide 212°F intermediate temperature classified heads.

~~7.~~**6.** MRI Rooms: Provide non-ferrous semi-recessed chrome plated head and escutcheon.

~~8.~~**7.** Animal Vivarium's: Provide recessed heads with gasket covers.

2.04 PIPING MATERIALS

~~A. Buried Water Service Entrance Piping~~

~~1. Pipe - Cement mortar lined ductile iron~~

~~2. Fittings – Cement mortar lined ductile iron using mechanical joints~~

~~3. Optionally, where building structural components permit, water service entrance may be composed of a single extended 90 degree fitting of fabricated 304 stainless steel tubing, maximum Working pressure of 175 psi with grooved end connection on the outlet (building) side and a cast iron pipe size coupler on the underground (inlet) side.~~

~~4. All pipe and fittings shall be encased with polyethylene film having a minimum thickness of 8 mils.~~

~~B.~~**A.** Unburied Piping

1. All pipe and fittings shall be provided with Microbiological Inhibiting Coating (MIC).

2. Pipe

   a. Interior pipe not subject to freezing shall be Schedule 40 (minimum thickness) black steel.

   b. Exterior pipe including pipe installed within parking garages shall be Schedule 40 (minimum thickness) galvanized steel.

   c. Interior pipe subject to freezing shall be Schedule 40 (minimum thickness) galvanized steel.

   d. Exception: Pipe within MRI rooms and MRI room ceiling space shall be Type “K” hard drawn copper.

3. Fittings

   a. Fittings shall be threaded malleable or cast iron, flanged cast iron, welded steel or grooved ductile iron with gaskets and mechanical fasteners.

   b. Exceptions:

      1) All fittings within MRI rooms and MRI room ceiling spaces shall be wrought copper or bronze pressure and brazed joints.

      2) The use of grooved type fittings on pipe size 2 ½” and smaller in diameter is not allowed.

      3) FlexHead: Flexible fire sprinkler hose with threaded end fittings are acceptable.

   c. Groove-less clamp or saddle type fittings shall not be used without specific written authorization from the EH&S program manager for fire & life Safety. The use of galvanize fittings on black steel piping is not acceptable. The use of non-galvanize fittings on galvanize piping is not acceptable.

   d. All grooved joint couplings, fittings and specialties shall be the products of a signal manufacturer. Grooving tools shall be of the same manufacture as the grooved components.

2.05 VALVES

A. Similar types of valves shall be the product of one manufacturer; i.e., all butterfly valves shall be of the same manufacture, all ball valves shall be of the same manufacture, etc.

B. All valves used to control the flow of water to and within standpipe and sprinkler systems shall be listed indicating type complete with electric supervisory switches. Coordinate wiring with the electrical Contractor.

C. Hose valves shall have bronze finish; 2-1/2" hose thread connections with cast brass pin lug cap and chain.

D. All 1-1/2" hose valves shall be provided with adjustable regulators where required to limit static and residual pressures to 100 psi. All 2-1/2" hose valves shall be provided with adjustable regulators where required to limit static and residual pressures to 175 psi. 2-1/2" hose valves shall be initially set for an outlet pressure of between 125 to 150 psi where allowed by system design.

~~2.06 FIRE VALVE CABINETS~~

~~A. Provided within Architectural Division 10 of these Specifications.~~

~~B. Coordinate with General Contractor prior to ordering hose valves for compatibility assurance.~~

~~2.07 FIRE DEPARTMENT SIAMESE CONNECTIONS~~

~~A. Fire department connections shall have quantity of 2-1/2" hose thread connections as required by system capacity and be complete with cast brass pin lug caps and chains. Finish shall be determined by Architect. Connections shall be identified as required by NFPA 14.~~

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation shall meet or exceed all applicable requirements and standards identified in Element Z2005 of UTMD Anderson Owner Design Guidelines.

B. All installation shall be in accordance with manufacturer's published recommendations.

C. Install all materials and products in accordance with manufacturer's published recommendations. Use tools manufactured for the installation of the specific material or product.

D. Sprinkler heads shall be located in a symmetrical pattern related to ceiling features such as grid, beams, light fixtures, diffusers, etc. and where applicable, heads shall be located symmetrically with the ceiling grid, centered in two directions. Locate heads to provide code required distances away from lights, exit signs, etc., and all other items that could interfere or effect sprinkler discharge.

E. Cover plates for concealed sprinklers are not to be installed until a field inspection is performed by Environmental Health and Safety to ensure the sprinkler heads are installed at the correct elevation within the ceiling tile as per manufacture product data sheets. The General Contractor on the project is responsible to coordinate this inspection through the MDA Project Manager. The project is to maintain, a copy of the manufacture product data sheet on the jobsite for this inspection.

F. Apply temporary protective covers during construction to ensure that sprinkler heads and escutcheons do not receive field paint.

G. Install fire sprinkler head cages/guards to sprinkler heads to protect heads susceptible to mechanical injury and to reduce the possible of accidental discharge (i.e. mechanical rooms, elevator shafts/pits, etc.).

H. Inspector's test valves shall be installed for each sprinkler control valve assembly equipped with a flow switch and piped to a stairwell drain test riser within the building. When used in combination with the drain and test riser requirements for testing standpipes equipped with pressure-regulating hose valves, the drain test riser size shall be a minimum size of 3 in. A 2-½" female test connection with cap shall be provided on each floor of the 3" test riser with using pressure reducing hose valves. Each drain test riser discharge shall be piped to the exterior of the building. The exterior discharge point shall not discharge on a sidewalk, driveway or any other area that could result in staining, water accumulation or soil erosion. When exterior piping is not feasible, the drain test riser shall be piped to a suitable drain having sufficient capacity to accept full flow of pressure-regulating hose valves. When a project cannot meet this requirement, an alternative plan must be submitted for approval by the Project Management team and Environmental Health and Safety, before installation of fire protection system.

I. Provide hangers for horizontal piping at intervals not exceeding twelve feet for pipe sizes 1-1/4" and smaller or fifteen feet for pipe sizes 1-1/2" and larger, and as recommended within NFPA.

J. Route piping in orderly manner, plumb and parallel to building structure and concealed above ceilings where possible. Locate concealed valves, switches and alarm connections in accessible location, and coordinate size and location of access panels/doors with General Contractor.

K. Install piping to conserve building space and not interfere with use of space and other work. Coordinate with other trades to avoid conflicts and provide all required offsets, piping, auxiliary drains, etc. to properly install system.

L. Group piping whenever practical at common elevations.

M. Install piping to allow for expansion and contraction without stressing pipe, joints or connected equipment.

N. Flange and coupling bolts shall be torque in sequence per manufacturer specifications.

O. Pipe joints, clamps, groove couplings, flanges, unions, etc., shall not directly contact or be encased in concrete, or be located within wall, floor or roof penetrations.

P. Slope piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe level.

Q. Provide an approved splash block at the point of drain or system test discharge outside of the building, where the ground may be disturbed by the flow of water.

R. Prepare pipe, fittings, supports and accessories for finish painting where required.

S. Provide thrust blocking and clamps for mechanical joint or gasketed underground water pipe at fittings with 3/4" rods and properly anchor and support.

T. Do not penetrate building structural members unless indicated otherwise on Contract Drawings.

~~U. Each pipe projecting through roof shall be installed in accordance with Contract Specifications and Drawings. Penetrations shall be sealed air and water tight. Refer to details on Contract Drawings and coordinate with General Contractor for flashing requirements.~~

~~V.~~**U.** Penetrations through fire rated walls, floors and partitions shall be sealed to provide a U.L. rating equal to or greater than the wall, floor or partition.

~~W.~~**V.** Seal all penetrations through exterior building walls and grade beams air and watertight.

~~X.~~**W.** Install valves with stems upright, not inverted. All valves shall be located such that the removal of their bonnets is possible. Valves placed in horizontal lines shall be installed with their valve stems inclined at an angle of a minimum of 30 degrees above the horizontal position. Valves shall be installed as nearly as possible to the locations indicated in the Construction Drawings. Any change in valve location must be so indicated on the Record Drawings. Remove protective coatings after installation.

~~Y.~~**X.** Provide drain valves at main shutoff valves, low points of piping and apparatus.

~~Z.~~**Y.** All shutoff and test valves shall be located on the floor they serve, unless specific written authorization is received from EH&S.

~~AA.~~**Z.** ~~Locate and secure hose cabinets plumb and level. Locate angle valve in cabinet at 60 inches above floor~~.

~~BB.~~**AA.** Provide two-hour enclosure around all fire standpipe piping routed outside fire stairwell.

~~CC.~~**BB.** All piping shall be clean when it is installed. Before installation it shall be checked, upended, swabbed, if necessary and all rust or dirt from storage or lying on the ground shall be removed. Flush entire system of foreign matter.

~~DD.~~**CC.** Heat generated by welding or soldering procedures shall not be transmitted to valves, groove couplings, or any other components installed within the piping system that may be damaged due to high temperatures. Contractor shall take all precautions necessary and allow heated piping to cool to ambient temperature before attachment.

~~EE.~~**DD.** All screw joints shall be made with taper threads properly cut. Joints shall be made tight with Teflon tape or non-toxic joint compound applied to the pipe threads only and not to fittings. When threads are cut on pipes, the ends shall be carefully reamed to remove any burrs. Before installing pipe that has been cut and threaded, the lengths of pipe shall be upended and hammered to remove all shavings and foreign material.

3.02 ELEVATOR SPRINKLER PROTECTION

A. Elevator fire protection shall comply with NFPA 13, NFPA 70, NFPA 72, and ANSI/ASME A17.1 or A17.3 as applicable.

B. When sprinklers are installed in elevator equipment rooms, the electrical power to the elevator controller must shut down prior to sprinkler activation. A heat detector shall activate an independently controlled shunt trip circuit breaker when the temperature in the machine room exceeds the setting of the heat detector. The detector shall have both a lower temperature rating and a higher sensitivity (lower Response Time Index) as compared to the sprinkler. Sprinkler heads shall be rated at 212°F and heat detectors shall be rated at 135°F. Heat detectors used to shut down elevator power prior to sprinkler operation shall be placed within two feet of each sprinkler head and connected to the fire alarm control panel.

C. Smoke detectors shall be provided to initiate phase one elevator recall, sending cars to the appropriate level prior to electrical power shut-down.

D. No sprinkler risers shall be permitted inside any hoist way. Sprinkler branch lines shall enter hoist ways only where a sprinkler is required.

3.03 WELDED PIPING

A. Welding of pipe/fittings in normally occupied buildings is prohibited. Offsite welding is acceptable. Should welding be required in a normally occupied building for connecting to an existing welded system, obtain written approval via MD Anderson's Hot Work Procedure and comply with NFPA 51 B and MD ANDERSON Environmental Health and Safety requirements.

B. All welding materials, procedures, qualifications and records shall comply with applicable NFPA requirements.

3.04 SYSTEM TESTING AND FLUSHING

A. Testing, cleaning, flushing and inspection shall be done in accordance with NFPA requirements.

B. The installing Contractor shall complete and sign the appropriate Contractor's Material and Test Certificates included within NFPA 13 and 14. Tests and signing of test certificates shall be witnessed by MD ANDERSON Environmental Health and Safety Department representative or designee.

3.05 ZONING

A. All flow switches and tamper switches shall relay their activation to each annunciator panel and the main fire alarm panel.

B. Sprinkler system zoning shall coincide with building smoke compartmentalization unless noted otherwise on Contract Drawings. As a minimum, each floor level shall be a separate zone.

3.06 TRAINING

A. Contractor shall provide for the service of a competent, trained and experienced agent to instruct and acquaint the Owner with the proper functioning, operation and maintenance of the fire protection systems and all installed components.

3.07 WARRANTY

A. The complete system shall be warranted in writing against defects in materials or Workmanship under normal use and service for a period of one year after date of Substantial Completion.

END OF SECTION 21 10 13

SECTION 22 10 00 – PLUMBING PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 SUMMARY

A. Provide materials and installation for complete first class plumbing systems, within and to five feet beyond building perimeter unless noted otherwise on Contract Drawings; Sanitary Waste and Vent Piping, Storm Drain Piping, Domestic Water Piping, Domestic Water Valves, Testing and other normal parts that make the systems operable, code compliant and acceptable to the authorities having jurisdiction.

1.03 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:

1. 2009 Edition of the International Plumbing Code.

2. NOTE: MD Anderson takes various exceptions to the International Plumbing Code and has adopted the more stringent requirements within the Uniform Plumbing Code. These exceptions are included within Project Specifications and/or Project Design Drawings.

3. ANSI/NSF Standard 61 - Drinking Water System Components - Health Effects.

1.04 QUALITY ASSURANCE

A. Manufacturer’s name and pressure rating shall be permanently marked on valve body.

B. The Contractor shall notify the manufacturer's representative prior to installing any copper press fittings. The Contractor shall obtain the representative’s guidance in any unfamiliar installation procedures. The manufacturer's representative of copper press fittings shall conduct periodic inspections of the installation and shall report in writing to the Contractor and Owner of any observed deviations from manufacturer’s recommended installation practices.

C. Manufacturer Qualifications: Company shall have minimum three years documented experience specializing in manufacturing the products specified in this section.

D. All grooved joint couplings, fittings, flanges, valves, and specialties of the same type shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.

E. Installer Qualifications:

1. Company shall have minimum three years documented experience specializing in performing the work of this section.

2. Installation of plumbing systems shall be performed by individuals licensed by the Texas State Board of Plumbing Examiners as a Journeyman or Master Plumber. Installation may be performed by Apprentice Plumbers provided they are registered with the Texas State Board of Plumbing examiners and under direct supervision of a licensed plumber. All installation shall be supervised by a licensed Master Plumber.

3. All installers of copper press fittings shall be trained by the fitting manufacturer's appointed representative. Written notification of training shall be submitted to Owner prior to any installation.

4. All installers of copper grooved fittings shall be trained by the fitting manufacturer's appointed representative. Written notification of training shall be submitted to Owner prior to any installation.

1.05 SUBMITTALS

A. Product Data:

1. Code and Standards compliance, manufacturer's data for pipe, fittings, valves and all other products included within this specification section.

2. Grooved joint valves, couplings and fittings shall be specifically identified with the applicable style or series designation.

3. Manufacturer’s installation instructions.

B. Record Documents:

1. Record actual locations of valves, etc. and prepare valve charts.

2. Test reports and inspection certification for all systems listed herein.

3. Provide a certificate of completion detailing the domestic water system chlorination procedure and all laboratory test results.

4. Submit proposed location of access panels which vary from quantities or locations indicated on Contract Drawings.

5. Provide full written description of manufacturer’s warranty.

C. Operation and Maintenance Data:

1. Include components of system, servicing requirements, Record Drawings, inspection data, installation instructions, exploded assembly views, replacement part numbers and availability, location and contact numbers of service depot.

1.06 DELIVERY, STORAGE AND HANDLING

A. All materials shall be new, undamaged, and free of rust.

B. Accept valves on Site in shipping containers and maintain in place until installation.

C. Provide temporary protective coating and end plugs on valves not packaged within containers. Maintain in place until installation.

D. Provide temporary end caps and closures on pipe and fittings. Maintain in place until installation.

E. Protect installed piping, valves and associated materials during progression of the construction period to avoid clogging with dirt, and debris and to prevent damage, rust, etc. Remove dirt and debris and repair materials as work progresses and isolate parts of completed system from uncompleted parts.

F. Protect all materials that are to be installed within this project from exposure to rain, freezing temperatures and direct sunlight. EXCEPTION: Materials manufactured for exterior locations.

1.07 EXTRA MATERIALS

A. Provide the Owner with one differential pressure meter kit for use with domestic hot water return circuit balancing valves installed within this project. Kit shall include meter, hoses, connection accessories, circular slide rule, carrying case and valve manufacturer's curve charts.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

B. Provide materials as specified herein and indicated on Contract Drawings. All materials and work shall meet or exceed all applicable Federal and State requirements and conform to adopted codes and ordinances of authorities having jurisdiction.

C. Pressure ratings of pipe, fittings, couplings, valves, and all other appurtenances shall be suitable for the anticipated system pressures in which they are installed.

2.02 SANITARY WASTE AND VENT AND STORM DRAINAGE PIPING

A. Service weight cast iron soil pipe and fittings with hubless connections using clamp type gasketed mechanical fasteners above ground and hub and spigot DWV pipe and fittings with neoprene compression gasket joints for all buried pipe. Cast iron soil pipe, fittings and hub gaskets shall be manufactured by Tyler Pipe or Charlotte Pipe and Foundry. All cast iron pipe and fittings shall be of the same manufacturer.

B. Secondary (emergency overflow) roof drain piping that discharges onto face of exterior building wall shall be CPVC Type IV, manufactured in accordance with ASTM F 2618, with CPVC drainage pattern fittings meeting ASTM D 3311. Joining method for CPVC pipe and fittings shall be with CPVC solvent cement manufactured in accordance with ASTM F 493. CPVC pipe and fittings shall meet 25/50 flame/smoke requirement for use in return air plenums when tested to ASTM E 84. All pipe, fittings and cement shall be supplied together and warranted as a system, manufactured by Spears Manufacturing Company or Owner approved equal. EXCEPTION: Secondary roof drain piping that discharges at grade level shall be as specified within paragraphs 2.02 A and/or C.

C. Unburied primary storm drainage and sanitary waste and vent piping for sizes 4” and smaller may be seamless copper DWV tube with wrought copper or wrought copper alloy solder joint drainage pattern DWV fittings.

D. Indirect waste piping sizes 1-1/4” through 2” serving fixtures and equipment shall be seamless copper DWV tube with wrought copper or wrought copper alloy solder joint drainage pattern DWV fittings.

E. Indirect waste piping sizes 1” and smaller serving equipment shall be type "L" hard drawn copper pipe and wrought copper or cast copper alloy solder joint fittings using lead-free solder and non-corrosive flux. Elbows shall be long radius type. Tee fittings shall be combination wye with 45 degree elbow.

F. Cast iron soil pipe compression gaskets shall be monolithically molded from an elastomer meeting ASTM C 564 and shall be of same manufacturer as pipe and fittings.

G. Clamps for joining hubless cast iron pipe and fittings sizes 1-1/2” through 15” shall meet the performance criteria of FM 1680, have type 304 stainless steel jacket, ASTM C 564 neoprene gasket and type 305 stainless steel band screws designed to be installed with a pre-set torque wrench. Couplings shall be manufactured by Clamp-All, Inc. HI-TORQ 125 or Husky, Inc., Orangeshield HD 4000.

H. Hubless piping systems shall not be used in a directly buried, underground application. EXCEPTION: No-hub type fittings with clamp type coupling joints may be used below ground for pipe sizes up to 10” at connections to existing cast iron sewers provided couplings are cast iron with stainless steel bolts as manufactured by MG Piping Products.

I. Solder for copper piping shall be lead-free Tin/Copper/Silver/Nickle(optional) solder conforming to ASTM B32, Wolverine Silvabrite 100 Lead-Free Solder or Harris Nick Lead-Free Solder. Use water soluble flux recommended by solder manufacturer and conforming to ASTM B813 and NSF 61, Wolverine Silvabrite 100 Water Soluable Flux or Bridgit Water Soluble Paste Flux.

J. Lubricant for drainage cleanout plugs shall be Loctite Marine Grade Anti-Seize or approved equal by Bostik Chemical Group, or Dow Corning Corporation.

K. Double sanitary tee fittings shall be not be used as a drainage fitting.

L. Provide IAPMO figure one, IAPMO figure five or double wye and eighth bend fittings on vertical lines serving back-to-back fixture drains.

M. Double wye and eighth bend fittings shall not be installed in horizontal drain lines.

N. All P-traps for floor drains, floor sinks and hub drains shall be deep-seal type.

O. Provide threaded brass or copper adapters to connect fixture supply stops and waste to service piping within walls. Galvanized nipples shall not be acceptable. Provide DWV copper trap adapters to connect lavatory, sink and drinking fountain trap outlets to sanitary system.

2.03 DOMESTIC WATER PIPING (INCLUDING COLD, HOT & SOFTENED WATER)

A. All materials within domestic water distribution systems that may come in contact with the potable water delivered shall comply with ANSI/NSF Standard 61.

B. All brass and bronze piping materials within domestic water distribution systems that may come in contact with the potable water delivered shall have no more than 15% zinc content.

C. Unburied piping shall be type "L" hard drawn copper pipe and wrought copper or cast copper alloy solder joint fittings using lead-free solder and non-corrosive flux. Piping sizes 2-1/2” and larger may be type “L” hard drawn copper and wrought copper or cast copper alloy roll groove fittings Style 607 Quick Vic utilizing no-sweat coupling with NSF 61 approved gasket for hot and cold water, and flange adapter Style 641 assemblies as manufactured by Victaulic or Owner approved equal by Anvil.

1. Flaring of tube and fitting ends to IPS dimensions is not allowed.

2. Provide a phenolic flange washer with flange adapter when the mating flange face is not a smooth, hard surface. Refer to manufacturer’s installation instructions for additional details.

D. Unburied piping sizes ½” through 4" installed within occupied buildings for modifying existing systems may utilize copper press fittings when the following conditions are met:

1. Written approval of the Owner's Property Manager shall be obtained prior to bidding.

2. Fittings shall be installed in portions of systems having an operating pressure that will not exceed 200 p.s.i.g.

3. Fittings shall conform to the material and sizing requirements of ASME B16.18 or ASME B16.22.

4. O-rings for copper press fittings shall be EPDM. Copper press fittings shall be rated at 200 psi working pressure and 250 degree working temperature.

5. All copper press fittings, couplings and specialties shall be manufactured by Viega.

6. Installation tools shall be as recommended by the fittings manufacturer.

E. Solder for copper piping shall be lead-free Tin/Copper/Silver/Nickle(optional) solder conforming to ASTM B32, Wolverine Silvabrite 100 Lead-Free Solder or Harris Nick Lead-Free Solder. Use water soluble flux recommended by solder manufacturer and conforming to ASTM B813 and NSF 61, Wolverine Silvabrite 100 Water Soluable Flux or Bridgit Water Soluble Paste Flux.

F. Buried domestic water service entrance piping 4" and larger shall be cement mortar lined Class 53 ductile iron pipe and 350 psi working pressure ductile iron fittings using mechanical joints. All buried ductile iron pipe and fittings shall be encased in polyethylene per ANSI/AWWA Standard C105/A21.5, Method A. Minimum thickness of polyethylene shall be 8 mil.

G. Buried pressurized piping sizes 1" and smaller shall be type "K" soft copper. No joints shall be allowed below slab. Encase piping within ½" thick un-slit flexible tube type elastomeric thermal insulation up to 1" above slab at both ends. Insulation shall be AP/Armaflex or Rubatex Insul-Tube 180.

H. Unburied trap primer piping shall be same as specified for domestic water except all elbows shall be long radius type.

I. Buried trap primer piping shall be type "K" soft copper. No joints shall be allowed below slab except at connection to drain. Encase piping within ½" thick un-slit flexible tube type elastomeric thermal insulation up 1" above slab. Insulation shall be AP/Armaflex or Rubatex Insul-Tube 180.

J. Dielectric waterway fittings shall have zinc electroplated steel pipe body with high temperature stabilized polyolefin polymer liner; manufactured by Victaulic, Style 47 or PPP, Inc. Series 19000, or Owner approved equal by Anvil.

K. Dielectric unions shall be rated at 250 psi, ground-joint type with inert, non-corrosive thermoplastic sleeve. End connection materials shall be compatible with respective piping materials; manufactured by EPCO Sales, Inc or Watts. Provide models to suit applicable transitions.

L. Dielectric flanges shall be rated at 175 psi, have nylon bolt isolators and dielectric gasket. Materials shall be compatible with respective piping materials; manufactured by EPCO Sales, Inc or Watts. Provide models to suit applicable transitions.

M. Pipe joint compound shall be lead-free, non-toxic, non-hardening and compliant with ANSI/NSF 61 and Federal Specification TT-S-1732. Temperature service range of -15ºF to +400ºF, manufactured by Hercules "MegaLoc" or approved equal by Rectorseal, La-Co or Oatey.

N. All exterior water piping sizes 2" and smaller installed above grade shall be provided with electric heat in the form of 120 volt, single phased tape rated at 5 watts per lineal foot at 50°F. Heat tracing shall be manufactured for freeze protection service and be self-regulating to energize at 50°F. Provide an accessible temperature sensing thermostat between electrical power supply and connections to heat tracing to prevent power from activating tracing unless outside ambient temperature is at or below 40°F. This Contractor shall coordinate with the electrical Contractor to provide electrical power supply and connection. Heat tracing shall be by Raychem XL-TRACE or Thermon FLX. Thermostats shall be Raychem AMC-F5 or Thermon N4X-40.

2.04 DOMESTIC WATER VALVES: (INCLUDING COLD, HOT & SOFTENED WATER)

A. All materials within domestic water distribution systems that may come in contact with the potable water delivered shall comply with ANSI/NSF Standard 61.

B. All brass and bronze valve materials within domestic water distribution systems that may come in contact with the potable water delivered shall have no more than 15% zinc content.

C. Similar types of valves shall be the product of one manufacturer; i.e., all butterfly valves shall be of the same manufacturer, all ball valves shall be of the same manufacturer, etc.

D. Line Shut-Off Valves up to and including 2” shall be two-piece bronze body of ASTM B584 Alloy 844, ASTM B61, or ASTM B62, full port ball type rated at 600 WOG with threaded connections, blow-out proof stem, plastic coated lockable lever handle, Teflon packing, 316 stainless steel ball and stem. Acceptable valves are NIBCO Model T-585-70-66-LL, or approved equivalent model by Crane, Milwaukee or Apollo.

E. Line Shut-Off Valves 2-1/2” and larger where system operating pressure will not exceed 160 p.s.i.g. shall be 200 WOG threaded lug type ductile iron body butterfly valve with extended neck, lockable lever handle, 416 stainless steel stem, aluminum bronze disc, EPDM liner and seal, suitable for bi-directional flow and dead end service with downstream flange removed. Acceptable valves are NIBCO Model LD-2000, or approved equivalent model by Keystone, Jamesbury, Milwaukee, Crane or Apollo.

F. Line Shut-Off Valves 2-1/2” and larger installed within systems having design operating pressures between 160 and 250 p.s.i.g. shall be threaded lug type ductile iron body butterfly valve with extended neck, lockable lever handle, 316 stainless steel stem and disc, EPDM liner and seal, suitable for bi-directional flow and dead end service with downstream flange removed. Acceptable valves are NIBCO Model LD-3022, or approved equivalent model by Keystone, Jamesbury, Dezurik, Milwaukee, Crane or Apollo.

G. Line Shut-Off Valves 2-1/2” and larger installed in roll grooved copper systems may be 300 psi roll grooved end type bronze body butterfly valve with lockable lever handle, bronze trim, EPDM coated disc, suitable for bi-directional flow and dead end service. Manufactured by Victaulic Series 608 or Anvil Model B680.

H. Provide stem extensions of a non-thermal conducting material for valves in insulated lines to allow unobstructed operation.

I. Provide memory stops on all ball valves installed in domestic hot water return lines. Memory stops shall be adjustable after pipe insulation is applied.

J. Provide line shut-off valves that have the same inside diameter of the upstream pipe in which they are installed.

K. Domestic Hot Water Return Circuit Balancing Valves 1/2" through 2" shall be 'Y or T' pattern with threaded inlet and outlet connections, equal percentage globe-style and provide precise flow measurement, precision flow balancing and positive drip-tight shut-off. Valves shall provide multi-turn, 360° adjustment with micrometer type indicators located on the valve handwheel. Valves shall have a minimum of five full 360° handwheel turns. 90° 'circuit-setter' style ball valves are not acceptable. Valve handle shall have hidden memory feature to provide a means for locking the valve position after the system is balanced. Valves shall be furnished with precision machined venturi built into the valve body to provide highly accurate flow measurement and flow balancing. The venturi shall have two, 1/4" threaded brass metering ports with check valves and gasketed caps located on the inlet side of the valve. Valves shall be furnished with flow smoothing fins downstream of the valve seat and integral to the forged valve body to make the flow more laminar. The valve body, stem and plug shall be brass. The handwheel shall be high-strength resin. Provide valves as scheduled on Contract Drawings manufactured by Armstrong Model CBV-VT or NIBCO T-1710 and F737-A, or Owner approved equal by Tour & Andersson/Victaulic. Furnish each valve complete with optional pre-formed 25/50 fire/smoke rated insulation.

L. Swing Check Valves, 2" and smaller - "Y" or "T" pattern bronze, Class 150, with threaded connections and screw-in cap. Manufactured by NIBCO Model T-433-Y or approved equivalent model by Milwaukee or Crane.

M. Spring Loaded Check Valves, 2" and smaller - Silent closing, bronze, Class 125, with threaded connections, Buna disc, bronze or stainless steel spring. Manufactured by NIBCO Model T-480 or approved equivalent model by Milwaukee or Crane.

N. Swing Check Valves, 2-1/2" and larger - 200 pound CWP, Iron body, with bronze or stainless steel trim. Manufactured by NIBCO Model F-918-B or approved equivalent model by Milwaukee or Crane.

O. Swing Check Valves, 2-1/2" and larger - 285 pound CWP, Iron body, with stainless steel trim. Manufactured by NIBCO Model F-938-33 or approved equivalent model by Milwaukee or Crane.

P. Spring Loaded Check Valves, 2-1/2" and larger - 200 pound CWP, Iron body, with bronze or stainless steel trim. Manufactured by NIBCO Model F-910 or approved equivalent model by Milwaukee or Crane.

Q. Spring Loaded Check Valves, 2-1/2" and larger - 400 pound CWP, Iron body, with bronze or stainless steel trim. Manufactured by NIBCO Model F-960 or approved equivalent model by Milwaukee or Crane.

2.05 DIFFERENTIAL PRESSURE METER: (FOR DOMESTIC HOT WATER CIRCUIT BALANCING VALVES)

A. Meter shall be equipped with one 4-1/2" round dial gauge, 0-135" pressure differential, one 4-1/2" round dial gauge, 0-60' pressure differential, 300 psig maximum working pressure, two five foot hoses with PMP connections and carrying case. Meter and accessories shall be manufactured by Armstrong Model CBDM-135/60, NIBCO 1022, or Owner approved equal by Tour & Andersson/Victaulic.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that excavations are to required grade, dry and not over-excavated. Do not install underground piping when bedding is wet or frozen.

B. Before commencing work, check final grade and pipe invert elevations required for drain terminations and connections to ensure proper slope.

3.02 PREPARATION

A. Ream pipes and tubes. Remove burrs, scale and dirt, inside and outside, before assembly. Remove foreign material from piping.

B. Prepare piping connections to equipment with flanges or unions.

3.03 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. All installation shall be in accordance with manufacturer's published recommendations.

C. General

1. Care shall be exercised to avoid all cross connections and to construct the plumbing systems in a manner which eliminates the possibility of water contamination.

2. Install all materials and products in accordance with manufacturer's published recommendations. Use tools manufactured for the installation of the specific material or product.

3. Wipe all paste residue and excess solder from all solder joints.

4. Heat generated by soldering procedures shall not be transmitted to valves, copper alloy roll groove fittings, copper press fittings, no-hub clamps, or any other components installed within the piping system that may be damaged due to high temperatures. Contractor shall take all precautions necessary, including utilizing wet wrapping or allowing heated piping to cool to ambient temperature before attachment.

5. Pipe joints, no-hub clamps, flanges, unions, etc., shall not directly contact or be encased in concrete, or be located within wall, floor or roof penetrations.

6. Route piping in direct orderly manner and maintain proper grades. Installation shall conserve headroom and interfere as little as possible with use of spaces. Route exposed piping parallel to walls. Group piping whenever practical at common elevations.

7. Install piping to allow for expansion and Contraction without stressing pipe, joints or connected equipment.

8. Furnish all supports required by the piping included in this specification section.

9. Penetrations through fire rated walls, floors and partitions shall be sealed to provide a U.L. rating equal to or greater than the wall, floor or partition.

10. Seal all penetrations through floors, exterior building walls and grade beams air and water tight.

11. Each plumbing pipe projecting through roof shall be installed in accordance with Contract Specifications and Drawings. Penetrations shall be sealed air and water tight. Refer to details on Contract Drawings and coordinate with General Contractor for flashing requirements.

12. Furnish and install all necessary valves, traps, gauges, strainers, unions, etc. for each piece of equipment (including Owner furnished equipment) having plumbing connections, to facilitate proper functioning, servicing and compliance with code.

13. Provide code-approved transition adapters when joining dissimilar piping materials. Adaptors installed shall be manufactured specifically for the particular transition.

14. All piping shall have reducing fittings used for reducing or increasing where any change in the pipe sizes occurs. No bushing of any nature shall be allowed in piping.

15. Close nipples shall not be installed in plumbing piping systems.

16. Bury outside water and drainage pipe minimum one foot below recorded frost depth.

17. Buried piping shall be supported throughout its entire length.

18. All excavation required for plumbing work is the responsibility of the plumbing Contractor and shall be done in accordance with Contract Documents.

19. Piping shall be insulated in accordance with Contract Documents.

20. Provide clearance for installation of insulation and for access to valves, air vents, drains, unions, etc.

21. Provide dielectric isolation device where non-ferrous components connect to ferrous components. Devices shall be dielectric union, coupling or dielectric flange fitting.

22. All piping shall be isolated from building structures, including partition studs, to prevent transmission of vibration and noise.

23. Isolate all bare copper pipe from ferrous building materials. “Tape is not an acceptable isolator.

D. Drainage and Vent Systems

1. Slope drainage lines uniformly at 1/4" per foot, for lines 3" and less, and 1/8" per foot for larger lines, unless noted otherwise on Contract Drawings. Maintain gradients through each joint of pipe and throughout system.

2. Buried pipe shall be laid on a smoothly graded, prepared subgrade soil foundation true to alignment and uniformly graded. Bell holes shall be hand-excavated so that the bottom of the pipe is in continuous contact with the surface of the prepared subgrade material. Piping invert shall form a true and straight line.

3. The size of drainage piping shall not be reduced in size in the direction of flow. Drainage and vent piping shall conform to the sizes indicated on the Contract Drawings. Waste lines from water closets shall not be smaller than four inches. Under no circumstances shall any drain or vent line below slab be smaller than two inches.

4. Unburied horizontal cast iron soil piping shall be supported at least at every other joint except that when the developed length between supports exceeds four feet, they shall be provided at each joint. Supports shall also be provided at each horizontal branch connection and at the base of each vertical rise. Supports shall be placed immediately adjacent to the joint. Suspended lines shall be braced to prevent horizontal movement. Unburied vertical cast iron soil piping rising through more than one floor level shall be supported with riser clamps at each floor level.

5. Install couplings for hubless pipe and fittings in accordance with manufacturer's published recommendations. Use pre-set torque wrench and tighten band screws as required by manufacturer’s published instructions.

6. All unburied change of direction fittings within the roof drainage system shall be braced against thrust. Bracing shall incorporate galvanized steel pipe clamps and tie rods.

7. Provide cleanouts within sanitary waste systems at locations and with clearances as required by the code, at the base of each waste stack and at intervals not exceeding 75 feet in horizontal runs.

8. Provide cleanouts at the base of each vertical downspout and at intervals not exceeding 75 feet in horizontal building storm drain. Provide clearances as required by code. Horizontal roof drain piping located above building ground floor level will not require cleanouts.

9. A removable sink or lavatory p-trap with cleanout plug shall be considered as an approved cleanout for 2” diameter pipe.

10. All interior cleanouts shall be accessible from walls or floors. Provide wall cleanouts in lieu of floor cleanouts wherever possible. A floor cleanout shall be installed only where installation of a wall cleanout is not practical.

11. Provide a wall cleanout for each water closet or battery of water closets. Locate wall cleanouts above the flood level rim of the highest water closet but no more than twenty four inches above the finished floor.

12. Coordinate the location of all cleanouts with the architectural features of the building and obtain approval of locations from the Project Architect.

13. Lubricate cleanout plugs with anti-seize lubricant before installation. Prior to final completion, remove cleanout plugs, re-lubricate and reinstall using only enough force to provide a water and gas tight seal.

14. Install trap primer supply to floor drains, hub drains and floor sinks that are susceptible to trap seal evaporation and where indicated on Project Drawings. Primer unit installation shall comply with manufacturer's published recommendations. Trap primer lines shall slope to drain at a minimum ¼" per foot.

15. Capped waste and vent connections for future extensions shall be located accessibly and not extend more than 24" from active main. Waste connections and vent connections shall be located at elevations that will allow future installation of properly sloped piping without the need to dismantle or relocate installed ductwork, piping, conduit, light fixtures, etc.

16. Unless indicated otherwise within Contract Documents, all sanitary vent pipes passing through the roof shall be provided with lead roof flashings constructed of 2-1/2 pound sheet lead with bases extending no less than ten inches on each side of the pipe. The vertical portion of the flashing shall extend upward the entire length of pipe and be turned tightly inside the pipe at least two inches and shall not reduce the inside diameter of vent pipe more than the thickness of the flashing. Lead flashings shall be furnished by Plumbing Contractor and turned over to Roofing Contractor for installation.

17. Locate all sanitary vent terminals a minimum of 25 feet horizontally from or 3 feet vertically above all air intakes, operable windows, doors and any other building openings.

18. Wastewater when discharged into the building drainage system shall be at a temperature not higher than 140°F. When higher temperatures exist, approved cooling methods shall be provided.

E. Domestic Water System

1. On each water supply line serving a plumbing fixture, item of equipment, or other device which has a water supply discharge outlet below the overflow rim, or where cross contamination may occur, provide and install an approved vacuum breaker or backflow preventer. Installation of vacuum breakers shall prevent any possible backflow through them.

2. Provide thrust blocking and clamps for mechanical joint or gasketed underground water pipe at fittings with 3/4" rods, and properly anchor and support. Restraining rods, clamps and hardware shall be thoroughly coated with bituminous material to prevent corrosion.

3. Copper piping shall be supported at no greater than six foot intervals for piping 1-1/2" and smaller and ten foot intervals for piping 2" and larger in diameter.

4. Install all water piping to allow all piping within the system to be drained at low points.

5. Air chambers, dead-legs, or any other piping arrangement that may allow water to stagnate shall not be installed within domestic water systems. Valves installed for future connections shall not extend more than 24" from an active main.

6. Provide manufactured water hammer arrestors in water supply lines as indicated on Contract Drawings and in accordance with Standard PDI-WH201.

7. Pipe insulation shall be applied over installed freeze protection heat tracing tape.

8. Install union type fitting downstream of isolation valves at equipment connections.

9. Solder joint fittings shall not be installed within 24" of a copper press fitting.

10. Threaded adaptors shall be of the same manufacture and type as the system's copper fittings.

11. Threaded adaptors on supply stub-outs shall be installed prior to construction of wall and shall not extend more than 1" beyond wall face.

12. Identify piping utilizing copper press fittings in accordance with project specification section 20 05 53.

F. Domestic Water Valves

1. Domestic water shut-off valves shall be installed where shown on Drawings, at each fixture and piece of equipment, at each branch take-off from mains, at the base of each riser, and at each battery of fixtures.

2. Install shut-off valves in accessible locations. Provide access panels where valves would otherwise be inaccessible. Coordinate quantity, size and location requirements of access panels with General Contractor.

3. Install shut-off valves with stems upright or horizontal, not inverted.

4. Where threaded valves are installed in copper piping systems special care shall be taken to avoid damaging the valve or its parts due to overheating. Install copper or bronze male adapters in each inlet of threaded valves. Sweat solder adapters to pipe prior to connecting to valve body.

5. Provide spring loaded type check valves on discharge of water pumps.

6. Provide accessible check valves in the individual cold and hot water fixture supply lines serving mixing valve type faucets or assemblies having hose connection outlets that are not equipped with integral check stops.

7. Install a shutoff valve immediately upstream of each strainer

8. Install domestic hot water return circuit balancing valves where indicated on Contract Drawings and locate a minimum of five pipe diameters downstream and three pipe diameters upstream of all fittings and/or line shut-off valves. Location of valves shall allow unobstructed access for monitoring and adjustment.

9. Adjust and set domestic hot water return circuit balancing valves to flows indicated on Contract Drawings and in accordance with valve manufacturer's published instructions. Use flow meter recommended by valve manufacturer.

10. Provide a temperature gauge, strainer, union and line shut-off valve upstream of each hot water return circuit balancing valve.

3.04 TESTING AND CLEANING

A. General

1. Equipment, material, power, and labor necessary for the cleaning, flushing, sterilization, inspection and testing of systems covered within this Specification Section shall be furnished by the Plumbing Contractor. All testing and inspection procedures shall be in accordance with Division 1 and Special Condition requirements of this Contract.

2. All new and parts of existing altered, extended, or repaired plumbing system piping shall be tested and inspected for leaks and defects. Piping being tested shall not leak nor show any loss in test pressure for duration specified.

3. In cases of minor installation and repairs where specified water and/or air test procedures are deemed impractical, Contractor shall obtain written approval from Owner's Representative to perform alternate testing and inspection procedures. Alternate testing and inspection procedures for minor installation and repairs shall include visual evaluation of installed components by Owner's Representative during a simulation of use.

4. The water utilized for tests shall be obtained from a potable source of supply.

5. Prepare testing reports. If testing is performed in segments, submit separate report for each segment, complete with diagram or clear description of applicable portion of piping. After inspection has been approved or portions thereof, certify in writing the time, date, name and title of the persons reviewing the test. This shall also include the description of what portion of the system has been approved. Obtain approval signature by Owner's Representative. A complete record shall be maintained of all testing that has been approved, and shall be made available at the job Site. Upon completion of the work, all records and certifications approving testing requirements shall be submitted to the Owner's Representative before final payment is made.

6. Verify systems are complete, flushed and clean prior to testing. Isolate all equipment subject to damage from test pressure. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. Leave piping uninsulated, uncovered and unconcealed until it has been tested and approved. Where any portion of piping system must be concealed before completion of entire system, the portion shall be tested separately as specified for the entire system prior to concealment. Contractor shall expose all untested covered or concealed piping.

7. Gauges used for testing shall have increments as follows:

   a. Tests requiring a pressure of 10 psi or less shall utilize a testing gauge having increments of 0.10 psi or less.

   b. Tests requiring a pressure of greater than 10 psi but less than or equal to 100 psi shall utilize a testing gauge having increments of 1 psi or less.

   c. Tests requiring a pressure of greater than 100 psi shall utilize a testing gauge having increments of 2 psi or less.

8. Separately test above and below ground piping.

9. Do not introduce test water into piping systems when exposure to freezing temperatures is possible.

10. Do not introduce test water into sections of piping located above existing sensitive areas and/or equipment that may be damaged or contaminated by water leakage. Coordinate with Owner's Representative to determine areas and/or equipment considered as being sensitive.

11. Defective work or material shall be reworked and replaced, and inspection and test repeated. Repairs shall be made with new materials. Pipe dope, caulking, tape, dresser couplings, etc., shall not be used to correct deficiencies.

12. The Contractor shall be responsible for cleaning up any leakage during flushing, testing, repairing and disinfecting to the original condition any building parts subjected to spills or leakage.

B. Drainage and Vent System

1. Subject gravity drainage and vent piping and joints to a vertical water column pressure of at least ten feet. If after 12 hours the level of the water has been lowered by leakage, the leaks must be found and stopped and the water level shall again be raised to the level described and the test repeated until, after a 12 hour retention period, there shall be no perceptible lowering of the water level in the system being tested. EXCEPTION: Portions of drainage and vent piping located on uppermost level of building shall be subjected to a water column pressure created by filling the system to point of overflow at roof vent terminals and roof drains. The pipes for the level being tested shall be filled with water to a verifiable and visible level as described above and be allowed to remain so for 12 hours.

2. Piping located above sensitive areas and/or equipment that may be damaged or become contaminated due to test water leakage shall be tested with air. Isolate the test section from all other sections and slowly fill pipe with oil-free air until there is a uniform gauge pressure of 5 pounds per square inch (34.5 kPa) or sufficient pressure to balance a 10-inch (254 mm) column of mercury. The air pressure shall be regulated to prevent the pressure inside the pipe from exceeding 5.0 PSIG. This pressure shall be held for a test period of at least 15 minutes. Any adjustments to the test pressure required because of changes in ambient temperature or the seating of gaskets shall be made prior to the beginning of the test period.

3. Test forced (pumped) drainage piping by plugging the end of the piping at the point of connection with the gravity drainage system and applying a pressure of 5psi (34.5 kPa) greater than the pump rating, and maintaining such pressure for 15 minutes.

4. Should the completion of these tests leave any reasonable question of a doubt relative to the integrity of the installation, additional tests or measures shall be performed to demonstrate the reliability of these systems to the complete satisfaction of the Owner's Representative.

5. Test plugs must extend outside the end of pipe to provide a visible indication for removal after the test has been completed.

6. During the Plumbing Systems Functional Performance Tests, each floor drain p-trap that has successfully passed pressure testing shall be proven clean and free of debris as follows:

    a. An inspection request shall be submitted to the Owner, identifying the quantity and location of drain(s) to be inspected.

    b. Vacuum out each floor drain p-trap in the presence of the Owner's Representative. A visual inspection of the trap shall be performed to verify that the trap is debris free.

    c. Perform a free flowing test by pouring two five gallon buckets of water down the floor drain.

    d. After the Owner's Representative has confirmed that the floor drain trap is clean and free of debris, insure that the trap is filled with water.

    e. Install Trap Guard if required.

    f. At the discretion of the Owner's Representative, a visual inspection of the trap utilizing a sewer scope may be required in addition to, or in lieu of, a vacuum procedure.

7. During the Plumbing Systems Functional Performance Tests, the Owner's Representative may require that any portion of the drainage, waste and vent systems installed under this Project Contract be proven undamaged, clean and free of debris. Verification of the interior condition of piping shall be accomplished utilizing a sewer scope or other method as determined by the Owner's Representative.

C. Domestic Water System

1. Subject piping system to a hydrostatic pressure of at least 125 pounds per square inch gauge, but not less than the operating pressure under which it is to be used, for a period of no less than 12 hours. During test period, all pipe, fittings and accessories in the particular piping system that is being tested shall be carefully inspected. If leaks are detected, such leaks shall be stopped and the hydrostatic test shall again be applied. This procedure shall be repeated until no leaks are detected for an entire 12 hour period. EXCEPTION: Piping located above sensitive areas and/or equipment that may be damaged or become contaminated due to test water leakage shall be tested with oil-free air in lieu of water.

2. After completion of the testing, all new and/or altered water piping systems shall be thoroughly sterilized with a solution containing not less than 50 parts per million of available chlorine. Do not exceed 150 parts per million at any time. Introduce chlorine into the supply stream at a rate sufficient to provide a uniform concentration throughout the system. All outlets shall be opened and closed several times. When the specified level of chlorine is detected at every outlet in the system, close all valves to prevent release of water from the system for 24 hours. At the completion of the 24 hour disinfection period, test every outlet for a minimum chlorine residual of fifty parts per million. This minimum residual must be present to proceed with flushing. Flush the system with clean water at a sufficient velocity until the residual chlorine detected at every outlet is within 0.2 parts per million of the normal water supply's level.

3. Sufficient samples must be taken no sooner than 24 hours after sterilization and flushing to represent the extent and complexity of the affected water system, along with a control sample to indicate municipal water quality at the time of testing. Send water samples to an accredited laboratory to perform qualitative and quantitative bacteriological analysis in accordance with AWWA C651. Contractor shall obtain written certification from the independent testing agency stating that the water samples meet Federal and State guidelines for safe drinking water. Upon satisfactory completion of all procedures, and receipt of acceptable laboratory test results, obtain written approval by Owner's representative. Failure to fully comply with the above procedures will result in a requirement to repeat the procedure until acceptable results are achieved, at no additional cost to the Owner.

4. Isolate or bypass equipment that would be detrimentally affected by disinfecting solution. Isolate all other sections of the domestic water system not being disinfected to prevent migration of chlorine.

5. Prior to injection of chlorine into the piping system, strategically place signs stating “Heavily Chlorinated Water - Do Not Drink”, and protect all outlets to prevent use during disinfection and flushing procedures.

D. A bacteria test is not necessary for small scale work. However, disinfection is required. Examples of small scale work are less than 20 feet of pipe, replacement and/or installation of a sink, drinking fountain, eyewash, backflow preventer, isolation valve, etc. Disinfect individual parts, fixtures, isolation valves, pipes, etc. by swabbing with full strength bleach (5.25%) or soaking for at least 30 minutes in a 500 ppm chlorine solution. The 500 ppm solution can be made by adding one part 5.25% bleach (household bleach) to 100 parts drinking water. For example 3-1/2 ounces of bleach can be added to 2-1/2 gallons drinking water. Materials should then be thoroughly rinsed before putting into service.

3.05 TRAINING

A. Obtain services of the copper press fitting manufacturer to provide on-site training for Contractor’s field personnel in the use of grooving tools, application of groove, and installation of grooved end couplings. The manufactures representative shall periodically visit the jobsite and provide the contractor information concerning the best recommended practices in grooved product installation. A distributor’s sales representative is not considered qualified to conduct the training or jobsite visit(s).

B. Obtain services of the grooved copper fitting manufacturer to provide on-site training for Contractor’s field personnel in the use of grooving tools, application of groove, and installation of grooved end couplings. The manufactures representative shall periodically visit the jobsite and provide the contractor information concerning the best recommended practices in grooved product installation. A distributor’s sales representative is not considered qualified to conduct the training or jobsite visit(s).

END OF SECTION 22 10 00

SECTION 22 10 30 – PLUMBING SPECIALTIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 SUMMARY

A. Provide all materials and installation for plumbing specialties within building domestic water, sanitary waste and storm drainage systems; floor drains, floor sinks, hub drains, roof drains, cleanouts, backflow preventers, vacuum breakers, pressure regulating valves, water hammer arrestors, wall hydrants, hose bibbs, trap primer units, strainers, temperature gauges, pressure gauges and other normal parts that make the systems complete, operable, code compliant and acceptable to the authorities having jurisdiction.

1.03 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:

1. 2009 Edition of the International Plumbing Code.

2. NOTE: MD Anderson takes various exceptions to the International Plumbing Code and has adopted the more stringent requirements within the Uniform Plumbing Code. These exceptions are included within Project Specifications and/or Project Design Drawings.

3. ANSI/NSF Standard 61 - Drinking Water System Components - Health Effects.

1.04 QUALITY ASSURANCE

1. Manufacturer’s name and pressure rating shall be permanently marked on valve body.

2. All materials shall be new, undamaged, and free of rust. Protect installed products and associated materials during progression of the construction period to avoid clogging with dirt, and debris and to prevent damage, rust, etc. Remove dirt and debris as work progresses.

3. Manufacturer Qualifications: Company shall have minimum three years documented experience specializing in manufacturing the products specified in this section.

4. Installer Qualifications: Company shall have minimum three years documented experience specializing in performing the work of this section. Installation of plumbing systems shall be performed by individuals licensed by the Texas State Board of Plumbing Examiners as a Journeyman or Master Plumber. Installation may be performed by Apprentice Plumbers provided they are registered with the Texas State Board of Plumbing examiners and under direct supervision of a licensed plumber. All installation shall be supervised by a licensed Master Plumber.

1.05 SUBMITTALS

A. Product Data:

1. Provide Code and Standards compliance, component dimensions, service sizes and finishes.

B. Record Documents:

1. Manufacturer's certification documentation for backflow preventers.

2. Submit proposed location of access panels which vary from quantities or locations indicated on Contract Drawings.

3. Provide full written description of manufacturer's warranty.

4. Record actual locations of plumbing specialties installed.

C. Operation and Maintenance Data:

1. Include testing procedures for backflow preventers, adjustment procedures for water pressure regulating valves.

2. Include installation instructions, exploded assembly views. servicing requirements, inspection data, installation instructions, spare parts lists, replacement part numbers and availability, location and contact numbers of service depot, for all plumbing specialties installed

1.06 DELIVERY, STORAGE AND HANDLING

A. Accept specialties on site in shipping containers and maintain in place until installation.

B. Provide temporary protective coating and end plugs on valves not packaged within containers. Maintain in place until installation.

C. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work and isolating parts of completed system.

D. Protect all materials before and after installation from exposure to rain, freezing temperatures and direct sunlight. EXCEPTION: Materials manufactured for installation within exterior environments.

1.07 EXTRA MATERIALS

A. Provide two loose keys for each type of wall hydrant box.

B. Provide manufacturer's standard test kit for each type of backflow preventer installed.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

B. Provide plumbing specialties as indicated and scheduled on the Contract Drawings and as specified herein. All materials and work shall meet or exceed all applicable Federal and State requirements and conform to adopted codes and ordinances of authorities having jurisdiction.

C. Pressure and temperature ratings of plumbing specialties shall be suitable for the anticipated system pressures and temperatures in which they are installed.

D. All materials within domestic water distribution systems that may come in contact with the potable water delivered shall comply with ANSI/NSF Standard 61.

E. All brass and bronze plumbing specialties within domestic water distribution systems that may come in contact with the potable water delivered shall have no more than 15% zinc content.

F. Specialties of same type shall be product of one manufacturer.

2.02 ACCEPTABLE MANUFACTURERS

A.	Floor Drains:	Wade, Zurn, Smith, Josam.
B.	Floor Sinks:	Wade, Zurn, Smith, Josam.
C.	Roof Drains:	Wade, Zurn, Smith, Josam.
D.	Wall/Floor Cleanouts:	Wade, Zurn, Smith, Josam.
E.	Backflow Preventers and Vacuum Breakers:	Watts Regulator, Febco, Conbraco.
F.	Water Pressure Regulating Valves:	Wilkins, Watts Regulator, Cla-Val.
G.	Water Hammer Arrestors:	Wade, Zurn, Smith, Josam.
H.	Wall Hydrants:	Wade, Zurn, Smith, Josam.
I.	Hose Bibbs:	Chicago.
J.	Trap Primer Units:	As Specified Herein
K.	Stainers:	Conbraco, Wilkins, Watts
L.	Temperature Gauges:	Ashcroft, Trerice, Weksler
M.	Pressure Gauges:	Ashcroft, Trerice, Weksler

2.03 FLOOR DRAINS (FD)

A. All floor drains shall be furnished and installed with all options and accessories required for a waterproof installation within the particular construction in which they are to be mounted.

B. Each floor drain shall be provided with a deep-seal p-trap unless noted otherwise.

C. Floor drains installed for general floor area drainage within toilet rooms and other finished spaces shall have cast iron body with flange, adjustable top and sediment bucket, integral reversible clamping collar, seepage openings, 1/2" plugged primer tap, and 6” diameter nickel bronze or stainless steel strainer with vandal proof screws.

D. Floor drains installed for general floor area drainage and light to medium flow indirect equipment discharge within mechanical rooms shall have cast iron body with plugged 1/2" primer tap, integral clamping collar, seepage openings, adjustable top and 11-1/2” diameter ductile iron loose set tractor grate.

E. Floor drains installed for non-monolithic shower stall floors shall have cast iron body with flange, adjustable top, integral reversible clamping collar, seepage openings and 5” diameter nickel bronze or stainless steel strainer with vandal proof screws.

F. All floor drains shall be as sized and scheduled on Contract Drawings.

2.04 FLOOR SINKS (FS)

A. All floor sinks shall be furnished and installed with all options and accessories required for a waterproof installation within the particular construction in which they are to be mounted.

B. Each floor sink shall be provided with a deep-seal p-trap unless noted otherwise.

C. Floor sinks installed for general floor area drainage shall have 8” round cast iron body with 3" sump, acid resistant enamel interior, aluminum dome strainer, seepage flange, membrane clamping device and 7-3/8” diameter stainless steel or nickel bronze top.

D. Floor sinks installed to receive indirect equipment discharge shall have cast iron 12" square body with 8" sump, acid resistant enamel interior, aluminum dome strainer, seepage flange, membrane clamping device and stainless steel top. Top shall be ½ or ¾ grate as scheduled on Drawings.

E. All floor sinks shall be as sized and scheduled on Contract Drawings.

2.05 HUB DRAINS (HD)

A. Hub drains shall be cast iron soil pipe manufactured hubs or hub adapters. Field cut no-hub or plain-end pipe stub-ups are not acceptable.

B. Each hub drain shall be provided with a deep-seal p-trap.

~~2.06 ROOF DRAINS (RD)~~

~~A. Primary roof drains shall be furnished and installed with all options and accessories required for a waterproof installation within the particular construction in which they are to be mounted and have lacquered cast iron body with sump, removable cast iron or bronze dome strainer, flashing flange and clamp, gravel stop, deck clamp and drain receiver. Provide extension where required.~~

~~B. Secondary (emergency overflow) roof drains shall be furnished and installed with all options and accessories required for a waterproof installation within the particular construction in which they are to be mounted and have minimum 2" high water dam, acid resistant epoxy coated cast iron body and sump, removable bronze dome strainer, flashing flange and clamp, gravel stop, deck clamp and drain receiver. Provide extension where required.~~

~~C. Roof drains shall be sized as indicated on Contract Drawings.~~

~~2.07~~**2.06** CLEANOUTS:

A. Cleanouts shall be the same nominal size as the pipe they serve up to four inches.

B. Cleanouts shall have cast iron body with tapered cast brass or bronze plug providing gas and watertight seal.

C. Interior floor cleanouts shall have stainless steel or nickel bronze scoriated top. Provide carpet marker when installed in areas to be covered by carpet.

D. Exterior cleanouts at grade shall have scoriated cast iron top.

E. Wall cleanouts shall be provided with stainless steel access covers of adequate size to allow rodding of drainage system. Wall cleanouts incorporating cover screws that extend completely through the access plug are not acceptable.

~~2.08~~**2.07** BACKFLOW PREVENTERS (INCLUDES BACKPRESSURE AND BACKSIPHONAGE)

A. Reduced Pressure Zone Type (Not For Use In Fire Protection Water Supply):

1. The assembly shall meet the requirements of ASSE 1013, AWWA C511.

2. The assembly shall consist of a pressure differential relief valve located in a zone between two positive seating check valves and captured springs. Backsiphonage protection shall include provision to admit air directly into the reduced pressure zone via a separate channel from the water discharge channel. The assembly shall include two tightly closing shutoff valves before and after the valve and test cocks.

3. Test cocks

4. Seats: Bronze, removable and replaceable without removing valve from the line.

5. Checks: Independently operating.

6. Relief Valve: Independently operating, located between the two check valves.

7. Rated 175 psi maximum working pressure with continuous temperature range of 33 to 140°F.

8. Unit to be complete with vent-port funnel to maintain the air gap and to provide a drain connection point.

9. Sizes 1/4" and 1/2" - Bronze body, bronze strainer, upstream and downstream quarter-turn ball valves, union connections: Watts Regulator Company Series 009.

10. Sizes 3/4" through 2" - Bronze body, bronze strainer, upstream and downstream quarter-turn ball valves, union connections: Watts Regulator Company Series 919.

11. Sizes 2-1/2" through 10" - FDA epoxy coated cast iron body, FDA epoxy coated strainer, upstream and downstream OSY – UL/FM outside stem and yoke resilient seated gate valves, flange connections: Watts Regulator Company Series 909.

B. Reduced Pressure Zone Type (For Use In Fire Protection Water Supply):

1. The assembly shall meet the requirements of ASSE 1013, be U.L. classified and FM Approved.

2. The assembly shall consist of a pressure differential relief valve located in a zone between two positive seating check valves and captured springs. Backsiphonage protection shall include provision to admit air directly into the reduced pressure zone via a separate channel from the water discharge channel. The assembly shall include two tightly closing shutoff valves before and after the valve and test cocks.

3. Test cocks

4. Replaceable seats

5. Checks: Independently operating.

6. Relief Valve: Independently operating, located between the two check valves.

7. Rated 175 psi maximum working pressure with continuous temperature range of 33 to 110°F.

8. Unit to be complete with vent-port funnel to maintain the air gap and to provide a drain connection point.

9. Sizes 2-1/2" through 10" - Schedule 40 stainless steel body, upstream and downstream UL/FM outside stem and yoke resilient seated gate valves or UL/FM grooved gear operated butterfly valves with tamper switches: Watts Regulator Company Series 957.

C. Double Check Valve Assembly (Not for Fire Protection Water Supply):

1. The assembly shall meet the requirements of ASSE 1015, AWWA C510

2. Top entry access points for each check assembly

3. Replaceable seats

4. Test cocks

5. Rated 175 psi maximum working pressure with continuous temperature range of 33 to 140°F.

6. Sizes 1/2" through 2" - Bronze alloy body, bronze strainer, upstream and downstream quarter-turn ball valves, union connections: Watts Regulator Company Series 719.

7. Sizes 2-1/2" through 10" - FDA epoxy coated cast iron body, FDA epoxy coated strainer, upstream and downstream OSY – UL/FM outside stem and yoke resilient seated gate valves, flange connections: Watts Regulator Company Series 709.

D. Double Check Valve Assembly (For Use In Fire Protection Water Supply):

1. The assembly shall meet the requirements of ASSE 1015, be U.L. classified and FM Approved.

2. Two independent tri-link check modules within a single housing

3. Sleeve access port

4. Four test cocks

5. Rated 175 psi maximum working pressure with continuous temperature range of 33 to 110°F.

6. Sizes 2-1/2" through 10" - Schedule 40 stainless steel body, upstream and downstream UL/FM outside stem and yoke resilient seated gate valves or UL/FM grooved gear operated butterfly valves with tamper switches: Watts Regulator Company Series 757.

E. Continuous Pressure Vacuum Breaker (Not For Use In Fire Protection Water Supply. Not to be used for backpressure protection):

1. Tested and certified under ASSE Standard 1056.

2. Suitable for continuous pressure hot and cold water.

3. Brass body and seat with silicon rubber discs.

4. Rated maximum pressure 150 psi and working temperature 33 to 180 degrees F.

5. Complete with quarter turn ball valves and test cocks.

6. Sizes 3/8” through 1” - Spill-resistant, Watts Regulator Company Series 008PCQT.

F. Dual Check Valves (For Use in Beverage Dispenser Water Supply):

1. Certified to ANSI/NSF Standard 18.

2. Tested and certified under ASSE Standard 1022.

3. Atmospheric port

4. 316 stainless steel body

5. Rated maximum pressure 150 psi and working temperature 33 to 130 degrees F.

6. Sizes ¼" and 3/8" – Watts Regulator Company Series SD-3.

~~2.09~~**2.08** WATER PRESSURE REGULATING VALVES

A. Low to Moderate Flow Systems (Less Than 70 GPM) and Individual Equipment

1. Sizes 1/2" through 2"
2. All bronze body
3. 0.25% maximum weighted average lead content
4. Integral stainless steel strainer screen
5. Built-in bypass check valve
6. FDA approved elastomers
7. Renewable seat
8. Union end connection
9. Rated for water temperature up to 180°F and minimum 300 psi inlet pressure. Provide model with inlet pressure rating, reduced pressure range and factory preset outlet pressure as scheduled on Contract Drawings.
10. Manufactured by Wilkins Series 600XL or approved equal by Watts.

B. Large Demand Systems

1. Sizes 1-1/4" through 2 - ASTM B62 bronze body
2. Sizes 2-1/2" and larger - ASTM A536 ductile iron body
3. Pressure reducing pilot control
4. Stainless steel disc guide, seat and bearing cover
5. Stainless steel stem, nut and spring
6. FDA approved Nylon reinforced Buna-N rubber diaphragm
7. Provide model(s) with size, temperature range, inlet pressure rating, reduced pressure range, outlet pressure and options as scheduled on Contract Drawings.
8. Cla-Val Company Series 90 or approved equal by Watts.

~~2.10~~**2.09** WATER HAMMER ARRESTORS (SHOCK ABSORBERS):

A. Nesting type bellows operated water hammer arrestor with male N.P.T. connection. Bellows and body casing made of Type 304 stainless steel. Water hammer arrestors shall be certified to the PDI WH-201 Standard and ASSE Standard 1010.

B. Arrestors shall be designed and manufactured for a maximum working temperature of 250F and maximum operating pressure of 125 P.S.I.G.

C. All arrestors shall be designed and approved for sealed wall installation without an access panel.

D. Water hammer arrestors shall be sized according to water hammer arresters standard PDI-WH-201 and as indicated on Contract Drawings.

~~2.11~~**2.10** WALL HYDRANTS (WH)

A. Provide antisiphon, non-freeze wall hydrant with brass casing, integral backflow preventer, vandalproof box with loose-key handle and finish as scheduled on Drawings.

~~2.12~~**2.11** HOSE BIBBS (HB)

A. General Areas: Provide Chicago Faucet No. 387 chrome plated brass hose bibb with ¾-inch female inlet, wall flange, tee handle and No. E27 vacuum breaker.

B. Housekeeping Mop Sinks: Provide Chicago Faucet No. 293-369COLDCP chrome plated brass hose bibb with ¾-inch female inlet, wall flange and lever handle.

~~2.13~~**2.12** FLOOR DRAIN TRAP PROTECTION INSERTS

A. Trap seal protection inserts shall only be installed where job conditions prevent the installation of water supplied trap primers.

1. Trap seal protection insert shall not be installed in drains receiving waste that may have a temperature greater than 140 degrees F.

2. Trap seal protection insert shall not be installed in drains receiving waste discharge flow of greater than 30 gallons per minute.

3. Trap seal protection insert shall not be installed in drains receiving corrosive or chemical waste.

B. Floor drain trap seal protection insert shall provide watertight seal inside the floor drain and prevent emission of sewer gas and backup of sewage.

C. Insert material shall be resistant to common cleaning solutions, lime scale and microbiological growth and incorporate a Elastomeric flexible tube that closes when water is not passing through and opens to permit water flow from an intermittent drip. Insert shall provide no restriction on water flow up to 30 gallons per minute.

D. Insert shall properly functions despite lodging of common debris such as mop strings, food residue, etc.

E. Trap seal protection insert shall be manufactured by ProSet "Trap Guard", model to suit installation.

~~2.14~~**2.13** WATER SUPPLIED TRAP PRIMER UNITS (TP)

A. Trap Priming devices that rely upon line pressure differential for activation are not allowed.

B. Electronic Trap Primers:

1. Provide model with quantity of outlets and type of mounting box as scheduled on Contract Drawings.

2. The number of traps served by a single trap priming device shall not exceed the number of header outlets provided within the device. Auxiliary distribution units are not allowed.

3. All unused header outlets shall be capped water-tight with compatible threaded fittings.

4. Each electronic trap primer device shall be provided with a readily serviceable strainer immediately upstream of the device solenoid valve.

5. Electronic trap primers shall provide 10 second water injection to traps every twenty-four hours, complete with galvanized steel box and cover, copper inlet connection, brass ball type stop valve, slow closing 24 VAC solenoid valve with integral strainer, 120-24 VAC transformer, brass atmospheric vacuum breaker, and copper waterway.

6. Electronic trap primers shall be manufactured by Zurn Z1020-CW or approved equal by Precision Plumbing Products “Prime Time”, model to suit installation.

C. Vacuum Breaker Trap Primer for use with exposed Flushometers:

1. This type of device shall not serve more than one trap.

2. One Piece, Chrome Plated Flush Connection.

3. Water Deflector to control the amount of water diverted from the flush.

4. 3/8” Elbow and Flex-bend Tube connection from Vacuum Breaker to wall.

5. Diverter Wall Flange and Fittings

6. Chrome Plated Wall Flange and Fitting to connect ½” NPT pipe.

7. High Back Pressure Vacuum Breaker.

8. One-piece Bottom Hex Coupling Nut.

9. Sloan Model VBF-72-A1

D. Trap Primer for use with Lavatory or Sink Drain Tailpiece:

1. This type of device shall not serve more than one trap.

2. Polished Chrome Plated Cast Bronze P-trap with Ground Joint Outlet.

3. Threaded Wall Tube, Slip Joint Nuts, Washers and Escutcheons.

4. 1/2" Polished Chrome Plated Bronze Primer Tube with Compression Fitting Connection at Wall.

5. Jay R. Smith Model 2698 or approved equal of a referenced acceptable manufacture.

~~2.15~~**2.14** STRAINERS

A. Strainers, 2" and smaller, bronze body, screwed ends, No. 20 mesh type 304 stainless steel screen, screwed cap with bronze blow-off valve (size to be determined by standard tap size in cap).

B. Strainers, 2-1/2" and larger, Cast iron body, isolating type flanged ends where installed in copper lines, .125” perforated type 304 stainless steel screen, flanged cap with bronze ball blow-off valve (size of blow-off valve shall be determined by standard tap size in cap). Special Note: All strainers 6" and larger shall have studs mounted in the body flange in lieu of bolts for removal of cap. Baskets for strainers 6" and larger shall have stainless steel reinforcing bands at ends to prevent collapsing.

~~2.16~~**2.15** TEMPERATURE GAUGES:

A. Thermometers shall be vapor or liquid actuated, direct-mounted, universal adjustable angle dial type with stainless steel or cured polyester powder coated cast aluminum case, stainless steel friction ring and glass window. Dial face shall be white with black figures; pointer shall be friction adjustable type. Movement shall be brass with bronze bushings. Bourdon tube shall be phosphor bronze with a brass socket.

B. Thermometer range shall be 30 - 240° Fahrenheit and have an accuracy of ±1 scale division.

C. Dial face shall be 4½” diameter where installed within eight feet of floor level and 6” diameter where installed higher than six feet above floor level. Provide remote read-out gauges for isolated or hard to access monitoring points.

D. Provide a brass or stainless steel separable thermowell for each thermometer.

E. Thermometers shall have a sensing bulb with an insertion length of roughly half of the pipe diameter; minimum insertion length shall be 2". Thermometers installed on tanks shall have a minimum insertion length of 5".

F. Where insulation thickness exceeds 2", provide proper bulb length and an extension neck separable thermowell. The extension neck shall be at least 2" long.

~~2.17~~**2.16** PRESSURE GAUGES:

A. Gauges shall comply with ASME B40.1, Grade 2A, and have ±0.5 percent of full scale accuracy, with type 304 stainless steel or aluminum case, bronze wetted parts and brass socket. Dial face shall be 3½” diameter where installed within six feet of floor level and 6” diameter where installed higher than eight feet above floor level. Dial face shall be aluminum with white background, black graduations and black markings. Pointer shall be adjustable with black finish. Provide remote read-out gauges for isolated or hard to access monitoring points.

B. Units of measure shall be in pounds per square inch (psi). The proper range shall be selected so that the average operating pressure falls approximately in the middle of the scale selected.

C. All pressure gauges shall be equipped with brass or stainless steel needle valves and pressure snubbers.

PART 3 - EXECUTION

3.01 PREPARATION

A. Coordinate cutting and forming of roof and floor construction to receive drains with General Contractor.

B. Verify location of equipment and housekeeping pads prior to installation of floor drains. Relocation due to misplacement shall be at Contractor's expense.

3.02 INSTALLATION

A. General

1. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

2. Install plumbing specialties in accordance with manufacturer's published instructions.

B. Drains and Cleanouts

1. Extreme care shall be used to set the top elevation of floor drains and floor sinks to meet the low point elevation of the finished floor.

2. Pipe connections to roof drains, above grade floor drains and floor sinks shall not directly contact or be encased in concrete.

3. Final mounting of interior cleanout top or access cover shall be set flush with the finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil.

4. Encase exterior cleanouts within 14" x 14" x 6" thick reinforced concrete pad. Set top flush with finished grade surface.

5. Locate cleanouts with required clearance for rodding of drainage system.

C. Backflow Preventers and Vacuum Breakers

1. Isolate all non-potable water requirements from the building domestic water system with backflow prevention device manufactured and certified for the particular application.

2. Pipe relief from backflow preventer indirectly to drain of sufficient size to evacuate maximum flow discharge.

3. Backflow preventers shall be duplexed full-size where located within domestic water lines serving in-patient areas, critical research areas, and/or any area or equipment where un-interruptible (24 hour) water service is required.

4. Test ports shall not be located more than 72 inches above finished floor or permanent platform.

5. Do not install vacuum breakers or backflow preventers above equipment, above ceilings, concealed within walls, or areas where water leakage can cause damage.

6. Install a strainer immediately upstream of each vacuum breaker and backflow preventer.

D. Water Hammer Arrestors (Hydraulic Shock Absorbers)-

1. Provide hydraulic shock absorbers in cold and hot water supply lines to each fixture branch, battery of fixtures and at each automatic, solenoid-operated or quick-closing valve serving equipment.

2. Locate and size hydraulic shock absorbers in accordance with PDI-WH-201 Standard and manufacturer's published recommendations.

E. Water Pressure Regulating Valves

1. Provide isolation valve, strainer and pressure gauge immediately upstream of each pressure regulating valve.

2. Provide pressure gauge and isolation valve immediately downstream of each pressure regulating valve.

3. Installation shall allow sufficient access to and space around components for adjustments and servicing.

4. Provide services of a direct factory representative for start-up service, inspection and necessary adjustments for all large demand regulators.

END OF SECTION 22 10 30

SECTION 22 40 00 – PLUMBING FIXTURES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 SUMMARY

A. This section includes the furnishing of all labor and materials necessary for a complete installation of all plumbing fixtures indicated on the Drawings and specified herein.

1.03 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:

1. 2009 Edition of the International Plumbing Code

2. NOTE: MD Anderson takes various exceptions to the International Plumbing Code and has adopted the more stringent requirements within the Uniform Plumbing Code. These exceptions are included within Project Specifications and/or Project Design Drawings.

3. Texas Department of Licensing and Regulation, Texas Accessibility Standards of the Architectural Barriers Act, Article 9102, Texas Civil Statutes

4. Americans with Disabilities Act, 28 CFR Part 35 Nondiscrimination on the Basis of Disability in State and Local Government Services, Final Rule, as published in the Federal Register

5. ICC/ANSI A117.1, "Accessible and Usable Buildings and Facilities" relative to plumbing fixtures for people with disabilities

6. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water

7. Texas Health and Safety Code, Chapter 372, Environmental Performance Standards for Plumbing Fixtures

8. ANSI/ASME A112, Plumbing Standards

1.04 PRODUCTS NOT FURNISHED BUT INSTALLED UNDER THIS SECTION

A. Rough-in for and make final connection to Owner furnished fixtures and equipment requiring plumbing services.

B. Rough-in for and make final connection to fixtures and equipment furnished under other divisions of these Contract Specifications requiring plumbing services.

1.05 QUALITY ASSURANCE

A. Fixtures, trim, accessories and carriers of any one type shall be by the same manufacturer throughout.

B. All fixtures and trim shall be new, institutional/commercial quality and free from mars, chips, scratches, blemishes or any defects.

1.06 SUBMITTALS

A. Product Data:

1. Provide manufacturer's data sheets indicating Code and Standards compliance, illustrations of fixtures, physical sizes, rough-in dimensions, utility sizes, trim and finishes.

B. Record Documents:

1. Provide full written description of manufacturer's warranty.

2. Manufacturer's installation instructions.

C. Operation and Maintenance Data:

1. Include installation instructions, exploded assembly views. servicing requirements, inspection data, installation instructions, spare parts lists, replacement part numbers and availability, location and contact numbers of service depot, for all plumbing specialties installed.

1.07 DELIVERY, STORAGE AND HANDLING

A. Accept fixtures on Site in factory packaging. Inspect for damage.

B. Protect all fixtures and trim before and after installation from exposure to rain, freezing temperatures and direct sunlight. EXCEPTION: Materials manufactured for installation within exterior environments.

C. Protect installed fixtures and trim from damage and/or entry of foreign materials by temporary covers during the construction phase of this project.

D. Do not allow use of installed fixtures and trim for any reason, other than testing, during the construction phase of this project.

1.08 EXTRA MATERIALS

A. Provide two service kits for each type of faucet, flush valve, shower/tub valve and all other trim/accessories having serviceable parts.

1.09 FIELD MEASUREMENTS

A. Verify that field measurements are either as indicated on Shop Drawings or as instructed by the manufacturer. Designate within submittals that measurements have been verified, and note which measurements are the basis for construction.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Stainless Steel Sinks: Just, Elkay

B. **Stainless Steel** Mop Sinks: ~~Crane/Fiat, Stern Williams~~**Just, Elkay**

C. Drinking Fountains: Oasis, Sunroc, Elkay, Halsey Taylor

D. Vitreous China Water Closets: American Standard, Kohler, Crane, Eljer

~~E. Vitreous China Clinical Flushing Rim Sinks: American Standard, Kohler, Crane, Eljer~~

~~F.~~**E.** Vitreous China Urinals: American Standard, Kohler, Crane, Eljer

~~G.~~**F.** Vitreous China Lavatories: American Standard, Kohler, Crane, Eljer

~~H. Cast Iron Bathtubs: American Standard, Kohler, Crane, Eljer~~

~~I.~~**G.** Manual Lavatory/Sink Faucets: Chicago

~~J. Manual Laboratory Sink Faucets: Chicago, WaterSaver~~

~~K.~~**H.** Electronic Lavatory/Sink Faucets (DC Powered): Chicago “HyTronic”

~~L.~~**I.** Electronic Lavatory/Sink Faucets (AC Powered): Chicago “HyTronic”

~~M. Manual Flush Valves: Sloan “Royal” or Zurn “AquaVantage”~~

~~N. Manual Flush Valves with Bedpan Washer: Sloan “Royal” or Zurn “AquaVantage”~~

~~O.~~**J.** Electronic Flush Valves (DC Powered): TOTO “EcoPower”, Sloan “Optima”, Zurn “AquaSense”

~~P. Electronic Flush Valves (AC Powered): Sloan “Optima” or Zurn “AquaSense”~~

~~Q.~~**K.** Shower/Bathtub Mixing Valves: Chicago “Tempshield”, Powers “Hydroguard”

~~R.~~**L.** Shower Heads/Hand Sprayer: Chicago, Powers, Leonard, Speakman

~~S. Bedpan Washers (Hand held): Chicago~~

~~T.~~**M.** Fixture Stops & Supplies: Chicago

~~U.~~**N.** Fixture Traps: Chicago, McGuire

~~V.~~**O.** Toilet Seats: Church, Bemis, Olsonite

~~W.~~**P.** Fixture Carriers: Wade, Josam, Zurn, Smith

~~X.~~**Q.** A.D.A. Insulation Kits: Mcguire, Truebro, Plumberex

2.02 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

B. Provide plumbing fixtures as indicated and scheduled on the Contract Drawings and as specified herein.

C. Fixtures, trim and accessories of any one type shall be by the same manufacturer.

D. All vitreous china fixtures shall be white in color unless noted otherwise on Drawings.

E. All plumbing fixture trim within public toilet rooms shall be furnished with vandal-proof trim.

F. All exposed brass fixture trim shall be heavily chrome plated.

G. Fittings and piping shall be brass and, wherever exposed, shall be polished chrome-plated. Provide tight fitting wall or floor escutcheons of chrome-plated brass or stainless steel wherever pipes pass through floors, walls or ceilings.

H. Fixture supplies shall be loose key angle stops with 1/2" I.P.S. female inlets and shall include wall flanges and brass risers. All components shall be chrome plated. In all cases, all piping, tubing, fittings and faucets shall be installed using mechanical non-slip connections, such as bull-nose, flanged, ferrule or threaded fittings. Fittings requiring a friction fit using slip-on or gasket connections are not acceptable. [EXCEPTION: Hose type riser supplies are acceptable when supplied and required by the fixture manufacturer]. Supply riser tubing for lavatories and sinks shall be minimum 3/8” O.D.

I. Provide A.D.A. compliant molded insulation on exposed water and drain piping beneath handicap accessible lavatories and sinks. Insulation shall be designed to allow removal and re-installation for pipe servicing.

J. Unless noted otherwise, install each lavatory, sink and drinking fountain with chrome-plated, 17 gauge trap with cleanout plug that is easily removable for servicing and cleaning. Slip joints shall be permitted only on the fixture trap inlet, within the trap seal and at outlet connection to the trap adapter.

K. Wall mounted water closets, lavatories, urinals and drinking fountains shall be supported with commercial carriers bolted to floor, model to suit installation. Provide concealed arm type carriers for lavatories.

L. Fixtures shall have flow control devices to limit the flow of water to a maximum rate in accordance with the following table:

FIXTURE	MAXIMUM WATER USAGE
Patient Shower Valve or Head	2.5 GPM (at 80 psi)
Non-Patient Shower Valve or Head	2.0 GPM (at 80 psi)
Staff Lavatory Faucet	2.2 GPM (at 60 psi)
Public Toilet Room Lavatory Faucet	0.5 GPM (at 60 psi)
Sink Faucet	2.2 GPM (at 60 psi)
Water Closet	1.28 Gallons Per Flush
Urinal	0.25 Gallon Per Flush

M. Stainless Steel Sinks

1. Stainless steel sinks shall be 18 gauge, Type 304 stainless steel with insulation undercoating.

2. Provide stainless steel covers for all unused sink faucet/accessory holes. Covers shall be secured with stainless steel bolt and wing nut. Snap-in type covers are not acceptable. Covers shall provide a watertight seal by utilizing rubber gasket or plumbers putty.

3. Sink strainer shall be 316 stainless steel.

N. Housekeeping Mop Sinks

1. Provide mop sink having dimensions as scheduled on Contract Drawings

2. Receptor shall be precast terrazzo composed of marble chips and Portland cement, ground smooth, grouted and sealed to resist stains.

3. Stainless steel caps shall be cast integral on all curbs.

4. Shoulders shall not be less than 9-3/4" high inside (12” high outside) measurement, and not less than 1-1/4" wide. Drop front shoulders shall have 6” high outside measurement.

5. Tiling flanges shall be cast integral and extend 1" above shoulder on 1, 2 or 3 sides (as required per Project).

6. Drain shall be cast brass with stainless steel strainer cast integral and shall provide for a code compliant connection to a 3" pipe.

O. Water Closets

1. Water closets shall be vitreous china, wall-mounted elongated bowl having siphon jet flushing action design.

2. Water closet bowls installed within non-ambulatory patient toilet rooms shall be furnished with slotted rim for bedpan holding.

3. Water closet bowl gaskets shall be neoprene, felt gaskets and wax rings are not permitted.

4. Wall mounted water closets shall be supported with extra-heavy duty commercial carriers bolted to floor and rated for a 500 pound load. Carrier model shall be designed for the actual fixture being supported and provided with all options and accessories manufactured by the carrier manufacturer for a complete installation. Provide auxiliary foot support as recommended by the manufacture to prevent bending of fixture support stud bolts.

5. Water closet seats shall be commercial/institutional grade, white in color, have open front and stainless steel self-sustaining check hinges.

P. Flush Valves

1. All electronic flush valves shall be provided with manual override activators. EXCEPTION: Flush valves located within specimen collecting toilet rooms shall be hard-wired without manual override activator.

2. AC powered electronic flush valves located within Patient Care areas and critical Research areas shall be connected to the emergency electrical system.

3. Flush valves in non-ambulatory patient toilet rooms shall be manually operated and have integral bedpan washer.

Q. Faucets

1. Provide faucets with laminar flow outlets. Aerators shall not be acceptable. Faucet flow control devices shall be located at the spout outlet.

2. Provide vacuum breakers for all faucets that have threaded or serrated hose connection outlets (including laboratory pure water faucets).

3. Gooseneck spout outlets shall terminate five inches minimum and five & one half inches maximum above top rim of lavatory or sink. Horizontal dimension from spout inlet to spout outlet shall be a minimum five & one half inches.

4. Provide integral hot and cold water inlet check stops in all mixing type sink faucets that have hose connection outlets.

5. All non-public use electronic faucets shall be designed and manufactured to allow continuous water flow during usage for at least sixty seconds after initial activation.

6. All electronic lavatory faucets located within public toilet rooms shall be designed and manufactured to allow continuous water flow during usage for a maximum duration of ten seconds after initial activation.

7. AC powered electronic faucets located within Patient Care areas and critical Research areas shall be connected to the emergency electrical system.

8. All lavatory faucets within non-patient room toilets shall have low-profile (non-gooseneck) spouts and electronic sensor activation.

9. Lavatory faucets within patient rooms shall have gooseneck spouts and manually activated four-inch wrist blade operation.

10. Staff Lavatory Faucets:

    a. Chicago – HyTronic Traditional with internal temperature control mixer, 2.2 GPM flow outlet, Model 116.211.AB.1 for DC power, and Model 116.111.AB.1 for AC power.

11. Public Toilet Room Lavatory Faucets

    a. Chicago – HyTronic Traditional with internal temperature control mixer, .05 GPM flow outlet, Model 116.211.AB.1 for DC power and Model 116.111.AB.1 for AC power.

R. Shower and Bathtub Mixing Valves

1. Shower and bathtub mixing valves shall be ASME A112.18.1M, CSA B125, ASSE 1016 and ADA compliant, having combination thermostatic/pressure balancing replaceable cartridge, integral check valves, integral stops and high temperature limit set at 110° F.

2. Thermostatic/pressure balance mixing valves shall have brass body construction with polished chrome plated finish, lever control handles for volume and temperature, and 1/2" NPT connections.

3. Provide showerheads, tub spouts, hand-held shower systems, diverters, vacuum breakers and other trim accessories as scheduled on Contract Drawings.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that walls and floor finishes are prepared and ready for installation of fixtures.

B. Confirm that millwork is constructed with adequate provision for the installation of countertop lavatories, sinks, faucets and related trim and accessories.

C. Verify that electric power is available and of the correct characteristics.

3.02 PREPARATION

A. Rough-in fixture piping connections in accordance with minimum sizes required by code, as recommended by the manufacturer, and as indicated in Contract Drawings fixture rough-in schedule.

3.03 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. All installation shall be in accordance with manufacturer's published recommendations.

C. Furnish and install all labor, materials, equipment, tools and services and perform all operations required in connection with or properly incidental to the installation of complete plumbing fixtures, as indicated on Contract Drawings, reasonably implied therein or as specified herein, unless specifically excluded.

D. Each piece of trim shall be furnished whether specifically mentioned or not, in order to provide a complete first-class installation. Furnish and install all required water, waste, soil and vent connections to all plumbing fixtures, together with all fittings, supports, fastening devices, cocks, valves, traps, etc., leaving all in complete working order.

E. Provide accessible check valves in the individual cold and hot water fixture supply lines serving mixing valve type faucets or assemblies having hose connection outlets that are not equipped with integral check stops.

F. Coordinate mounting heights of plumbing fixtures with architectural details/elevations.

G. Install A.D.A. compliant water closet flush valve handles on wide side of toilet stalls.

H. Install fixtures and trim in accordance with manufacturer's instructions.

I. All exposed chrome plated, polished or enameled fixtures and trim shall be installed with special care, leaving no tool marks on finishes. Install flexible brass fixture supply risers using manufactured tube bending tools. Bending tubes only with the use of hands shall not be permitted.

J. Install each fixture trap, easily removable for servicing and cleaning.

K. Provide chrome-plated deep escutcheons where required to cover non-chrome-plated piping projecting through walls.

L. Thoroughly fill spaces between fixtures and walls, countertops and/or floors with waterproof, mold resistant, non-toxic, non-shrinkable white tile caulking.

M. Install components firmly fixed, level and plumb.

N. Install and secure all wall mounted fixtures in place with commercial carriers and bolts in accordance with manufacturer's instructions. Fixture weight shall not be transmitted to walls, partitions or service piping. Installation shall prevent any movement of fixture during use.

O. All non-monolithic shower floors shall be provided with drain pan attached to floor drain flange in accordance with the latest edition of the Uniform Plumbing Code. Refer to Architectural Contract Specifications and Drawings for pan materials and additional installation requirements.

3.04 INTERFACE WITH OTHER PRODUCTS AND TRADES

A. Review millwork Shop Drawings. Confirm location and size of fixtures and openings before rough-in and installation.

B. Provide templates for all fixtures to be mounted in millwork to General Contractor.

C. Coordinate with Electrical Contractor and insure proper power is provided for electric drinking fountains, sensor operated faucets and sensor operated flush valves

3.05 TESTING

A. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise or overflow.

B. Adjust and set sensor faucet mixing valves to provide desired water temperature at spout outlet.

C. Insure that all traps are filled with water and maintain trap seal. Each fixture shall be filled and then drained. Traps and fixture connections shall be proven water tight by visual inspection.

D. After fixtures have been installed and water systems are pressurized, test each fixture and associated trim for proper operation and inspect for leaks. Replace malfunctioning fixtures and components, then retest. Repeat procedure until all components operate properly.

E. Test drain pans installed for non-monolithic shower floors prior to installation of finished flooring. Fill pan with water to within 1” of top. Pan must maintain test water level without leakage for at least eight hours

3.06 CLEANING

A. Thoroughly clean all plumbing fixtures and equipment furnished under this Contract prior to final acceptance.

B. Thoroughly flush and clean all faucet spout outlet screens and flow control devices.

3.07 PROTECTION OF FINISHED WORK

A. Do not permit use of fixtures until after Substantial Completion has been announced by Owner.

END OF SECTION 22 40 00

SECTION 22 45 00 – EMERGENCY SHOWER AND EYE WASH EQUIPMENT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 SUMMARY

A. Provide all materials and labor for emergency shower and eye wash equipment, and associated piping, supports, valves, and accessories to provide complete, operable, and code compliant installation that is acceptable to the authorities having jurisdiction.

B. Emergency shower and eye wash equipment addressed by this specification shall be installed within conditioned or ventilated spaces having ambient temperatures between 60 and 100 degrees Fahrenheit.

1.03 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:

1. 2009 Edition of the International Plumbing Code.

2. ANSI Standard: Comply with ANSI Z358.1-2004, "Emergency Eyewash and Shower Equipment."

3. Texas Department of Licensing and Regulation, Texas Accessibility Standards of the Architectural Barriers Act, Article 9102, Texas Civil Statutes.

4. Americans with Disabilities Act, 28 CFR Part 35 Nondiscrimination on the Basis of Disability in State and Local Government Services, Final Rule, as published in the Federal Register.

5. ICC/ANSI A117.1, "Accessible and Usable Buildings and Facilities" relative to plumbing fixtures for people with disabilities.

6. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.

1.04 QUALITY ASSURANCE

A. All materials shall be new, undamaged, and free of rust. Protect installed products and associated materials during progression of the construction period to avoid clogging with dirt, and debris and to prevent damage, rust, etc. Remove dirt and debris as Work progresses.

B. Manufacturer Qualifications: Company shall have minimum three (3) years documented experience specializing in manufacturing the products specified in this section.

C. Installer Qualifications: Company shall have minimum three (3) years documented experience specializing in performing the Work of this Section. Installation of plumbing systems shall be performed by individuals licensed by the Texas State Board of Plumbing Examiners as a Journeyman or Master Plumber. Installation may be performed by Apprentice Plumbers provided they are registered with the Texas State Board of Plumbing examiners and under direct supervision of a licensed plumber. All installation shall be supervised by a licensed Master Plumber.

1.05 SUBMITTALS

A. Product Data:

1. Provide Code and Standards compliance, component dimensions, service sizes and finishes.

B. Record Documents:

1. Record actual locations of supply isolation valves, emergency shower and eye wash equipment installed.

2. Provide full written description of manufacturer's warranty.

3. Manufacturer's Installation Instructions: Indicate assembly and support requirements, adjustment and testing procedures.

C. Operation and Maintenance Data:

1. Include installation instructions, exploded assembly views, servicing requirements, inspection data, installation instructions, spare parts lists, replacement part numbers and availability, location and contact numbers of service depot, for all components installed.

2. Include cleaning, testing and adjustment procedures for all components installed.

1.06 DELIVERY, STORAGE AND HANDLING

A. Accept equipment and materials on Site in shipping containers and maintain in place until installation.

B. Protect installed equipment from damage and/or entry of foreign materials by temporary covers during the construction phase of this Project.

C. Do not allow use of installed equipment for any reason, other than testing, during the construction phase of this Project.

D. Protect all materials before and after installation from exposure to rain, freezing temperatures and direct sunlight.

1.07 EXTRA MATERIALS

A. Provide manufacturer's drench shower tester for each emergency shower installed.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

B. Provide emergency equipment as indicated and scheduled on the Contract Drawings and as specified herein.

C. Pressure ratings of equipment and related accessories shall be suitable for the anticipated system pressures in which they are installed.

D. Equipment and components of same type shall be product of one (1) manufacturer.

E. All emergency equipment shall meet American with Disabilities Act (ADA) accessibility requirements for activation of controls and height of eye/face outlets with the following exceptions:

1. Equipment within boiler rooms or central plants.

2. Eye/face outlets located in countertops that are not required to be accessible.

F. Emergency equipment activation devices shall be designed so that the flushing water remains on without requiring the use of the operator's hands. The valve shall be designed to remain activated until intentionally shut off.

G. Shower head flow rate shall be 20 gallons per minute at a minimum 30 pounds per square inch water pressure.

H. Eye Wash unit shall provide flushing fluid at 0.4 gallons per minute at a minimum 30 pounds per square inch water pressure.

I. Face Wash unit shall provide flushing fluid at 3 gallons per minute at a minimum 30 pounds per square inch water pressure.

2.02 ACCEPTABLE MANUFACTURERS:

A. Water Saver

B. Bradley

C. Haws

D. Speakman

E. Guardian

2.03 COMBINATION EMERGENCY SHOWER AND EYE/FACE WASH:

A. Barrier-free design with coated galvanized steel piping; 10 inch diameter yellow impact-resistant plastic shower head; Chrome-plated brass 1 inch IPS stay-open ball-type shower valve operated by stainless steel pull rod having triangular handle; 10 inch diameter stainless steel eye wash bowl; chrome-plated brass spray head assembly with twin, soft flow, eye wash heads and protective spray head covers; integral flow control capable of maintaining uniform flow under varying water supply conditions from 30-90 psig; Chrome-plated 1/2 inch IPS stay-open ball-type eye wash valve hand operated by a large, highly visible safety yellow PVC push handle; chrome-plated circular face spray ring; universal identification sign; inspection tag, and 1-1/4 inch water supply connection.

B. Combination emergency shower and eye/face wash units shall be Bradley Model S19-310BF or approved equal by an acceptable manufacturer listed herein.

2.04 DRENCH SHOWER WITH HORIZONTAL SUPPLY:

A. Barrier-free design with coated galvanized steel piping; 10 inch diameter yellow impact-resistant plastic shower head; Chrome-plated brass 1 inch IPS stay-open ball-type shower valve operated by stainless steel pull rod having triangular handle; universal identification sign; inspection tag, and 1 inch water supply connection.

B. Drench shower units with horizontal supply shall be Bradley Model S19-120BF or approved equal by an acceptable manufacturer listed herein.

2.05 DRENCH SHOWER - FLUSH-MOUNTED:

A. Barrier-free design with coated galvanized steel piping; 12-7/8 inch diameter flanged stainless steel shower head; Chrome-plated brass 1 inch IPS stay-open ball-type shower valve operated by stainless steel pull rod having triangular handle; universal identification sign; inspection tag, and 1 inch water supply connection.

B. Flush-mounted drench shower units shall be Bradley Model S19-120FMBF or approved equal by an acceptable manufacturer listed herein.

2.06 DRENCH SHOWER WITH VERTICAL SUPPLY:

A. Barrier-free design with 10 inch diameter stainless steel shower head; stainless steel 1 inch IPS stay-open ball-type shower valve operated by stainless steel pull rod having triangular handle; universal identification sign; inspection tag, and 1 inch water supply connection.

B. Drench shower units with horizontal supply shall be Bradley Model S19-130SSBF or approved equal by an acceptable manufacturer listed herein.

2.07 DRENCH SHOWER TESTER:

A. Watertight, chemical resistant 84 inch long funnel constructed of Tyvek®, with weighted bottom and 6 foot telescoping aluminum handle.

B. Drench shower testers shall be Bradley Model S19-330ST or approved equal by an acceptable manufacturer listed herein.

2.08 EYEWASH - SWING-TYPE, COUNTER MOUNTED:

A. Chrome-plated brass spray head assembly with twin, soft flow, eye wash heads and protective spray head covers; integral flow control capable of maintaining uniform flow under varying water supply conditions from 30-90 psig; Chrome-plated 1/2 inch IPS stay-open ball-type eye wash valve hand operated by a large, highly visible stainless steel push handle; chrome plated brass pipe and fittings; universal identification sign; inspection tag, and 1/2 inch water supply connection.

B. Swing-type eyewash units shall be Bradley Model S19-270(B)(L) or approved equal by an acceptable manufacturer listed herein.

2.09 EYE/FACE WASH - SWING-TYPE, COUNTER MOUNTED:

A. Universal right or left hand mounting with locking mechanism; twin perforated disc eye/face wash heads with protective pop-off spray head covers; integral flow control capable of maintaining uniform flow under varying water supply conditions from 30-90 psig; Chrome-plated 1/2 inch IPS stay-open ball-type valve operated by pulling swing arm 90 degrees over sink; chrome plated brass pipe and fittings; universal identification sign; inspection tag, and 1/2 inch water supply connection.

B. Swing-type eye/face wash units shall be Bradley Model S19-270E or approved equal by an acceptable manufacturer listed herein.

2.10 EYE/FACE WASH - DECK/COUNTER TOP MOUNTED:

A. Stainless steel 13-5/8 inch diameter bowl; twin perforated disc eye/face wash heads with protective pop-off spray head covers; integral flow control capable of maintaining uniform flow under varying water supply conditions from 30-90 psig; Chrome-plated 1/2 inch IPS stay-open ball-type valve operated by stainless steel push down handle; coated galvanized steel pipe and fittings; dome type strainer; 1-1/4 inch drain fitting; universal identification sign; inspection tag, and 1/2 inch water supply connection.

B. Counter top mounted bowl type eye/face wash units shall be Bradley Model S19-260 or approved equal by an acceptable manufacturer listed herein.

2.11 EYE/FACE WASH - WALL MOUNTED:

A. Barrier-free design with stainless steel 10 inch diameter bowl; stainless steel wrap-around skirt; chrome-plated brass spray head assembly with twin, soft flow, eye wash heads and protective spray head covers; integral flow control capable of maintaining uniform flow under varying water supply conditions from 30-90 psig; Chrome-plated 1/2 inch IPS stay-open ball-type eye wash valve hand operated by a large, stainless steel push handle; chrome-plated circular face spray ring; chrome plated brass pipe and fittings; dome type strainer; 1-1/4 inch drain fitting, wall tube and trap; universal identification sign; inspection tag, and 1/2 inch water supply connection.

B. Wall mounted bowl type eye/face wash units shall be Bradley Model S19-220BF or approved equal by an acceptable manufacturer listed herein.

2.12 EYEWASH - WALL CABINET MOUNTED:

A. Barrier-free design with stainless steel cabinet and doors; lockable, hinged bottom panel for plumbing access; chrome-plated brass spray head assembly with twin, soft flow, eye wash heads and protective spray head covers; integral flow control capable of maintaining uniform flow under varying water supply conditions from 30-90 psig; Chrome-plated 1/2 inch IPS stay-open ball-type eye wash valve activated by pulling door down 90 degree; chrome plated brass pipe and fittings; 1-1/4 inch drain fitting and trap; brass water stop valve; universal identification sign; inspection tag, and 1/2 inch water supply connection.

B. Wall cabinet mounted eyewash units shall be Bradley Model S19-282PT or approved equal by an acceptable manufacturer listed herein.

PART 3 - EXECUTION

3.01 PREPARATION

A. Examine roughing-in for plumbing piping systems to verify actual locations of piping connections prior to installation of emergency equipment. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Coordinate location of emergency equipment with General Contractor to allow identification of required clear floor space area for emergency shower access.

C. Coordinate location of counter mounted emergency eyewash and eye/face wash fixture with General Contractor for proper drilling/cutting of casework to allow drenching water to spill into sink.

3.02 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. All installation shall be in accordance with manufacturer’s published recommendations.

C. Install in emergency shower, eyewash and eye/face wash equipment in accordance with manufacturer’s published instructions.

D. Locate emergency equipment on a level surface area for user.

E. Safety drenching equipment shall not be located within eighteen (18) inches of electrical apparatus, telephones, thermostats, or power outlets.

F. Emergency shower heads shall be positioned 82 inches – 96 inches from floor. The center of the spray pattern shall be located at least 16 inches from wall or nearest obstruction.

G. Emergency eyewash nozzles shall be positioned 33 inches- 45 inches from floor and at least 6" from wall or nearest obstruction.

H. Connect potable water supply having a temperature between 60 degrees F. and 100 degrees F. to emergency equipment. Potable water supply shall be capable of supplying adequate flushing to meet requirements of reference standards.

I. Provide hydraulic shock absorbers in water supply lines to each emergency shower. Locate and size in accordance with PDI-WH-201 Standard and manufacturer's published recommendations.

J. Provide and accessible ball type shutoff valve in individual water supply line serving safety drenching equipment. Valves shall be labeled for identification and locked in the open position.

K. Provide and install stainless steel escutcheons on piping wall and ceiling penetrations in exposed, finished locations.

L. Coordinate with General Contractor for location and installation of emergency equipment identification signage and inspection tags.

3.03 TESTING

A. Adjust or replace fixture flow regulators for proper flow.

B. After plumbing connections have been made, test for compliance with requirements. Verify ability to achieve required flows and temperatures.

C. Report test results in writing.

END OF SECTION 22 45 00

SECTION 22 60 00 – MEDICAL VACUUM AND GAS PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 SUMMARY

A. This section includes the furnishing of all labor and materials necessary for complete installation, cleaning, testing and certification of medical vacuum, waste anesthesia gas disposal and gas distribution and monitoring systems, including; piping, inlets, outlets, alarms, valves, supports, labeling, identification and all related accessories. Medical gas systems include Oxygen, Compressed Air, Nitrous Oxide, Carbon Dioxide and Nitrogen.

1.03 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:

1. NFPA 99 Standard for Health Care Facilities

2. NFPA 70 National Electrical Code

3. ASTM B819 Seamless Copper Tube for Medical Gas Systems

4. AWS A5.8 Brazing Filler Metal

5. CGA V-5 Diameter Index Safety System

6. Title 25, Texas Administrative Code, Chapter 133, Hospital Licensing

D. Comply with all Federal and State regulations applicable to this installation.

1.04 QUALITY ASSURANCE

A. All materials, equipment, installation, testing and certification shall be in strict accordance with NFPA 99 for Level 1 Medical–Surgical Vacuum, WAGD and Gases.

B. Manufacturer's name and pressure rating shall be permanently marked on valve body.

C. Products of same type shall be by one manufacturer. All valves, valve boxes, inlets, outlets, alarms and associated components shall be supplied by a single manufacturer and shall be fully compatible with existing system and service devices.

D. Verify compatibility of all new components with existing system and services.

E. Maintain one copy of each Contract Document on Site.

F. Prior to any installation Work, the installer of medical vacuum and gas piping shall provide and maintain documentation on the job Site for the qualification of brazing procedures and individual brazers as required by NFPA 99.

1.05 SUBMITTALS

A. General:

1. All submitted data shall be specific to this project and identified as such. Generic submittal data will not be accepted.

B. Product Data:

1. Manufacturers descriptive literature, illustrations and installation instructions for all components included within this project indicating compliance with applicable referenced standards, size, dimensions, model number, electrical characteristics and connection requirements.

C. Shop Drawings:

1. Wiring diagrams for medical vacuum and gas alarm systems. Differentiate between manufacturer-installed and field-installed wiring.

D. Record Documents:

1. Record actual locations of piping, valves, alarm sensors, alarm panels, station inlets and outlets.

2. Prepare and provide valve charts.

3. Provide record of test procedures and the results of all tests indicating room and area designations, dates of the tests, and names of persons conducting the tests.

4. Brazer Certificates: Installation Contractor shall present written documentation (less than 3 years old) from a recognized agency trained in administering and testing brazing techniques as per AWS B2.2 or ASME Section IX, certifying that all brazers have been thoroughly trained and tested in the complete installation of medical gas systems.

5. Provide full written description of manufacturer's warranty.

E. Operation and Maintenance Data:

1. Operation Data: Include manufacturer's installation and operating instructions.

2. Maintenance Data: Servicing and testing requirements, inspection data, exploded assembly views, Record Documents, inspection data, test reports, installation instructions, replacement part numbers and availability, location and contact numbers of service depot.

1.06 DELIVERY, STORAGE AND HANDLING

A. Tubes, valves, fittings, station outlets, and other piping components in medical gas systems shall have been cleaned for oxygen service by the manufacturer prior to installation in accordance with CGA 4.1, Cleaning Equipment for Oxygen Service, except that fittings shall be permitted to be cleaned by a supplier or agency other than the manufacturer.

B. Each length of tube shall be delivered plugged or capped by the manufacturer and kept sealed until prepared for installation.

C. Fittings, valves, and other components shall be delivered sealed, labeled, and kept sealed until installation.

D. Where contamination is known to have occurred, the materials affected must be removed and replaced with new materials that are cleaned and sealed by the manufacturer or supplier.

1.07 QUALIFICATIONS

A. General: Companies specializing in manufacturing, installing, testing, certifying and servicing the products and systems specified in this section shall have minimum five years documented experience and be certified as required by the Texas Department of Health and NFPA 99.

B. Manufacturers: Firms regularly engaged in manufacture of medical gas systems equipment and products, of types, materials, and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years. References may be required.

C. Equipment Supplier: The medical vacuum and gas systems equipment supplier shall provide the services of a manufacturer authorized product specialist to periodically coordinate with the installing Contractor during initial installation of the pipeline systems and have a service organization located within 50 miles of the project Site to provide ongoing service support to MD Anderson after project completion.

D. Installer: Firm with at least 5 years of successful installation experience on projects with medical gas systems work similar to that required for project. All installations of the medical gas piping systems shall be done only by, or under the direct supervision of a holder of a master plumber license or a journeyman plumber license with a medical gas piping installation endorsement issued by the Texas State Board of Plumbing Examiners. All installers of medical gas system components must be qualified in accordance with the requirements of NFPA 99 and ASSE 6010, Medical Gas Systems Installers Professional Qualifications Standard. In addition, all brazers of medical gas system piping must be qualified in accordance with the requirements of either Section IX, Welding and Brazing Requirements of the ASME Boiler and Pressure Vessel Code, or AWS B2.2, Standard for Brazing Procedure and Performance Qualification.

E. System Verification Testing Agency: Testing shall be conducted by a party technically competent and experienced in the field of medical gas and vacuum pipeline testing and meeting the requirements of ANSI/ASSE Standard 6030, Medical Gas Verifiers Professional Qualifications Standard. Quality control standards of testing agency shall be in strict accordance with American National Standards Institute (ANSI) Q-91. Firm shall be regularly engaged in the testing and certification of similar facilities with a minimum of 5 years of experience.

F. Installer of axially swaged fittings shall be certified by a recognized agency trained in administering axially swaged fitting installation techniques. Installation Contractor shall present written documentation of certification (less than 3 years old).

1.08 MEDICAL GAS PIPE "HOT-TAP" PROCEDURE

A. Connections to active medical gas piping may be performed only when approved in writing by and closely coordinated with the Owner.

B. Connections shall be performed by a firm specializing in "Hot-Tapping" existing active medical gas piping systems.

C. The procedure shall incorporate blocking valves, blocking glands, pneumatic end seals and employ a cryogenic compression fitting technology that is approved by The National Fire Protection Association and manufactured for use on medical gas and vacuum pipe systems.

D. Cryogenic compression fittings shall be ASTM F 2063, nickel-titanium, shape-memory-alloy, manufactured cleaned, purged, and sealed for oxygen service according to CGA G-4.1. Memory-metal fittings shall be tested and rated to burst pressure of the copper pipe, approximately 7500 psig. The coupling shall meet or exceed the standard for a brazed joint and not generate any contamination during installation.

E. Couplings shall be applied without the use of heat and shall provide a permanent, leak-free, metal-to-metal seal between the coupling and the tubes or pipe throughout the life of the joint.

F. Redundant components shall be available during the procedure for re-installation purposes.

G. Acceptable Medical Gas "Hot-Tapping" Vender:

1. Smart Tap, Inc. - P.O. Box 277 - 415 Main Street - Oley, PA 19547 - Ph: 610-987-3001

1.09 SCHEDULING

A. Schedule Work to ensure installation is complete, tested and certified prior to Substantial Completion.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.02 PRESSURIZED MEDICAL GAS PIPING

A. All pipe shall be Type "K", ASTM B819, hard drawn seamless copper medical gas tubing. Pipe shall be identified by the manufacturer's markings, "OXY," "MED," or "OXY/MED" and with size designated reflecting nominal inside diameter.

B. Turns, offsets, and other changes in direction shall be made with brazed wrought copper capillary fittings complying with ANSI B16.22, Wrought Copper and Copper Alloy Solder-Joint Fittings; or brazed fittings complying with MSS SP-73, Brazed Joints for Wrought and Cast Copper Alloy Solder Joint Pressure Fittings. Cast copper alloy fittings shall not be permitted.

C. Brazed joints shall be made using a brazing alloy that exhibits a melting temperature in excess of 538°C (1000°F). Copper-to-copper joints shall be brazed using a copper–phosphorus or copper–phosphorus–silver brazing filler metal (BCuP series) without flux. Flux shall only be used when brazing dissimilar metals such as copper and bronze or brass, using a silver (BAg series) brazing filler metal. Brazing alloy comply with ANSI/AWS A.5.8, Specification for Brazing Filler Metal.

D. Threaded joints in medical gas distribution piping shall be limited to connections to pressure/vacuum indicators, alarm devices, and source equipment. All threads shall be tapered pipe threads complying with ANSI B1.20.1, Pipe Threads, General Purpose and be made up with polytetrafluoroethylene (such asTeflon™) tape or other thread sealant recommended for oxygen service, with the sealant applied to the male threads only. Where threaded nipples are required these shall be I.P.S. brass.

E. The use of shape memory alloy couplings may be used when making connections to existing piping sizes 2" and smaller. Memory-metal couplings shall have temperature and pressure ratings joints not less than that of a brazed joint. Shape memory alloy couplings shall be manufactured by TW Metals "CryoMed" or Aerofit "CryoFit".

F. The use of brass axially swaged, elastic strain preload fittings may be used when making connections to existing piping sizes 2" and smaller. Non-braze fittings shall provide metal to metal seal having pressure and temperature ratings not less than that of a brazed joint and when complete are permanent and nonseparable. Axially swaged fittings shall be cleaned and sealed for oxygen service and manufactured by Lokring Technology LLC.

G. Straight-threaded connections, including unions, flared and compression-type connections, including connections to station outlets and inlets, alarm devices, and other components shall not be permitted.

H. All pipe and fittings shall be supplied cleaned and sealed for oxygen service.

2.03 MEDICAL VACUUM PIPING

A. All vacuum piping sizes 1-1/2" and smaller shall be as specified for pressurized medical gas pipe. Vacuum pipe sizes 2" and larger shall be Type "K" or "L" hard-drawn seamless copper, either ASTM B 819 medical gas tube or ASTM B 88 water tube.

B. Turns, offsets, and other changes in direction shall be made with brazed wrought copper capillary fittings complying with ANSI B16.22, Wrought Copper and Copper Alloy Solder-Joint Fittings; or brazed fittings complying with MSS SP-73, Brazed Joints for Wrought and Cast Copper Alloy Solder Joint Pressure Fittings. Cast copper alloy fittings shall not be permitted.

C. Brazed joints shall be made using a brazing alloy that exhibits a melting temperature in excess of 538°C (1000°F). Copper-to-copper joints shall be brazed using a copper–phosphorus or copper–phosphorus–silver brazing filler metal (BCuP series) without flux. Flux shall only be used when brazing dissimilar metals such as copper and bronze or brass, using a silver (BAg series) brazing filler metal. Brazing alloy comply with ANSI/AWS A.5.8, Specification for Brazing Filler Metal.

D. Threaded joints in medical vacuum distribution piping shall be limited to connections to pressure/vacuum indicators, alarm devices, and source equipment. All threads shall be tapered pipe threads complying with ANSI B1.20.1, Pipe Threads, General Purpose and be made up with polytetrafluoroethylene (such asTeflon™) tape or other thread sealant recommended for oxygen service, with the sealant applied to the male threads only. Where threaded nipples are required, these shall be I.P.S. brass. Close nipples shall not be installed.

E. The use of shape memory alloy couplings may be used when making connections to existing piping sizes 2” and smaller. Memory-metal couplings shall have temperature and pressure ratings joints not less than that of a brazed joint. Shape memory alloy couplings shall be manufactured by TW Metals “CryoMed” or Aerofit “CryoFit”.

F. The use of brass axially swaged, elastic strain preload fittings may be used when making connections to existing piping sizes 2” and smaller. Non-braze fittings shall provide metal to metal seal having pressure and temperature ratings not less than that of a brazed joint and when complete are permanent and nonseparable. Axially swaged fittings shall be cleaned and sealed for oxygen service and manufactured by Lokring Technology LLC.

G. Mechanically formed, drilled and extruded tee-branch connections shall not be permitted.

H. Couplings and fittings incorporating an o-ring seal shall not be permitted.

I. Roll-grooved joints shall not be permitted.

J. Straight-threaded connections, including unions, flared and compression-type connections, including connections to station outlets and inlets, alarm devices, and other components shall not be permitted.

2.04 MEDICAL VACUUM AND GAS VALVES

A. General:

1. All valves for pressurized gases and valves for vacuum or WAGD services 1-1/2” and smaller shall be supplied cleaned and sealed (bagged) for oxygen service by the manufacturer.

2. Valves for vacuum or WAGD service sizes 2” and larger will not be required to be cleaned and sealed for oxygen service.

3. Provide quantity and size of valves as indicated on Contract Drawings and as required by NFPA 99.

4. Medical vacuum and gas valves, zone valve boxes and related accessories shall be manufactured by Patton’s Medical/Amico, BeaconMedaes, or Owner approved equal.

B. Source, Main, Riser and Service Line Shut-Off Valves:

1. Shut-off valves shall be full port, double seal, ball-type three piece design, designed for vacuum to 29 inches Hg and working pressures up to 600 WOG with bronze/brass body, blow-out proof stem and chrome plated brass ball and be serviceable in the line. Valve body shall have Teflon (TFE) material ball seat and stem seals. Seats/seals, lubricants and valve material shall be compatible with medical oxygen, nitrous oxide, compressed air, carbon dioxide, nitrogen and mixtures thereof at continuous pressure up to 600 psig and up to 100 degrees Fahrenheit.

2. Valve shall be provided with and operated by a lever-type handle requiring only a quarter turn from a fully open position to a fully closed position.

3. All valves shall be equipped with type "K" washed and degreased copper pipe stub extensions at both the inlet and outlet sides of the valve port to facilitate installation. On outlet pipe stub provide 1/8” FPT tap with plug to accept gauge or nitrogen purge connection. Stub extensions shall be supplied to Site capped at both ends

4. Valve tags showing the appropriate gas services, pressure rating, etc. shall be attached to each valve.

5. Each shut-off valve shall be provided with locking kit.

C. Zone Valve and Box Assemblies:

1. Each zone valve cabinet shall be recessed type and consist of the following components: A steel valve box housing single or multiple shut-off ball valves with tube extensions, an aluminum frame, and a pull-out removable window. Boxes shall be provided to accommodate size and type of medical vacuum and gas valves as indicated on Contract Drawings.

2. The valve box shall be constructed of 18 gauge steel complete with a white epoxy finish and provided with two galvanized steel brackets for the purpose of mounting to structural support. The assembly trim shall accommodate various finished wall thickness of up to one inch and be field adjustable. Cabinets shall be designed to permit box assemblies to be ganged together in a vertical stack.

3. The doorframe assembly shall be constructed of anodized aluminum mounted to the back box assembly by screws as provided and shall have a sliding removable front consisting of an opaque door with a pre-mounted pullout ring and clear gauge window. Access to the zone shut-off valves shall be by merely pulling the ring assembly to remove the window from the doorframe. The window shall be capable of re-installation without the use of tools and only after the valve handles have been returned to the open position. The window shall be labeled "Caution – Medical Gas Shut-Off Valve - Close Only in Emergency", or equivalent wording in accordance with NFPA 99.

4. Valves shall be same as specified herein for line shut-off valves except locking devices are not required.

5. Each valve shall be supplied with an identification bracket bolted directly onto the valve body for the purpose of applying an approved medical gas identification label. A package of labels shall be supplied with each valve box assembly for application by the installer.

6. All valves shall be securely attached to the box and provided with Type "K" washed and degreased copper pipe stub extensions of sufficient length to protrude beyond the sides of the box for connection to system piping. All pipe stub extensions shall be supplied with 1/8" NPT gauge port located on the terminal outlet side of the valve to register pipeline pressure or vacuum. Suitable plugs or caps shall be installed by the manufacturer to prevent contamination of the assembly prior to installation.

7. Gauges shall be minimum 1-1/2” diameter, with metal case and ring, and an 1/8" NPT brass stud at the back of the gauge for the purpose of mounting onto pipe stub extension within the box. The pipe stub extension shall be complete with a soldered gauge holder. Gauge holders shall be sealed with a brass plug to prevent contamination prior to mounting gauges. Pressure gauges shall read 0-700 kPa (0-100 psig) for all gases except nitrogen, which shall read 0-2000 kPa (0-300 psig), and vacuum, which shall read -100-0 kPa (0-30" Hg). Gauges shall be visible through the door of the zone valve box.

8. Valve box may house one to six valves.

9. Each valve may incorporate a gas specific DISS demand check valve for installation of a DISS specific sensor.

2.05 MEDICAL VACUUM AND GAS CHECK VALVES

A. Check valves shall be center guided, self-aligning, spring loaded ball type check with brass body, Teflon seat, straight-through flow, 400 psi WOG minimum working pressure, having vibration free, silent operation.

B. Check valves shall be 100% leak tested and comply with NFPA 99.

2.06 SERVICE INLETS AND OUTLETS

A. General:

1. Inlets and outlets shall be UL listed and conform to applicable NFPA and CGA standards.

2. Inlets and outlets shall consist of separate roughing-in and finish assemblies and be modular in design for wall recessed type installation and attachment to concealed piping.

3. For positive pressure gas services, the outlet shall be equipped with a primary and secondary check valve. The secondary check valve shall be rated at a minimum 1379 KPa (200 psi) in the event the primary check valve is removed for maintenance.

4. The roughing-in assembly shall be corrosion resistant with a permanent pin-keying system for each specific gas and be provided with a Type "K", 1/2" outside diameter, 6-1/2” long copper inlet pipe stub, which is silver brazed to the outlet body. The copper tubing inlet shall rotate 360 degrees to allow connection from any direction. The assembly shall allow pressure testing without additional labor to remove plug or adapter after testing.

5. The finishing assembly shall contain a primary check valve, pin-key indexing, a minimum of 2.5 square inches of color coding and incorporate a plaster adjustment from 3/8" to 3/4" variation in wall thickness. Design shall be such as to ensure absolutely no gas flow until the correct adapter is fully engaged. Each assembly shall have a separate cover plate for ease of service without preventing use of other inlets or outlets.

6. All inlets and outlets shall be factory assembled, tested, cleaned for oxygen service, and supplied with temporary protective covers and packages to protect outlet during handling and installation at the job Site.

7. Medical inlets and outlets and related accessories shall be manufactured by Patton's Medical/Amico, BeaconMedaes, or Owner approved equal.

B. Wall Inlets:

1. Wall inlets for Waste Anesthesia Gas Disposal (WAGD) services shall be quick-connect recessed type and be compatible with Medaes Diamond style pin indexed adapters.

2. Wall inlets for Vacuum services shall be Diameter Index Safety System (DISS) recessed type and only accept corresponding DISS type gas specific adapters.

3. Each vacuum outlet shall have an adjacent slide for supporting vacuum bottle assembly.

C. Wall Outlets:

1. Wall outlets for oxygen, nitrous oxide, nitrogen, carbon dioxide and medical compressed air service shall be Diameter Index Safety System (DISS) recessed type and only accept corresponding DISS type gas specific adapters.

D. Ceiling Inlets and Outlets with Hose Drops:

1. Ceiling outlets for oxygen, nitrous oxide, medical compressed air, vacuum and evacuation services shall be Diameter Index Safety System (DISS) recessed type and only accept corresponding DISS type gas specific adapters.

2. Provide an upper hose assembly with a reel-type retractor kit. Hose shall terminate 6'-4" above finished floor.

3. Hose assembly shall consist of a UL-listed high-pressure color-coded conductive hose with a DISS nut and gland on the upper end. Provide a DISS Hand-I-Twist check unit on the lower end for all services except WAGD. Provide a Diamond quick-connect on the lower end for the Waste Anesthesia Gas Disposal service.

2.07 MEDICAL VACUUM AND GAS ALARMS

A. General:

1. Provide master alarms for source equipment as indicated on Contract Drawings and as required by NFPA 99.

2. Provide area alarms for station inlets and outlets as indicated on Contract Drawings and as required by NFPA 99.

3. Alarms shall provide signals as required by the latest edition of NFPA 99. Alarms shall be listed to UL 1069 and CSA C22.2 NO 601.1-M90 and comply with the following electromagnetic compatibility standards: FCC Part 15 Class A, ICES 003 Class A, EN 61326, EN 61000-3-2 and EN 61000-3-3.

4. All field wiring and signals shall be self-monitoring and on a closed circuit. Fault signals shall activate on an open circuit.

5. Input power to the alarm panel shall be 100 to 250 VAC 50/60 Hz, double fused on the input side. An internal power supply shall convert the input voltage to low voltage +5 and +24 VDC. All user accessible electronics and wiring shall utilize low voltage. A guard must be removed to access the high voltage wiring.

6. A green front panel POWER ON indicator shall illuminate when the alarm panel is powered. Each monitored condition shall have a separate red indicator illuminated when in alarm. A red indicator on the alarm silence button shall be illuminated after any audible alarm has been silenced.

7. Each panel shall provide an audible signal activated by digital display modules or multi-signal alarm modules. The audible signal shall produce a minimum sound pressure level of 90 dBA measured at a distance of 3 feet. The alarm panel shall contain alarm silence, test, and setup buttons.

8. Each panel shall include a general fault relay for the entire panel, an RS-485 data port and an additional auxiliary relay.

9. Medical gas alarm panels, sensors and related accessories shall be manufactured by Patton's Medical/Amico, BeaconMedaes, or Owner approved equal.

B. Area Alarms

1. Area alarm panels shall be provided to monitor all medical gas, medical/surgical vacuum, and piped WAGD systems supplying anesthetizing locations, and other vital life support and critical areas such as post anesthesia recovery, intensive care units, emergency departments, and where indicated on Contract Drawings.

2. Digital display modules shall provide a digital LED display continuously indicating the pressure or vacuum in the piping system being monitored. The brightness of the LED display shall be adjustable to compensate for ambient lighting. The display shall be programmable to read psig, in Hg, mm Hg, or kPa in increments of 1 psig, 1 in Hg, 1 mm Hg, or 1 kPa respectively.

3. The digital display module shall provide an audible and visual signal when a fault condition occurs. A front panel alarm mute button shall be provided to silence the audio. A visual signal shall flash until the alarm silence button is pressed, and shall then remain statically illuminated. The visual signal shall automatically cancel when the fault is corrected.

4. Separate visual signals for system pressure or vacuum are NORMAL (green LED), LOW (red LED), and HIGH (red LED). Signal limits are factory set per NFPA 99 and field programmable without the use of tools. Pressing and holding the front panel TEST button initiates a self-test function to test the LED display, visual indicators, audible alarm, and to view the alarm set points.

5. Each digital display module shall be equipped with separate relays for high and low alarms. Relays shall be single-pole double-throw type (30 VAC/VDC 2A max). Digital readings from one display module shall be capable of being monitored by another digital display module at a remote panel.

6. A sensor module shall be provided for each digital display module. Sensor modules shall contain a transducer capable of providing calibrated signals to the digital display module. Sensor modules shall be gas specific. The alarm panel shall be factory configured for sensor mounting within the alarm panel rough-in box (local sensors) or directly to the medical gas pipeline (remote sensors). Remote sensors may be located within zone valve box or readily accessible above ceiling..

7. Pipeline connections shall be 3/8" nominal (1/2" OD) Type "K" copper tube. Connectors shall be provided for attaching field wiring. Sensors shall be gas specific for periodic testing without interrupting medical gas pipeline pressures or vacuum.

C. Master Alarms

1. A master alarm system shall be provided to monitor the operation and condition of the source of supply, the reserve source, and the pressure in the main lines of each medical vacuum and gas piping system. The master alarm system shall consist of two or more alarm panels located in at least two separate locations as required by NFPA 99.

2. Each Multi-signal alarm module shall be capable of monitoring up to a minimum of five (5) dry-contact signals. Each signal shall illuminate a green LED to indicating normal conditions. When a fault occurs, the green LED shall turn off, a red LED shall illuminate, and an audible alarm shall sound. The red LED shall flash until the front panel alarm silence button is pressed. After the alarm silence button is pressed, the red LED shall remain statically illuminated. The red indicator shall automatically turn off and the green LED shall illuminate when the fault is corrected.

3. LED illumination for unused signals shall be deactivated in the field. Field programming shall be accomplished without the use of tools. Pressing and holding the front panel TEST button shall initiate a self-test function to test the LED indicators and audible alarm. The multi-signal module shall be supplied with five, dry-contact, normally closed relays for connection to a building automation system. Relay ratings shall be 30 VAC/VDC 2A max.

4. A blank overlay shall be used to fill unused alarm panel locations and/or reserve a module location for future expansion. It shall be removable for installing additional modules.

D. Vacuum and Pressure Switches

1. Switches shall incorporate UL listed single-pole, double-throw, and snap-action switching elements. Switch shall automatically reset.

2. Signal setting for low vacuum shall be at 12” HG.

3. Signal settings for all pressure gases except Nitrogen shall be; Low – 40 psig, High – 60 psig.

4. Signal settings for Nitrogen gas shall be; Low – 140 psig, High – 190 psig.

5. Pressure switches shall be cleaned and sealed for oxygen service.

2.08 LINE GAUGES

A. General:

1. Gauges shall comply with ANSI/ASME B-40.1 and be constructed of materials compatible with medical vacuum and gas applications. Pressure indicators for medical gas piping systems shall be cleaned for oxygen service.

2. Gauge housings shall be drawn steel with black, corrosion-resistant paint. Dial shall be 4-1/2” in diameter with white background and black markings. Pointer shall be aluminum with black finish. Gauge movement shall be brass construction. Bottom of gauge shall be provided with ¼” – 18 NPT – 2A brass connection.

3. Indicators adjacent to master alarm actuators and area alarms shall be labeled to identify the name of or chemical symbol for the particular piping system that they monitor.

4. Provide Diameter Index Safety System connection kits with all appropriate fittings for connecting gauges to pipelines.

B. Medical vacuum and gas line gauges and DISS connection kits shall be manufactured by Patton’s Medical/Amico, BeaconMedaes, or Owner approved equal.

C. Vacuum Line Gauges

1. Vacuum bourbon tube shall be beryllium copper and soft soldered.

2. Gauge shall register 0 – 30 inches HG.

D. Pressure Line Gauges

1. Pressure bourbon tube shall be phosphor bronze and soft soldered.

2. Gauge shall register 0 – 100 psig for all medical gases except Nitrogen.

3. Gauge shall register 0 – 300 psig for Nitrogen gas.

4. Gauges for positive pressure gases shall be cleaned and sealed for oxygen service.

2.09 UNDERGROUND WARNING TAPE

A. Minimum 3 inch wide polyethylene detectable type marking tape. The tape shall be resistant to alkalis, acids and other destructive agents found in soil and impregnated with metal so that it can be readily recognized after burial by standard locating equipment.

1. Lamination bond of 1 layer of Minimum 0.35 mils thick aluminum foil between 2 layers of minimum 4.3 mils thick inert plastic film.

2. Minimum tensile strength: 63 LBS per 3 IN width.

3. Minimum elongation: 500 percent.

4. Provide continuous yellow with black letter printed message repeated every 16 to 36 inches warning of pipe by specific name buried below (e.g.: "CAUTION OXYGEN LINE BURIED BELOW").

5. Manufactured by Reef Industries “Terra Tape” or approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. All installation shall be in accordance with manufacturer’s published recommendations.

C. Install all system components in complete compliance with referenced standards and manufacturer’s published instructions.

D. Exercise great care in the storage and handling of all materials and in the condition of tools used in cutting and reaming to prevent oil or grease or any contaminants from being introduced into tubing. The interior surfaces of tube ends, fittings, and other components that were cleaned for oxygen service by the manufacturer, but become contaminated prior to being installed, shall be recleaned on-Site by the installer by thoroughly scrubbing the interior surfaces with a clean, hot water–alkaline solution, such as sodium carbonate or trisodium phosphate 450 g to 11 L (1 lb to 3 gal) of potable water and thoroughly rinsing them with clean, hot potable water. Material that has become contaminated internally and is not clean for oxygen service shall not be installed.

E. The exterior surface of all tubes, joints and fittings shall be cleaned prior to brazing with non-abrasive pads by washing with hot water after assembly to remove any surface oxides or excess flux and provide for clear visual inspection of brazed connections. A visual inspection of each brazed joint shall be made to assure that the alloy has flowed completely around the joint at the tube-fitting interface. Where flux has been used, assure that solidified flux residue has not formed a temporary seal that could hold test pressure.

F. Apply flux sparingly to the clean tube only and in a manner to avoid leaving any excess inside of completed joints. (NOTE: Ensure proper ventilation. Some BAg series filler metals contain cadmium, which, when heated during brazing, can produce toxic fumes.)

G. Joints shall be brazed within one hour after the surfaces are cleaned for brazing.

H. While being brazed, all vacuum and oxygen piping joints shall be continuously purged with oil-free, dry Nitrogen to prevent the formation of copper oxide on the inside surfaces of the joint. The purge shall be maintained until the joint is cool to the touch. The final connection of new piping to an existing, in-use pipeline shall be permitted to be made without the use of a nitrogen purge.

I. Bury all underground piping at least 3 feet below finished grade and fully encase within schedule 40 PVC piping sleeve. Provide a continuous detectable warning tape immediately above buried lines. Warning tape shall clearly identify the pipeline by specific name. A continuous warning means shall also be provided on tamped backfill above the pipeline at approximately one-half the depth of bury.

J. Do not install piping in the same trench with other buried utilities. The minimum horizontal clearance between medical pipe and parallel buried utility pipe shall be 8 feet. Do not install pipe through catch basins, vaults, manholes or similar underground structures.

K. Piping systems for gases shall not be used as a grounding electrode.

L. Piping shall not be installed in kitchens, electrical switchgear rooms, elevator shafts, and areas with open flames.

M. Memory-metal couplings shall not be installed within eight inches of a brazed joint.

N. Shut-off valves installed for future connections shall be provided with downstream piping closed with a brazed cap and sufficient tubing allowance for cutting and re-brazing.

O. Branch takeoffs from horizontal piping shall be taken off above the centerline of the main or branch pipe and rise vertically or at an angle of not less than 45 degrees from vertical.

P. Support all piping in accordance with NFPA 99 and Contract Documents.

Q. Pressure and vacuum indicators shall be readable from a standing position.

R. All alarm sensors shall be installed at readily accessible locations and shall not be obstructed by other building components.

S. Zone valve boxes shall be installed where they are visible and accessible at all time and readily operable from a standing position in the corridor on the same floor they serve.

T. Area alarm panels shall be located where indicated on Contract Drawings at a nurse's station or other location that will provide for continuous responsible surveillance.

U. Locate master alarm panels shall where indicated on Contract Drawings in at least two separate locations as required by NFPA 99.

V. All alarm panels shall be mounted at a height allowing monitoring and operation from a standing position.

W. Coordinate with Electrical Contractor to insure that power is provided to alarms from the life safety branch of the emergency electrical system as described in NFPA 99.

X. Provide low voltage wiring from sensors to alarm panels as required by NFPA 99. All low voltage wiring shall be routed within conduit. Wiring from switches or sensors shall be supervised or protected as required by NFPA 70, National Electrical Code, for emergency system circuits.

3.02 LABELING

A. Label all piping, valves, station inlets and outlets, and alarms in accordance with NFPA 99 requirements and Contract Documents.

B. Re-label existing shut-off valves and alarm panels when modifications are made changing the areas served. New labels shall be in accordance with NFPA 99 and Contract Documents.

3.03 TESTING AND INSPECTION

A. Inspection and testing shall be performed on all new piped gas systems, additions, renovations, temporary installations, or repaired systems, to assure the facility, by a documented procedure, that all applicable provisions of NFPA 99 have been adhered to and system integrity has been achieved or maintained.

B. After brazing, the outside of all joints shall be cleaned by washing with water and a wire brush to remove any residue and permit clear visual inspection of the joint. Each brazed joint shall be visually inspected after cleaning the outside surfaces. Brazed joints identified as defective shall be repaired or replaced as required by NFPA 99.

C. After installation of the distribution piping and before installation of station outlets/inlets and other system components (e.g., pressure/vacuum alarm devices, pressure/vacuum indicators), piping in medical vacuum and gas distribution systems shall be blown clear by means of oil-free, dry Nitrogen.

D. Installer shall perform initial pressure tests, cross-connection test, piping purge test and standing pressure test prior to third party system verification and in strict accordance with NFPA 99.

E. The rated accuracy of indicators used for testing shall be 1 percent (full scale) or better at the point of reading.

F. System verification tests shall be performed only after all installer performed tests, have been completed. Equipment Vendor or installing Contractor shall not perform system verification, final testing or certification.

G. A Third Party Medical Gas System Verification Testing Agency shall perform standing pressure test, cross-connection test, valve test, alarm test, piping purge test, piping particulate test, piping purity test, final tie-in test, operational pressure test and medical gas concentration test.

H. The Third Party Medical Gas System Verification Testing Agency shall verify the presence and correctness of labeling required by this standard for all components (e.g., station outlets/inlets, shutoff valves, and alarm panels).

I. It shall be the responsibility of the Third Party Medical Gas System Verification Testing Agency to make periodic job Site visits to assure all requirements of this specification and NFPA 99 are strictly adhered to.

J. Certification shall clearly state that the system is approved for patient use and meets all requirements of NFPA-99 inclusive of all referenced and/or related documents. Any exceptions or limitations shall be clearly stated on the same certification document.

3.04 VENDOR SUPERVISION AND OPERATING INSTRUCTIONS

A. An authorized representative of the equipment manufacturer shall periodically check with the installing Contractor during initial installation of the pipeline systems and equipment and shall assist the Contractor in final check to make certain that all systems are operating as recommended by the manufacturer, as specified and in accordance with NFPA 99. The equipment manufacturer's representative shall provide a minimum of 4 hours instruction to MD Anderson personnel in the use of the piping systems and the related equipment operated from those systems.

END OF SECTION 22 60 00

SECTION 22 60 53 – LABORATORY VACUUM AND GAS PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 SUMMARY

A. This section includes the furnishing of all labor and materials necessary for complete installation, cleaning, testing and certification of laboratory vacuum, and gas distribution and monitoring systems, including; piping, inlets, outlets, alarms, valves, supports, labeling, identification and all related accessories. Laboratory gas systems include Oxygen, Compressed Air, Carbon Dioxide and Nitrogen.

1.03 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:

1. NFPA 45 Fire Protection For Laboratories Using Chemicals

2. NFPA 99 Standard for Health Care Facilities.

3. NFPA 70 National Electric Code

4. ASTM B819 Seamless Copper Tube for Medical Gas Systems.

5. AWS A5.8 Brazing Filler Metal.

6. CGA V-5 Diameter Index Safety System.

D. Comply with all Federal and State regulations applicable to this installation.

1.04 QUALITY ASSURANCE

1. All materials, equipment, installation, testing and certification shall be in strict accordance with NFPA 99 for Level 1 Medical–Surgical Vacuum, WAGD and Gases.

2. Manufacturer's name and pressure rating shall be permanently marked on valve body.

3. Products of same type shall be by one manufacturer. All valves, valve boxes, inlets, outlets, alarms and associated components shall be supplied by a single manufacturer and shall be fully compatible with existing system and service devices.

4. Verify compatibility of all new components with existing system and services.

5. Maintain one copy of each Contract Document on Site.

6. Prior to any installation Work, the installer of laboratory vacuum and gas piping shall provide and maintain documentation on the job Site for the qualification of brazing procedures and individual brazers as required by NFPA 99.

1.05 SUBMITTALS

A. General:

1. All submitted data shall be specific to this project and identified as such. Generic submittal data will not be accepted.

B. Product Data:

1. Manufacturers descriptive literature, illustrations and installation instructions for all components included within this project indicating compliance with applicable referenced standards, size, dimensions, model number, electrical characteristics and connection requirements.

C. Shop Drawings:

1. Wiring diagrams for laboratory vacuum and gas alarm systems. Differentiate between manufacturer-installed and field-installed wiring.

D. Record Documents:

1. Record actual locations of piping, valves, alarm sensors, alarm panels, station inlets and outlets.

2. Prepare and provide valve charts.

3. Provide record of test procedures and the results of all tests indicating room and area designations, dates of the tests, and names of persons conducting the tests.

4. Brazer Certificates: Installation Contractor shall present written documentation (less than 3 years old) from a recognized agency trained in administering and testing brazing techniques as per AWS B2.2 or ASME Section IX, certifying that all brazers have been thoroughly trained and tested in the complete installation of medical gas systems.

5. Product Certificates: The installer shall furnish documentation certifying that all installed pipe, valves, fittings, station outlets, and other piping components in laboratory gas systems shall have been cleaned for oxygen service in accordance with CGA 4.1, Cleaning Equipment for Oxygen Service and NFPA 99. Submit letter signed by manufacturer certifying that copper tubing complies with NFPA 99. Submit letter from manufacturer stating that station outlets and inlets are designed and manufactured to comply with NFPA 99. Outlet and inlet shall bear label of approval as an assembly, by Underwriters Laboratories, Inc., or Associated Factory Mutual Research Corporation.

6. Inspection and Test Reports: Furnish documentation that all installer inspections and tests required by NFPA 99 for Level 1 Medical–Surgical Vacuum, WAGD and Gases have been performed. Identify test type, procedure and results.

7. Independent Third Party System Verification Testing Agency Reports and Certification: Documentation verifying that completed systems have been installed, tested, purged, and analyzed in accordance with the requirements of referenced standards and contract documents. Provide copy of agency's written Q-91 standards.

8. Provide full written description of manufacturer's warranty.

E. Operation and Maintenance Data:

1. Operation Data: Include manufacturer's installation and operating instructions.

2. Maintenance Data: Servicing and testing requirements, inspection data, exploded assembly views, Record Documents, inspection data, test reports, installation instructions, replacement part numbers and availability, location and contact numbers of service depot.

1.06 DELIVERY, STORAGE AND HANDLING

A. Tubes, valves, fittings, station outlets, and other piping components in laboratory gas systems shall have been cleaned for oxygen service by the manufacturer prior to installation in accordance with CGA 4.1, Cleaning Equipment for Oxygen Service, except that fittings shall be permitted to be cleaned by a supplier or agency other than the manufacturer.

B. Each length of tube shall be delivered plugged or capped by the manufacturer and kept sealed until prepared for installation.

C. Fittings, valves, and other components shall be delivered sealed, labeled, and kept sealed until installation.

D. Where contamination is known to have occurred, the materials affected must be removed and replaced with new materials that are cleaned and sealed by the manufacturer or supplier.

1.07 QUALIFICATIONS

A. General: Companies specializing in manufacturing, installing, testing, certifying and servicing the products and systems specified in this Section shall have minimum five (5) years documented experience and be certified as required by the Texas Department of Health and NFPA 99.

B. Manufacturers: Firms regularly engaged in manufacture of medical vacuum and gas systems equipment and products, of types, materials, and sizes required, whose products have been in satisfactory use in similar service for not less than five (5) years. References may be required.

C. Equipment Supplier: The laboratory vacuum and gas systems equipment supplier shall provide the services of a manufacturer authorized product specialist to periodically coordinate with the installing Contractor during initial installation of the pipeline systems and have a service organization located within 50 miles of the Project Site to provide ongoing service support to MD Anderson Cancer Center after project completion.

D. Installer: Firm with at least five (5) years of successful installation experience on projects with medical vacuum and gas systems work similar to that required for Project. All installations of the piping systems shall be done only by, or under the direct supervision of a holder of a master plumber license or a journeyman plumber license with a medical gas piping installation endorsement issued by the Texas State Board of Plumbing Examiners. All installers of laboratory vacuum and gas system components must be qualified in accordance with the requirements of NFPA 99 and ASSE 6010, Medical Gas Systems Installers Professional Qualifications Standard. In addition, all brazers of laboratory gas system piping must be qualified in accordance with the requirements of either Section IX, Welding and Brazing Requirements of the ASME Boiler and Pressure Vessel Code, or AWS B2.2, Standard for Brazing Procedure and Performance Qualification.

E. System Verification Testing Agency: Testing shall be conducted by a party technically competent and experienced in the field of medical gas and vacuum pipeline testing and meeting the requirements of ANSI/ASSE Standard 6030, Medical Gas Verifiers Professional Qualifications Standard. Quality control standards of testing agency shall be in strict accordance with American National Standards Institute (ANSI) Q-91. Firm shall be regularly engaged in the testing and certification of similar facilities with a minimum of five (5) years of experience.

F. Installer of axially swaged fittings shall be certified by a recognized agency trained in administering axially swaged fitting installation techniques. Installation Contractor shall present written documentation of certification (less than 3 years old).

1.08 LABORATORY GAS PIPE "HOT-TAP" PROCEDURE

A. Connections to active laboratory gas piping may be performed only when approved in writing by and closely coordinated with the Owner.

B. Connections shall be performed by a firm specializing in "Hot-Tapping" existing active laboratory gas piping systems.

C. The procedure shall incorporate blocking valves, blocking glands, pneumatic end seals and employ a cryogenic compression fitting technology that is approved by The National Fire Protection Association and manufactured for use on medical gas and vacuum pipe systems.

D. Cryogenic compression fittings shall be ASTM F 2063, nickel-titanium, shape-memory-alloy, manufactured cleaned, purged, and sealed for oxygen service according to CGA G-4.1. Memory-metal fittings shall be tested and rated to burst pressure of the copper pipe, approximately 7500 psig. The coupling shall meet or exceed the standard for a brazed joint and not generate any contamination during installation.

E. Couplings shall be applied without the use of heat and shall provide a permanent, leak-free, metal-to-metal seal between the coupling and the tubes or pipe throughout the life of the joint.

F. Redundant components shall be available during the procedure for re-installation purposes.

G. Acceptable Medical Gas "Hot-Tapping" Vender:

1. Smart Tap, Inc. - P.O. Box 277 - 415 Main Street - Oley, PA 19547 - Ph: 610-987-3001

1.09 SCHEDULING

A. Schedule Work to ensure installation is complete, tested and certified prior to Substantial Completion.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.02 PRESSURIZED LABORATORY GAS PIPING

A. All pipe shall be Type "K", ASTM B819, hard drawn seamless copper medical gas tubing. Pipe shall be identified by the manufacturer's markings, "OXY," "MED," or "OXY/MED" and with size designated reflecting nominal inside diameter.

B. Turns, offsets, and other changes in direction shall be made with brazed wrought copper capillary fittings complying with ANSI B16.22, Wrought Copper and Copper Alloy Solder-Joint Fittings; or brazed fittings complying with MSS SP-73, Brazed Joints for Wrought and Cast Copper Alloy Solder Joint Pressure Fittings. Cast copper alloy fittings shall not be permitted.

C. Brazed joints shall be made using a brazing alloy that exhibits a melting temperature in excess of 538 degrees C (1000 degrees F). Copper-to-copper joints shall be brazed using a copper–phosphorus or copper–phosphorus–silver brazing filler metal (BCuP series) without flux. Flux shall only be used when brazing dissimilar metals such as copper and bronze or brass, using a silver (BAg series) brazing filler metal. Brazing alloy comply with ANSI/AWS A.5.8, Specification for Brazing Filler Metal.

D. Threaded joints in laboratory gas distribution piping shall be limited to connections to pressure/vacuum indicators, alarm devices, and source equipment. All threads shall be tapered pipe threads complying with ANSI B1.20.1, Pipe Threads, General Purpose and be made up with polytetrafluoroethylene (such asTeflon™) tape or other thread sealant recommended for oxygen service, with the sealant applied to the male threads only. Where threaded nipples are required these shall be I.P.S. brass.

E. The use of shape memory alloy couplings is may be used when making connections to existing piping sizes 2 inches and smaller. Memory-metal couplings shall have temperature and pressure ratings joints not less than that of a brazed joint. Shape memory alloy couplings shall be manufactured by TW Metals "CryoMed" or Aerofit "CryoFit".

F. The use of brass axially swaged, elastic strain preload fittings may be used when making connections to existing piping sizes 2” and smaller. Non-braze fittings shall provide metal to metal seal having pressure and temperature ratings not less than that of a brazed joint and when complete are permanent and nonseparable. Axially swaged fittings shall be cleaned and sealed for oxygen service and manufactured by Lokring Technology LLC.

G. Straight-threaded connections, including unions, flared and compression-type connections, including connections to station outlets and inlets, alarm devices, and other components shall not be permitted.

H. All pipe and fittings shall be supplied cleaned and sealed for oxygen service.

2.03 LABORATORY VACUUM PIPING

A. All vacuum piping sizes 1-1/2 inches and smaller shall be as specified for pressurized laboratory gas pipe. Vacuum pipe sizes 2 inches and larger shall be Type "K" or “L” hard-drawn seamless copper, either ASTM B 819 medical gas tube or ASTM B 88 water tube.

B. Turns, offsets, and other changes in direction shall be made with brazed wrought copper capillary fittings complying with ANSI B16.22, Wrought Copper and Copper Alloy Solder-Joint Fittings; or brazed fittings complying with MSS SP-73, Brazed Joints for Wrought and Cast Copper Alloy Solder Joint Pressure Fittings. Cast copper alloy fittings shall not be permitted.

C. Brazed joints shall be made using a brazing alloy that exhibits a melting temperature in excess of 538 degrees C (1000 degrees F). Copper-to-copper joints shall be brazed using a copper–phosphorus or copper–phosphorus–silver brazing filler metal (BCuP series) without flux. Flux shall only be used when brazing dissimilar metals such as copper and bronze or brass, using a silver (BAg series) brazing filler metal. Brazing alloy comply with ANSI/AWS A.5.8, Specification for Brazing Filler Metal.

D. Threaded joints in laboratory vacuum distribution piping shall be limited to connections to pressure/vacuum indicators, alarm devices, and source equipment. All threads shall be tapered pipe threads complying with ANSI B1.20.1, Pipe Threads, General Purpose and be made up with polytetrafluoroethylene (such asTeflon™) tape or other thread sealant recommended for oxygen service, with the sealant applied to the male threads only. Where threaded nipples are required, these shall be I.P.S. brass. Close nipples shall not be installed.

E. The use of shape memory alloy couplings may be used when making connections to existing piping sizes 2 inches and smaller. Memory-metal couplings shall have temperature and pressure ratings joints not less than that of a brazed joint. Shape memory alloy couplings shall be manufactured by TW Metals “CryoMed” or Aerofit “CryoFit”.

F. The use of brass axially swaged, elastic strain preload fittings may be used when making connections to existing piping sizes 2” and smaller. Non-braze fittings shall provide metal to metal seal having pressure and temperature ratings not less than that of a brazed joint and when complete are permanent and nonseparable. Axially swaged fittings shall be cleaned and sealed for oxygen service and manufactured by Lokring Technology LLC.

G. Mechanically formed, drilled and extruded tee-branch connections shall not be permitted.

H. Couplings and fittings incorporating an o-ring seal shall not be permitted.

I. Roll-grooved joints shall not be permitted.

J. Straight-threaded connections, including unions, flared and compression-type connections, including connections to station outlets and inlets, alarm devices, and other components shall not be permitted.

2.04 LABORATORY VACUUM AND GAS VALVES

A. General:

1. All valves for pressurized gases and valves for vacuum services 1-1/2 inches and smaller shall be supplied cleaned and sealed (bagged) for oxygen service by the manufacturer.

2. Valves for vacuum service sizes 2 inches and larger will not be required to be cleaned and sealed for oxygen service.

3. Provide quantity and size of valves as indicated on Contract Drawings and as required by NFPA 99.

4. Laboratory vacuum and gas valves, zone valve boxes and related accessories shall be manufactured by Patton's Medical/Amico, BeaconMedaes, or Owner approved equal.

B. Source, Main, Riser and Service Line Shut-off Valves:

1. Shut-off valves shall be full port, double seal, ball-type three piece design, designed for vacuum to 29 inches Hg and working pressures up to 600 WOG with bronze/brass body, blow-out proof stem and chrome plated brass ball and be serviceable in the line. Valve body shall have Teflon (TFE) material ball seat and stem seals. Seats/seals, lubricants and valve material shall be compatible with oxygen, nitrous oxide, compressed air, carbon dioxide, nitrogen and mixtures thereof at continuous pressure up to 600 psig and up to 100 degrees Fahrenheit.

2. Valve shall be provided with and operated by a lever-type handle requiring only a quarter turn from a fully open position to a fully closed position.

3. All valves shall be equipped with type "K" washed and degreased copper pipe stub extensions at both the inlet and outlet sides of the valve port to facilitate installation. On outlet pipe stub provide 1/8 inch FPT tap with plug to accept gauge or nitrogen purge connection. Stub extensions shall be supplied to Site capped at both ends

4. Valve tags showing the appropriate gas services, pressure rating, etc. shall be attached to each valve.

5. Each shut-off valve shall be provided with locking kit.

C. Zone Valve and Box Assemblies:

1. Each zone valve cabinet shall be recessed type and consist of the following components: A steel valve box housing single or multiple shut-off ball valves with tube extensions, an aluminum frame, and a pull-out removable window. Boxes shall be provided to accommodate size and type of vacuum and gas valves as indicated on Contract Drawings.

2. The valve box shall be constructed of 18 gauge steel complete with a white epoxy finish and provided with (2) two galvanized steel brackets for the purpose of mounting to structural support. The assembly trim shall accommodate various finished wall thickness of up to one inch and be field adjustable. Cabinets shall be designed to permit box assemblies to be ganged together in a vertical stack.

3. The doorframe assembly shall be constructed of anodized aluminum mounted to the back box assembly by screws as provided and shall have a sliding removable front consisting of an opaque door with a pre-mounted pullout ring and clear gauge window. Access to the zone shut-off valves shall be by merely pulling the ring assembly to remove the window from the doorframe. The window shall be capable of re-installation without the use of tools and only after the valve handles have been returned to the open position. The window shall be labeled "Caution – Laboratory Gas Shut-Off Valve - Close Only in Emergency", or equivalent wording in accordance with NFPA 99.

4. Valves shall be same as specified herein for line shut-off valves except locking devices are not required.

5. Each valve shall be supplied with an identification bracket bolted directly onto the valve body for the purpose of applying an approved identification label. A package of labels shall be supplied with each valve box assembly for application by the installer.

6. All valves shall be securely attached to the box and provided with Type "K" washed and degreased copper pipe stub extensions of sufficient length to protrude beyond the sides of the box for connection to system piping. All pipe stub extensions shall be supplied with 1/8 inch NPT gauge port located on the terminal outlet side of the valve to register pipeline pressure or vacuum. Suitable plugs or caps shall be installed by the manufacturer to prevent contamination of the assembly prior to installation.

7. Gauges shall be minimum 1-1/2 inch diameter, with metal case and ring, and an 1/8 inch NPT brass stud at the back of the gauge for the purpose of mounting onto pipe stub extension within the box. The pipe stub extension shall be complete with a soldered gauge holder. Gauge holders shall be sealed with a brass plug to prevent contamination prior to mounting gauges. Pressure gauges shall read 0-700 kPa (0-100 psig) for all gases except nitrogen, which shall read 0-2000 kPa (0-300 psig), and vacuum, which shall read -100-0 kPa (0-30 inches Hg). Gauges shall be visible through the door of the zone valve box.

8. Valve box may house one to six valves.

9. Each valve may incorporate a gas specific DISS demand check valve for installation of a DISS specific sensor.

2.05 SERVICE INLETS AND OUTLETS

A. General:

1. Inlets and outlets shall be UL listed and conform to applicable NFPA and CGA standards.

2. Inlets and outlets shall consist of separate roughing-in and finish assemblies and be modular in design for wall recessed type installation and attachment to concealed piping.

3. For positive pressure gas services, the outlet shall be equipped with a primary and secondary check valve. The secondary check valve shall be rated at a minimum 1379 KPa (200 psi) in the event the primary check valve is removed for maintenance.

4. The roughing-in assembly shall be corrosion resistant with a permanent pin-keying system for each specific gas and be provided with a Type "K", 1/2 inch outside diameter, 6-1/2 inch long copper inlet pipe stub, which is silver brazed to the outlet body. The copper tubing inlet shall rotate 360 degrees to allow connection from any direction. The assembly shall allow pressure testing without additional labor to remove plug or adapter after testing.

5. The finishing assembly shall contain a primary check valve, pin-key indexing, a minimum of 2.5 square inches of color coding and incorporate a plaster adjustment from 3/8 inch to 3/4 inch variation in wall thickness. Design shall be such as to ensure absolutely no gas flow until the correct adapter is fully engaged. Each assembly shall have a separate cover plate for ease of service without preventing use of other inlets or outlets.

6. All inlets and outlets shall be factory assembled, tested, cleaned for oxygen service, and supplied with temporary protective covers and packages to protect outlet during handling and installation at the jobsite.

7. Inlets and outlets and related accessories shall be manufactured by Patton's Medical/Amico, BeaconMedaes, or Owner approved equal.

B. Wall Inlets:

1. Wall inlets for Vacuum services shall be Diameter Index Safety System (DISS) recessed type and only accept corresponding DISS type gas specific adapters.

2. Each vacuum outlet shall have an adjacent slide for supporting vacuum bottle assembly.

C. Wall Outlets:

1. Wall outlets for oxygen, nitrogen, carbon dioxide and laboratory compressed air service shall be Diameter Index Safety System (DISS) recessed type and only accept corresponding DISS type gas specific adapters.

D. Ceiling Inlets and Outlets with Hose Drops:

1. Ceiling outlets for oxygen, laboratory compressed air, vacuum and evacuation services shall be Diameter Index Safety System (DISS) recessed type and only accept corresponding DISS type gas specific adapters.

2. Provide an upper hose assembly with a reel-type retractor kit. Hose shall terminate 6'-4" above finished floor.

3. Hose assembly shall consist of a UL-listed high-pressure color-coded conductive hose with a DISS nut and gland on the upper end. Provide a DISS Hand-I-Twist check unit on the lower end for all services except WAGD.

E. Casework Inlets and Outlets:

1. Laboratory casework fittings will be furnished to the jobsite by the laboratory equipment supplier, with necessary holes cut in the laboratory equipment. This Contractor shall receive, store and install the fittings and make all necessary connections thereto in accordance with manufacturer's published instructions.

2.06 LABORATORY VACUUM AND GAS ALARMS

A. General:

1. Provide master alarms for source equipment as indicated on Contract Drawings and as required by NFPA 99.

2. Provide area alarms for station inlets and outlets as indicated on Contract Drawings and as required by NFPA 99.

3. Alarms shall provide signals as required by the latest edition of NFPA 99. Alarms shall be listed to UL 1069 and CSA C22.2 NO 601.1-M90 and comply with the following electromagnetic compatibility standards: FCC Part 15 Class A, ICES 003 Class A, EN 61326, EN 61000-3-2 and EN 61000-3-3. All field wiring and signals shall be self-monitoring and on a closed circuit. Fault signals shall activate on an open circuit.

4. Input power to the alarm panel shall be 100 to 250 VAC 50/60 Hz, double fused on the input side. An internal power supply shall convert the input voltage to low voltage +5 and +24 VDC. All user accessible electronics and wiring shall utilize low voltage. A guard must be removed to access the high voltage wiring.

5. A green front panel POWER ON indicator shall illuminate when the alarm panel is powered. Each monitored condition shall have a separate red indicator illuminated when in alarm. A red indicator on the alarm silence button shall be illuminated after any audible alarm has been silenced.

6. Each panel shall provide an audible signal activated by digital display modules or multi-signal alarm modules. The audible signal shall produce a minimum sound pressure level of 90 dBA measured at a distance of 3 feet. The alarm panel shall contain alarm silence, test, and setup buttons.

7. Each panel shall include a general fault relay for the entire panel, an RS-485 data port and an additional auxiliary relay.

8. Laboratory vacuum and gas alarm panels, sensors and related accessories shall be manufactured by Patton's Medical/Amico, BeaconMedaes, or Owner approved equal.

B. Area Alarms

1. Area alarm panels shall be provided to monitor laboratory gas and vacuum systems supplying animal procedure rooms, and other critical areas where indicated on Contract Drawings.

2. Digital display modules shall provide a digital LED display continuously indicating the pressure or vacuum in the piping system being monitored. The brightness of the LED display shall be adjustable to compensate for ambient lighting. The display shall be programmable to read psig, in Hg, mm Hg, or kPa in increments of 1 psig, 1 in Hg, 1 mm Hg, or 1 kPa respectively.

3. The digital display module shall provide an audible and visual signal when a fault condition occurs. A front panel alarm mute button shall be provided to silence the audio. A visual signal shall flash until the alarm silence button is pressed, and shall then remain statically illuminated. The visual signal shall automatically cancel when the fault is corrected.

4. Separate visual signals for system pressure or vacuum are NORMAL (green LED), LOW (red LED), and HIGH (red LED). Signal limits are factory set per NFPA 99 and field programmable without the use of tools. Pressing and holding the front panel TEST button initiates a self-test function to test the LED display, visual indicators, audible alarm, and to view the alarm set points.

5. Each digital display module shall be equipped with separate relays for high and low alarms. Relays shall be single-pole double-throw type (30 VAC/VDC 2A max). Digital readings from one display module shall be capable of being monitored by another digital display module at a remote panel.

6. A sensor module shall be provided for each digital display module. Sensor modules shall contain a transducer capable of providing calibrated signals to the digital display module. Sensor modules shall be gas specific. The alarm panel shall be factory configured for sensor mounting within the alarm panel rough-in box (local sensors) or directly to the pipeline (remote sensors). Remote sensors may be locatedwithin zone valve box or readily accessible above ceiling.

7. Pipeline connections shall be 3/8 inch nominal (1/2 inch OD) Type “K” copper tube. Connectors shall be provided for attaching field wiring. Sensors shall be gas specific for periodic testing without interrupting gas pipeline pressures or vacuum.

C. Master Alarms

1. A master alarm system shall be provided to monitor the operation and condition of the source of supply, the reserve source, and the pressure in the main lines of each laboratory vacuum and gas piping system. The master alarm system shall consist of two or more alarm panels located in at least two (2) separate locations as required by NFPA 99.

2. Each Multi-signal alarm module shall be capable of monitoring up to a minimum of five (5) dry-contact signals. Each signal shall illuminate a green LED to indicating normal conditions. When a fault occurs, the green LED shall turn off, a red LED shall illuminate, and an audible alarm shall sound. The red LED shall flash until the front panel alarm silence button is pressed. After the alarm silence button is pressed, the red LED shall remain statically illuminated. The red indicator shall automatically turn off and the green LED shall illuminate when the fault is corrected.

3. LED illumination for unused signals shall be deactivated in the field. Field programming shall be accomplished without the use of tools. Pressing and holding the front panel TEST button shall initiate a self-test function to test the LED indicators and audible alarm. The multi-signal module shall be supplied with five, dry-contact, normally closed relays for connection to a building automation system. Relay ratings shall be 30 VAC/VDC 2A max.

4. A blank overlay shall be used to fill unused alarm panel locations and/or reserve a module location for future expansion. It shall be removable for installing additional modules.

D. Vacuum and Pressure Switches

1. Switches shall incorporate UL listed single-pole, double-throw, and snap-action switching elements. Switch shall automatically reset.

2. Signal setting for low vacuum shall be at 12 inches HG.

3. Signal settings for all pressure gases except Nitrogen shall be; Low – 40 psig, High – 60 psig.

4. Signal settings for Nitrogen gas shall be; Low – 140 psig, High – 190 psig.

E. Pressure switches shall be cleaned and sealed for oxygen service.

2.07 LINE GAUGES

A. General:

1. Gauges shall comply with ANSI/ASME B-40.1 and be constructed of materials compatible with medical vacuum and gas applications.

2. Gauge housings shall be drawn steel with black, corrosion-resistant paint. Dial shall be 4-1/2 inch in diameter with white background and black markings. Pointer shall be aluminum with black finish. Gauge movement shall be brass construction. Bottom of gauge shall be provided with ¼ inch – 18 NPT – 2A brass connection.

3. Provide Diameter Index Safety System connection kits with all appropriate fittings for connecting gauges to pipelines.

4. Laboratory vacuum and gas line gauges and DISS connection kits shall be manufactured by Patton's Medical/Amico, BeaconMedaes, or Owner approved equal.

B. Vacuum Line Gauges

1. Vacuum bourbon tube shall be beryllium copper and soft soldered.

2. Gauge shall register 0 – 30 inches HG.

C. Pressure Line Gauges

1. Pressure bourbon tube shall be phosphor bronze and soft soldered.

2. Gauge shall register 0 – 100 psig for all laboratory gases except Nitrogen.

3. Gauge shall register 0 – 300 psig for Nitrogen gas.

4. Gauges for positive pressure gases shall be cleaned and sealed for oxygen service.

2.08 UNDERGROUND WARNING TAPE)

A. Minimum 3 inch wide polyethylene detectable type marking tape. The tape shall be resistant to alkalis, acids and other destructive agents found in soil and impregnated with metal so that it can be readily recognized after burial by standard locating equipment.

1. Lamination bond of one (1) layer of Minimum 0.35 mils thick aluminum foil between two (2) layers of minimum 4.3 mils thick inert plastic film.

2. Minimum tensile strength: 63 LBS per 3 IN width.

3. Minimum elongation: 500 percent.

4. Provide continuous yellow with black letter printed message repeated every 16 to 36 inches warning of pipe by specific name buried below (e.g.: "CAUTION OXYGEN LINE BURIED BELOW").

5. Manufactured by Reef Industries “Terra Tape” or approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. All installation shall be in accordance with manufacturer’s published recommendations.

C. Exercise great care in the storage and handling of all materials and in the condition of tools used in cutting and reaming to prevent oil or grease or any contaminants from being introduced into tubing. The interior surfaces of tube ends, fittings, and other components that were cleaned for oxygen service by the manufacturer, but become contaminated prior to being installed, shall be recleaned on-Site by the installer by thoroughly scrubbing the interior surfaces with a clean, hot water–alkaline solution, such as sodium carbonate or trisodium phosphate 450 g to 11 L (1 lb to 3 gal) of potable water and thoroughly rinsing them with clean, hot potable water. Material that has become contaminated internally and is not clean for oxygen service shall not be installed.

D. The exterior surface of all tubes, joints and fittings shall be cleaned prior to brazing with non-abrasive pads by washing with hot water after assembly to remove any surface oxides or excess flux and provide for clear visual inspection of brazed connections. A visual inspection of each brazed joint shall be made to assure that the alloy has flowed completely around the joint at the tube-fitting interface. Where flux has been used, assure that solidified flux residue has not formed a temporary seal that could hold test pressure.

E. Apply flux sparingly to the clean tube only and in a manner to avoid leaving any excess inside of completed joints. (NOTE: Ensure proper ventilation. Some BAg series filler metals contain cadmium, which, when heated during brazing, can produce toxic fumes.)

F. Joints shall be brazed within one (1) hour after the surfaces are cleaned for brazing.

G. While being brazed, all vacuum and oxygen piping joints shall be continuously purged with oil-free, dry Nitrogen to prevent the formation of copper oxide on the inside surfaces of the joint. The purge shall be maintained until the joint is cool to the touch. The final connection of new piping to an existing, in-use pipeline shall be permitted to be made without the use of a nitrogen purge.

H. Bury all underground piping at least three (3) feet below finished grade and fully encase within schedule 40 PVC piping sleeve. Provide a continuous detectable warning tape immediately above buried lines. Warning tape shall clearly identify the pipeline by specific name. A continuous warning means shall also be provided on tamped backfill above the pipeline at approximately one-half the depth of bury.

I. Do not install piping in the same trench with other buried utilities. The minimum horizontal clearance between laboratory pipe and parallel buried utility pipe shall be eight (8) feet. Do not install pipe through catch basins, vaults, manholes or similar underground structures.

J. Piping shall not be installed in kitchens, electrical switchgear rooms, elevator shafts, and areas with open flames.

K. Memory-metal couplings shall not be installed within eight inches of a brazed joint.

L. Shut-off valves installed for future connections shall be provided with downstream piping closed with a brazed cap and sufficient tubing allowance for cutting and re-brazing.

M. Branch takeoffs from horizontal piping shall be taken off above the centerline of the main or branch pipe and rise vertically or at an angle of not less than 45 degrees from vertical.

N. Support all piping in accordance with NFPA 99 and Contract Documents.

O. Pressure and vacuum indicators shall be readable from a standing position.

P. All alarm sensors shall be installed at readily accessible locations and shall not be obstructed by other building components.

Q. Zone valve boxes shall be installed where they are visible and accessible at all time and readily operable from a standing position in the corridor on the same floor they serve.

R. Area alarm panels shall be located where indicated on Contract Drawings at a nurse's station or other location that will provide for continuous responsible surveillance.

S. Locate master alarm panels shall where indicated on Contract Drawings in at least two (2) separate locations as required by NFPA 99.

T. All alarm panels shall be mounted at a height allowing monitoring and operation from a standing position.

3.02 LABELING

A. Label all piping, valves, station inlets and outlets, and alarms in accordance with NFPA 99 requirements and Contract Documents.

B. Re-label existing shut-off valves and alarm panels when modifications are made changing the areas served. New labels shall be in accordance with NFPA 99 and Contract Documents.

3.03 TESTING AND INSPECTION

A. Inspection and testing shall be performed on all new piped gas systems, additions, renovations, temporary installations, or repaired systems, to assure the facility, by a documented procedure, that all applicable provisions of NFPA 99 have been adhered to and system integrity has been achieved or maintained.

B. After brazing, the outside of all joints shall be cleaned by washing with water and a wire brush to remove any residue and permit clear visual inspection of the joint. Each brazed joint shall be visually inspected after cleaning the outside surfaces. Brazed joints identified as defective shall be repaired or replaced as required by NFPA 99.

C. After installation of the distribution piping and before installation of station outlets/inlets and other system components (e.g., pressure/vacuum alarm devices, pressure/vacuum indicators), piping in laboratory vacuum and gas distribution systems shall be blown clear by means of oil-free, dry Nitrogen.

D. Installer shall perform initial pressure tests, cross-connection test, piping purge test and standing pressure test prior to third party system verification and in strict accordance with NFPA 99.

E. System verification tests shall be performed only after all installer performed tests, have been completed. Equipment Vendor or installing Contractor shall not perform system verification, final testing or certification.

F. A Third Party Medical Gas System Verification Testing Agency shall perform standing pressure test, cross-connection test, valve test, alarm test, piping purge test, piping particulate test, piping purity test, final tie-in test, operational pressure test and gas concentration test.

G. The Third Party Medical Gas System Verification Testing Agency shall verify the presence and correctness of labeling required by this standard for all components (e.g., station outlets/inlets, shutoff valves, and alarm panels).

H. It shall be the responsibility of the Third Party Medical Gas System Verification Testing Agency to make periodic jobsite visits to assure all requirements of this specification and NFPA 99 are strictly adhered to.

I. Certification shall clearly state that the system is approved for use and meets all requirements of NFPA-99 inclusive of all referenced and/or related documents. Any exceptions or limitations shall be clearly stated on the same certification document.

3.04 VENDOR SUPERVISION AND OPERATING INSTRUCTIONS

A. An authorized representative of the equipment manufacturer shall periodically check with the installing Contractor during initial installation of the pipeline systems and equipment and shall assist the Contractor in final check to make certain that all systems are operating as recommended by the manufacturer, as specified and in accordance with NFPA 99. The equipment manufacturer's representative shall provide a minimum of 4 hours instruction to MD Anderson Cancer Center personnel in the use of the piping systems and the related equipment operated from those systems.

END OF SECTION 22 60 53

SECTION 23 05 90 – CONTRACTOR COORDINATION WITH TESTING, ADJUSTING, AND BALANCING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 SUMMARY

A. Perform all Work required to prepare the building HVAC systems for testing, adjusting, and balancing (TAB) Work indicated by the Contract Documents, including the following:

1. Preparation of air systems for testing, adjusting and balancing.

2. Preparation of hydronic and steam systems for testing, adjusting and balancing.

3. Providing materials and labor to assist TAB Firm in meeting testing, adjusting and balancing requirements.

B. Testing, adjusting and balancing of the air conditioning systems and related ancillary equipment will be performed by a technically qualified TAB Firm. The preparation for and corrections necessary for the testing, adjusting and balancing of these systems, as described herein, are the responsibility of this Contractor.

C. Make any changes or replacements to the sheaves, belts, dampers and valves required for correct balance as advised by the TAB Firm, at no additional cost to the Owner.

1.03 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:

1. AABC: National Standards for Testing and Balancing Heating, Ventilating and Air Conditioning Systems.

2. AABC: Testing and Balancing Procedures.

3. ASHRAE HVAC Applications Chapter 37: Testing, Adjusting and Balancing.

4. ANSI/ASHRAE Standard 111: Practices for Measurement, Testing, Adjusting and Balancing of Buildings, Heating, Ventilation, Air Conditioning and Refrigeration Systems.

1.04 QUALITY ASSURANCE

A. Provide and coordinate the services of qualified, responsible Subcontractors, suppliers and personnel as required to correct, repair, and/or replace any and all deficient items or conditions found during the course of this project, including during the testing, adjusting and balancing period.

B. In order that systems may be properly tested, adjusted, and balanced, the Contractor shall operate systems at Contractor's expense for the length of time necessary to properly verify the systems' completion and readiness for TAB.

C. Project Contract completion schedules shall allow for sufficient time to permit the completion of TAB services prior to Owner occupancy. Allow adequate time for the testing and balancing activities during the construction period and prior to Substantial Completion.

PART 2 - PRODUCTS

2.01 GENERAL

A. None used.

PART 3 - EXECUTION

3.01 PREPARATION

A. Contractor shall be responsible to prepare the building heating, ventilating, and air conditioning systems ready for TAB when scheduled.

B. Operational readiness requires that construction status of the building will permit the closing of doors, windows, ceilings installed, etc., to obtain simulated or projected operating conditions.

C. Notification of System Readiness:

1. Upon completion of the system installation Work, the Contractor shall notify the Owner and TAB Firm in writing, certifying that the Work has been accomplished and that the air conditioning systems are in operational readiness for testing, adjusting, and balancing.

2. TAB Firm shall notify the Contractor of TAB Firm's readiness for balancing.

3. Should the TAB Firm be notified as described above, and the TAB Work commenced and the systems are found NOT to be in readiness or a dispute occurs as to the readiness of the systems, the Contractor shall request an inspection be made by a duly appointed representative of the Owner, Architect, TAB Firm and the Contractor. This inspection will establish to the satisfaction of the represented parties whether or not the systems meet the basic requirements for TAB services. Should the inspection reveal the TAB services notification to have been premature, all cost of the inspection and wasted Work accomplished by the TAB Firm shall be the responsibility of the Contractor.

3.02 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. All installation shall be in accordance with manufacturer's published recommendations.

C. Allow sufficient time for the TAB Firm to perform TAB Firm's Work within the Project schedule. Complete installation Work by system or floor, whichever is the most efficient for scheduling. Develop the Project schedule in close coordination with the TAB Firm.

D. The Drawings and Specifications indicate valves, dampers and miscellaneous adjustment devices for the purpose of adjustment to obtain optimum operating conditions. Install these devices in a manner that will leave the devices accessible and readily able to be adjusted. Immediately correct any malfunction encountered that the TAB Firm reports so that the balancing Work can proceed with minimal delay.

E. Contractor shall promptly correct deficiencies of materials and workmanship identified as delaying completion of TAB Work.

3.03 SYSTEMS VERIFICATION

A. Air Distribution Systems:

1. Verify installation for conformity to the Contract Documents. All supply, return, and exhaust ducts shall be terminated and pressure tested for leakage as required by the Contract Documents.

2. All volume, smoke and fire/smoke dampers are properly located and functional. Dampers serving requirements of minimum and maximum outside, return, and relief air shall provide tight closure and full opening, smooth and free operation.

3. All supply, return, exhaust and transfer grilles, registers, diffusers and terminal devices are installed and airflow at each device shall be verified.

4. Air handling systems, units and associated apparatus, such as heating and cooling coils, filter sections, access doors, etc., shall be sealed or blanked-off to eliminate excessive uncontrolled bypass or leakage of air.

5. All fans (supply, return and exhaust) operating and verified for freedom from vibration, with proper fan rotation and belt tension. Heater elements in motor starters are of proper size and rating. Record motor amperage and voltage on each phase at Start-up and running, and verify they do not exceed nameplate ratings.

6. All single and/or double duct variable and constant volume terminal units ("mixing boxes") shall be installed and functional (i.e. controls functioning).

7. Duct systems and air handling units and coils are clean and free of debris.

8. Air systems are pressure independent and can be tested by floor, riser, system, etc. but once the all systems are installed, the total flows and system tracking will require final testing, adjusting and balancing.

B. Water Circulating Systems:

1. Check and verify pump alignment and rotation.

2. Open all valves to their full open position, close bypass stop valves. Set mixing valves to full-flow through systems components. After the system is flushed and checked for proper operation, remove and clean all strainers. Repeat the operation until circulating water is clean.

3. Record the amperage of each pump motor on each phase and voltage after reaching rated speed. Readings shall not exceed nameplate rating.

4. Verify that the electrical heater elements are of the proper size and rating.

5. All water circulating systems shall be full and free of air. Expansion tanks shall be set for proper water level and all air vents shall be installed at high points of systems and operating freely. Systems shall be cleaned and flushed. Chemicals shall be added to closed systems to treat piping and inhibit corrosion.

6. Check and set operating temperatures and other parameters of the heat exchangers and control devices to the design requirements.

7. Installation and system verification of condenser water, hot water, and chilled water systems must be 100 percent complete prior to balancing.

C. Building Automation System (BAS):

1. Verify that all control components are installed in accordance with the Contract Documents and that all control components are functional, including all electrical interlocks, damper sequences, air and water resets, fire and freeze stats, high and low temperature thermostats, safeties, etc.

2. Verify that all controlling instruments are calibrated and set for design operating conditions with the exception of room thermostats or sensors, which shall be calibrated at the completion of TAB services with cooperation between the TAB Firm and BAS Provider.

3. BAS Provider shall thoroughly check all controls, sensors, operators, sequences, etc. before notifying the TAB Firm that the building automation system is operational. The BAS Provider shall provide technical support, including technicians and necessary computers, to the TAB Firm for a complete check of these systems.

4. BAS Provider shall assist the Contractor with functional performance testing and point-to-point testing back to the main graphics.

5. BAS Provider, if requested by Owner, shall set-up controls on sample fan powered terminal units at TAB Firm's office.

END OF SECTION 23 05 90

SECTION 23 05 93 – SYSTEM TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 SUMMARY

A. Testing, adjusting, and balancing (TAB) of the air conditioning systems and related ancillary equipment will be performed by a technically qualified TAB Firm.

B. TAB Firm shall be capable of performing the TAB services as specified in accordance with the Contract Documents, including the preparation and submittal of a detailed report of the actual TAB Work performed.

C. TAB Firm shall check, adjust, and balance components of the air conditioning system which will result in optimal noise, temperature, and airflow conditions in the conditioned spaces of the building while the system equipment is operating economically and efficiently. This is intended to be accomplished after the system components are installed and operating as specified in the Contract Documents. It is the responsibility of the Contractor to place the equipment into service. Variable air volume systems shall be balanced in accordance with AABC Standard, Latest Edition or NEBB Standards for Testing, Adjusting, Balancing of Environmental Systems (Latest Edition).

D. TAB Firm shall check, adjust, and balance all hydronic systems including pumps, water distribution systems, ~~chillers, cooling towers, boilers, heat exchangers,~~ coils, and related equipment.

E. Liaison and Early Field Inspection:

1. TAB Firm shall act as a liaison between the Owner, Architect and Contractor. TAB Firm shall perform the following reviews (observations) and tests:

   a. During construction, review all HVAC submittals such as control diagrams, air handling devices, etc., that pertain to the ability to satisfactorily balance systems.

   b. Test at least one or at least 10 percent of the single and fan-powered terminal units if the number of units are greater then twenty (20), for casing and damper leakage when the shipment arrives at the Project Site. All testing (except for the initial terminal units) shall be performed at the Project Site.

c. Test one (1) lab configuration including fume hood with air valve, general exhaust air with air valve and supply air with air valve for performance capability through a full range of inlet pressures. The tracking capability of the exhaust air versus the supply air will be with the submitted hood sash fully open and as the sash is closed in 2 inch increments until fully closed. Track the valves' response time in relation to sash movement and the lab differential.

2. During the balancing process, as the TAB Firm discovers abnormalities and malfunctions of equipment or components, the TAB Firm shall advise the Contractor in writing so that the condition can be corrected by the Contractor prior to finishing the TAB scope of Work. Data from malfunctioning equipment shall not be recorded in the final TAB report.

1.03 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:

1. AABC - National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems.

2. NEBB - National Environmental Balancing Bureau, Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems.

3. ASHRAE HVAC Applications Chapter 37: Testing, Adjusting and Balancing.

4. ANSI/ASHRAE Standard 111: Practices for Measurement, Testing, Adjusting and Balancing of Buildings, Heating, Ventilation, Air Conditioning and Refrigeration Systems.

5. CTI - Cooling Technology Institute CODE ATC-105.

1.04 QUALITY ASSURANCE

A. TAB Firm shall have operated a minimum of five (5) years under TAB Firm's current name and shall be in good standing with the State of Texas, Franchise Tax Board. TAB Firm shall submit full incorporated name, Charter Number, and Taxpayer's I.D. Number for proper verification of TAB Firm's status.

B. TAB Firm's personnel performing Work at the Project Site shall be either professional engineers or certified air and water balance technicians, who shall have been permanent, full time employees of the TAB Firm for a minimum of six (6) months prior to the start of Work for this Project.

C. TAB firm shall have a background record of at least five (5) years of specialized experience in the field of air and hydronic system balancing and shall possess properly calibrated instrumentation.

1.05 SUBMITTALS

A. The activities described in this Section shall culminate in a report to be provided in quadruplicate (4), individually bound and also provided electronically to the Contractor to be presented to the Owner. Neatly type and arrange data. Include with the data, the dates tested, personnel present, weather conditions, nameplate record of test instrument and list all measurements taken after all corrections are made to the system. Record all failures and corrective action taken to remedy incorrect situation. The intent of the report is to provide a reference of actual operating conditions for the Owner's operations personnel.

B. All measurements and recorded readings (of air, water, electricity, etc.) that appear in the report must have been made at the Project Site by the permanently employed technicians or engineers of the TAB Firm.

C. At the Owner’s option, all data sheets tabulated each day by TAB Firm personnel shall be submitted for review and sign-off by the Owner’s Construction Inspector. Those data sheets, as initialed by Owner’s Construction Inspector, shall be presented as a supplement to the final TAB report.

D. Submit reports on electronic forms approved by the Owner and Architect/Engineer which will include the following information as a minimum:

1. Title Page:

a. Company name.

b. Company address.

c. Company telephone number.

d. Project name.

e. Project location.

f. Project Manager.

g. Project Engineer.

h. Project Contractor.

i. Project identification number.

2. Instrument List:

a. Instrument.

b. Manufacturer.

c. Model.

d. Serial number.

e. Range.

f. Calibration date.

g. What test instrument was used for.

3. Fan Data (Supply and Exhaust):

a. Identification and location.

b. Manufacturer.

c. Model.

d. Air flow, specified and actual.

e. Total static pressure (total external), specified and actual.

f. Inlet pressure.

g. Discharge pressure.

h. Fan RPM.

4. Air Handler Return Air/Outside Air Data (If fans are used, provide fan data as noted above):

a. Identification and location.

b. Design return air flow.

c. Actual return air flow.

d. Design outside air flow.

e. Return air temperature.

f. Outside air temperature.

g. Required mixed air temperature.

h. Actual mixed air temperature.

5. Electric Motors:

a. Manufacturer.

b. Horsepower/brake horsepower.

c. Phase, voltage, amperage, nameplate, actual.

d. RPM.

e. Service factor.

f. Starter size, heater elements, rating.

6. V-Belt Drive:
    a. Identification and location.
    b. Required driven RPM.
    c. Driven sheave, diameter and RPM.
    d. Belt, size and quantity.
    e. Motor sheave, diameter and RPM.
    f. Center-to-center distance, maximum, minimum and actual.
7. Duct Traverse:
    a. System zone/branch.
    b. Duct size.
    c. Area.
    d. Design velocity.
    e. Design air flow.
    f. Test velocity.
    g. Test air flow.
    h. Duct static pressure.
    i. Air temperature.
    j. Air correction factor.
8. Air Monitoring Station Data:
    a. Identification and location.
    b. System.
    c. Size.
    d. Area.
    e. Design velocity.
    f. Design air flow.
    g. Test velocity.
    h. Test air flow.

9. Variable or Constant Volume Terminal Unit Test Sheet:

    a. Identification number.

    b. Room number/location.

    c. Terminal type (FP if fan powered) and / or (SDVV, SDCV, DDVV, DDCV), and (HWRH or ERH if reheat coil is used).

    d. Terminal size.

    e. Area factor.

    f. Design velocity.

    g. Design maximum and minimum air flow.

    h. Test (final) velocity.

    i. Test (final) maximum and minimum air flow.

    j. For DDC instrumentation: Measure and record computer readout and calibration factor at the final measurement conditions.

    k. Air dry bulb temperature at the discharge of the terminal unit.

10. Pump Data:

    a. Identification and location.

    b. Manufacturer.

    c. Size/model.

    d. Impeller size.

    e. Service (~~CTW,~~ CHW, ~~CDW,~~ HW, etc.).

    f. Developed head pressure and BHP at design flow rate.

    g. Developed head pressure and BHP at actual flow rate.

    h. Pump discharge pressure.

    i. Pump suction pressure.

    j. Total operating head pressure at final balance.

    k. Shut off, discharge and suction pressure.

    l. Shut off, total head pressure.

    m. Pressure differential settings.

    n. Fluid temperature.

11. Cooling Coil Data:
    a. Identification number.
    b. Location.
    c. Service.
    d. Manufacturer.
    e. Entering air DB temperature, design and actual.
    f. Entering air WB temperature, design and actual.
    g. Leaving air DB temperature, design and actual.
    h. Leaving air WB temperature, design and actual.
    i. Water pressure flow, design and actual.
    j. Water pressure drop, design and actual.
    k. Pressure independent control valve water pressure drop, design and actual.
    l. Entering water temperature, design and actual.
    m. Leaving water temperature, design and actual.
    n. Air quantity CFM design, and CFM actual.
    o. Air pressure drop, design and actual.
    p. Sensible Btu/hr design, and actual.
    q. Total Btu/hr design, and actual.
12. Heating Coil Data:
    a. Identification number.
    b. Location.
    c. Service.
    d. Manufacturer.
    e. Air flow, design and actual.
    f. Water flow (gpm) or Steam mass flow rate (lbs per hour) design and actual.
    g. Pressure drop water (feet w.g.) or steam (psid), design and actual.
    h. Pressure independent control valve water pressure drop, design and actual.
    i. Entering water or steam temperature, design and actual.

j. Leaving water or steam temperature, design and actual.

k. Entering air temperature, design and actual.

l. Leaving air temperature, design and actual.

m. Air quantity CFM design, and CFM actual.

n. Air pressure drop, design and actual.

o. Sensible Btu/hr design, and actual.

p. Electric heat kW, number of stages, kW per stage – specified and actual (if applicable).

~~13.Heat Exchanger Data:~~

~~a.Identification and location.~~

~~b.Service.~~

~~c.Manufacturer.~~

~~d.Steam flow rate, design and actual.~~

~~e.Water flow rate, design and actual.~~

~~f.Water pressure drop, design and actual.~~

~~g.Pressure independent control valve water pressure drop, design and actual.~~

~~h.Entering steam temperature and pressure, design and actual.~~

~~i.Entering water temperature, design and actual.~~

~~j.Leaving water temperature, design and actual.~~

~~k.Electric heat, full load kW, number of stages, kW per stage – specified and actual (if applicable).~~

~~14.Chiller:~~

~~a.Identification and location.~~

~~b.Manufacturer and model number.~~

~~c.Condenser cooling medium (water or air cooled).~~

~~d.Number of compressor types and number of stages.~~

~~e.Chilled water entering and leaving temperature - specified and actual - one hour log.~~

~~f.Condenser water entering and leaving temperature - specified and actual - one hour log.~~

~~g.Evaporator section and condenser section water side pressure drop - specified and actual.~~

~~h.Air cooled condenser entering and leaving dry bulb temperatures.~~

~~i.Compressors full load amperage - specified and actual.~~

~~j.Voltage, phase, and cycle - specified and actual.~~

~~k.Ambient temperature, DB/WB, time of day, and weather conditions at time of test.~~

~~l.Cooler tons, condenser tons, and measured operating kW / ton compared to factory certified performance test data.~~

~~15.Cooling Tower:~~

~~a.Identification and location.~~

~~b.Manufacturer.~~

~~c.Model number.~~

~~d.Size and serial number.~~

~~e.Motor horsepower and RPM.~~

~~f.Voltage, phase, hertz.~~

~~g.Full load amps.~~

~~h.Running amps.~~

~~i.Cooling tower water flow rate through the tower.~~

~~j.Cooling water flow rate through the bypass piping.~~

~~k.Air entering and leaving wet bulb temperatures.~~

~~l.Record airflow velocities and rates at the tower air inlets.~~

~~m.Specified and actual tons capacity at design conditions.~~

~~16.Hot Water Boiler or Steam Boiler:~~

~~a.Identification and location.~~

~~b.Unit manufacturer and model number.~~

~~c.Heating water flow gpm - specified and actual (if applicable).~~

~~d.Steam capacity lbs per hour - specified and actual (if applicable).~~

~~e.Steam temperature and pressure - specified and actual.~~

~~f.MBtuh Input / output - specified and actual.~~

~~g.MBtuh output - specified and actual.~~

~~h.Gas / Fuel oil burner CFH / gpm.~~

~~i.Gas / Fuel oil inlet pressure, in water / psig.~~

~~j.Blower motor horsepower and FLA .~~

~~k.Fire rate - gas, therm. / oil, btu per lbm.~~

~~l.High fire set point(s).~~

~~m.Low fire set point(s).~~

~~n.NOx measurement (based on capacity of boiler per the Texas Commission on Environmental Quality).~~

~~17.~~**13.** Sound Level Report:

a. Location (Location established by the Engineer).

b. Baseline background NC curve for eight (8) bands – with equipment off.

c. Operating NC curve for eight (8) bands – with equipment on.

~~18.~~**14.** Vibration Test on equipment having 10 horsepower motors or greater:

a. Location of points:

1) Fan bearing, drive end.

2) Fan bearing, opposite end.

3) Motor bearing, center (if applicable).

4) Motor bearing, drive end.

5) Motor bearing, opposite end.

6) Casing (bottom or top).

7) Casing (side).

8) Duct after flexible connection (discharge outlet).

9) Duct after flexible connection (suction inlet).

b. Test readings:

1) Horizontal, velocity and displacement.

2) Vertical, velocity and displacement.

3) Axial, velocity and displacement.

c. Normally acceptable readings, velocity and acceleration.

d. Unusual conditions at time of test.

e. Vibration source (if non-complying).

~~19.~~**15.** Control verification indicating date performed and any abnormalities identified:

a. Point Location/Description.

b. EMS Readout (Setpoint and Actual).

c. Actual Readout.

d. Interlocks.

e. Safeties:

1) VSD Normal Operation.

2) VSD Bypass Operation.

f. Alarms.

g. Sequences of Operation.

~~20.~~**16.** Include in the appendix all submittals for air handling units, pumps, fans, heat exchangers, energy recovery units control system, etc.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.01 AIR BALANCE

A. When systems are installed and ready for operation, the TAB Firm shall perform an air balance for all air systems and record the results. The outside, supply, exhaust and return air volume for each air handling unit, supply fan and exhaust fan and the supply, exhaust or return air volume for each distribution device shall be adjusted to within +/- 5 percent of the value shown on the Drawings. Air handling unit and fan volumes shall be adjusted by changing fan speed and adjusting volume dampers associated with the unit. Air distribution device volume shall be adjusted using the spin-in tap damper for flexible duct connected devices and the device opposed blade damper (OBD) for duct connected devices. Air distribution devices shall be balanced with air patterns as specified. Duct volume dampers shall be adjusted to provide air volume to branch ducts where such dampers are shown.

B. The general scope of balancing by the TAB Firm shall include, but is not limited to, the following:

1. Filters: Check air filters and filter media and balance only systems with essentially clean filters and filter media. The Contractor shall install new filters and filter media prior to the final air balance.

2. Blower Speed: Measure RPM at each fan or blower to design requirements. Where a speed adjustment is required, the Contractor shall make any required changes.

3. Ampere Readings: Measure and record full load amperes for motors.

4. Static Pressure: Static pressure gains or losses shall be measured across each supply fan, cooling coil, heating coil, return air fan, air handling unit filter and exhaust fan. These readings shall be measured and recorded for this report at the furthest air device or terminal unit from the air handler supplying that device. Static pressure readings shall also be provided for systems, which do not perform as designed.

5. Equipment Air Flow: Adjust and record exhaust, return, outside and supply air CFM(s) and temperatures, as applicable, at each fan, blower and coil.

6. Coil Temperatures: Set controls for full cooling and for full heating loads. Read and record entering and leaving dry bulb and wet bulb temperatures (cooling only) at each cooling coil, heating coil and reheat coil at each VAV terminal unit. At the time of reading record water flow and entering and leaving water temperatures (In variable flow systems adjust the water flow to design for all the above readings).

7. Zone Air Flow: Adjust each HVAC VAV terminal unit and VAV air handling unit for design CFM.

8. Outlet Air Flow: Adjust each exhaust inlet and supply diffuser, register and grille to within + 5 percent of design air CFM. Include all terminal points of air supply and all points of exhaust. Note: For Labs and rooms that are negative exhaust air flow shall be set to design + 10 percent and supply to design - 5 percent. Positive areas will have opposite tolerances.

9. Pitot Tube Traverses: For use in future troubleshooting by Owner, all exhaust ducts, main supply ducts and return ducts shall have air velocity and volume measured and recorded by the traverse method. Locations of these traverse test stations shall be described on the sheet containing the data.

10. Maximum and minimum air flow on terminal units.

3.02 HYDRONIC SYSTEM BALANCE

A. When systems are installed and ready for operation, the TAB Firm shall perform water balance for each chilled and heating hot water system.

B. The general scope of balancing by the TAB Firm shall include, but not be limited to, the following:

1. Adjusted System Tests: Adjust pressure independent control valves at each coil and heat exchanger for design flow, +/- 5 percent, in accordance with valve manufacturer's published commissioning procedure. Pressure independent valve manufacturer will provide service tool and/or service software for use in this commissioning process, and provide training in its use. Adjust balancing valves at pumps to obtain design water flow. Record pressure rise across pumps and GPM flow from pump curve. Permanently mark the balanced position for each valve. (Note: If discharge valves on the pumps are used for balancing record the head being restricted by the valves).

2. Temperature Readings: Read and record entering and leaving water temperature at each water coil, converter and heat exchanger. Adjust as necessary to design conditions. Provide final readings at all thermometer well locations.

~~3.Test cooling towers in accordance with CTI Code ATC – 105.~~

~~4.~~**3.** Pressure Readings: Water pressure shall be recorded at all gauge connections. Pressure readings at coils and pumps shall be related to coil and pump curves in terms of GPM flow through flow measuring status, if provided and installed, at each air handler. The flow of water through all water coils shall be adjusted by manipulating pressure independent control valves, in accordance with valve manufacturer's published commissioning procedures until the rated pressure drops across each coil is obtained and total water flow is verified by flow measuring status. Verify required pressure drop across each pressure independent control valve. For coils equipped with 3-way valves, the rated pressure drop shall first be adjusted through the coils. The bypass valve shall then be adjusted on each coil until an equal pressure drop between supply and return connections is the same as with the flow through the coil.

~~5.~~**4.** Ampere Readings: Reading and record full load amperes for each pump motor.

3.03 SOUND VIBRATION AND ALIGNMENT

A. Sound: Read and record sound levels at up to fifteen (15) locations per floor in the building as designated by the Architect/Engineer. All measurements shall be made using an Octave Band Analyzer. All tests shall be conducted when the building is quiet and in the presence of the Architect/Engineer, at the Architect/Engineer's option.

B. Vibration: Read and record vibration for all water circulating pumps, air handling units, and fans which have motors larger than 10 horsepower Include equipment vibration, bearing housing vibration, foundation vibration, building structure vibration, and other tests as directed by the Architect/Engineer. Readings will be made using portable IRD (or approved equal) equipment capable of filtering out various unwanted frequencies and standard reporting forms. Maximum vibration at any point listed above, or specified, shall not exceed one mil on fans and one mil on pumps unless otherwise specified. Equipment manufacturer shall rectify all systems exceeding vibration tolerances.

3.04 BUILDING AUTOMATION SYSTEMS

A. In the process of performing the TAB Work, the Contractor shall:

1. Work with the Building Automation System (BAS) Provider and Owner to ensure the most effective total system operation within the design limitations, and to obtain mutual understanding of intended control performance.

2. Verify that all control devices are properly connected.

3. Verify that the intended controllers operate all dampers, valves and other controlled devices.

4. Verify that all dampers and valves are in the position indicated by the controller; open, closed, or modulating.

5. Verify the integrity of valves and dampers in terms of tightness of close-off and full-open positions. This includes all duct-mounted dampers, dampers in terminal units, and fire/smoke dampers.

6. Observe that all valves are properly installed in the piping system in relation to direction of flow and location. Observe that all pressure independent control valves are properly installed in accordance with manufacturer's published installation instructions.

7. Observe the calibration and operation of all controllers.

8. Verify the proper application of all normally opened and normally closed valves.

9. Observe the locations of all thermostats and humidistats for potential erratic operation from outside influences such as sunlight, drafts, or cold walls.

10. Observe the locations of all sensors to determine whether their position will allow them to sense only the intended temperatures or pressures of the media. BAS Provider will relocate sensors as deemed necessary by the TAB Firm or Contractor.

11. Verify that the sequence of operation for any control mode is in accordance with approved Shop Drawings and Specifications. Verify that no demand for simultaneous heating and cooling occurs at the terminal units.

12. Verify that all controller setpoints meet the Contract Documents.

13. Check all dampers for free travel.

14. Verify the operation of all interlock systems.

15. Perform variable volume system verification to assure the system and system components track with changes from full flow to minimum flow.

~~3.05STAIRWELL PRESSURIZATION SYSTEMS~~

~~A.With all doors closed, measure the door pull to determine that the opening force required is less than or no greater than 30 pound-force.~~

~~B.With all doors closed, measure the pressure differential across each door to verify the pressure differentials at each floor. Pressure differential shall not exceed 0.15 inches w.g. and shall be greater than 0.05 inches w.g.~~

~~C.Measure the airflow in the stairwell with the maximum number of doors fully open by pitot tube traverse, if traverse locations are available. If traverse locations are not available, TAB Firm shall measure air flow at each outlet.~~

~~D.Verify with smoke that the smoke detector in the stair pressurization fan inlet shuts down the fan.~~

END OF SECTION 23 05 93

SECTION 23 07 13 – DUCTWORK INSULATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 SUMMARY

A. Perform all Work required to provide and install ductwork insulation and jackets indicated by the Contract Documents with supplementary items necessary for proper installation.

1.03 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:

1. ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate.

2. ASTM C168 - Terminology Relating to Thermal Insulation Materials.

3. ASTM C518 - Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.

4. ASTM C553 - Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.

5. ASTM C612 - Mineral Fiber Block and Board Thermal Insulation.

6. ASTM C1071 - Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).

7. ASTM C1104 - Standard Test Method for Determining the Water Vapor Sorption of Unfaced Mineral Fiber Insulation.

8. ASTM C1290 - Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts.

9. ASTM C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.

10. ASTM C1338 - Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings.

11. ASTM E84 - Surface Burning Characteristics of Building Materials.

12. ASTM E96 - Water Vapor Transmission of Materials.

13. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.

14. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.

15. NFPA 255 - Surface Burning Characteristics of Building Materials.

16. SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

17. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors.

18. UL 723 - Surface Burning Characteristics of Building Materials.

19. ASTM E2336 - Standard for Grease Ducts.

20. ASTM D5590 - - Standard Test Method for Determining the Resistance of Paint Films and Related Coatings to Fungal Defacement by Accelerated Four-Week Agar Plate Assay

1.04 QUALITY ASSURANCE

A. All ductwork requiring insulation shall be insulated as specified herein and as required for a complete system. In each case, the insulation shall be equivalent to that specified and materials applied and finished as described in these Specifications.

B. All insulation, jacket, adhesives, mastics, sealers, etc., utilized in the fabrication of these systems shall meet NFPA for fire resistant ratings (maximum of 25 flame spread and 50 smoke developed ratings) and shall be approved by the insulation manufacturer for guaranteed performances when incorporated into their insulation system, unless a specific product is specified for a specific application and is stated as an exception to this requirement. Certificates to this effect shall be submitted along with Contractor's submittal data for this Section of the Specifications. No material may be used that, when tested by the ASTM E84-89 test method, is found to melt, drip or delaminate to such a degree that the continuity of the flame front is destroyed, thereby resulting in an artificially low flame spread rating.

C. Application Company Qualifications: Company performing the Work of this Section must have minimum three (3) years experience specializing in the trade.

D. All insulation shall be applied by mechanics skilled in this particular Work and regularly engaged in such occupation.

E. All insulation shall be applied in strict accordance with these Specifications and with factory printed recommendations on items not herein mentioned. Unsightly, inadequate, or sloppy Work will not be acceptable.

1.05 SUBMITTALS

A. Product Data:

1. Provide product description, list of materials, “k” value, “R” value, mean temperature range, and thickness for each service and location.

B. Record Documents:

1. Submit under provisions of Division 01.

C. Operation and Maintenance Data:

1. Samples: When requested, submit three (3) samples of any representative size illustrating each insulation type.

2. Manufacturer’s Installation Instructions: Indicate procedures that ensure acceptable standards will be achieved. Submit certificates to this effect.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect, and handle products to the Project Site under provisions of Division 01 and Division 20.

B. Deliver materials to Site in original factory packaging, labeled with manufacturer’s identification including product thermal ratings and thickness.

C. Store insulation in original wrapping and protect from weather and construction traffic. Protect insulation against dirt, water, chemical, and mechanical damage.

D. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics and insulation cements.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.02 MANUFACTURERS

A. CertainTeed Corporation.

B. Johns Manville Corporation.

C. Knauf Corporation.

D. Owens-Corning.

E. Armacell North America.

F. Unifrax 1 LLC. (FyreWrap)

G. 3M Fire Protection Products (Fire Barrier Duct Wrap 615+)

2.03 INSULATION MATERIALS

A. Type D1: Flexible glass fiber; ASTM C553 and ASTM C1290; commercial grade; 'k' value of 0.25 at 75 degrees F; 1.5 lb/cu ft minimum density; 0.002 inch foil scrim kraft facing for air ducts.

B. Type D2: Rigid glass fiber; ASTM C612, Class 1; 'k' value of 0.23 at 75 degrees F; 3.0 lb/cu ft minimum density; 0.002 inch foil scrim kraft facing for air ducts.

~~C.Type D3: Ductliner (to be used in return air sound boots only), flexible glass fiber; ASTM C1071; Type II, 'k' value of 0.23 at 75 degrees F; 3.0 lb/cu ft minimum density; coating air side for maximum 4,000 feet per minute air velocity. The airstream surface must be protected with a durable acrylic surface coating specifically formulated to:~~

~~1.Be no more corrosive than sterile cotton when tested in accordance with the test method for corrosiveness in ASTM C665.~~

~~2.Absorb no more than 3 percent by weight when tested in accordance with the test method for moisture vapor sorption in ASTM C1104.~~

~~3.Not support the growth of fungus or bacteria, when tested in accordance with the test method for fungi resistance in ASTM C1071, ASTM C1338, ASTM G21, and ASTM G22.~~

~~4.Show no signs of warpage, cracking, delaminating, flaming, smoking, glowing, or any other visibly negative changes when tested in accordance with the test method for temperature resistance in ASTM C411.~~

~~5.Have a flame spread rating of 25 or less and a smoke developed rating of 50 or less when tested in accordance with the test method for surface burning in ASTM E 84.~~

~~6.Meet the sound absorption requirements when tested in accordance with the test method for sound absorption in ASTM C423.~~

~~7.Show no evidence of continued erosion, cracking, flaking, peeling, or delamination when tested in accordance with the test method for erosion resistance in UL181.~~

~~D.Type D4: Fire Rated Grease Duct Insulation (High Temperature Flexible Blanket); 1-1/2-inch thick refractory grade fibrous fire barrier material with minimum service temperature design of 2,000 degrees F; aluminum foil laminated on both sides; with a minimum 'k' value of 0.25 and a minimum density of 6 lbs/cu ft; containing no asbestos. Listed by a nationally recognized testing laboratory (NRTL) UL to meet ASTM E 2336, ASTM E119, and with flame spread/smoke minimum rating of 25 / 50 when tested as per ASTM E84/UL 723.~~

~~E.~~**C.** Type D5: Outdoor Duct Insulation (Closed Cell Flexible Elastomeric Insulation); 1 inch thick material that has a service temperature range from –60 degrees F to 180 degrees F. This outdoor duct insulation meets ASTM C 177 or C 518 and shall have minimum 'k' value of 0.27 Btu-in. / hr-ft2- degrees F at minimum density measurement of 3 lb/cu ft. The insulation and outside surface must be protected with a white Thermo Plastic Rubber Membrane formulated to:

1. Be resistant to UV, and ozone, acid rain, and physical elements produced from outdoor weather per ASTM E 96 Procedure A.

2. Have aflame spread rating of 25 or less and a smoke developed rating of 50 or less when tested in accordance with the test method for surface burning in ASTM E 84.

3. Show no evidence of continued erosion, delaminating, cracking, flaking, or peeling when tested in accordance with the test method for erosion resistance in UL181. Be resistant to mold growth resistance, ASTM G 21/C 1338 resistant to fungi, and resistant to bacteria growth per ASTM G 22.

~~F.Type D6: Ductliner (to be used in return air sound boots only), flexible glass fiber; ASTM C1071; Type II, 'k' value of 0.23 at 75 degrees F; 3.0 lb/cu ft minimum density; coating air side for maximum 4,000 feet per minute air velocity. The airstream surface must be protected with a durable polyacrylate copolymer emulsion specifically formulated to:~~

~~1.Not support the growth of fungus or bacteria, when tested in accordance with the test method for fungi resistance in ASTM D 5590 with "0" growth rating.~~

~~2.Act as a fungicidal protective coating: water based, VOC < 50 g/l. Fungicidal coating must be EPA registered for use in HVAC duct systems. Manufacturer: H.B. Fuller Construction Products Inc., Foster 40-20 (white) or 40-30 (black) Fungicidal Protective Coating or approved equal. Coatings may also be used to repair damage to duct liner insulation.~~

2.04 INSULATION ACCESSORIES

A. Adhesives: Waterproof vapor barrier type, meeting requirements of ASTM C916; Childers CP-82 or Foster 85-20/85-60.

B. Weather Barrier: Breather Mastic:, Childers CP-10/CP-11 or Foster 46-50 White..

C. Vapor Barrier Coating: Permeance - ASTM E 96, Procedure B, 0.08 perm or less at 45-mil dry film thickness, tested at 100F and 50%RH; Foster 30-65 or Childers CP-34

1. When higher humidity levels may be of concern, only specify the following fungus/mold resistant coating: Foster 30-80 AF (anti fungal). Coating must meet ASTM D 5590 with 0 growth rating**

D. Reinforcing Mesh: 10x10 or 9x8 glass mesh; Foster Mast a Fab or Childers #10

E. Jacket: Pre-sized glass cloth, minimum 7.8 oz/sq yd.

F. Type D4 Insulation Adhesive: Fire resistive to ASTM E84, Childers CP-82 or Foster 85-20.

G. Impale Anchors: Galvanized steel, 12 gage self-adhesive pad.

H. Joint Tape: Glass fiber cloth, open mesh.

I. Tie Wire and Wire Mesh: Annealed steel, 16 gage.

J. Stainless Steel Banding: 3/4-inch wide, minimum 22 gage, 304 stainless.

K. Armaflex 520, 520 BLV, or Foster 85-75 contact adhesive.

L. Armatuff 25 white seal seam tape.

PART 3 - EXECUTION

3.01 PREPARATION

A. Verify that ductwork has been tested before applying insulation materials.

B. Verify that surfaces are clean, foreign material removed, and dry.

C. Maintain required ambient temperature during and after installation for a minimum period of 24 hours.

3.02 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. All installation shall be in accordance with manufacturer's published recommendations.

C. Extend duct insulation without interruption through walls, floors, and similar penetrations, except where otherwise indicated.

D. Provide external insulation on all round ductwork connectors to ceiling diffusers and on top of diffusers as indicated in the Ductwork Insulation Application and Thickness Schedule and the Drawings. Secure insulation to the top of ceiling diffusers with adhesive that meets NFPA 90A and 90B 25/50 requirements, and vapor barrier or tape to match jacket. Do not insulate top of ceiling diffuser if it is used in ceiling return air plenum or in an open space with no ceiling.

E. Flexible and Rigid fiberglass insulation (Types D1 and D2) application for exterior of duct:

1. Secure flexible insulation jacket joints with vapor barrier adhesive, tape. Tape shall be UL181B-FX listed polypropylene duct tape..

2. Install without sag on underside of ductwork. Use 4-inch wide strips of adhesive on 8-inch centers and mechanical fasteners where necessary to prevent sagging. Seal vapor barrier penetrations by mechanical fasteners with vapor barrier adhesive. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.

3. Insulate standing seams and stiffeners that protrude through the insulation with 1-1/2 inch thick, unfaced, flexible blanket insulation. Cover with reinforcing mesh and coat with vapor barrier finish coating.

4. On circumferential joints, the 2-inch flange on the facing shall be secured with 9/16 inch outward clinch steel staples on 2-inch centers, and taped with minimum 3-inch wide strip of glass fabric and finish coating.

5. Vapor seal all seams, joints, pin penetrations and other breaks with vapor barrier coating reinforced with reinforcing mesh.

~~H.~~**F.** Insulation (Type D5) application for outdoor ducts:

1. Horizontal ductwork located outdoors shall be sloped at a minimum 2-degree angle to prevent the accumulation of water on top of the finished insulated duct. Support members that connect directly to the ductwork are to be insulated with this same material. Keep compression or sharp creases of outdoor insulation to a minimum by distributing the weight of the duct resting on horizontal duct support members.

2. Follow the insulation manufacturer's installation instructions and procedures to assure the ductwork is properly insulated and that the insulation will meet the manufacturer's warranty requirements.

~~I.~~**G.** All ductwork, accessories, and all plenums including metal and masonry construction, etc., shall be insulated as indicated on the Drawings, as specified herein and as required for a complete system. In each case, the insulation shall be equal to that specified and materials applied and finished as described in these Specifications.

~~J.~~**H.** Flexible ductwork connections to equipment shall not be insulated.

~~K.~~**I.** Where vapor barriers are required, the vapor barrier shall be on the outside. Extreme care shall be taken that the vapor barrier is unbroken. Joints, etc., shall all be sealed. Where insulation with a vapor barrier terminates, it shall be sealed off with the vapor barrier being continuous to the surface being insulated. Ends shall not be left raw.

~~L.~~**J.** Extreme care shall be taken in insulating high and medium pressure ductwork including all ductwork between the fan discharge and all mixing boxes to ensure the duct is not pierced with sheet metal screws or other fasteners. All high and medium pressure ducts in these Specifications are classified as high velocity ductwork.

~~M.~~**K.** Where canvas finish is specified use lagging adhesive/coating to prevent mildew in securing canvas. Do not use wheat paste.Use only anti fungal lagging adhesive that adheres to ASTM D 5590 with 0 growth rating. (Foster 30-36AF, Childers CP-137AF). In addition, cover all exterior canvas-covered insulation with a fire retardant weather barrier mastic.

~~N.~~**L.** All supply ductwork in the Project shall be insulated; all exhaust and fume hood exhaust ductwork shall not be insulated, unless used for energy recovery purposes or noted on drawings.

~~O.~~**M.** Flexible round ducts shall be factory insulated.

3.03 INSPECTION

A. Visually inspect the completed insulation installation per manufacturers recommended materials, procedures and repair or replace any improperly sealed joints.

B. Where there is evidence of vapor barrier failure or "wet" insulation after installation, the damaged insulation shall be removed, duct surface shall be cleaned and dried and new insulation shall be installed.

3.04 DUCTWORK INSULATION APPLICATION AND THICKNESS SCHEDULE

Ductwork System	Application	Insulation Type	Insulation Thickness
Supply Air (Hot, Cold, Combination)	Outside of Mechanical Rooms	D1	2"
	Inside of Mechanical Rooms	D2	1-1/2"
Return Air, Relief Air, and Exhaust Air	All	D1	1"
Outside Air	Treated and Untreated	D1	2"
~~Kitchen Grease Hood Exhaust Air~~	~~All~~	~~D4~~	~~3"~~
~~Duct mounted coils~~	~~Inside of Mechanical Rooms~~	~~D2~~	~~2"~~
Terminal Unit Heating Coils	All	D1	2"
Supply Air Diffusers	Top of Diffuser	D1	2"
~~Supply Air Duct~~	~~Outdoor Environment~~	~~D5~~	~~2"~~
~~Return, Exhaust Air Duct~~	~~Outdoor Environment~~	~~D5~~	~~1-1/2"~~
~~Return Air Sound Boots/Elbows~~	~~All~~	~~D3~~	~~1"~~

END OF SECTION 23 07 13

SECTION 23 09 10 – LABORATORY TRACKING SYSTEMS AND CONSTANT VOLUME AIR VALVES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 SUMMARY

A. Furnish and install Phoenix Venturi Air Valves for all laboratory spaces and Vivarium areas as shown on the drawings. The Phoenix system is to be Bacnet integrated to the Building Automation System (BAS).

B. The Phoenix CELERIS system will be used for all ~~Laboratory~~ spaces ~~that have chemical fume hoods / radioisotope hoods~~ requiring full high speed actuator capabilities for proper VAV control. The Phoenix CELERIS system with low speed electric actuation will be used ~~for all Laboratory spaces with no fume hoods~~**where specifically called out on plans and schedules** but have additional sequence requirements as noted by the schedules and/or sequence of operation. All other spaces, such as ~~equipment rooms~~**storage rooms**, ~~dark rooms~~**offices**, and ~~environmental~~ **conference** rooms, requiring general room pressurization control will utilize the Phoenix TRACCEL tracking pair system. A laboratory airflow control system shall be furnished and installed to control the airflow into and out of laboratory rooms. The exhaust flow rate of a laboratory fume hood shall be precisely controlled to maintain a constant average face velocity into the fume hood. The system shall have the capabilities to provide constant face velocity control at either a standard / in use or a standby level based on an operator being present in front of the fume hood. The laboratory control system shall vary the amount of makeup/supply air into the room to operate the laboratories at the lowest possible airflow rates necessary to maintain temperature control, achieve minimum ventilation rates, and maintain laboratory pressurization in relation to adjacent spaces (positive or negative). The laboratory airflow control system shall be capable of operating as a stand-alone system, or as a system integrated with the Building Automation System (BAS).

C. Installation of the air valves is by Division 23. Wiring and interface to the Building Automation System (BAS) is to be furnished by Division 25. Start-up and System Commissioning to be furnished by Divisions 23 and 25.

1.03 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within all references.

1.04 SUBMITTALS

A. Product Data:

1. Submit product data for valve electronic and electrical components and optional accessories. Each air valve model product name, and model ordering number, design air flow rates and differential pressure requirements across the valve.

B. Record Documents:

1. Submit complete point-to-point wiring diagrams for each applicable room configuration as shown on the Owner's Drawings.

1.05 WARRANTY

A. Warranty shall commence upon the date of Owner acceptance and extend for a period of twenty-four months, whereupon, any defects in materials or system performance shall be repaired by manufacturer at no cost to the Owner.

B. During the Warranty Period, if a service contract for the routine care, calibration, parts replacement, or upgrade of the system is required or recommended by the manufacturer, or such a contract is to be offered to the Owner during or after the Warranty Period, such contract and services shall also be included during the Warranty Period at no cost to the Owner.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.02 ACCEPTABLE MANUFACTURER

A. Phoenix™ Controls Corporation, which is a subsidiary of Honeywell International, Inc.

2.03 LABORATORY AIRFLOW CONTROL SYSTEM

A. The Laboratory Airflow Control System (LACS) is a microprocessor-based airflow control system that is used for research laboratories and other critical room environments. The LACS shall have a Bacnet™ interface for bi-directional communication with the BAS. The LACS shall provide data values, alarms, and set points used in each room-environment control scheme to the BAS, and also provide remote diagnostics and comprehensive reports and trends through the BAS.

B. Each individual lab zone shall have a dedicated laboratory airflow control system. Each dedicated laboratory airflow control system shall support a minimum of twenty (20) network controlled airflow devices.

C. The laboratory airflow control system shall employ individual average face velocity controllers that directly measure the area of the fume hood sash opening and proportionally control the hood's exhaust airflow to maintain a constant face velocity over a minimum range of 20% to 100% of sash travel.

D. The hood exhaust airflow control device shall respond to the fume hood sash opening by achieving 90% of its commanded value within one second of the sash reaching 90% of its final position with no more than 5% overshoot or undershoot of the required airflow. Rate of sash movement shall be between 1.0 to 1.5 feet per second.

E. The hood exhaust airflow control device shall have the capability of automatically switching between in-use and standby levels based on operator presence immediately in front of the hood. A presence and motion sensor shall activate the switching. The airflow control device shall achieve the required in-use commanded value in less than one second from moment of detection with no more than a 5% overshoot or undershoot.

F. The controller shall be integrated via Bacnet™ with the following points as a minimum;

1. Fume Hood Exhaust Flow (CFM).
2. Supply/Make-up Airflow (CFM).
3. General Exhaust Flow (CFM).
4. Total Lab Exhaust Flow (CFM).
5. Total Lab Supply Flow (CFM).
6. Room Offset (CFM,).
7. Fume Hood Exhaust Low Flow Alarm.
8. Fume Hood Sash Position.
9. Common Fume Hood Emergency Exhaust Alarm (Digital Contact).
10. Occupied, unoccupied, and emergency modes (command and status) of operation and associated command able and adjustable points. I.e. Temperature set point, minimum and maximum airflow set point.

G. The Control Unit shall also accept direct input signals from the BAS.

2.04 FUME HOOD CONTROLLER

A. linear controller shall be installed on the sash mullion of each hood and shall provide user interface/alarm functions and a linear control system, which translates the sash position into a proportional control signal to modulate the hood's exhaust air valve. Hood airflow shall be varied to maintain a nominally constant face velocity at the hood opening. No air velocity sensors shall be employed. Hood airflow shall be varied to maintain a constant face velocity over no less than a 5 to 1 change in the sash open area (change in sash position).

B. Fume hood control system shall respond to and maintain the face velocity set point to ensure fume hood containment.

C. Provide a fume hood controller to receive a sash position signal from the sash sensor, process this signal and then output an exhaust airflow control signal to the hood exhaust valve.

D. The face velocity and minimum exhaust flow level of the fume hood shall be set at the fume hood monitor via trim pot adjustments. Accurate adjustments of the face velocity shall be provided at the minimum and maximum sash positions.

E. An emergency exhaust switch with an audible and dedicated visual alarm shall be provided on each fume hood monitor to override the sash sensor and command maximum exhaust airflow. Dedicated push to start, push to stop, pushbutton switches shall force the hood exhaust volume control device to its full flow position and force the supply valve to its specified minimum or maximum position.

F. Fume hood controller shall have a visual and an audible enunciator to alarm the occurrence of a low face velocity. Muting of the enunciator will not cancel the visual alarm until the low flow condition is no longer present. The fume hood alarm shall be initiated by:

1. A differential pressure switch located across a hood exhaust valve that senses a reduction in airflow of approximately 20 percent of set point.

2. When the airflow value sent to the hood exhaust valve by the control unit is different than the actual airflow feedback value.

3. The sash being raised above a specified height and/or specified area for fume hoods not sized for 100 percent opening.

4. The alarm wire being disconnected.

G. Fume hood controller shall include an LCD readout to indicate face velocity of hood; green LED indication for normal operation, yellow LED and audible alarm for an unsafe flow condition, yellow LED and audible alarm for night energy waste alert and red LED and audible alarm to indicate emergency exhaust operation.

H. A pushbutton switch shall be provided to mute the audible alarms. The mute mode is automatically reset when the alarm condition ceases.

I. Each of the flows and system “offset” shall be adjustable.

J. A set of input contacts shall be provided inside the hood controller to remotely command the Emergency Exhaust mode from an external SPST contact.

K. Momentary or extended losses of power shall not change or affect any of the control system’s set points, calibration settings, or emergency exhaust mode status. After power returns the system shall continue operation exactly as before without need of operator intervention. Under no circumstances shall loss of power command the exhaust system to full flow upon return of power.

L. Control power for the hood controller shall be provided from the supply air control panel.

2.05 FUME HOOD SASH POSITION SENSORS

A. A sash sensor shall be provided to measure hood sash position and output a sash position signal to the hood controller. The sash sensor shall consist of a precision ten turn potentiometer mechanically coupled to a constant tension spring reel. A stainless steel, vinyl-coated cable shall be attached to the spring reel. Expected lifetime based on manufacturer's component data and tests shall be over 200,000 full height sash movements.

B. The hood sash position sensor shall be designed to meet the UL 913, Class 1, Division 1, Groups C and D, and methane standard for intrinsically safe equipment used in hazardous locations.

2.06 AIRFLOW CONTROL DEVICES

A. The airflow control device shall be a Phoenix Accel II venturi valve with an option for 100% shut-off capabilities. The valve assembly manufacturer's Quality Management System shall be registered to ISO 9001:2000. The valve body is constructed of 16 gauge spun aluminum with continuous welded seam, composite Teflon shaft bearings, and a spring grade stainless steel spring in the slider assembly. Supply valves to be insulated with 3/8" flexible closed cell polyethelene insulation material. Airflow devices have an operating range of 32-122° F ambient at 10-90% RH.

B. The airflow control device shall be pressure independent over its specified differential static pressure operating ranges of 0.3"W.C – 3.0"W.C or 0.6"W.C – 3.0"W.C. An integral pressure independent assembly shall respond and maintain specific airflow within one second of a change in duct static pressure irrespective of the magnitude of pressure and/or flow change or quantity of airflow controllers on a manifold system.

C. The airflow control device shall maintain accuracy within ±5% of signal over an airflow turndown range as shown in the table below and stated by the venturi's original manufacturer's sizing chart in the "Ideal Selection Range" without exceeding 2000 FPM velocity through any airflow device and have no deviation or loss of accuracy through the entire range of the flow device.

Pressure Drop Range	**Airflow**	**Turndown**	**Valve Type**
0.6- 3.0 in w.c. Medium Pressure	Devices up to 1,000 CFM	20 to 1	Standard
	Devices up to 1,500 CFM	16 to 1	Standard
	Devices up to 2,500 CFM	12 to 1	Standard
	Devices up to 850 CFM	17 to 1	Shutoff
	Devices up to 1,300 CFM	14 to 1	Shutoff
0.3- 3.0 in w.c. Low Pressure	Devices up to 550 CFM	11 to 1	Standard
	Devices up to 1,050 CFM	11 to 1	Standard

D. No minimum entrance or exit duct diameters shall be required to ensure accuracy and/or pressure independence.

E. The airflow control device shall maintain accuracy within ±5% of signal over an airflow turndown range without exceeding 2000 FPM.

F. The airflow control device shall be constructed of one of the following three types or classes:

1. Class A – Body and cone of uncoated aluminum; shaft uncoated stainless steel.

2. Class B – Body and cone with phenolic coating; PFA coated stainless steel shaft. (For standard Fume Hood and Biological Safety Cabinet applications)

3. Class C – Body, cone and hardware with phenolic coating; PFA coated stainless steel shaft. (For highly corrosive Fume Hood applications)

G. For two-position or VAV operation, an electric actuator shall be factory mounted to the valve. Loss of control power shall cause the actuator to fail in last position. When failed in last position, pressure independent airflow control is to be maintained by the airflow control device during power failure. Electric actuators that fail in last position exclusively are not acceptable. Tracking pair low speed electric actuators fail in last position, but will continue to control air flow and be pressure independent with no power.

H. The controller for the airflow control devices shall be microprocessor based and operate using a peer-to-peer control architecture. The room-level airflow control devices shall function as a stand-alone network or can be fully integrated.

I. The room-level control network shall utilize a Lon Talk peer to peer communications protocol.

J. There shall be no reliance on external or building-level control devices to perform room-level control functions. Each laboratory control system shall have the capability of performing; Fume hood control, Pressurization control, Temperature control, Humidity control, and implement Occupancy and Emergency mode control schemes.

K. The laboratory airflow control systems shall integrate digitally with the BAS through Bacnet™ SIP Ethernet connect.

L. Each airflow control device shall be factory calibrated to the job specific airflows as detailed on the plans and specifications using NIST traceable air stations and instrumentation having a combined accuracy of at least ±1% of signal over the entire range of measurement. Electronic airflow control devices shall be further calibrated and their accuracy verified to ±5% of signal at a minimum of forty-eight different airflows across the full operating range of the device. All flow data for any given device shall be stored at the factory and be available on presentation of the unique serial number within 24 hours. Flow data for all valves shall be stored at a location away from the factory for disaster recovery purposes.

M. All airflow control devices shall be individually marked with device specific, factory calibration data. At a minimum, it should include: tag number, serial number, model number, eight point characterization information (for electronic devices), and quality control inspection numbers. All information shall be stored by the manufacturer for use with as built documentation

N. Valves will be selected and sized to not exceed the flow and pressure ranges in the following table:

Description	Size	Operating Range in CFM Single	Dual	Valve Type
M- Medium Pressure 0.6” – 3.0	8”	35 - 650		Standard
	10”	50 - 900		Standard
	12”	90 - 1350	180 - 2850	Standard
	14”	200 - 2300	400 - 4750	Standard
M- Medium Pressure 0.6” – 3.0	8”	35 - 500		Shut - Off
	10”	50 - 800		Shut - Off
	12”	90 - 1200	180 - 2500	Shut - Off
	14”	200 - 1500	400 - 3000	Shut - Off
L- Low Pressure 0.3” – 3.0	8”	35 - 450		Standard
	10”	50 - 500		Standard
	12”	90 - 950	180 - 1900	Standard
	14”	200 - 1300	400 - 2600	Standard
L- Low Pressure 0.3” – 3.0	8”	35 - 350		Shut - Off
	10”	50 - 400		Shut - Off
	12”	90 - 850	180 - 1700	Shut - Off
	14”	200 - 950	400 - 1900	Shut - Off

O. The shutoff airflow control device shall have shutoff and casing leakage of no more than:

Static Pressure Across Valve in Shutoff	Airflow	Shutoff Leakage	Casing Leakage
5.0 in w.c.	Shutoff devices up to 850 CFM	6 CFM	0.12 CFM/ ft²
	Shutoff devices up to 1,300 CFM	6 CFM	0.12 CFM/ ft²
	Low leakage shutoff devices up to 850 CFM	0.005 CFM	0.010 CFM/ ft²
	Low leakage shutoff devices up to 1,300 CFM	0.010 CFM	0.010 CFM/ ft²

P. 100% Shut-off sequence can be initiated through a universal input or remotely via the local area network from the BAS or a Local Display Unit. 100% Shut-off confirmation is available through a local digital output or an integrated point. The 100% shut-off confirmation is required by positive position verification.

2.07 CONTROL FUNCTIONS

A. The airflow control devices shall utilize a peer-to-peer, distributed control architecture to perform room-level control functions. Master/Slave control schemes shall not be acceptable. Control functions shall at a minimum include, pressurization, temperature, humidity control and respond to occupancy and emergency control command.

B. Pressurization Control

1. The laboratory control system shall control supply and auxiliary exhaust airflow devices in order to maintain a volumetric offset (either positive or negative). Offset shall be maintained regardless of any change in flow or static pressure. This offset shall be field adjustable and represents the volume of air, which will enter (or exit) the room from the corridor or adjacent spaces.

2. The pressurization control algorithm shall sum the flow values of all Supply and Exhaust airflow devices and command appropriate controlled devices to new set points to maintain the desired offset. The offset shall be adjustable.

3. With the Celeris system, the pressurization control algorithm shall support the ability to regulate the distribution of total supply airflow across multiple supply airflow control devices or total general exhaust airflow across multiple exhaust airflow control devices in order to optimize air distribution in the space.

4. Where shown on the drawings, differential room pressure is to me monitored by a Critical Room Control. (CRC-RM)

a. The room pressure controller (Controllers) shall be capable of measuring the differential pressure between two individual spaces at all locations shown on the prints. Each room shall have its own controller capable of stand-alone operation. Each monitor is capable of both visual and audible alarms. Each monitor will use direct pressure measurement utilizing industrial quality differential pressure transducer technology.

b. Implied pressure measurement systems utilizing thermal (hot wire or thermal mass) air velocity measurement are not acceptable.

c. Each monitor shall have an easy to navigate microprocessor based controller with full color TFT touch screen interface. Touch screen shall be capable of displaying room conditions in full color i.e. Red screen for alarm. All settings and programming shall be made via simple touch screen.

d. Display shall be fully programmable with custom graphics and fonts. Monitor will store all settings in non volatile memory. Monitor to be capable to incorporate custom JPEG's or BMP's for display. Monitor will continually display room differential pressure. Monitor settings shall be accessed via programmable and password protected touch screen. Monitor shall be capable of custom color, graphics and messages per the owner. Monitor shall be recess mounted. Supply voltage shall be 24 volt ac/dc.

e. The sensor shall continuously monitor and or control bi-directional room pressurization using direct pressure sensing referenced to the adjacent space. Wall / ceiling mounted assembly fittings and stainless steel cover plate shall be provided with the controller as a complete unit.

f. The Isolation room system shall be the CRC-RM as manufactured by Critical Room Control (CRC) Milwaukee, Wisconsin or approved equal.

g. Performance:

1) Each monitor will use direct pressure measurement utilizing industrial quality differential pressure transducer technology.

2) Accuracy Class (F.S.): shall be 0.4 - 0.8%. Accuracy includes the effects of linearity, hysteresis and repeatability. Stability maximum change F.S./year .5%. Monitor shall be bi-directional. Operating temperature shall be -40 to 180 degrees F. The room pressure controller shall be factory calibrated. The room pressure transducer shall factory calibrated with NIST traceable standards.

3) Each Monitor shall incorporate a high speed microprocessor based controller, designed for critical environment control applications.

4) Each monitor shall have four (4) universal analog inputs for 4-20mA, 0-5V and 0-10V jumper selectable.

5) Each monitor shall have two (2) 0-10V and two (2) 4-20mA analog outputs, four (4) digital inputs, and four (4) digital Contact (relay) outputs.

6) Each controller shall have a two (2) wire RS485 serial network interface.

7) The room pressure monitor shall be mounted in the corridor adjacent to the lab entrance. Monitor shall be in clear view for staff in corridor.

C. Temperature Control

1. The laboratory control system shall regulate the space temperature through a combination of volumetric thermal override and control of reheat coils and/or auxiliary temperature control devices. The laboratory control system shall support up to four separate temperature zones for each pressurization zone. Each zone shall have provisions for monitoring up to five (5) temperature inputs and calculating a straight-line average to be used for control purposes. Separate cooling and heating set points shall be writable from the BMS, with the option of a local offset adjustment.

2. Temperature control shall be implemented through the use of independent primary cooling and heating control functions, as well as an auxiliary temperature control function, which may be used for either supplemental cooling or heating. Cooling shall be provided as a function of thermal override of conditioned air with both supply and exhaust airflow devices responding simultaneously so as to maintain the desired offset. Heating shall be provided through modulating control of a properly sized reheat coil.

3. The laboratory control system shall also provide the built-in capability for being configured for Hot Deck/Cold Deck temperature control.

4. The auxiliary temperature control function shall offer the option of either heating or cooling mode and to operate as either a stand-alone temperature control loop, or staged to supplement the corresponding primary temperature control loop.

D. Humidity Control

1. The Laboratory control system shall have an embedded humidity control function, which allows the monitoring and control of the relative humidity level in the pressurized zone. Using peer-to-peer control, the airflow devices shall have the ability to monitor the relative humidity level of the space and, based on a BAS writable set point, develop a control signal to drive one or the other humidification or dehumidification control circuits.

2. The humidity control loop(s) shall share a common set point, with a configurable dead band adjustment to prevent the humidification and dehumidification control functions to operate at the same time.

E. Occupancy Control

1. The laboratory control system shall have the ability to change the minimum ventilation (supply airflow) and temperature control set points, based on the occupied state, in order to reduce energy consumption when the space is not occupied. The occupancy state may be set by either the BAS, as a scheduled event, or through the use of a local occupancy sensor or switch. The laboratory control system shall support a local occupancy override button that allows a user to override the occupancy mode and set the space to occupied, for a predetermined interval. The override interval shall be configurable for 1 to 1,440 minutes. The local occupancy sensor/switch, or bypass button shall be given priority over a BAS command.

F. Emergency Mode Control

1. The laboratory control system shall provide a means of overriding temperature and pressurization control in response to a command indicating an emergency condition exists and airflow control devices are to be driven to a specific flow set point. The system shall support up to four (4) emergency control modes. The emergency control modes may be initiated either by a local contact input, or BAS command.

2. Once an Emergency mode is invoked, pressurization and temperature control are overridden for the period that the mode is active. Emergency modes shall have a priority scheme allowing a more critical mode to override a previously set condition.

G. Airflow Shut-off Function

1. The airflow control devices shown on the drawings and schedules as type SOV shall be capable of shut off function. Each device shall be capable of accepting a digital input to switch each individual air valve from the set point flow to shutoff position. This valve shall utilize an electric actuator with fail to last position operation. Feedback shall be available to indicate flow and shutoff. Confirmation of shut off shall be available through a digital output. These valves shall also be capable of network operation and being commanded to shutoff position from the BAS.

2.08 TERMINAL UNIT CONNECTIONS

A. Single valve terminal unit duct connections shall consist of round inlet connections suitable for flanged and bolted connection to rigid round duct as detailed on the Drawings. If circular bolt flanges are not noted on the drawings, then the Phoenix Controls Valve Draw band Clamp kit shall be utilized on both the inlet and outlet connections to the ductwork. Standard slip-in duct connections with sheet metal screws and sealer is not acceptable. Where multiple valves are employed, a common inlet plate suitable for slip connection to a single rectangular duct inlet duct shall be factory installed on the terminal unit using a press fit and silicone seal connection.

2.09 BAS INTEGRATION

A. The room controllers shall be capable of direct communications with the existing BAS system via Bacnet SIP open protocol.

B. The BAS shall be interfaced to allow remote monitoring of specified controller outputs and inputs and shall be capable of resetting room temperature set point.

C. The BAS interface must be installed and fully operational before the control system will be accepted.

D. The airflow control device shall have provisions to connect a notebook PC commissioning tool and every node on the network shall be accessible from any point in the system.

2.10 CONDUIT AND WIRING SYSTEM

A. Cabling for these systems shall be either fiber optic, 24 AWG shielded twisted copper pair, or a mix of both. The Owner will consider exceptions to this requirement only if the laboratory tracking systems and constant volume valve manufacturer provides technical documentation, demonstrating that:

1. This system will not function unless a different type of cable is used.

2. The National Electrical Code requires cables to be shielded.

PART 3 - EXECUTION

3.01 PREPARATION

A. Provide a Project Manager, who shall, as a part of the Project Manager's duties, be responsible for the following activities:

1. Coordination between the Contractor and all other trades, Owner, local authorities and the Architect/Engineer.

2. Scheduling of manpower, material delivery, equipment installation, and checkout.

3. Maintenance of construction records such as Project scheduling, manpower planning, and AutoCAD Drawings for Project coordination and As-Built Drawings.

B. Calibration:

1. Each airflow control valve shall be factory calibrated to the Project specific airflows as detailed on the Contract Documents. Valve shall be electronically calibrated / characterized at the factory by certified NIST traceable air stations. The valve's characterization shall be determined at eight (8) unique airflows including a test of the valve's pressure independence at three (3) different static pressures. A total of nineteen (19) airflow checks shall be performed and recorded for each air valve. All information shall be stored on computer diskette in ASCII format for future retrieval or for hard copy printout.

2. Field adjustment shall not be required other than minor changes as required by the TAB Firm. Accuracies and performance shall be guaranteed as specified irrespective of field conditions.

3. Air shall be maintained plus or minus 5 percent of the design air quantity setting (subject to valve maximum and minimum CFM limits) over an inlet static pressure rate of 0.3 or 0.6 to 3.0 inches static pressure.

3.02 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. All installation shall be in accordance with manufacturer's published recommendations.

C. Coordinate hood installation provisions with the project hood supplier.

D. Coordinate the placement and installation of the sash position sensor with Project hood supplier or manufacturer.

END OF SECTION 23 09 10

SECTION 23 21 13 – HYDRONIC PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 SUMMARY

A. Furnish and install all labor, materials, equipment, tools and services and perform all the operations required in connection with, or associated with, the construction of complete hydronic piping systems, including chilled and heating hot water piping, ~~condenser water piping process chilled or~~ hot water piping, condensate drain piping ~~and generator cooling water piping~~ systems as indicated on the Drawings.

1.03 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:

1. ANSI/ASME Sec 9 - Welding and Brazing Qualifications.

2. ASTM A53 – Standard Specification for Pipe, Steel, Black and Hot Dipped, Zinc Coated, Welded and Seamless.

3. ANSI/ASME B16.3 - Malleable Iron Threaded Fittings Class 150 and 300.

4. ANSI/ASME B16.9 – Factory-Made Wrought Butt welding Fittings.

5. ANSI/ASME B16.23 – Cast Copper Alloy Solder Drainage Fitting – DWV.

6. ANSI/ASME B16.29 – Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings – DWV.

7. ANSI/ASME B31.9 - Building Services Piping.

8. ASME B36.1 – Standardization of dimensions of welded and seamless wrought steel pipe for high or low temperatures and pressures.

9. ANSI/AWS D1.1 - Structural Welding Code.

10. ASTM A53 - Pipe, Steel, Black and Hot-Dipped Zinc Coated (Galvanized), Welded and Seamless, for Ordinary Uses.

11. ASTM A105 – Standard Specification for Carbon Steel Forgings for Pipe Applications.

12. ASTM A106 Grade B, Seamless or Electric Resistance Welded (ERW) piping.

13. ASTM A234 - Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.

14. ASTM A312 – Standard Specification for Seamless and Welded Austenitic Stainless Steel Pipe.

15. ASTM A536 – Standard Specification for Ductile Iron Castings.

16. ASTM B88 – Standard Specification for Seamless Copper Water Tube.

1.04 QUALITY ASSURANCE

A. Valves: Manufacturer's name and pressure rating shall be clearly marked on the outside of the valve body.

~~B.All grooved joint couplings, fittings, flanges, valves, and specialties of the same type shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.~~

~~C.~~**B.** Welding Materials and Procedures: Conform to Chapter V, ASME/ANSI B31.9 and applicable state labor regulations.

~~D.~~**C.** Welders Certification: Furnish in accordance with AWS D10.12 and ASME B31.9.

~~E.~~**D.** Each threaded fitting shall be stamped as specified by ANSI B16.3.

~~F.~~**E.** Each welded fitting shall be stamped as specified by ANSI B31.9.

1.05 SUBMITTALS

A. Product Data:

1. Submit product data on pipe materials, pipe fittings, valves, and accessories. Clearly indicate make, model, type, size, and pressure rating for each device.

2. Submittal data for all fittings shall include a letter signed by an official of the manufacturing company certifying compliance with these Specifications.

B. Record Documents:

~~1.Grooved joint couplings and fittings shall be shown on drawings and product submittals and shall be specifically identified with the applicable Victaulic or Anvil style or series designation.~~

~~2.~~**1.** Include welder's certification of compliance in accordance with Chapter V, ASME/ANSI B31.9.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

B. Wall, Floor and Ceiling Plates:

1. Provide chrome-plated brass floor and ceiling plates.

C. Threaded Fittings:

1. All threaded fittings shall be USA factory made, wrought carbon or alloy steel threaded fittings conforming to ASTM A234 or malleable iron threaded fittings conforming to ASME B16.3.

2. Acceptable manufacturers: Grinnell, Tube Turn, Weld Bend Hackney, Taylor Forge or Ladish Company.

~~D.Grooved Fittings:~~

~~1.All grooved joint couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components. Fittings shall comply with ASTM A536; ASTM A234; or factory fabricated from carbon steel pipe conforming to ASTM A53.~~

~~2.Acceptable Manufacturers: Victaulic Company of America, Anvil International.~~

~~3.Gaskets shall be verified as suitable for the intended system service, a minimum temperature of 250 degrees, fluid chemistry, and system pressure prior to installation. Gaskets shall be molded and produced by the coupling manufacturer.~~

~~E.~~**D.** Welded Fittings:

1. All welded fittings shall be USA factory made wrought carbon steel butt welding fittings conforming to ASTM Spec. A234 or ASME B16.9.

2. Acceptable manufacturers: Grinnell, Tube Turn, Weld Burn Hackney, Taylor forge or Ladish Company.

~~F.~~**E.** Flanges:

1. All 150 lb. and 300 lb. ANSI flanges shall be weld neck and shall be domestically manufactured, forged carbon steel, conforming to ANSI B16.5 and ASTM A-191 Grade I or II or A-105 as made by Tube Turn, Hackney or Ladish Company. Slip on flanges shall not be used. Complete test reports may be required for any fitting selected at random.

2. Flanges shall have the manufacturer's trademark permanently identified in accordance with MSS SP-25. Contractor shall submit data for firm certifying compliance with these Specifications.

3. Bolts used shall be carbon steel bolts with semi-finished hexagon nuts of American Standard Heavy dimensions. All-thread rods will not be an acceptable substitute for flange bolts. Bolts shall have a tensile strength of 60,000 psi and an elastic limit of 30,000 psi.

4. All flanges shall be gasketed. Place gasket between flanges of flanged joints. Gaskets shall fit within the bolt circle on raised face flanges and shall be full face on flat face flanges. Gaskets shall be cut from 1/16 inch thick, non-metallic, non-asbestos gasket material suitable for operating temperatures from -150 degrees F to +750 degrees F, Klingerseal C-4400, Manville Style 60 service sheet packing or accepted substitution. Gaskets must be compatible with flowing fluid, temperature, and pressure of system.

~~G.~~**F.** Branch Connections:

1. For pipe 2 inches and smaller, use threaded fittings for steel pipe.

2. For 2-1/2 inches through 14 inches welded piping: When branch size is the same as or one size smaller than header size, use a welded tee. Use a Weld-o-let when branch is two or more sizes smaller than the header. For threaded branch connections, use a Thread-o-let welded to header.

3. No Branch connection shall be made by burning a hole in the main.

~~H.~~**G.** Copper Fittings:

1. Mechanically formed, drilled and extruded tee-branch connections shall not be permitted.

2.02 PIPE

~~A.TECO Distribution Pipe:~~

~~1.Pipe 2-1/2 inches and smaller: Black steel ASTM A106, Grade B, Schedule 80. seamless,~~

~~a.Fittings: Screwed.~~

~~b.Joints: Screwed.~~

~~c.Unions: Forged steel, ASTM A105, screwed with stainless steel seats.~~

~~2.Pipe 3 inches and larger: Black steel ASTM A106, Grade B, Standard weight seamless,~~

~~a.Fittings: ASTM A234 Carbon steel welding type.~~

~~b.Joints: Butt welded.~~

~~c.Flange: ANSI B16.5 Class 150, forged carbon steel.~~

~~B.~~**A.** Building Chilled Water and Heating Water Piping – 150 psi System:

1. Steel:

   a. Pipe 2 inches and smaller: Black steel ASTM A106, Grade A or B, seamless, Schedule 40.

      1) Fittings: Screwed, malleable iron, Class 150.

      2) Joints: Screwed.

      3) Unions: Forged steel, ASTM A105, screwed with stainless steel seats.

   b. Pipe 2-1/2 inches and larger: Black steel ASTM A106, Grade B, seamless:

      1) 2-1/2 inches through 12 inches – Schedule 40.

      2) 14 inches through 36 inches – 0.375 inch wall thickness.

      3) Fittings:

         a) ASTM A234 carbon steel welding type, long radius type elbows unless specified otherwise on the Drawings.

         b) ASTM A536 ductile iron; A234 carbon steel; or factory fabricated A53; grooved end long radius type elbows unless specified otherwise on the Drawings.

      4) Joints:

         a) Butt welded.

         b) Grooved mechanical couplings.

      5) Flange: ANSI B16.5 Class 150, forged carbon steel.

2. Steel ERW Pipe (Not to be used on HW systems):

   a. 2 inches and smaller Black Steel ASTM A106 Gr. A or B – Schedule 40.

      1) 2" and under ASTM A47, malleable iron, 150 lb.

      2) Joints screwed

      3) Unions: Forged steel, ASTM A105, screwed with stainless steel seats.

   b. 2½ inches to 24 inches Black Steel ASTM A53 Grade B,

      1) 2½ inches through 12 inches – Schedule 40.

      2) 14 inches through 24 inches – 0.375 inch wall thickness.

   c. Fittings: ASTM A234 Carbon steel welding type.

   d. Joints: Butt welded.

e. Flange: ANSI B16.5 Class 150, forged carbon steel.

3. Copper:

a. Pipe 2 inches and smaller; Copper Tubing: ASTM B 88, Type L, hard drawn. All brass and bronze piping components shall have no more than 15 percent zinc content.

1) Fittings: ASME B16.18, cast bronze, or ASME B16.22 wrought copper and bronze.

2) Joints: ASTM B 32, solder, Grade 95TA (lead free).

b. Pipe over 2 inches: Copper Tubing: ASTM B88, Type K, hard drawn. All brass and bronze piping components shall have no more than 15 percent zinc content.

1) Fittings: ASME B16.18, cast bronze or ASME B16.22, wrought copper and bronze.

~~C.~~**B.** Building Chilled Water and Heating Water Piping – 300 psi System:

1. Steel:

a. Pipe 2 inches and smaller: Black Steel ASTM A53, Grade A or B, Schedule 40, seamless

1) Fittings: Screwed, AAR malleable iron Class 300.

2) Joints: Screwed.

3) Unions: Forged steel, ASTM A105, screwed with stainless steel seats.

b. Pipe 2-1/2 inches and larger: Black steel ASTM A53, Grade B, seamless:

1) 2-1/2 inches or 12 inches – Schedule 40.

2) 14 inches through 24 inches – 0.375 wall thickness.

3) Fittings:

a) ASTM A234 carbon steel welding type, long radius type elbows unless specified otherwise on the Drawings.

b) ASTM A536 ductile iron; A234 carbon steel; or factory fabricated A53; grooved end long radius type elbows unless specified otherwise on the Drawings.

4) Joints:

a) Butt welded.

b) Grooved mechanical couplings.

5) Flange: ANSI B16.5 Class 150, forged carbon steel.

2. Copper:

   a. Pipe 2 inches and smaller; Copper Tubing: ASTM B 88, Type K, hard drawn.

      1) Fittings: ASME B16.8, cast bronze, or ASME B16.22 wrought copper and bronze.

      2) Joints:

         a) AWS A5.8 BcuP silver braze (lead free).

         b) Grooved mechanical couplings.

   b. Pipe over 2 inches: Copper Tubing: ASTM B 88, Type K, hard drawn.

      1) Fittings: ASME B16.18, cast bronze or ASME B16.22, wrought copper and bronze.

      2) Joints: AWS A5.8 BcuP silver braze (lead free).

3. Stainless Steel:

   a. Pipe 2 inches and smaller; Stainless Steel Piping: ASTM A 312, Type 304/304L, Schedule 5S.

   b. Fittings: Precision, cold drawn, austenitic stainless steel, with elastomer O-ring seals.

~~D.Generator Cooling Water Pressure:~~

~~1.Pipe 2 inches and smaller: Black Steel ASTM A53, Grade A or B, seamless, Schedule 40.~~

~~a.Fittings: Screwed, malleable iron Class 150.~~

~~b.Joints: Screwed.~~

~~c.Unions: Forged steel, ASTM A105, screwed with stainless steel seats.~~

~~2.Pipe 2-1/2 inches and larger: Black steel ASTM A53, Grade B, seamless:~~

~~a.2-1/2 inches through 12 inches – Schedule 40.~~

~~b.14 inches and larger – 0.375 inches wall thickness.~~

~~c.Fittings:~~

~~1)ASTM A234 carbon steel welding type, long radius type elbows unless specified otherwise on the Drawings.~~

~~2)ASTM A536 ductile iron; A234 carbon steel; or factory fabricated A53; grooved end long radius type elbows unless specified otherwise on the Drawings.~~

~~3.Joints:~~

~~a.Butt welded.~~

~~b.Grooved mechanical couplings.~~

~~c.Flange: ANSI B16.5 Class 150, forged carbon steel.~~

~~4.Stainless Steel:~~

~~a.Pipe 2 inches and smaller; Stainless Steel Piping: ASTM A 312, Type 304/304L, Schedule 5S.~~

~~1)Fittings: Precision, cold drawn, austenitic stainless steel, with elastomer O-ring seals.~~

~~E.Chiller Condenser Water Piping:~~

~~1.Pipe: Black steel, ASTM A53, Grade B:~~

~~a.2-1/2 inches through 12 inches – Schedule 40.~~

~~b.14 inches and larger – 0.375 inch thickness.~~

~~2.Fittings:~~

~~a.ASTM A234 carbon steel welding type.~~

~~b.ASTM A536 ductile iron; A234 carbon steel; or factory fabricated A53; grooved end type.~~

~~3.Joints:~~

~~a.Butt welded.~~

~~b.Grooved mechanical couplings.~~

~~4.Flange: ANSI B16.5 Class 150, forged carbon steel.~~

~~5.Coat exterior condenser water pipe, valves, and fittings, with minimum 8 mil thick coal tar epoxy.~~

~~F.Equipment Drains and Overflows:~~

~~1.Pipe: Galvanized steel ASTM A53, Schedule 40.~~

~~a.Fittings: Galvanized cast iron, ductile iron, steel, or ATM B16.3 malleable iron.~~

~~b.Joints: Screwed, or grooved mechanical couplings.~~

~~2.Tubing: Copper ASTM B88, Type L, hard drawn.~~

~~a.Fittings: ASME B16.23 cast brass, or ASME B16.29 solder wrought copper.~~

~~b.Joints: ASTM B32, solder, Grade 95TA or grooved mechanical couplings.~~

~~G.~~**C.** Cooling Coil Condensate Recovery:

1. Pipe: Galvanized steel ASTM A53, Schedule 40.

   a. Fittings: Galvanized cast iron, ductile iron, steel, or ATM B16.3 malleable iron.

   b. b. Joints: Screwed, or grooved mechanical couplings.

2. Tubing: Copper ASTM B88, Type L, hard drawn.

   a. Fittings: ASME B16.23 cast brass, or ASME B16.29 solder wrought copper.

   b. Joints: ASTM B32, solder, Grade 95TA or grooved mechanical couplings.

~~2.03GROOVED MECHANICAL COUPLINGS AND FITTINGS~~

~~A.Grooved mechanical couplings shall consist of two ductile iron housing segments conforming to ASTM A536, with pressure responsive elastomer gasket, and zinc electroplated carbon steel bolts and nuts.~~

~~1.Sizes 2-1/2 inches through 8 inches:~~

~~a.Rigid Type Couplings: Installed to provide rigidity and system support and hanging in accordance with ANSI B31.1 and 31.9.Victaulic Style 107 Quick-Vic™ or Anvil Fig. 7400, 7401, 7402.~~

~~b.Flexible Type Couplings: Use in locations where vibration attenuation and stress relief are required. Victaulic Style 77 or 177 Quick-Vic™ or Anvil Fig. 7012, 7084.~~

~~c.Flange Adapters: Flat face, for direct connection to ANSI Class 125 or 150 flanged components. Victaulic Style 741 or Anvil Fig. 7012, 7084.~~

~~2.Sizes 10 inches through 12 inches:~~

~~a.Rigid Type Couplings: Installed to provide rigidity and system support and hanging in accordance with ANSI B31.1 and B31.9. Victaulic Style 07 or Anvil Fig. 7401.~~

~~b.Flexible Type Couplings: Use in locations where vibration attenuation and stress relief are required. Victaulic Style 77or Anvil Fig. 7001.~~

~~c.Flange Adapters: Flat face, for direct connection to ANSI Class 125 or 150 flanged components. Victaulic Style 741or Anvil Fig. 7012, 7084..~~

~~3.Sizes 14 inches through 24 inches:~~

~~a.Rigid Type Couplings: Installed to provide rigidity and system support and hanging in accordance with ANSI B31.1 and B31.9. Victaulic Style W07 or Anvil Fig. 7401, 7401-2.~~

~~b.Flexible Type Couplings: Installed to allow for linear and angular movement. Victaulic Style W77 or Anvil Fig. 7001, 7001-2.~~

~~c.Grooved couplings shall be installed to the required torque.~~

~~B.Grooved mechanical fittings shall be manufactured of ductile iron conforming to ASTM A536; forged carbon steel conforming to ASTM A234; or fabricated from carbon steel pipe conforming to ASTM A53.~~

~~2.04~~**2.03** VALVES

A. General

1. All valves used in 150 psi circulating systems shall be ANSI Class 150. All valves in 300 psi systems shall be Class 300 valves and shall be constructed of all ASTM B-61or B-584 composition. All gate, globe and angle valves shall be screw-over-bonnet design. Metal used in the stems of all bronze gate, globe and angle valves shall conform to ASTM B371 Alloy 694, ASTM B99 Alloy 651 or other corrosion resistant equivalents. Secure written approvals by Owner for the use of alternative materials.

2. The following manufacturers are acceptable: NIBCO, Keystone, Crane, Jamesbury, Dezurik, Daniels, Williams, Velan Vogt, Victaulic or Anvil.

3. All iron body valves shall have the pressure containing parts constructed of ASTM designated of A536 grade 65-45-12 ductile iron or A126 class B iron. Stem material shall meet ASTM A582 or A564 stainless steel, B16 Alloy 360, or ASTM 371 Alloy 876 silicon bronze or its approved equivalent model by listed manufacturers.

4. All cast steel body valves shall have the pressure containing parts constructed of ASTM designation A-216-GR-WCB carbon steel. Stems shall meet ASTM designation A-186-F6 chromium stainless steel. Seat ring shall be hard faced carbon steel or 13^ chromium A-182-F6 stainless. Handwheels shall be A47 grade 35018 malleable iron or ductile iron ASTM A536.

5. All forged steel body valves shall have the pressure containing parts constructed of ASTM 105, Grade 2 forged carbon steel. Seat and wedges shall meet ASTM-A-182-F6 chromium stainless steel. Seat rings shall be hard faced. Valves shall conform to ANSI B16-34 pressure-temperature rating.

6. All gate valves, globe valves, angle valves and shutoff valves shall have malleable iron hand wheels, except iron body valves 2-½ inches and larger which may have either malleable iron or ASTM A-126 Class B, gray iron hand wheels.

7. Packing for all valves shall be free of asbestos fibers and selected for the pressure-temperature service of the valve. It is incumbent upon the manufacturer to select the best quality, standard packing for the intended valve service.

8. Provide stem extensions on all insulated valves.

9. Valve chain operators shall be of cast iron or malleable iron and designed to provide positive grip on wheel. Provide chain guide to prevent chain from slipping or jumping on wheel. Employ rustproof chain complete with closing link of sufficient length to operate at 6 feet-6 inches above floor level.

10. Provide valves suitable for connection to adjoining pipe as specified for pipe joints above. Use valves that are full size of pipe in which installed.

~~B.Gate Valves:~~

~~1.150 Pound Class Valves:~~

~~a.Threaded pipe 2 inches and smaller: NIBCO T-134 or approved equivalent model by listed manufacturers, bronze body, union bonnet, rising stem, solid wedge disc, threaded.~~

~~b.Welded pipe 2-1/2 inches and larger: NIBCO F-617-0 or approved equivalent model by listed manufacturers, iron body, flanged, OS&Y (Outside Screw and Yoke), rising stem, solid wedge.~~

~~2.300 Pound Class Valves:~~

~~a.Threaded pipe 2 inches and smaller: NIBCO T-174-A or accepted substitute, bronze body, union bonnet, rising stem, solid wedge with integral seats threaded.~~

~~b.Welded pipe 2-1/2 inches and larger: NIBCO F-667-0 or accepted substitute, iron body, OS&Y, rising stem, solid wedge, flanged.~~

~~3.Bolted bonnet with OS&Y (outside screw and yoke) and rising stem design, integral seats, with pressure temperature rating conforming to ANSI B16.34; NIBCO T-174-A for 2 inches and smaller.~~

~~C.Globe Valves:~~

~~1.150 Pound Class Valves:~~

~~a.Threaded pipe 2 inches and smaller: NIBCO T235-Y, Anvil equivalent or Victaulic TA Series 787 Y-Pattern, 150-pound screwed, inside screw, rising stem, bronze body, union Bonnet.~~

~~b.Welded pipe 2-1/2 inches and larger: NIBCO F-718-B, Anvil equivalent or Victaulic TA Series 788 or 789(grooved) Y-Pattern, Cast Iron with Brass Trim.~~

~~2.300 Pound Class Valves:~~

~~a.Threaded pipe 2 inches and smaller: NIBCO T276-AP, Class 300 screwed, inside screw rising stem, bronze body, union bonnet, stainless steel disc.~~

~~b.Welded pipe 2-1/2 inches and larger. NIBCO F-768-B, Class 250 iron body, flanged, bolted bonnet, Brass Trim.~~

~~D.Soft Seated Butterfly Valves:~~

~~1.200 Pound Soft Seated:~~

~~a.NIBCO LD-2000 (flanged),, Victaulic Vic®-300 MasterSeal™/ Victaulic AGS Vic®-300 (grooved), Anvil7700 Series, 8200 Series or approved equal.~~

~~b.Ductile Iron body with Aluminum Bronze Disc, 400 series stainless steel stem offset from the disk centerline to provide full 360 degree circumferential seating.~~

~~c.Temperature range from -50°F to +200°F.~~

~~d.Valves 6 inches and smaller shall have lockable hand lever operators; 8 inches and larger shall have gear operators.~~

~~e.All butterfly valves shall be suitable for bi-directional dead-end service without the need for a downstream flange.~~

~~E.High Performance Butterfly Valves:~~

~~1. 150 Pound Soft Seated Class Valves:~~

~~a.NIBCO LCS-6822, carbon steel lug body valves. ANSI rated Class 150.~~

~~b.Valves to provide tight shutoff up to 285 psi.~~

~~c.Valves 6 inches and smaller shall have lockable hand lever operators; 8 inches and larger shall have gear operators~~

~~d.Provide 316 or UNS-S31803 stainless shaft, cast stainless steel disc, and soft seat.~~

~~e.Temperature range from -50°F to +200°F.~~

~~2.300 Pound Class Valves: NIBCO LCS-7822 300 lb. ANSI class raised face, lug body, carbon steel body, stainless steel pin and shaft and disc, soft seat,and gear operators.~~

~~F.Check Valves:~~

~~1.150 Pound Class Valves:~~

~~a.Threaded pipe 2 inches and smaller. NIBCO T453-B, bronze body, Class 200, screwed connection, regrinding disc and seat with screw in cap.~~

~~b.Welded or Grooved pipe 2-1/2 inches and larger. NIBCO F910-B. Flanged style, or Victaulic Series 716 or 779 or Anvil7800 Series grooved style spring loaded type. Rate for 150 psig working pressure; Cast or ductile Iron body, Bronze plates and 316 Stainless Steel springs.~~

~~G.Plug Valves:~~

~~1.150 Pound Class Valves:~~

~~a.Threaded pipe 2 inches and smaller: Dezurik 128-S-1-RS-26, Keystone 542, 150-pound screwed, eccentric plug valve, carbon steel or semi steel body, Buna-N faced plug, lever operated, nonlubricated, short pattern plug valve.~~

~~b.Welded pipe 2-1/2 inches and larger: Dezurik 128-F-1-RS-26, Homestead 583, or Victaulic Series 377 or Anvil equivalent. 150-pound flanged or grooved eccentric carbon steel or semi steel, Hycar or Buna-N faced plug, manually operated, nonlubricated, short pattern plug.~~

~~2.300 Pound Class Valves:~~

~~a.Threaded pipe 2 inches and smaller: Tufline 066, PowerII 3058. 300 psi working pressure, cast carbon steel body and plug, threaded end valve, bolted bonnet, nonlubricated or lubricated with lubricant suitable for water -20 degrees F to 450 degrees F temperature, wrench operated.~~

~~b.Flanged piping 2-½ inches, cast carbon steel body and plug conforming to ASTM A216, Gr. WCB. Gear operated, bolted gland. Flanged per ANSI B16.5. Pipe sizes 4 inches through 12 inches. Nonlubricated or lubricated with lubricant suitable for water -20 degrees F to 450 degrees F temperature, 100 percent port.~~

~~H.~~**B.** Ball Valves:

1. Threaded pipe 2 inches and smaller: NIBCO T 585-70-66-LL. For threaded pipe 2-1/2 inches to 3 inches: Crane 9303-S or approved equivalent model by listed manufacturers.

   a. Threaded full port two-piece bronze body (ASTM-B584 Alloy 844, ASTM B61, or ASTM B62 (No brass containing more than 15 percent Zinc will be acceptable).

   b. Stainless steel ball and stem, blowout proof stem with stem extension made of non-thermal conducting material and having an adjustable memory stop after insulation is installed.

   c. Ball valves shall be provided with SS lockable handles and locking devices.

2. Welded ~~or grooved~~ pipe 2-1/2 inches and larger: NIBCO F-515-CS-66FS or accepted substitute for 150 pound Class; NIBCO F-535-CS-66FS for 300 pound class, split steel body, full bore, blowout proof stem with, flanged connections, or Victaulic Series 726 with grooved connections or Anvil Series 7500..

PART 3 - EXECUTION

3.01 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt on inside and outside before assembly.

C. Prepare piping connections to equipment with flanges or unions.

D. After completion, fill, clean, and treat systems.

3.02 PIPING STORAGE REQUIREMENT

A. All ERW and seamless piping shall be clearly identified and stored on separate construction pipe racks to prevent the intermixing of piping.

B. Shop fabricated piping spool and pup pieces of ERW and seamless pipe shall be clearly identified and separated in the lay down yard to prevent the intermixing of piping.

3.03 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. All valve installations shall be in accordance with manufacturer's published recommendations.

C. Pipe Installation:

1. All the various piping systems shall be made up straight and true and run in orderly manner, plumb and parallel to building structural. Install piping to conserve building space. Coordinate location with other trades and do not interfere with use of space for other work.

2. Piping shall follow as closely as possible the routes shown on Drawings which take into consideration conditions to be met at the Site.

3. Should any unforeseen conditions arise, lines shall be changed or rerouted after proper approval has been obtained.

4. All piping shall be installed with due regard to expansion and contraction and so as to prevent excessive strain and stress in the piping, in connections, or in equipment to which the lines are connected.

5. Group piping whenever practical at common elevations.

6. Slope piping and arrange system to drain at low points. Use eccentric reducers where applicable to maintain the bottom of pipe level.

7. Branch tap connections are to be from the top to horizontal position of pipe run.

8. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

9. Provide and install Pete's plugs adjacent to thermo wells for electronic temperature sensors, to electronic pressure sensors and install Pete's plugs adjacent where shown or noted on piping drawings or drawing details. The piping taps for the Pete's plugs, permanently mounted pressure gauges, and instruments sensors shall be a minimum size of ½ inch schedule 40 pipe and be able to isolate them with a ½ inch stainless steel ball valve. Systems provided with pressure independent control valves shall be provided with a Pete's plug downstream of the control valve, to facilitate verification of the valve manufacturer's recommended water pressure drop across the pressure independent control valve.

10. Provide clearance for installation of insulation, and access to valves and fittings.

11. Prepare pipe, fittings, supports, and accessories for finish painting. Chilled water piping insulated with cellular glass does not require finish painting.

12. All piping shall be clean when it is installed. Before installation it shall be checked to assure it is the correct material to be used on the piping system, upended, swabbed if necessary, and all rust or dirt from storage or from lying on the ground shall be removed.

13. Where leaks occur, the pipe shall be repaired and the tests repeated. No leaks shall be corrected by peening. Defective piping and joints shall be removed and replaced.

14. Procedure of Assembling Screw Pipe Fittings: All screw joints shall be made with taper threads, properly cut. Joints shall be made tight with Teflon tape or Teflon-based compound appropriate to the medium, material and temperature range of the system. Compound shall be applied to the pipe threads only and not to fittings. When threads are cut on pipes, the ends shall be carefully reamed to remove any burrs. Before installing pipe that has been cut and threaded, the lengths of pipe shall be upended and hammered to remove all shavings and foreign material.

D. Valve Installation:

1. Locate all valves such that the removal of their bonnets is possible. All flanged valves shown in horizontal lines with the valve stem in a horizontal position shall be positioned so the valve stem is inclined one bolt hole above the horizontal position.

2. Screw pattern valves placed in horizontal lines shall be installed with their valve stems include at an angle of a minimum of 30 degrees above the horizontal position.

3. Pressure independent control valves shall be installed in accordance with valve manufacturer's published installation instructions, with regard to orientation, clearances, and lengths of straight pipe upstream and downstream of the valve.

4. All valves must be true and straight at the time the system is tested and inspected for final acceptance.

5. Valves shall be installed as nearly as possible to the locations indicated in the Drawings. Any change in valve location must be so indicated on the Record As-Built Drawings.

6. Provide line shut-off valves at locations required for proper operation, servicing and troubleshooting of the HVAC hydronic distribution systems and connected components. Locations shall include but not be limited to the following; at each piece of equipment, at each branch take-off from mains, at the base of each riser, where recommended by equipment manufacturers and at strategic locations to allow sectional isolation while limiting disruption of services to large portions of the system.

7. All valves must be of threaded or flanged type. No solder connected valves shall be used on this Project.

8. Equipment, valves, expansion joints, relief devices, strainers, etc., must be removed or isolated during the test if the pressure/force ratings of the devices are not as high as that specified for the test. Piping shall be drained and protected any time ambient temperature is below freezing.

9. Where leaks occur, the pipe shall be repaired and the tests repeated. No leaks shall be corrected by peening. Defective piping and joints shall be removed and replaced.

10. All threaded valves.installed in copper piping shall be provided with copper or bronze male adapters on each side of valves. Sweat solder adapters to pipe before installing valves.

11. Provide access where valves and fittings are not exposed. Coordinate size and location of access doors with architectural drawings.

12. Install valves with stems upright or horizontal, not inverted.

13. All manually operated shutoff valves to equipment that are 2-1/2 inches and larger located 8 feet (Bottom of pipe) or higher above finished floor or stationary platform in mechanical rooms and accessible pipe chases or as noted on Project Drawings shall be chain wheel operated. Chains shall be installed and secured to allow clear passage at walk through areas.

3.04 TESTING

A. All welds are subject to inspection, visual and/or x-ray, for compliance with Specifications. The Owner will, at the Owner's option, provide employees or employ a testing laboratory for the purposes of performing said inspections and/or x-ray testing. Initial visual and x-ray inspections will be provided by the Owner. The Contractor shall be responsible for all labor, material and travel expenses involved in the re-inspection and retesting of any welds found to be unacceptable. In addition, the Contractor shall be responsible for the costs involved in any and all additional testing required or recommended by ASME/ANSI Standards B31.9 due to the discovery of poor, unacceptable or rejected welds.

B. Welds lacking penetration, containing excessive porosity or cracks, or are found to be unacceptable for any reason, must be removed and replaced with an original quality weld as specified herein. All qualifying tests, welding and stress relieving procedures shall, moreover, be in accord with Standard Qualification for Welding Procedures, Welders and Welding Operators, Appendix A, Section 6 of the Code, current edition.

C. System Pressure Tests:

Line	Testing Medium	Testing Pressure (psig)	Time (hours)
Chilled Water ~~and Condenser Water~~	Water	1-½ times working pressure, minimum 125	24
Heating Water ~~and Generator Cooling Water~~	Water	1-½ times working pressure, minimum 125	24

1. Refer to the Drawings for system design pressure.

3.05 HOT TAP PROCEDURE

A. Contractor shall provide MD ANDERSON drawings with the location of all hot taps shown 10 days prior to scheduled start of work. Contractor shall also clearly identify all locations in the field.

B. Upon receipt of drawings MD ANDERSON will field verify abatement requirements. MD ANDERSON will also identify and coordinate, through the building mission groups, the impact of potential system shut downs, Owner requirements and will issue a notice to proceed.

C. Upon MD ANDERSON's issuance of a notice to proceed the Contractor shall perform the following hot tap procedures:

1. Preparation

a. Remove insulation at identified and approved hot tap locations and save for reinstallation as noted below.

b. Ultra-sound pipe at each weld location to verify pipe thickness. If pipe fails to pass ultra-sound follow procedure outlined in paragraph A to establish new tap location.

c. Temporarily reinstall pipe insulation upon completion of ultra-sound to prevent condensation.

d. Repeat above listed steps on all approved hot tap locations.

2. Installation

a. Remove insulation as required for installation of scheduled hot tap.

b. Weld saddle sleeve to pipe. All welds shall be made as per 15510-1.06-B

c. Install new valve on saddle sleeve.

d. Install blind flange on valve to prevent accidental opening.

e. Pressure test valve/seating to one and a half (1-1/2) times design operating pressure for 24 hours. MD ANDERSON representative shall witness this test.

f. Upon passing pressure test and prior to hot tapping pipe:

1) Verify that MD ANDERSON has staff ready to perform emergency shut-off procedures.

2) Verify emergency patch is on location and sized to match pipe being tapped.

3) Verify cleaning company is on call with portable shop vacuum(s).

g. Hot tap pipe, remove plug and wire to valve handle.

h. Clean all strainers in pipes affected by hot taps made that day.

i. Reinsulate pipe.

j. Repeat above listed steps for all remaining taps.

D. Unless approved by Owner all hot taps in horizontal lines shall be made at or above center line of pipe.

~~3.06TRAINING~~

~~A.Victaulic Company shall provide on-site training for Contractor's field personnel in the use of grooving tools, application of groove, and installation of grooved end couplings. The manufactures representative shall periodically visit the jobsite and provide the contractor information concerning the best recommended practices in grooved product installation. A distributor's sales representative is not considered qualified to conduct the training or jobsite visit(s).~~

~~3.07~~**3.06** APPLICATION

A. Install valves and unions at equipment connections. Install unions on equipment side of valves. Provide dielectric isolation only where non-ferrous components connect to ferrous components.

B. Provide EPDM gasket material with a maximum service temperature of 120 degrees C at all hot water dielectric union installations.

C. Install brass male adapters each side of valves in copper piped system. Sweat solder adapters to pipe.

D. Install ball valves in piping 3 inches and smaller and butterfly valves in piping 4 inches and larger for shut-off and to isolate equipment, parts of systems, or vertical risers.

E. Install ball valves in piping 2 inches and smaller and butterfly valves in piping 2-1/2 inches and larger for throttling, bypass or manual flow control services. Under this application, throttling valves are not to be used for shutoff, and additional valves shall be installed for isolation.

F. Use plug valves for throttling service where indicated on Drawings.

G. Provide gate or ball drain valves at main shutoff valves, low points of piping, bases of vertical risers and at equipment. Pipe to nearest drain.

~~3.08~~**3.07** FLUSHING AND CLEANING OF PIPING SYSTEMS

A. MD ANDERSON Systems:

1. Clean piping systems thoroughly. Purge pipe of construction debris and contamination before placing the piping systems in service. Provide whatever temporary connections are required for cleaning, purging and circulating fluids through the piping system.

2. On completely new piping system installations, the contractor shall use temporary strainers and temporary pumps that can create fluid velocities up to 10 ft / sec if necessary to flush and clean the piping systems. Do not use Owner's permanent strainers to trap debris during pipe flushing operations. Fit the temporary construction strainers with a line size blowoff valve.

3. When constructing minor piping modifications or additions verify with Owner if the Owner's pumps and strainers can be used for flushing and chemical cleaning operations. When the flushing and cleaning operations are complete, the contractor shall insure the strainer baskets and screens installed in the piping systems permanent strainers replaced with clean elements. Keep temporary strainers in service until the equipment has been tested, then replace straining element with a new strainer and clean and deliver the old straining elements to Owner. Fit the Owners strainers with a line size blowoff valve.

4. Install bypass piping or hoses at the supply and return piping connections at heat exchangers, chillers, cooing towers, pumps and cooling coils, etc, to prevent debris from being caught or causing damage to equipment which will be connected to the piping system

5. Circulate a chemical cleaner in chilled and heating water as well as condenser and generator cooling piping systems to remove mill scale, grease, oil and silt. Circulate Betz Entec 323 detergent with Betz Entec 234 antifoam compound. Circulate for 48 hours, flush system and replace with clean water. Dispose of chemical solution in accordance with local codes. The chilled and heating water system should then be treated with Betz Entec 338, nitride borate, 350 ppm as nitride with MBP inhibitor. When the chemical cleaning is complete, remove, clean and reinstall all permanent screens. Contractor shall notify Owner so that the reinstallation of clean strainer screens may be witnessed.

~~B.TECO System Requirements:~~

~~1.Cleaning: It is imperative to ensure that all piping or equipment connected to the TECO chill water system has been thoroughly cleaned to removed oils, dirt and other foreign materials.~~

~~a.Make certain the new system is properly isolated from the TECO chilled water system.~~

~~b.Using clean potable water, fill the system piping and add 1 to 2 percent (based on volume) of Tetra Potassium Pyro Phosphate (TKPP) solution to the new system.~~

~~c.Circulate for at least three (3) hours. During circulation maintain the maximum flow rate through the piping and equipment (target a minimum flow velocity of 3 feet per second).~~

~~d.The addition of the TKPP will cause the pH in water to rise. Neutralize the pH by flushing with potable water. Continue to flush the system until the circulating water quality is consistent with potable water.~~

~~e.Begin the passivation procedure immediately. DO NOT allow the water in the system to stand longer than two (2) hours before starting the passivation procedure.~~

~~2.Passivation: Contact TECO at the following address to obtain the latest passivation specification requirements:~~

~~a.Contact: Steve Lehr, Thermal Energy Corporation(TECO), Supervising Senior Project Manager,~~

~~b.Address: 1615 Braeswood, Houston, Texas 77030.~~

~~c.Phone number: 713-791-6731.~~

~~3.Before TECO will provide thermal services to the Project, the following is required:~~

~~a.Chilled Water System:~~

~~1)A copy of an approved certified flushing report that the system is clean.~~

~~2)TECO personnel to take a minimum of three samples from drains and test for iron (1.0 ppm is acceptable).~~

~~3)The building pipe must be full of clean water without chemicals of any type.~~

~~4)All metering devices to be installed and Contractor supplied 20-amp, 3-wire circuit connected.~~

~~5)If the piping system is not filled with TECO chilled water immediately after testing, test must again be taken prior to providing services.~~

~~b.Quality Assurance: Provide only chemical products which are acceptable under state and local pollution control regulations.~~

~~3.09~~**3.08** WELDING

A. Scope: This article applies to welded chilled and heating water piping fittings and other appurtenances.

1. Piping and fittings shall be welded and fabricated in accordance with the latest edition of ASME/ANSI the latest editions of Standards B31.9 for all systems. Machine beveling in shop is preferred. Field beveling may be done by flame cutting to recognized standards.

2. Ensure complete penetration of deposited metal with base metal.

   a. Contractor shall provide filler metal suitable for use with base metal. Contractor shall keep inside of fittings free from globules of weld metal.

   b. All welded pipe joints shall be made by the fusion welding process, employing a metallic arc or gas welding process.

   c. All pipe shall have the ends beveled 37-½ degrees and all joints shall be aligned true before welding.

   d. Except as specified otherwise, all changes in direction, intersection of lines, reduction in pipe size and the like shall be made with factory-fabricated welding fittings. Mitering of pipe to form elbows, notching of straight runs to form tees, or any similar construction is not permitted.

3. Align piping and equipment so that no part is offset more than 1/16-inch. Set all fittings and joints square and true, and preserve alignment during welding operation. Use of alignment rods inside pipe is prohibited.

4. No weld shall project into the pipe so as to restrict it. Tack welds, if used, must be of the same material and made by the same procedure as the completed weld. Otherwise, remove tack welds during welding operation.

5. Remove all split, bent, flattened or otherwise damaged piping from the Project Site.

6. Remove dirt, scale and other foreign matter from the inside of piping, by swabbing or flushing, prior to the connection of other piping sections, fittings, valves or equipment.

7. Schedule 40 pipe shall not be welded with less than three (3) passes including one stringer/root, one filler and one lacer. Schedule 80 pipe shall be welded with not less than four (4) passes including one stringer/root, two filler and one lacer. In all cases, however, the weld must be filled before the cap weld is added.

END OF SECTION 23 21 13

SECTION 23 21 30 – HYDRONIC SPECIALTIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 SUMMARY

A. Perform all Work required to provide and install air vents, pressure gauges, thermometers, strainers, air separators, expansion tanks, relief valves, water flow measuring and balancing systems, and water flow integrating meters as indicated by the Contract Documents with supplementary items necessary for their proper installation and operation.

1.03 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:

1. ANSI/ASME Boilers and Pressure Vessel Code, Section VIII, Division 1 Design and Fabrication of Pressure Vessels.

1.04 QUALITY ASSURANCE

A. Manufacturer: For each product specified, provide components by the same manufacturer throughout.

1.05 SUBMITTALS

A. Product Data:

1. Submit Shop Drawings and product data, including component sizes, rough-in requirements, service sizes, and finishes.

2. Submit manufacturer's installation instructions.

1.06 EXTRA MATERIALS

A. Provide the Owner with one differential pressure meter kit from the installed balancing valve manufacturer for use with circuit balancing valves installed within this project. Kit shall include meter, hoses, connection accessories, circular slide rule, carrying case and valve manufacturer's curve charts. If the contractors scope of the project is a renovation in an existing building and the balance valves match existing manufacturer and models the contractor shall inquire with Owners maintenance staff if a meter kit is required.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.02 MANUFACTURERS

~~A.Expansion Tanks: Bell & Gossett, Taco, C. Adamson, Woods.~~

~~B.~~**A.** Automatic Air Vents: Armstrong.

~~C.Air Separators: Bell & Gossett, Taco, P. Wood, Armstrong.~~

~~D.Water Relief Valves: Keckley, Watts, Bell & Gossett.~~

~~E.~~**B.** Circuit Balancing Valves: Armstrong, Tour & Anderson.

~~F.~~**C.** Coil Package Valve Sets: Nexus, Tour and Anderson

~~G.Integrating Flowmeters: Panametrics, Balance Master, Controlotron, EMCO.~~

~~H.~~**D.** Pressure Gauges: Ashcroft, Dwyer, Weksler, Marsh Instrument, H.O. Trerice, Moeller Instrument Co, Weiss.

~~I.~~**E.** Thermometers: Ashcroft, Dwyer, Marsh Instrument, Weksler, Moeller Instrument, H.O. Trerice, Weiss, Controlotron Corporation.

~~J.Pump Suction Fittings: Bell and Gossett, Taco, Victaulic, Anvil.~~

~~K.~~**F.** Strainers: Keckley, Mueller, Muessco, Strainers, Inc., Victaulic, Anvil.

~~2.03EXPANSION TANKS~~

~~A.Tank Construction: Closed, welded steel, tested and stamped in accordance with Section VIII, Division 1, of ANSI/ASME Boiler and Pressure Vessel Code, 125 psig rating. Clean, prime coat, and supply with steel support saddles. Supply with renewable heavy duty butyl rubber bladder. Construct tank with tappings for installation of accessories.~~

~~B.Provide with quick connect air charging valve connection (standard tire valve) tank drain.~~

~~C.Provide automatic cold water fill assembly complete with pressure relief valve, pressure reducing valve and valved bypass.~~

~~D.Set expansion tank pressure relief valve and pressure reducing valve at pressures indicated on Drawings.~~

~~E.Tank dimensions are as scheduled on Drawings.~~

~~2.04~~**2.03** AUTOMATIC AIR VENTS

A. Provide air vents at the highest points of the hydraulic piping systems and on the uppermost connections to all hydraulic coils; 125 psig pressure rating. Provide shutoff valves to facilitate maintenance of air vents.

B. Locate all air vents and their discharge lines in accessible locations, preferably clustered.

C. Route discharge lines to nearest floor drain without air traps.

~~2.05AIR SEPARATORS~~

~~A.Steel tank, flanged inlet and outlet connections, separate top fittings for make-up line connection, automatic air vent, and bottom connection for blow-down and cleaning. ASME construction and stamped for 125 psig design pressure.~~

~~B.Provide stainless steel strainer with 3/16 inch diameter perforations and total free area of not less than five (5) times the cross sectional area of the connecting pipe.~~

~~C.Units shall be full line size.~~

~~2.06WATER RELIEF VALVES~~

~~A.Pressure relief valves installed for the protection of the water circulating circuits shall be single seated diaphragm and spring type valve with screwed connections, similar to Watts No. 174A.~~

~~B.¾ inch size of bronze construction with bronze seat, composition shut-off disc, and rubber diaphragm.~~

~~2.07~~**2.04** COIL CIRCUIT BALANCING VALVES

A. Install in chilled and hot water piping systems and elsewhere where shown on Drawings per manufacturer's recommendation and installation instructions. Balance valves shall not be required on systems provide with pressure independent control valves. Balance valves shall be rated to operate and perform their intended design function at the system's operating temperature and maximum design pressure. The valve body shall be a wye pattern, globe-style, and provide two pressure/temperature metering ports (PT Ports), and digital handwheel. Balancing valve handle shall have a integral memory stop for locking the valve position after the system is balanced.

B. Valves may also be furnished with precision machined venturi built into the valve body to provide highly accurate flow measurement and flow balancing. The venturi shall have two, 1/4" threaded brass metering ports and gasketed caps located on the inlet side of the valve.

~~2.08~~**2.05** COIL PACKAGE VALVE SETS

A. Install per manufacturers recommendations and instructions on hot water terminal coils with automatic flow control Valves from ½ inch thru 2 inch: valve bodies shall be manufactured from brass ASTM B 283 capable of working at a maximum temperature of 370 F. at a pressure of 600 psi. The valve body is a Y type with cartridge set capable of working and maintaining flow rate at a differential pressure range between 2 to 45 psi.

B. Valves shall be furnished with precision machined cartridge orifice to provide automatic flow balancing. The valve shall have a blow down valve to clear fine particulate from the cartridge, and two, 1/4" threaded brass ports located on the inlet side of the valve use to acquire a differential pressure measurement. The ports shall have caps with O-ring seals.

C. In lieu of automatic flow control valves, Tour and Anderson STAP differential pressure controllers may be installed in conjunction with preset standard TA valves and coil components. Supply side coil package shall including a ball valve Y strainer combo with PT port, union, and blow down. Return side coil package shall include a union port fitting with PT port, manual air vent, union, and male threaded tail piece as well as the TA balancing valve. STAP shall be installed per manufacturer's recommendations and at the locations shown on drawings with a partner TA valve adjacent on the supply line for capillary connection.

D. Systems provided with pressure independent control valves shall not require automatic or manual balancing valves.

~~2.09INTEGRATING FLOWMETERS~~

~~A.General:~~

~~1.Install in main building chilled and hot water piping systems and elsewhere as shown on the Drawings.~~

~~2.Integrating flowmeters must have the following characteristics:~~

~~a.Uses the transit-time principle of ultrasonic flow metering.~~

~~b.Flow sensors that are portable, clamp-on type and that do not come in contact with the fluid or protrude into the flow path.~~

~~3.Flow element shall be installed in a straight run of pipe in accordance to manufacturer's guidelines for the specific installation in order to maintain rated accuracy.~~

~~B.Flow Stations:~~

~~1.Flow stations shall consist of dual flow sensors and carriers mounted in the transverse arrangement with laminated or metal identification tag on chain giving pipe size, meter series, and station identification.~~

~~2.Maximum fluid operating ranges:~~

~~a.Pressure: 0 to 150 psig.~~

~~b.Temperature: 32 degrees F to 250 degrees F.~~

~~3.Flow stations shall be of steel construction.~~

~~C.Flow Meter:~~

~~1.Provide a hand-held, portable meter that instantaneously displays flow and/or changes in flow by means of a high-visibility, integral, backlit LCD, dual channel (one for chilled water, the other for steam condensate or hot water as noted on Drawings) that displays instantaneous flow rate in GPM and total gallons. Charts and tables are not acceptable.~~

~~2.Each channel shall have dual outputs for each of the displayed values. Outputs shall be 4-20 mA and TTL pulse rate, each proportional to display values.~~

~~3.Meter shall have positive zero flow indication.~~

~~4.Meter shall be complete with adequate lengths of flow cables attached to sensors, with installation and operating instructions.~~

~~5.Meter shall be capable of interfacing with and delivering a signal to the building automation system.~~

~~2.10~~**2.06** -FLEXIBLE HOSE

A. Furnish and install Amber-Booth Metalflex flexible hose connectors or accepted substitution. Hose and braid shall be bronze and male fittings shall be steel.

B. Install connector in a straight line without offset. Piping shall be supported so that connector does not carry pipe load.

C. Install in line without twisting connector.

D. For pipe sizes ½ inch to 2 inches only. Model BR-SM.

~~2.11~~**2.07** PRESSURE GAUGES

A. Application: Provide pressure gauges as indicated on Drawings; 4-½ inch face diameter with 0.5 percent accuracy of full span, Grade 2A, ANSI B40.1.

B. Gauge Ranges:

1. Provide 0 - 160 psi gauges for 150 psi chilled/hot water service.

2. Provide 0 – 300 psi gauges for 300 psi, chilled/hot water service.

3. Provide 0 - 200 psi gauges for domestic cold water service.

4. Provide 0 – 150 psi gauges for condenser water and generator cooling water service.

5. Provide liquid glycerin filled compound pressure gauges with a graduation ratio of 30 psi to 30 inches of mercury across basket strainer at suction of condensing water pump.

C. For each gauge, provide bronze gauge lock and globe type bleed valve:

1. Similar to Jenkins 750, Crane 362E, Stockham B-66, Powell 120 or accepted substitution of the pressure rating for the system installed.

~~2.12~~**2.08** THERMOMETERS

A. Placement: Provide, where shown on Drawings and as indicated below, thermometers of suitable range for the service required. Provide thermometers on the inlet and outlet sides of all coils, heat exchangers, and heat generators.

B. Furnish thermometers for services in the following ranges and divisions with English scales:

1. Domestic hot water:

a. Range: 30 to 200 degrees F.

b. Division: 1 degrees F.

2. Heating hot water and generator cooling water:

a. Range: 30 to 240 degrees F.

b. Division: 2 degrees F.

3. Chilled water:

a. Range: 0 to 100 degrees F.

b. Division: 1 degrees F.

4. Condenser water:

a. Range: 0 to 120 degrees F.

b. Division: 1 degrees F.

C. Sockets: Provide thermometer sockets at all thermometer locations. Provide thermometer sockets only, fitted with plug and chain and conforming to the requirements specified for thermometers. Install all sockets vertical or at a 45-degree vertical angle to permit filling with conducting liquid for tests.

D. Construction: Provide thermometers that are 9 inches long with an etched glass enclosed scale of 2-degree increments, a cast aluminum case, and red reading mercury. Furnish an adjustable, angle-type scale with a swivel nut connection into ¾-inch brass separable sockets. Use a 3-1/2 inch stem length for all pipe sizes up through 8 inches, a 6-inch stem length for 10 inch pipe size, and a 9-inch stem length for pipe sizes larger than 10 inches.

E. Extensions: Where thermometers are installed in insulated lines, use extension-neck separable sockets.

F. Remote Thermostats: Furnish remote bulb thermometers where specified and shown. Provide thermometers with corrosion-resistant movements set in cast aluminum cases with black enamel finish.

1. Furnish dials 4-½ inches in diameter, with black numbers on white dials.

2. Use copper capillary tubing protected by a spiral or double-braided bronze armor.

~~2.13PUMP SUCTION FITTINGS~~

~~A.Fitting: Angle pattern, cast iron body, flanged for over 2 inches, rated for 125 psig working pressure with inlet vanes, cylinder strainer with 3/16-inch diameter openings, disposable fine mesh strainer to fit over cylinder strainer, and permanent magnet located in flow stream and removable for cleaning.~~

~~B.Accessories: Adjustable foot support, blowdown tapping in bottom, gauge tapping inside.~~

~~C.Provide mated flanges at all pump suctions.~~

~~2.14~~**2.09** STRAINERS

A. 2 inches and smaller: Screwed brass or iron body, Y pattern with 1/32 inch stainless steel perforated screen. 150 psi or 300 psi pressure rating to match system pressure.

B. 2-1/2 inches to 4 inches: Flanged iron body, Y pattern with 3/64 inch, screen body to be all 304/316 stainless steel construction and SS perforated screen with internal supports resistant to high differential pressure. 150 psi or 300 psi pressure rating to match system pressure.

C. Over 4 inches: Flanged iron body, basket pattern with 1/8 inch , screen body to be all 304/316 stainless steel construction and SS perforated screen with internal supports resistant to high differential pressure. 150 psi or 300 psi pressure rating to match system pressure.

PART 3 - EXECUTION

3.01 PREPARATION

A. Flush and clean expansion tanks prior to delivery to the Project Site, and keep sealed during construction.

3.02 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. All installation shall be in accordance with manufacturer’s published recommendations.

~~C.Support expansion tanks from building structure in accordance with manufacturer's instructions.~~

~~D.~~**C.** Provide automatic air vents at system high points and as indicated.

~~E.~~**D.** Provide manual air vents at entrance to all heating hot water coils, with a "cane" shaped discharge tube, positioned to permit draining to a portable receptacle.

~~F.~~**E.** For automatic air vents in above-ceiling spaces or other concealed locations, extend vent tubing to nearest drain.

~~G.Provide air separator on suction side of system circulation pump and connect as shown on Drawings.~~

~~H.~~**F.** Provide valved drain and hose connection on strainer blow down connection.

~~I.Provide pump suction fitting on suction side of base mounted centrifugal pumps. Remove temporary strainers after cleaning systems. Clean all permanent strainers after circulating systems for a minimum of 48 hours at full capacity.~~

~~J.Support pump fittings with floor mounted pipe and flange supports.~~

~~K.Provide relief valves on pressure tanks, low-pressure side of reducing valves, heat exchangers, and expansion tanks.~~

~~L.Select system relief valve capacity so that capacity is greater than make-up pressure reducing valve capacity. Select equipment relief valve capacity to exceed rating of connected equipment.~~

~~M.~~**G.** ~~Pipe relief valve outlet to nearest floor drain~~.

~~N.~~**H.** Where one line vents several relief valves, make cross sectional area equal to sum of individual vent areas.

~~O.~~**I.** Install all pressure gauges so that they are easily readable.

~~P.~~**J.** Provide glycerin-filled compound pressure gauge upstream and downstream of each strainer.

~~Q.Provide liquid glycerin-filled gauges across all pumps and air compressors of ranges indicated above. This does not include control air compressor.~~

~~R.Pressure gauges need not be furnished across in-the-line circulators. Where air compressors and receivers are for control air only, standard 2-inch instrument gauges will be acceptable. Equip stem gauges with coil siphons.~~

~~S.~~**K.** Valve bodies and /or piping components that meet ISO 6509 and ASTM B858 made with dezincification resistant brass alloy designated with acronym (DZR) do not require dielectric unions on piping installations with dissimilar metals.

END OF SECTION 23 21 30

SECTION 23 31 00 – DUCTWORK

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 SUMMARY

A. Provide materials and installation for complete first class HVAC systems; install ductwork, flexible duct, hangers, supports, sleeves, flashings, vent flues, and all necessary accessories as indicated in the Contract Documents. Provide any supplementary items necessary for proper installation that make the systems operable, code compliant and acceptable to the authorities having jurisdiction.

1.03 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:

1. ASHRAE - Handbook of Fundamentals; Duct Design.

2. ASHRAE - Handbook of HVAC Systems and Equipment; Duct Construction.

3. ASTM A 90 - Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles.

4. ASTM E 96 - Standard Test Methods for Water Vapor Transmission of Materials.

5. ASTM A 167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.

6. ASTM A 525 - General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.

7. ASTM A 527 - Steel Sheet, Zinc-Coated (Galvanized) by Hot-Dip Process, Lock Forming Quality.

8. ASTM B209 - Aluminum and Aluminum Alloy Sheet and Plate.

9. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.

10. NFPA 90B - Installation of Warm Air Heating and Air Conditioning Systems.

11. NFPA 96 - Installation of Equipment for the Removal of Smoke and Grease-Laden Vapors from Commercial Cooling Equipment.

12. NFPA 45 – Laboratory Ventilating Systems and Hood Requirements.

13. SMACNA – HVAC Duct Construction Standards.

14. SMACNA – Rectangular Industrial Duct Construction Standards.

15. SMACNA – Round Industrial Duct Construction Standards.

16. SMACNA – HVAC Air Duct Leakage Test Manual.

17. UL 181 - Factory-Made Air Ducts and Connectors.

18. Engineering Design Manual for Air Handling Systems, United McGill Corporation (UMC).

19. Assembly and Installation of Spiral Ducts and Fittings, UMC.

20. Engineering Report No. 132 (Spacing of Duct Hangers), UMC.

21. AWSD1.1 American Welding Society Structural Welding Code.

1.04 INSTALLER QUALIFICATIONS:

A. Company shall have minimum three years documented experience specializing in performing the work of this section.

B. Installation of HVAC systems shall be performed by qualified Journeyman.

1.05 DEFINITIONS

A. Low Pressure

1. 2 inch W.G. Pressure Class: Ductwork systems up to 2 inch w.g. positive or negative static pressure with velocities less than or equal to 1500 fpm.

B. Medium Pressure

1. 3 inch W.G. Pressure Class: Ductwork systems over 2 inch w.g. and up to 3 inch w.g. positive or negative static pressure with velocities less than or equal to 2500 fpm.

2. 4 inch W.G. Pressure Class: Ductwork systems over 3 inch w.g. and up to 4 inch w.g. positive or negative static pressure with velocities less than or equal to 2500 fpm.

3. 6 inch W.G. Pressure Class: Ductwork systems over 4 inch w.g. and up to 6 inch w.g. positive or negative static pressure with velocities less than or equal to 2500 fpm.

C. High Pressure

1. 10 inch W.G. Pressure Class: Ductwork systems over 6 inch w.g. and up to 10 inch w.g. positive or negative static pressure with velocities greater than 2500 fpm.

1.06 SUBMITTALS

A. Product Data:

1. Provide the following information for each sheet metal system furnished on the Project:

a. System name and type.

b. Duct system design pressure.

c. Duct material.

d. Duct gage.

e. Transverse joint methods.

f. Longitudinal seam type.

g. Sealant type.

h. SMACNA rectangular reinforcement type.

i. SMACNA intermediate reinforcement type.

j. SMACNA transverse reinforcement type.

B. Record Documents:

1. Submit Shop Drawings on all items of ductwork, plenums, and casings including construction details and accessories specified herein in accordance with Division 01. Ductwork construction details and materials used for duct sealant, flexible connections, etc. shall be submitted and approved prior to the fabrication of any ductwork.

~~2.[Option if no Shop Drawings are required: Prepare Shop Drawings for the purpose of coordination with other trades including structural, piping, plumbing, electrical, lighting, and architectural. When Shop Drawings are not required to be submitted for the Project, field sketches and shop tickets must be available to the Owner upon request. Changes required during construction to accommodate coordination issues will be performed at no additional cost to the Owner.]~~

~~3.~~**2.** Draw ductwork Shop Drawings on minimum 1/4 inch equal to one foot scale building floor plans and shall indicate duct sizes, material, insulation type, locations of transverse joints, fittings, ductwork bottom elevation, offsets, ductwork specialties, fire and fire/smoke dampers, and other information required for coordination with other trades. Clearly designate fire and fire/smoke partitions on the Shop Drawings. Detail Drawings for mechanical rooms and air handling unit locations shall be submitted at a minimum scale of 1/4 inch equal to one foot.

~~4.~~**3.** Coordinate with all other trades and building construction prior to submitting Shop Drawings for review. Indicate location of all supply, return, exhaust, and light fixtures from approved reflected ceiling plans on Shop Drawings.

1.07 DELIVERY, STORAGE AND HANDLING

A. Deliver products to the Project Site and store and protect products under provisions of Division 01 and Division 20.

B. Protect materials from rust both before and after installation.

1.08 WARRANTY

A. All ductwork shown on the Drawings, specified or required for the air conditioning and ventilating systems shall be constructed and erected in a first class workmanlike manner.

B. The Work shall be guaranteed for a period of one (1) year from the Project Substantial Completion date against noise, chatter, whistling, vibration, and free from pulsation under all conditions of operation. After the system is in operation, should these defects occur, they shall be corrected as directed by the Owner at Contractor's expense.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.02 APPLICATION

A. Ductwork systems shall be constructed in accordance with the following Materials as a minimum standard. Refer to Drawings for any deviation from this Table.

AIR SYSTEM	**MATERIAL**	**MINIMUM PRESSURE CLASSIFICATION (1)**
Supply and Return Systems:		
Untreated Outside Air Intake (Louver) to AHU Plenum	304 Stainless Steel	Low Pressure
~~Treated Outside Air to AHU~~	~~Galvanized Steel~~	~~Medium Pressure~~
~~Single Zone FCU Supply~~	~~Galvanized Steel~~	~~Low Pressure~~
~~Single Zone AHU Supply~~	~~Galvanized Steel~~	~~Medium Pressure~~
Mixed Air (AHU Plenum)	Galvanized Steel	Medium Pressure
AHU Discharge/Vertical Supply Riser	Galvanized Steel	Medium Pressure
Vertical Supply Riser to Terminal Unit	Galvanized Steel	Medium Pressure
Terminal Unit Connection	Metal Flexible Duct	As Specified
Terminal Units to Supply Air Device	Galvanized Steel (2)	Low Pressure
Vivarium Supply Air Valve to Air Device	316L Stainless Steel (5)	Low Pressure
~~Return Air Device to Return Distribution~~	~~Galvanized Steel (2)~~	~~Low Pressure~~
~~Return Air Distribution~~	~~Galvanized Steel~~	~~Medium Pressure~~
~~Return Air Distribution/Vertical Riser~~	~~Galvanized Steel~~	~~Medium Pressure~~
~~Ductwork in MRI Rooms~~	~~Aluminum~~	~~As Specified~~

AIR SYSTEM	**MATERIAL**	**MINIMUM PRESSURE CLASSIFICATION (1)**
Exhaust Systems:		
Exhaust Air Device to Exhaust Distribution	Galvanized Steel (2)	Low Pressure
Exhaust Air Distribution	Galvanized Steel	Medium Pressure
General Exhaust Vertical Riser to Fan	Galvanized Steel	Medium Pressure
~~Kitchen Hood Exhaust~~	~~316L Stainless Steel~~	~~Medium Pressure (3)~~
~~Dishwasher Exhaust~~	~~316L Stainless Steel~~	~~Medium Pressure~~
General Lab Exhaust Air Device to Horizontal Distribution	Galvanized Steel	Low Pressure
Hood/Biosafety Cabinet Exhaust to Horizontal Distribution	316L Stainless Steel	Medium Pressure

AIR SYSTEM	MATERIAL	MINIMUM PRESSURE CLASSIFICATION (1)
Combination Lab and General Exhaust Horizontal Distribution ~~(Serving General Exhaust and 3 or fewer CFHs)~~	316L Stainless Steel	Medium Pressure(4)
~~Combination Lab and General Exhaust Horizontal Distribution (Serving General Exhaust and 4 or more CFHs)~~	~~Galvanized Steel~~	~~Medium Pressure (4)~~
~~Combination Lab and General Exhaust Vertical Riser~~	~~Galvanized Steel~~	~~Medium Pressure (4)~~
~~Combination Lab and General Exhaust Riser to Filter Housing/Exhaust Plenum~~	~~Galvanized Steel~~	~~Medium Pressure (4)~~
~~Combination Lab and General Exhaust Fan to Exhaust Stack (including Exhaust Stack~~	~~316L Stainless Steel~~	~~Medium Pressure (4)~~
~~Emergency Generator Exhaust~~	~~Double Wall or Black Steel~~	~~As Specified~~
~~MRI Cryogen Vents~~	~~304 Stainless Steel or 6061 Aluminum~~	~~As Specified~~
Vivarium General Exhaust Air Valve to Air Device	316L Stainless Steel (5)	Low Pressure

B. Notes to Table:

1. Positive pressure unless noted otherwise in Table.

2. Air device connections may be made with insulated flexible duct as specified herein.

3. Verify minimum pressure classification per NFPA 96 requirements.

4. Applies to exhaust system for general laboratory exhaust, fume hoods, and biosafety cabinets. Refer to Drawings for construction of any additional exhaust systems.

5. Where ductwork systems are subject to routine decontamination (HPV, Clidox, etc.), provide 316L stainless steel ductwork as indicated.

~~**[NOTE TO SPECIFIER: THE ABOVE TABLE CAN BE MODIFIED TO SUIT PROJECT REQUIREMENTS. IF PROJECT CONDITIONS DIFFER FROM THE TABLE, CHANGES SHALL BE NOTED ON THE DRAWINGS AND IN THE SUBMITTALS.]**~~

2.03 DUCTWORK MATERIAL AND CONSTRUCTION

A. All ductwork indicated on the Drawings, specified or required for the air conditioning and ventilating systems shall be of materials as hereinafter specified unless indicated otherwise on Drawings. All air distribution ductwork shall be fabricated, erected, supported, etc., in accordance with all applicable standards of SMACNA where such standards do not conflict with NFPA 90A and where class of construction equals or exceeds that noted herein.

B. Ductwork shall be constructed of G-90 coated galvanized steel of ASTM A653 and A924 Standards.

C. Minimum gage of round, oval or rectangular ductwork shall be 26 gage per SMACNA Standards.

D. All duct sizes shown on the Drawings are clear inside dimensions. Allowance shall be made for internal lining, where specified, to provide the required free area.

E. All holes in ducts for damper rods and other necessary devices shall be either drilled or machine punched (not pin punched), and shall not be any larger than necessary. All duct openings shall be provided with sheet metal caps if the openings are to be left unconnected for future connections/phases, otherwise plastic covers are acceptable.

F. Except for specific duct applications specified herein, all sheet metal shall be constructed from prime galvanized steel sheets and/or coils up to 60 inches in width. Each sheet shall be stenciled with manufacturer's name and gage.

G. Sheet metal must conform to SMACNA sheet metal tolerances as outlined in SMACNA's "HVAC Duct Construction Standards."

H. Where ducts are exposed to view (including equipment rooms) and where ducts pass through walls, floors or ceilings; furnish and install sheet metal collars around the duct.

I. Spin-in fittings shall be as specified under Section 23 33 00 – Ductwork Accessories.

J. Duct Sealing: All ductwork, regardless of system pressure classification, shall be sealed in accordance with Seal Class A, as referenced in SMACNA Standards. All transverse joints, longitudinal seams, and duct wall penetrations shall be sealed.

1. All seams and joints in shop and field fabricated ductwork shall be sealed by applying one layer of sealant, then immediately spanning the joint with a single layer of 3 inches wide open weave fiberglass scrim tape. Sufficient additional sealant shall then be applied to completely embed the cloth.

2. Sealant shall be water based latex UL 181A-M sealant with flame spread of 0 and smoke developed of 0. Sealants shall be Hard Cast Iron Grip 601, Ductmate Pro Seal, Foster 32-19, Childers CP-146 or Design Polymerics DP 1010.

3. Scrim tape shall be fiberglass open weave tape, 3 inches wide, with maximum 20/10 thread count, similar to Hardcast FS-150.

4. Sealer shall be rated by the manufacturer and shall be suitable for use at the system pressure classification of applicable ductwork.

5. Except as noted, oil or solvent-based sealants are specifically prohibited.

6. For exterior applications, “Uni-Weather” (United McGill Corporation), solvent-based sealant, or Foster 32-19 shall be used.

2.04 RECTANGULAR AND ROUND DUCTWORK

A. Metal gages listed in SMACNA HVAC Duct Construction Standards, Metal and Flexible Duct, are the minimum gages which shall be used. Select metal gage heavy enough to withstand the physical abuse of the installation. In no case shall ductwork be less than 26 gage per SMACNA Standards.

B. All longitudinal seams for rectangular duct shall be selected for the specified material and pressure classification. Seams shall be as referenced in SMACNA Standards.

C. Longitudinal seams in laboratory hood exhaust ducts shall be welded.

D. All transverse joints and intermediate reinforcement on rectangular duct shall be as shown in SMACNA Standards. Transverse joints shall be selected consistent with the specified pressure classification, material, and other provisions for proper assembly of ductwork.

E. Spiral round duct and fittings shall be as manufactured by United McGill Sheet Metal Company or approved equivalent. All fittings shall be factory fabricated, machine formed and welded from galvanized sheet metal.

F. Joints in spiral duct and fittings shall be assembled, suspended, sealed, and taped per manufacturer’s published assembly and installation instructions.

G. Contractor may use DUCTMATE or Ward Industries coupling system, as an option, on rectangular ductwork. The DUCTMATE or Ward Industries system shall be installed in strict accordance with manufacturer’s recommendations.

H. Rectangular ductwork field fabricated offsets shall not exceed 30 degrees.

2.05 FLAT OVAL DUCTWORK AND FITTINGS

A. Oval ducts shall be spiral flat oval or welded flat oval equivalent to those of United McGill Sheet Metal Company with gage and reinforcing as recommended by the manufacturer. Duct may be shop fabricated of completely welded construction in accordance with SMACNA Standards.

B. Oval ducts greater than 24 inch x 72 inch shall be longitudinal seam, flat oval duct, rolled, welded and provided in standard lengths of 5 and 10 feet. Transverse joints shall be factory welded or field connected with flanges or slip couplings. Duct will be fabricated from galvanized steel meeting ASTM A 527 standards.

C. Duct reinforcing angles shall be of sizes specified for same size rectangular duct. Galvanized angles shall be used where standing seams are specified for rectangular duct.

D. Oval fittings shall comply with requirements, sealing, etc., similar to that specified for round ductwork. Manifolding taps may be permitted without increasing the length of run in the branch duct system.

E. Elbows in oval ducts may be smooth long radius or 5-piece 90-degree elbows and 3-piece 45-degree elbows. Joints in sectional elbows shall be sealed as specified for duct sealing.

2.06 CONICAL BELLMOUTH FITTINGS AND TAPS

A. Conical bellmouth fittings shall be made from 26-gage G-90 coated galvanized steell. Two-piece construction with a minimum overall length of 6 inches and factory sealed for high-pressure requirements. Average of loss coefficient for sizes 6, 8 and 10 shall be less than 0.055.

B. Provide each fitting with minimum 24-gage damper plate with locking quadrant operator and sealed end bearings. Damper blade shall be securely attached to shaft to prevent damper form rotating around shaft. Shaft shall be extended to clear insulation.

C. Provide a flange and gasket with adhesive peel-back paper for ease of application. The fittings shall be further secured by sheet metal screws spaced evenly at no more than 4 inches on center with a minimum of four (4) screws per fitting.

D. Conical bellmouth fittings shall be Series 3000G as manufactured by Flexmaster U.S.A., Inc. or Buckley Air Products, Inc., “AIR-TITE”.

2.07 CASINGS AND PLENUMS - 2 INCH W.G. PRESSURE CLASS

A. All 2 inch w.g. pressure class casings and plenums for mixed air plenums shall be constructed in accordance with SMACNA Standards.

B. All casings shall enclose the filter and automatic dampers as shown on the Drawings. Casings shall be fabricated of galvanized sheet metal erected with three-foot center maximum standing seams reinforced with ¼-inch bars. The casing shall be stiffened on three-foot centers maximum with angle irons tack welded in place.

C. All openings to the casing shall be properly sealed to prevent any air leakage. Access doors shall be installed as indicated on the Drawings and shall be air tight, double skin insulated construction with frames welded in place. Doors shall be rubber gasketed with #390 Ventlok gasketing and equipped with fasteners equal to Ventlok #310 latches and #370 hinges that can be operated from both the inside and the outside.

D. Casings shall be anchored by the use of angle irons sealed and bolted to the curb and floor of the apparatus casing. Casings shall be tested and provided tight at a pressure of three inches water column.

E. Insulate per Section 23 07 13.

2.08 CASINGS AND PLENUMS – 6 INCH W.G. PRESSURE CLASS

A. Shall enclose filters and automatic dampers at air handling unit systems. Casings shall be constructed of cellular, standing seam panels with 3 inch deep reinforced “hat” sections as manufactured by metal deck manufacturers and as described in SMACNA Standards.

B. All openings to the casing shall be properly sealed to prevent air leakage. Install access doors for easy access to equipment. Access doors shall be air tight, double skin insulated construction with frames welded in place. Doors shall be rubber gasketed with #390 Ventlok gasketing and equipped with fasteners equal to Ventlok #310 latches that can be operated from both the inside and outside. Hinges shall be equivalent to Ventlok #370.

C. Anchor casing by the use of galvanized angle irons sealed and bolted to the curb and floor of the apparatus casing as indicated in SMACNA Standards.

D. A fan discharge diffuser plate shall be located on the fan discharge and shall be constructed of 10 gage steel perforated plate installed in 6 inch channel iron frames (8.2#) rigidly supported to withstand the fan discharge velocity. Perforations shall be 3/8 inch (0.375 inch) staggered on 11/16 inch centers (27 percent open area). One section shall be hinged to provide an access door between the discharge side of the fan and the entering side of the coils. After fabrication of the diffuser plate, coat with rust-resistant paint. After installation, touch up diffuser plate and paint channel iron frames with rust-resistant paint.

E. Provide sufficient access openings to allow access for maintenance of all parts of the apparatus. Access door size shall be as large as feasible for the duty required.

F. Insulate per Section 23 07 13.

2.09 ELBOWS RECTANGULAR DUCTS

A. Construct elbows as follows in order of preference:

1. Long radius, unvaned elbows.

2. Short radius, single thickness vaned elbows.

3. Rectangular, double thickness vaned elbows.

B. Long radius elbows shall have a centerline radius of not less than one and one-half (1-1/2) times the duct width. Short radius elbows shall have a centerline radius of not less than one times the duct width.

C. Contractor shall have the option to substitute short radius vaned elbows, but shall request the substitution at the time of submittal of Product Data.

D. Provide turning vanes in all rectangular elbows and offsets.

E. Job fabricated turning vanes, if used, shall be fabricated of the same gage and type of material as the duct in which they are installed. Vanes must be fabricated for same angle as duct offset. Submit Shop Drawings on factory fabricated and job fabricated turning vanes.

F. All turning vanes shall be anchored to the cheeks of the elbow in such a way that the cheeks will not breathe at the surfaces where the vanes touch the cheeks. In most cases, this will necessitate the installation of an angle iron support on the outside of the cheek parallel to the line of the turning vanes.

G. In 90-degree turns that are over 12 inches wide in the plane of the turn, provide and install double thickness vanes on integral side rails. For ducts under 12 inches in width, use single thickness vanes. The installation of the turning vanes shall be as described for single thickness vanes. On other types of turns or elbows, single thickness trailing edge vanes shall be used.

2.10 FLEXIBLE DUCT

A. Flexible duct shall be used where flexible duct connections are shown on the Drawings to air distribution devices and terminal units and as scheduled under “Ductwork System Applications.

B. Acoustical Flexible Duct to Diffusers, Grilles, and Terminal Units:

1. Maximum flex duct length 6’-0” (six feet), installed with no more than 90 degrees of bend to diffusers and grilles. Where longer duct runs or more bends are necessary, provide rigid round ductwork.

2. Maximum flex duct length 2’-0” (two feet), installed as a straight run to the inlet of the terminal units.

3. Acoustical flexible duct shall be manufactured with an acoustically rated CPE inner film as the core fabric, mechanically locked by a corrosion-resistant galvanized steel helix.

4. Core shall be factory pre-insulated with a total thermal performance of R-3.5 or greater. Outer jacket shall be a fire retardant polyethylene vapor barrier jacket with a perm rating not greater than 0.10 per ASTM E 96, Procedure A.

5. Duct shall be rated for a minimum positive working pressure of 6 inches w.g. and a negative working pressure of 4 inches w.g. minimum.

6. Temperature range shall be –20 degrees F to 250 degrees F.

7. Duct must comply with the latest NFPA Bulletin 90A and be listed and labeled by Underwriter's Laboratories, Inc., as Class I Air Duct, Standard 181, and meet GSA, FHA and other U. S. Government standards; flame spread less than 25; smoke developed less than 50.

8. Acoustical flexible duct shall be similar to Flexmaster Type 8M for construction and acoustical performance standards.

C. Metal Flexible Duct:

1. May be used for terminal unit connections from sheet metal ductwork where shown on the Drawings.

2. Maximum length 2’-0” (two feet), installed in straight runs only. Where longer duct runs or direction changes are necessary, provide rigid round ductwork.

3. Duct shall be constructed of 0.005 inch thick 3003-H14 aluminum alloy in accordance with ASTM B209. Duct shall be spiral wound into a tube and spiral corrugated to provide strength and flexibility.

4. Core shall be factory pre-insulated with a total thermal performance of R-3.5 or greater. Outer jacket shall be fire retardant metalized vapor barrier jacket of fiberglass reinforced aluminum foil, with a permeance rating not greater then 0.05 per ASTM E96, Procedure A.

5. The duct shall be rated for a minimum positive and negative working pressure of 10 inch w.g.

6. Temperature range shall be –40 degrees F to 250 degrees F.

7. Duct must comply with the latest NFPA Bulletin 90A and be listed and labeled by Underwriter's Laboratories, Inc., as Class I Air Duct, Standard 181, and meet GSA, FHA and other U. S. Government standards; flame spread less than 25; smoke developed less than 50.

8. Metal flexible duct shall be similar to Flexmaster triple lock Type TL-M.

2.11 STAINLESS STEEL DUCTWORK

A. Applies to general laboratory exhaust, fume hood, biosafety cabinet, radioisotope hood, vivarium supply and exhaust systems subject to routine decontamination (HPV, Clidox, etc.), and moisture exhaust systems where indicated on the Drawings and as specified herein.

B. Stainless steel shall be 316-L with welded longitudinal seams and welded transverse joints. Welds on exposed ductwork shall be positioned for minimum view and shall be ground and polished. Duct sealant shall not be used to seal this ductwork.

C. All ductwork risers shall be installed as vertical as possible within the constraints of the design indicated on the Drawings.

D. In all cases, ductwork shall be installed so that the washdown water, where installed, shall drain back to the hood.

E. Metal gages shall be not less than the following:

DUCT SIZE	GAGE
30-inch diameter or less	18
31-inch to 60-inch diameter	16
61-inch diameter or greater	14
Greater than 60 x 42 (rectangular or oval)	Comply with SMACNA

F. The joining of stainless steel ductwork with galvanized ductwork where indicated in the Drawings shall use ductwork construction methods specified herein for galvanized ductwork.

G. Connections to Air Devices Cabinets or Hoods:

1. Where approved by Owner, flexible stainless steel ducting can be used in lieu of hard pipe stainless steel at cabinets or hoods

2. For all non insulated duct applications flexible ducting shall be 316TI stainless steel; pressure rated for 12 inches w.g. positive and negative; UL 181, Class 0 air duct rated; Velocity Rated for 5500 fpm. Similar to Flexmaster Type SS-NI-TL.

3. For all insulated duct applications, flexible ducting shall be 316 stainless steel; pressure rated for 12 inches w.g. positive and negative; UL 181, Class 1 air duct rated; Velocity Rated for 5500 fpm. Similar to Flexmaster Type SS-TLM.

~~2.12ALUMINUM DUCTWORK~~

~~A.Provide 6061 Aluminum ductwork only where indicated on the Drawings and as specified herein. Applies typically to ductwork within MRI rooms.~~

~~B.Duct joints shall be all soldered construction, one standard gage heavier than for the same size galvanized steel ducts. Refer to SMACNA for equivalent aluminum thickness and reinforcement.~~

~~C.Construction method shall follow the specified methods for galvanized ductwork, except that no ferrous materials may be used. Only aluminum, copper and brass must be used in construction in locations requiring aluminum ductwork; this includes fasteners, hangers, anchors, etc.~~

~~D.Connections to Equipment:~~

~~1.Where approved by Owner, flexible stainless steel ducting can be used in lieu of hard pipe stainless steel.~~

~~2.Flexible ducting shall be 316 TI stainless steel; pressure rated for 12 inches w.g. positive and negative; UL 181, Class 0 air duct rated; Velocity Rated for 5500 fpm. Similar to Flexmaster Type SS-NL-TL.~~

~~2.13KITCHEN HOOD EXHAUST~~

~~A.Stainless steel with liquid tight welded longitudinal seams and transverse joints, as specified under "Stainless Steel Ductwork" and as further specified herein.~~

~~B.Construction shall be in accordance with NFPA 96 and applicable SMACNA Standards.~~

~~C.Slope duct toward hood connections and cleanout points as shown on the Drawings.~~

~~D.No turning vanes, dampers, or other interior intrusions shall be installed in the ductwork system.~~

~~E.All changes in direction shall be with radius elbows (centerline radius equal 1.5 x duct width).~~

~~F.Provide rated access doors for installation by the Contractor at all locations necessary.~~

~~G.Coordinate required rated enclosure of kitchen hood exhaust and access points with the Contractor.~~

~~H.Manufactured double wall duct systems with NFPA certification for grease systems may be used in lieu of above referenced materials.~~

~~2.14EMERGENCY GENERATOR EXHAUST SYSTEM~~

~~A.Selkirk Metalbestos (Model IPS-C2), Metal Fab. Minimum standard weight black steel pipe with calcium silicate insulation is acceptable in lieu of double wall system specified herein.~~

~~B.Factory-built modular exhaust system and published skin temperatures shall be laboratory tested and listed by Underwriters Laboratories, Inc., for use with building heating equipment and appliances with produce exhaust flue gases at temperature not exceeding 1400 degrees F under continuous operating conditions. This exhaust system shall be designed to compensate for all flue gas induced thermal expansions.~~

~~C.Exhaust system shall be double wall and have an outer jacket of Type 316 stainless steel, 0.025 inch thick in 6 inch through 24 inch diameter and 0.034 inch thick for larger diameter duct. The inner flue gas carrying conduit shall be Type 316 stainless steel. The inner liner shall be 0.035 inch nominal thickness for all duct diameters.~~

~~D.To control the venting pressure should a backfire occur, an explosion relief valve shall be incorporated in the exhaust system per NFPA 37.~~

~~E.Fiber insulated exhaust system shall have a fiber insulation between the walls of 2 inches thick. Asbestos materials may not be used.~~

~~F.Inner pipe joints shall be sealed by use of overlapping type V-band (P-OVB) with a premixed 200 degrees F sealant (P-200E). The outer channel bands shall be sealed with a 600 degrees F sealant (P-600) where exposed to weather.~~

~~G.When the engine exhaust system is installed according to the manufacturer's installation instructions and the limits of its listing, it shall comply with National Safety Standards and Building Codes.~~

~~H.Exhaust system shall terminate as shown on the Drawings and per NFPA 37 and NFPA 211 requirements.~~

~~I.All exhaust system parts exposed to the atmosphere shall be protected by a minimum of one base coat and one finished coat of paint, such as Series 4200 or 4300 heat resistance paint as manufactured by Rust-Oleum Corp.~~

~~J.The exhaust system shall be installed as designed by the manufacturer and in accordance with the terms of the manufacturer's 10-year warranty.~~

~~K.Furnish all parts required to completely install the exhaust system including all flashing, storm collar, miter cuts, supports, bracing, ventilated roof thimble, sealants, tensioner, wall guide, rings, tee cap, adapter, bellows, etc. Coordinate installation with roofing Contractor.~~

~~2.15MRI CRYOGEN VENT PIPE~~

~~A.For cryogenic venting, welded stainless steel or aluminum pipe shall be used in all MRI or similar rooms where shown on the Drawings.~~

~~B.Stainless steel pipe shall be Type 304 non-ferromagnetic, thickness 0.035 inch minimum and 0.125 inch maximum.~~

~~C.Aluminum pipe shall be Type 6061-T6, thickness 0.083 inch minimum and 0.125 maximum.~~

~~D.Piping shall be installed with bracing as required to withstand the forces encountered during a cryogenic release event.~~

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. All installation shall be in accordance with manufacturer's published recommendations.

C. Cleanliness:

1. Before installing ductwork, wipe ductwork to a visibly clean condition.

2. During construction, provide temporary closures of metal or taped polyethylene on open ductwork and duct taps to prevent construction dust or contaminants from entering ductwork system. Seal ends of ductwork prior to installation to keep ductwork interior clean. Remove closures only for installation of the next duct section.

3. For ductwork supplying Clean Rooms, Operating Rooms and other Critical Care areas, sanitize ductwork with a biocidal agent EPA approved for HVAC systems immediately prior to sealing ductwork.

4. During duration of construction, maintain the integrity of all temporary closures until air systems are activated.

D. Provide openings in ductwork where required to accommodate thermometers, controllers and other devices. Provide pitot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring. Sleeve of pitot tube opening shall be no more than one inch long. Opening shall be one inch wide to accept pitot tube.

E. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

F. Slope underground ducts to plenums or low pump out points at 1:500. Provide access doors for inspection.

G. Coat buried, metal ductwork without factory jacket with one coat and seams and joints with additional coat of asphalt base protective coating.

H. Set plenum doors 6 to 12 inches above floor. Arrange door swings so that fan static pressure holds door in closed position.

I. Provide residue traps in kitchen hood exhaust ducts at base of vertical risers with provisions for cleanout. Use stainless steel for ductwork exposed to view and stainless steel for ducts where concealed.

J. All visible welds in ductwork between biosafety cabinets, canopy hoods and fume hoods and the ceiling shall be ground and polished.

K. Slope duct toward grilles for moisture-laden ducts. Provide drain and trap at elbow of main moisture exhaust duct system.

L. Project inspector shall be notified to inspect all field fabricated offsets before cover-up or external insulation is applied.

M. Flexible Duct:

1. The terminal ends of the duct core shall be secured by compression coupling or stainless steel worm gear type clamp.

2. Fittings on terminal units and on sheet metal duct shall have flexible duct core slipped over duct and coupling or clamp tightened, then connection sealed with sealant. Insulation of flexible duct shall be slipped over connection to point where insulation abuts terminal unit or insulation on duct.

3. These insulation connections shall be sealed by embedding fiberglass tape in the sealant and coating with more sealant to provide a vapor barrier.

N. Support flexible ducts as per SMACNA standards to prevent sags, kinks and to have 90 degree turns.

O. Hangers and Supports:

1. All ductwork supports shall be in accordance with Table 4-1 (rectangular duct) and Table 4-2 (round duct) of the SMACNA Standards, with all supports directly anchored to the building structure.

2. Rectangular duct shall have at least one pair of supports on minimum 8’-0" (eight feet) centers. All horizontal round and flat oval ducts shall have ducts hangers spaced 10’-0" (ten feet) maximum.

3. Lower attachment of hanger to duct shall be in accordance with Table 4-4 of the SMACNA Standards.

4. Vertical ducts shall be supported where they pass through the floor lines with 1-1/2 inch x 1-1/2 inch x 1/4 inch angles for duct widths up to 60 inches. Above 60 inches in width, the angles must be increased in strength and sized on an individual basis considering space requirements.

5. Hanger straps on duct widths 60 inches and under shall lap under the duct a minimum of 1 inch and have minimum of one fastening screw on the bottom and two on the sides.

6. Hanger straps on duct widths over 60 inches shall be bolted to duct reinforcing with 3/8 inch bolts minimum.

3.02 DUCTWORK SYSTEM CLEANING

A. If the system has been operated without scheduled filters or if the integrity of temporary closures has been compromised, Contractor shall have ductwork cleaned according to National Air Duct Cleaners Association (NADCA) Standards by a Certified Regular Member of the NADCA.

1. For ductwork supplying Clean Rooms or patient care areas, also sanitize the ductwork interior per NADCA standards with a biocidal agent approved by the EPA for use in HVAC Systems.

B. Before turning the installation over to the Owner, Contractor shall certify that the air handling systems have only been operated with scheduled filters in place. Otherwise, Contractor shall present evidence that the ductwork was cleaned as required above.

3.03 TESTING

A. All medium and high pressure duct systems (positive or negative) shall be pressure tested according to SMACNA test procedures (HVAC Air Duct Leakage Test Manual). Notify Owner minimum seven (7) calendar days in advance of leakage testing.

1. Design pressure for testing ductwork shall be determined from the maximum pressure generated by the fan at the nominal motor horsepower selected.

2. Total allowable leakage shall not exceed 1 percent of the total system design airflow rate.

3. When partial sections of the duct system are tested, the summation of the leakage for all sections shall not exceed the total allowable leakage.

4. Leaks identified during leakage testing shall be repaired by:

a. Complete removal of the sealing materials.

b. Thorough cleaning of the joint surfaces.

c. Installation of multiple layers of sealing materials.

5. The entire ductwork system shall be tested, excluding connections upstream of the terminal units (i.e. ductwork shall be capped immediately prior to the terminal units, and tested as described above).

6. After testing has proven that ductwork is installed and performs as specified, the terminal units shall be connected to ductwork and connections sealed with extra care. Contractor shall inform the Owner when joints may be visually inspected for voids, splits, or improper sealing of the joints. If any leakage exists in the terminal unit connections/joints after the systems have been put into service, leaks shall be repaired as specified for other leaks.

7. Fixed flow measurement devices (i.e. orifice tubes, nozzles, etc.) shall have current calibration documentation showing that the device was verified to a National Institute Of Standards and Technology (NIST) standard within the previous five years or as recommended by the manufacture and be accurate to at least +/- 2% of reading.

8. Pressure measurement instrumentation (i.e. manometer) shall have current calibration documentation showing that the device was verified to a NIST standard within the previous year or as recommended by the manufacture. Instrumentation shall have an accuracy of at least +/- 2% of reading and have a resolution of 2:1 with respect to the measured pressure (i.e. resolution of 0.01 measured 0.1).

B. All low-pressure duct systems (positive or negative) shall be inspected for visible and audible signs of leakage.

1. Leaks identified by inspection shall be repaired by:

a. Complete removal of the sealing materials.

b. Thorough cleaning of the joint surfaces.

c. Installation of multiple layers of sealing materials.

2. Discrepancies found during testing and balancing between duct traverses and diffuser/grille readings shall result in re-inspection, repair and retest until discrepancies are eliminated.

C. At the option of the Owner, if documented in writing, Contractor may be allowed to eliminate testing of terminal units by capping the supply ductwork prior to the terminal units, then inspecting the connection to the terminal units when complete. This option may only be exercised by the Owner, only if documented in writing prior to testing.]

D. Ductwork leakage testing and/or inspection shall be performed prior to installation of external ductwork insulation.

END OF SECTION 23 31 00

SECTION 23 33 00 – DUCTWORK ACCESSORIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 SUMMARY

A. Perform all Work required to provide and install the following ductwork accessories indicated by the Contract Documents with supplementary items necessary for proper installation.

1. Airflow control dampers and spin-in fittings.

2. Fire dampers, smoke dampers, and combination fire and smoke dampers.

3. Flexible duct connections.

4. Duct access doors.

5. Screens

6. Duct test holes.

~~7.Guy wire systems.~~

1.03 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:

1. AMCA 500D – Laboratory Method of Testing Dampers for Rating.

2. AMCA 500L – Laboratory Method of Testing Louvers for Rating.

3. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.

4. NFPA 101 - Life Safety Code.

5. SMACNA - HVAC Duct Construction Standards.

6. UL 33 - Heat Responsive Links for Fire-Protection Service.

7. UL 555 – Standard for Fire Dampers.

8. UL 555C – Standard for Ceiling Dampers.

9. UL 555S – Standard for Smoke Dampers.

1.04 SUBMITTALS

A. Product Data:

1. Provide product data for shop fabricated assemblies including, but not limited to, volume control dampers, duct access doors, and duct test holes. Provide product data for hardware used.

B. Record Documents:

1. Fire Dampers: The damper manufacturer's literature submitted for approval prior to the installation shall include performance data developed from testing in accordance with AMCA 500D standards and shall show the pressure drops for all sizes of dampers required at anticipated air flow rates. Maximum pressure drop through fire damper shall not exceed 0.05-inch water gauge.

2. Combination Fire/Smoke Dampers: Assign identification numbers for each damper with corresponding number noted on Drawings. Provide air quantity, size, free area of damper, pressure drop and proposed velocity through each damper. Provide manufacturer's data of damper and its accessories or options. At Owner's request, provide two (2) dampers (18 inch x 12 inch) for the purpose of illustrating damper operation to Owner's operating and maintenance personnel.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.02 MANUFACTURERS

A. Dampers:

1. Greenheck.

2. Louvers and Dampers, Inc.

3. Nailor Industries.

4. Prefco.

5. Ruskin.

6. Portorff

B. Regulators, Locking Quadrants:

1. Ventfabrics

2. Mercer Rubber

2.03 AIR FLOW CONTROL DAMPERS

A. Furnish and install dampers where shown on the Drawings and wherever necessary for complete control of airflow, including all supply, return, outside air, and exhaust branches, "division" in main supply, return and exhaust ducts, and each individual air supply outlet. Where access to dampers through a permanent suspended ceiling (gypsum board) is necessary, the Contractor shall be responsible for the proper location of the access doors.

B. Dampers larger than three (3) square feet in area shall be controlled by a self-locking splitter damper assembly.

C. Volume damper blades shall not exceed 48 inches (48") in length or twelve inches (12") in width and shall be of the opposed interlocking type. The blades shall be of not less than No. 16 gage galvanized steel supported on one-half inch (1/2") diameter rust-proofed axles. Axle bearings shall be the self-lubricating ferrule type.

D. Volume dampers and other manual dampers shall be carefully fitted, and shall be manually controlled by damper regulators as follows:

1. On exposed uninsulated ductwork the locking quadrant shall be made with a base plate of 16-gage cold-rolled steel and a heavy die cast handle designed with a 3/8 inch bearing surface. A 1/4 inch-20 zinc plated wing nut shall firmly lock the handle in place.

2. On exposed externally insulated ductwork the regulator shall be 4-1/4 inch diameter, for 1/2 inch rod, designed for use on duct with insulation thickness specified for duct, and shall have four (4) 3/16 inch holes provided to rivet or screw regulator to the duct surface. The flange that covers the raw edge of the insulation shall be high enough so that it slightly compresses the insulation and holds insulation in place. The handle shall be 3/8 inch above the flange, and shall easily turn without roughing up the insulation.

3. On concealed ductwork above inaccessible ceilings, the regulator shall be 2-5/8 inch diameter chromium plated cover plate that telescopes into the base, for 1/2 inch rod. Regulator shall be cast into a box for mounting in ceilings. Base shall be 1-1/2 inch deep. The cover shall be secured by two screws that can be easily removed for damper adjustment.

4. Furnish and install end bearings for the damper rods on the end opposite the quadrant.

E. Spin-in fittings may be used for duct taps to air devices and shall include dampers on all duct to air devices (diffusers and grilles) even though a volume damper is specified for the air device. Spin-in fittings shall be similar to Flexmaster FLD with BO3 including a 2 inch buildout, nylon bushings, locking quadrant similar to Duro Dyne KR-3, and a 3/8 inch square rod connected to the damper with U-bolts. Spin-in fittings shall be sealed at the duct tap with sealant as specified herein. Determine location of spin-in fittings after terminal units are hung or after location of light fixtures are confirmed to minimize flexible duct lengths and sharp bends.

2.04 FIRE DAMPERS

A. Each fire damper shall be constructed and tested in accordance with Underwriters Laboratories Safety Standard 555, latest edition. Dampers shall possess a 1-1/2 hour or 3 hour (as appropriate for the construction shown in the architectural Drawings) protection rating, 160 or 165 degrees F fusible link, and shall bear a U.L. label in accordance with Underwriters' Laboratories labeling procedures. Construct fire dampers such that damper frame material and curtain material are galvanized.

B. Fire dampers shall be curtain blade type and damper shall be constructed so that the blades are out of the air stream to provide 100 percent free area of duct in which the damper is housed.

C. Equip fire dampers for vertical or horizontal installation as required by location shown on Drawings. Install fire dampers in wall and floor openings utilizing steel sleeves, angles and other material and practices as required to provide an installation equivalent to that utilized by the manufacturer when the respective dampers were tested by Underwriters Laboratories. Mounting angles shall be minimum 1-1/2 inch by 1-1/2 inch by 14 gage and bolted, tack welded or screwed to the sleeve at maximum spacing of 12 inches and with a minimum of two connections at all sides. Mounting angles shall overlap at least equal to the duct gage as defined by the appropriate SMACNA Duct Construction Standard, latest edition, and as described in NFPA 90A. The entire assembly, following installation, shall be capable of withstanding 6 inch water gauge static pressure.

D. All fire dampers shall be dynamic rated type.

E. Completely seal the damper assembly to the building components using manufacturer recommended material(s).

2.05 COMBINATION FIRE/SMOKE DAMPERS

A. Each combination fire/smoke damper shall be 1-1/2 hour fire rated under UL Standard 555, Current Edition, and shall be further classified by Underwriters Laboratories as a Leakage Rated Damper for use in smoke control systems under the latest version of UL555S, and bear a UL label attesting to same. Damper manufacturer shall have tested and qualified with UL, a complete range of damper sizes covering all dampers required by this Specification. Testing and UL qualifying a single damper size is not acceptable. The leakage rating under UL555S shall be no higher than Leakage Class II (4 CFM per square foot at one-inch water gauge pressure and 8 CFM per square foot at 4 inches water gauge pressure). Maximum air pressure drop through each combination fire/smoke damper shall not exceed 0.10-inch water gauge at the design air quantity. (Note that this may require a larger damper than the connected duct size.) All ratings shall be dynamic.

B. Damper frame shall be minimum 20-gage galvanized steel formed into a structural hat channel shape with tabbed corners for reinforcement, as approved in testing by Underwriters Laboratories. Bearings shall be integral high surface area non electrolytic materials construction to incorporate a friction free frame blade lap seal, or molybdenum disulfide impregnated stainless steel or bronze oilite sleeve type turning in an extruded hole in the frame or an extruded frame raceway. Dampers may be either parallel or opposed blade type. Blades shall be constructed with a minimum of 14-gage equivalent thickness. Blade edge seal material shall be able to withstand 450 degrees F. Jamb seals shall be flexible stainless steel compression type or lap seal type.

C. In addition to the leakage ratings specified herein, combination fire/smoke dampers and their operators shall be qualified under UL555S to an elevated temperature of 350 degrees F. Electric operators shall be installed by the damper manufacturer at the time of damper fabrication. Damper and operator shall be supplied as a single entity that meets all applicable UL555 and UL555S qualifications for both dampers and operators. Manufacturer shall provide a factory-assembled sleeve. Sleeve shall be minimum 20-gage for dampers where neither width nor height exceeds 48 inches or 16-gage where either dimension equals or exceeds 48 inches.

D. As part of the UL qualification, dampers shall have demonstrated a capacity to operate (open and close) under HVAC system operation conditions, with pressures at least 4 inches water gauge in the closed position, and 2500 fpm air velocity in the open position.

E. Each combination fire/smoke damper, except as noted hereinafter, shall be equipped with a UL Classified firestat/releasing device. The firestat/releasing device shall electrically (24 VAC) and mechanically (pneumatically) lock the damper in a closed position when the duct temperatures exceed 165 degrees F and still allow the appropriate authority to operate the damper as may be required for smoke control functions. Damper must be operable while the temperature is above 350 degrees F. Actuator/operator package shall include two damper position indicator switches linked directly to damper blade to provide capability of remotely indicating damper position. One switch shall close when the damper is fully open, and the other switch shall close when the damper is fully closed. The firestat/releasing device and position indicator switches shall be capable of interfacing electrically with the smoke detectors, building fire alarm system, and remote indicating/control stations or building automation system (BAS).

F. Damper releasing device shall be mounted within the airstream. Device shall be activated and the damper shall close and lock when subjected to duct temperatures in excess of approximately 285 degrees F.

G. Motors for operation of smoke dampers shall be smoke system fail safe, spring return normally open supplies and normally closed returns, or as indicated on the Drawings, and shall be furnished and installed by the damper manufacturer as required by the U.L. rating mentioned above. Motors shall be electric or pneumatic to match the type of temperature control system specified elsewhere in this Specification. Furnish all required relays, EP switches, wiring piping and other labor and material necessary to completely interconnect the smoke detector system.

H. Furnish each damper in a square or rectangular configuration. Furnish and install sleeves manufactured by the approved damper manufacturer for each damper. Construct sleeves with square or rectangular to square, rectangular, round, or oval adapters as required. Dampers shall be installed in the sleeves in accordance with manufacturer's U.L. installation instructions. The entire assembly, following installation, shall operate smoothly and be capable of withstanding 6 inch water gauge static pressure.

I. Each combination fire/smoke damper shall be equipped with a Damper Test Switch. The damper test switch will have the ability to "cycle test" the fire/smoke damper by pushing and holding the test button until the damper has cycled.

J. All combination fire/smoke dampers shall be dynamic type.

K. Completely seal the damper assembly to the building components using manufacturer recommended material(s).

2.06 SMOKE DAMPERS

A. Each smoke damper shall be dynamic rated type and shall be further classified by Underwriters Laboratories as a Leakage Rated Damper for use in smoke control systems under the latest version of UL555S, and bear a UL label attesting to same. Damper manufacturer shall have tested, and qualified with UL, a complete range of damper sizes covering all dampers required by this Specification. Testing and UL qualifying a single damper size is not acceptable. Leakage rating under UL555S shall be no higher than Leakage Class II (4 CFM per square foot at one-inch water gauge pressure and 8 CFM per square foot at 4 inches water gauge pressure). Maximum air pressure drop through each smoke damper shall not exceed 0.10-inch water gauge at the design air quantity. (Note that this may require a larger damper than the connected duct size.) All ratings shall be dynamic.

B. Damper frame shall be minimum 0.125-inch aluminum formed into a structural hat channel shape with corner braces for reinforcement, as approved in testing by Underwriters Laboratories. Bearings shall be stainless steel sleeve type turning in an extruded hole in the frame or an extruded frame raceway. Dampers shall be opposed blade type. Blades shall be airfoil shaped double skin construction. Blade edge seal material shall be silicone rubber designed to withstand 450 degrees F. Jamb seals shall be aluminum flexible metal compression type.

C. In addition to the leakage ratings specified herein, smoke dampers and their operators shall be qualified under UL555S to an elevated temperature of 350 degrees F. Pneumatic operators shall be installed by the damper manufacturer at the time of damper fabrication. Damper and operator shall be supplied as a single entity that meets all applicable UL555 and UL555S qualifications for both dampers and operators. Manufacturer shall provide factory-assembled sleeve. Sleeve shall be minimum 21-gage for dampers where neither width nor heights exceeds 48 inches or 16-gage where either dimensions equals or exceeds 48 inches.

D. As part of the UL qualification, dampers shall have demonstrated a capacity to operate (open and close) under HVAC system operation conditions, with pressures of at least 4 inches water gauge in the closed position, and 2000 fpm air velocity in the open position.

E. The damper must be operable while the temperature is above 350 degrees F. The actuator/operator package shall include two damper position indicator switches linked directly to damper blade to provide capability of remotely indicating damper position. One switch shall close when the damper is fully open, and the other switch shall close when the damper is fully closed. Position indicator switches shall be capable of interfacing electrically with the smoke detectors, building fire alarm systems, and remote indicating/control stations (BAS).

F. Motors for operation of smoke dampers shall be smoke system fail safe, spring return normally open supplies and normally closed returns, or as indicated on the Drawings, and shall be furnished and installed by the damper manufacturer as required by the UL rating mentioned above. Motors shall be (electric) or (pneumatic) to match the type of temperature control system specified elsewhere in this Specification. Furnish all required relays, EP switches, wiring piping and other labor and material necessary to completely interconnect the smoke detector system.

G. Furnish each damper in a square or rectangular configuration. Furnish and install sleeves manufactured by the approved damper manufacturer for each damper. Construct sleeves with square or rectangular to square, rectangular, round, or oval adapters as required. Install dampers in the sleeves in accordance with manufacturer's UL installation instructions. Entire assembly, following installation, shall operate smoothly and be capable of withstand 6 inch water guage static pressure.

H. Each smoke damper shall be equipped with a Damper Test Switch. The damper test switch will have the ability to "cycle test" the smoke damper by pushing and holding the test button until the damper has cycled.

I. All smoke dampers shall be dynamic type.

J. Completely seal the damper assembly to the building components.

2.07 FLEXIBLE CONNECTIONS

A. Where ducts connect to, flexible connections shall be made using "Flexmaster TL-M" or "Ventglas" fabric that is temperature-resistant, fire-resistant, waterproof, mildew-resistant and practically airtight, weighing approximately thirty ounces (30 oz.) per square yard. Ventglas is good for connections for inside building environments where ultra-violet light is not present.

B. Material used outdoors shall be resistant to ultra-violet sunrays. There shall be a minimum of one-half inch (1/2-inch) slack in the connections, and a minimum of two and one-half inches (2-1/2-inch) distance between the edges of the. This does not apply to air handling units with internal isolation. A more rugged flexible material that is resistant to ultra violet rays needs to be used when connecting an exhaust fan or exhaust air plenum to ductwork. Mercer Rubber supplies a more durable flex connection for outdoor use.

C. Connections to Chemical Fume Hoods

1. Flexible connections shall be made using a coupling with stainless steel bands as manufactured by Fernco, Inc.

2.08 ACCESS DOORS

A. Furnish and install in the ductwork, hinged rectangular, pressure relief, or round "spin-in" access doors to provide access to all fire dampers, mixed air plenums, steam reheat coils (install upstream), automatic dampers, etc.

B. Where ductwork is insulated, access doors shall be double skin doors with one inch (1") of insulation in the door.

C. Where duct size permits, doors shall be eighteen inches (18") by sixteen inches (16"), or eighteen inches in diameter, and shall be provided with Ventlok No. 260 latches (latches are not required in round doors).

D. Latches for rectangular doors smaller than 18 inch x 16 inch shall be Ventlok No. 100 or 140.

E. Doors for zone heating coils shall be Ventlok, stamped, insulated access doors, minimum 10 inch x 12 inch, complete with latch and two (2) hinges, or twelve inches (12") in diameter.

F. Round access doors shall be "Inspector Series" spin-in type door as manufactured by Flexmaster USA.

G. Doors for personnel access to ductwork shall be nominal twenty-four inches (24") in diameter. Doors may be fabricated in a local approved sheet metal shop in accordance with SMACNA Standards.

H. Where access doors are installed above a suspended ceiling, this Contractor shall be responsible for the proper location of ceiling access doors.

~~2.09SCREENS~~

~~A.Furnish and install screens on all duct, fan, etc., openings furnished by this Contractor which lead to, or are located outdoors.~~

~~B.Screens shall be No. 16 gage, one-half inch (1/2") mesh in removable galvanized steel frame.~~

~~C.Provide safety screens meeting OSHA requirements for protection of maintenance personnel on all fan inlets and fan outlets to which no ductwork is connected.~~

~~2.10GUY WIRE SYSTEM~~

~~A.Provide 1/4-inch diameter American Aircraft Steel Cable (plastic coated) with clip for vertical stack off utility fans on roof, with eyebolts for attachment to anchor systems on the roof.~~

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. All installation shall be in accordance with manufacturer's published recommendations.

C. Provide balancing dampers at points on low pressure supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing.

D. Provide all dampers furnished by the BAS Provider in strict accordance with manufacturer's written installation instruction and requirements of these Specifications.

E. Provide fire dampers, and combination fire and smoke dampers at locations indicated, where ducts and outlets pass through fire rated components. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.

1. Instructions to A/E and Contractor:

a. Fire dampers, smoke dampers and combination fire smoke dampers should not be installed where ducts pass through non fire/smoke rated architectural or structural components. Remove all fire and smoke dampers and combination fire smoke dampers from non-fire rated structural architectural or structural.

F. Provide backdraft dampers on exhaust fans or exhausts ducts where indicated. Install dampers so that they will open freely.

G. Flex connectors are not required at equipment with internally isolated fans. Cover connections to medium and high pressure fans with leaded vinyl sheet, held in place with metal straps where noted on the Owner's drawings.

H. Provide duct access doors for inspection and cleaning before and after duct mounted filters, coils, fans, automatic dampers, at fire dampers, and elsewhere as indicated on Drawings. Provide minimum 8 x 8 inch (200 x 200 mm) size for hand access, 18 x 18 inch (450 x 450 mm) size for shoulder access, and as indicated.

I. Provide duct test holes where indicated and where required for testing and balancing purposes.

1. Furnish and install Ventlok No. 699 instrument test holes in the return air duct and in the discharge duct of each fan unit.

2. Install test holes in locations as required to measure pressure drops across each item in the system, e.g., outside air louvers, filters, fans, coils, intermediate points in duct runs, etc.

J. Access doors as specified elsewhere shall be provided for access to all parts of the fire and combination fire and smoke dampers. Doors shall open not less than 90 degrees following installation and shall be insulated type where installed in insulated ducts.

K. Install each fire and combination fire and smoke damper square and true to the building. The installation shall not place pressure on the damper frame, but shall enclose the damper as required by UL555 and UL555S.

3.02 TESTING

A. After each fire damper, smoke damper and combination fire and smoke damper has been installed and sealed in their prescribed openings and prior to installation of ceilings, Contractor shall, as directed by Owner, activate part or all dampers as required to verify "first-time" closure.

B. Activation of damper shall be accomplished by manually operating the resettable link, disconnecting the linkage at the fire damper fusible link, and manually operating the fire/smoke damper through the pneumatic or electronic controls as appropriate.

C. Failure of damper to close properly and smoothly on the first attempt will be cause to replace the entire damper assembly.

D. Coordinate smoke damper system interlock requirements with the fire alarm system.

END OF SECTION 23 33 00

SECTION 23 33 19 – SOUND ATTENUATORS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 SUMMARY

A. Perform all Work required to provide and install the following sound attenuators indicated by the Contract Documents with supplementary items necessary for proper installation.

1. Silencers.

~~2.Attenuators.~~

~~3.~~**2.** ~~Acoustic housings~~.

~~4.~~**3.** Ductwork lagging.

1.03 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. Conform to applicable code for sound levels at Project property line.

D. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:

1. AMCA 300 - Test Code for Sound Rating.

2. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data.

3. AMCA 302 - Application of Sound Loudness Ratings for Non-Ducted Air Moving Devices.

4. AMCA 303 - Application of Sound Power Level Ratings for Ducted Air Moving Devices Recommended Typical dBa Calculation.

5. AMCA 1011 - Certified Ratings Program Acoustical Duct Silencers.

6. ANSI S1.13 - Methods for Measurement of Sound Pressure Levels.

7. ARI 270 - Sound Rating of Outdoor Unitary Equipment.

8. ARI 575 - Measuring Machinery Sound Within Equipment Rooms.

9. ASA 16 (ANSI S1.36) - Survey Methods for Determination of Sound Power Levels of Noise Sources.

10. ASA 29 (ANSI S1.29) - Measurement and Designation of Noise Emitted by Computer and Business Equipment.

11. ASA 47 (ANSI S1.4) - Specification for Sound Level Meters.

12. ASA 49 (ANSI S12.1) - Preparation of Standard Procedures to Determine the Noise Emission from Sources.

13. ASA 61 (ANSI S12.10) - Computer and Business Equipment.

14. ASHRAE 68 - Method of Testing In-Duct Sound Power Measurement Procedure for Fans.

15. ASHRAE Handbook - Systems Volume, Chapter "Sound and Vibration Control".

16. ASTM E90 - Method for Laboratory Measurement of Airborne Sound Transmission of Building Partitions.

17. ASTM E477 – Method of Testing Duct Liner Materials and Prefabricated Silencers for Acoustical and Airflow Performance.

18. ASTM E596 - Method for Laboratory Measurement of the Noise Reduction of Sound Isolating Enclosures.

19. SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

1.04 QUALITY ASSURANCE

A. Perform Work in accordance with ASA 61 (ANSI S12.10) standards and recommendations of ASHRAE 68.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this Section with minimum three (3) years documented experience.

C. Design application of duct silencers or acoustic housings under direct supervision of a Professional Engineer experienced in design of this Work and licensed in the State of Texas.

D. Performance Requirements:

1. Performance requirements of silencers shall be required to meet discharge sound power levels specified by acoustical consultant and as indicated on equipment schedules.

2. Static pressure drop shall not exceed that indicated in equipment schedules.

3. External liner shall be factory-tested air–tight to a positive static pressure equal to 2 inches w.g above air handling unit rating or the rating of attached ductwork or a maximum of 12 inches w.g.

4. Maintain sound level of spaces at levels not to exceed those listed below by utilizing acoustical devices as required to achieve specified sound levels.

5. Maintain rooms at following maximum sound levels, in Noise Criteria (NC) as defined by ASHRAE Handbook and ANSI S1.8:

a. Offices:

Executive	30
Conference Rooms	30
Private	35
Open-Plan Areas	40
Computer/Business Machine Areas	45
Public Circulation	45

b. Patient Care and Research:

Private Rooms	35
Wards	35
Operating Rooms	30
Laboratories	40
Corridors	40
Public Areas	40
Libraries	30
Lecture Theaters	30
Training Rooms	35
Research Laboratories	45
Animal Rooms	45

1.05 SUBMITTALS

A. Record Documents:

1. Submit Shop Drawings and product data that indicate the size, type, performance and certified test reports from a nationally known qualified independent testing laboratory corroborating the catalogue performance. Test reports shall be based on a 24 inch x 24 inch cross sectional area of each type and model required for this Project.

B. Operation and Maintenance Data:

1. Manufacturer's Installation Instructions: Indicate installation requirements that maintain integrity of sound isolation.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

B. Fabricate products in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.

C. Acoustical Fill Material:

1. Acoustical fill materials shall consist of inorganic mineral or glass fiber of a density required to obtain the specified acoustic performance and packed under not less than 5 percent compression to eliminate voids due to vibration and settling.

2. Material shall be inert, vermin and moisture proof, and impart no odor into the air.

3. The incombustible acoustical filler material shall exhibit not more than the following fire hazard classification values when tested in accordance with the Standard ASTM E-84, or UL 723 test method:

a. Flame Spread: 25.

b. Smoke Developed: 50.

2.02 MANUFACTURERS

A. Duct Silencers:

1. Industrial Acoustics.

2. Commercial Acoustics.

3. Ruskin Sound Control.

4. United McGill.

5. Vibro-Acoustics.

2.03 DUCT AND AIR HANDLING SILENCERS

A. Description:

1. Duct section with sheet metal outer casing, sound absorbing fill material, with Mylar cover, and inner casing of perforated sheet metal; incorporating interior baffles of similar construction.

B. Configuration:

1. Tubular with inner casing and liner, with absorptive aerodynamically shaped center body with nose cone and truncated tail cone.

2. Rectangular with line splitters with radiused nose cone and contoured tails, modular.

C. Materials:

1. Outer Casing: Minimum 22 gage thick galvanized steel stiffened as required, with [welded seams] [mastic filled lock formed], 2 inch long, 11 gage slip joints on both ends.

2. Inner Casing and Splitters: Minimum 24 gage thick, perforated galvanized steel.

3. Fill: Glass fiber or mineral wool of minimum 4-lb./cu ft. density.

D. Fill Liner: 1 mil Mylar film.

2.04 RETURN AIR SOUND ATTENUATORS

A. Description:

1. Duct sections with sheet metal outer casing, sound absorbing fill material and inner casing of perforated sheet metal incorporating interior baffles of similar construction.

B. Configuration:

1. Rectangular, lined with inner casing with splitters with radiused nosed and contoured tails. Mylar covering inside and extend over around the edge, and sealed with no exposure.

C. Materials:

1. Outer Casing: Minimum 22 gage thick galvanized steel with welded seams, 3-inch long, 11 gage slip joint on both ends.

2. Inner Casing and Splitters: Minimum 24 gage thick perforated galvanized steel.

3. Fill: Glass fiber of minimum [4 lb./cu ft (64 kg/cu m)] [3 lb./cu ft (48 kg/cu m)] density.

4. Fill Liner: 1 mil (0.0254 mm) Mylar film.

~~2.05EXHAUST FAN INLET SOUND ATTENUATORS~~

~~A.Description:~~

~~1.Packless type. Duct section with sheet metal outer casing, and inner casing of perforated sheet metal; incorporating interior baffles of similar construction.~~

~~B.Configuration:~~

~~1.Rectangular with lined splitters with radiused nose and contoured tails.~~

~~C.Materials:~~

~~1.Vivarium Exhaust System:~~

~~a.Outer casing: Minimum 22 gage thick type 304 stainless steel, stiffened as required, with welded seams, 2 inch long, 11 gage slip joints on both ends.~~

~~b.Inner casing and splitter: Minimum 24 gage thick perforated, Type 304 stainless steel.~~

~~c.Fill: None.~~

~~2.All Other Exhaust Systems:~~

~~a.Outer casing: Minimum 22 gage thick galvanized steel, stiffened as required, with welded seams, 2 inch long, 11 gage slip joints on both ends.~~

~~b.Inner casing and splitter: Minimum 24 gage thick perforated galvanized steel.~~

~~D.Fill: Glass fiber of minimum [4 lb./cu ft (64 kg/cu m)] [3 lb./cu ft (48 kg/cu m)] density.~~

~~2.06~~**2.05** SUPPLY AIR TERMINAL SOUND ATTENUATORS

A. Description:

1. Packless type. Duct section with sheet metal outer casing, sound absorbing fill material, and inner casing of perforated sheet metal; incorporating interior baffles of similar construction.

B. Configuration:

1. Rectangular with lined splitters with radiused nose and contoured tails.

C. Materials:

1. Outer casing: Minimum 22 gage thick galvanized steel, stiffened as required, with [mastic filled] [welded] seams, 2 inch long, 11 gage slip joints on both ends.

2. Inner casing and splitter: Minimum 24 gage thick, perforated galvanized steel.

3. Packless type silencers shall have no acoustical fill media, no fabric material, and no Mylar material inside perforated partitions.

~~2.07~~**2.06** EXHAUST AIR TERMINAL SOUND ATTENUATORS – FUME HOODS, BIOSAFETY CABINETS, AND VIVARIUM BIOHAZARD EXHAUST

A. Description:

1. Packless type. Duct section with sheet metal outer casing and inner casing of perforated sheet metal; incorporating interior baffles of similar construction.

B. Configuration:

1. Rectangular with lined splitters with radiused nose and contoured tails.

C. Materials:

1. Outer casing: Minimum 22 gage thick type 304 stainless steel, stiffened as required, with welded seams, 2 inch long, 11 gage slip joints on both ends.

2. Inner casing and splitter: Minimum 24 gage thick perforated type 304 stainless steel.

3. Fill: None allowed.

~~2.08~~**2.07** EXHAUST AIR TERMINAL SOUND ATTENUATORS – LAB GENERAL EXHAUST, VIVARIUM GENERAL EXHAUST

A. Description:

1. Duct sections with sheet metal outer casing, sound absorbing fill material and inner casing of perforated sheet metal incorporating interior baffles of similar construction.

B. Configuration:

1. Rectangular with lined splitters with radiused nose and contoured tails.

C. Materials:

1. Outer casing: Minimum 22 gage thick galvanized steel, stiffened as required, with [mastic filled lock formed] [welded] seams, 2 inch long, 11 gage slip joints on both ends.

2. Inner casing and splitter: Minimum 24 gage thick perforated galvanized steel.

3. Fill: Glass fiber of minimum [4 lb./cu ft (64 kg/cu m)] [3 lb./cu ft (48 kg/cu m)] density.

4. Erosion Protection Liner: Not required.

~~2.09CROSS-TALK SILENCERS~~

~~A.Description:~~

~~1.Duct sections with sheet metal outer casing, sound absorbing fill material and inner casing of perforated sheet metal, incorporating interior baffles of similar construction.~~

~~B.Configuration:~~

~~1.Rectangular, lined, inner casing, splitters with radiused nosed and contoured tails.~~

~~C.Materials:~~

~~1.Outer Casing: Minimum 22 gage thick galvanized steel with [mastic filled lock formed] [welded] seams, 3 inch long, 11 gage slip joint on both ends.~~

~~2.Inner casing and splitter: Minimum 24 gage thick, perforated galvanized steel.~~

~~3.Fill: Glass fiber of minimum [4 lb./cu ft (64 kg/cu m)] [3 lb./cu ft (48 kg/cu m)] density.~~

~~4.Fill Liner: [Bounded glass fiber.] [1 mil Mylar film.]~~

~~2.10ACOUSTIC HOUSINGS~~

~~A.Description:~~

~~1.Modular panels, including access doors and windows nominal 4 inches thick, with outer and inner casing.~~

~~B.Materials:~~

~~1.Outer Casing: Outer Casing: Minimum [22 gage] [18 gage] thick galvanized steel stiffened as required, with [mastic filled lock formed] [welded] seams for [internal flange butt] [covering strip butt over], 3 inch long, 11 gage slip joint on both ends.~~

~~2.Inner Casing and Splitters: Minimum 22 gage thick perforated galvanized steel.~~

~~3.Fill: Glass fiber or mineral wool of minimum [4 lb/cu ft] [4-3/4 lb/cu ft] density.~~

~~4.Fill liner: [bounded glass fiber matting] [1 mil Mylar film].~~

~~5.Window: Doubled glazed with ¼ inch safety glass.~~

~~2.11~~**2.08** DUCTWORK LAGGING

A. Acoustic Insulation: 2 inch thick, 3 to 5 lb/cu ft density glass fiber or mineral wool.

B. Covering: Gypsum board with surface weight minimum 4 lb/sq ft.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. All installation shall be in accordance with manufacturer's published recommendations.

C. Support duct silencers with ductwork. Refer to Sections 23 31 00 and 23 33 00.

~~D.Install cross-talk silencers in wall with wall penetrations caulked.~~

~~E.~~**D.** Lag ductwork, where indicated by wrapping with insulation and covering. Apply covering to be airtight. Do not attach covering rigidly to ductwork.

~~F.~~**E.** Attach ductwork to acoustic louvers with flexible duct connections. Refer to Section 23 33 00.

~~G.Furnish and install prefabricated silencers in ductwork systems inside air handling units where shown on Drawings.~~

3.02 TESTING

A. Acoustical testing shall be determined by the "duct to a reverberation room", as recommended by SIW 42 Subcommittee of the American National Standards Institute. Test shall be run with air flowing through the silencer at not less than three (3) different flow rates and also at zero (0) flow. All ratings shall be based on test data from a nationally known, qualified, independent testing laboratory.

B. Test methods shall eliminate effects due to end reflection vibration flaring transmission and standing waves in the reverberant room. Air flow and pressure loss data shall be taken in accordance with AMCA 1011, and the data shall be obtained from the same silencer used for acoustical performance test.

C. Static pressure drop shall not exceed that indicated in equipment schedules on Drawings.

END OF SECTION 23 33 19

SECTION 23 36 00 – AIR TERMINAL UNITS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 SUMMARY

A. Perform all Work required to provide and install the following products as indicated by the Contract Documents with supplementary items necessary for proper installation.

1. Single duct variable or constant volume terminal units.

2. Dual duct variable or constant volume terminal units.

3. Fan powered constant volume terminal units.

4. Integral heating coils.

5. Integral controls.

6. Integral sound attenuator.

1.03 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:

1. NFPA 90A - Installation of Air Conditioning and Ventilation Systems.

2. UL 181 - Factory-Made Air Ducts and Connectors.

3. ARI Standard 880 for Air Terminals.

4. ANSI/ASHRAE Standard 130 – Methods of Testing for Rating Ducted Air Terminal Units.

1.04 SUBMITTALS

A. Product Data:

1. Shop Drawings of product data indicating configuration, general assembly, access space required for service, and materials used in fabrication.

2. Electronic or Printed Catalog performance ratings that indicate nominal inlet size, CFM, applicable static pressure at the inlet or discharge of terminal unit, and noise criteria with sound octave band and sound decibel test in accordance with ARI 880, for the insulation lining selected.

3. Leakage curves indicating inlet static pressure and actual tested leakage rates shall be submitted for all non-standard or custom-built terminal units.

4. Unit manufacturer shall test and certify that each terminal unit used on this Project has been tested as specified.

B. Record Documents:

1. Submit under provision of Division 01.

C. Operation and Maintenance Data:

1. Operating instructions and maintenance manuals indicating maintenance and repair data, parts lists.

D. Sample Units:

1. One sample, 8 inch size, production run unit of each type shall be submitted for examination and approval by the Engineer, Owner, and TAB Firm.

2. This sample unit shall be submitted in addition to the required written submittal, well in advance of any requirement for installation of units, but absolutely no later than 60 calendar days after the Notice to Proceed with Construction.

3. Contractor shall allow a minimum of three (3) weeks for testing of the sample unit from the time shipped to the TAB Firm. The TAB Firm will test single duct terminal for casing leakage, damper leakage, and the specification requirements. The fan powered terminal will be tested for damper leakage, airflow tracking from minimum primary to maximum primary, discharge pressures from 0.25 inches w.c. to 0.6 inches w.c. with three different airflows (maximum, midpoint, and minimum). The fan powered terminal must maintain its downstream airflow ±5 percent. The fan powered terminal will be observed to maintain the Specification requirement. This period shall restart if the sample unit is rejected and another unit is resubmitted.

4. If rejected for any reason, Contractor shall expedite the documented corrections and shall resubmit a sample unit as soon as possible.

5. Any delay in submittal of the unit for approval shall not be grounds for Contractor's claim of delay. If approved, the unit shall remain in the possession of the Owner at the Project Site for comparison with units as shipped to the Project.

6. Unit(s) shall be installed in the Project, at an accessible, marked location.

1.05 SHIPMENT TESTING PRIOR TO INSTALLATION

A. Shipment Testing: At the Owner's discretion, a minimum of ten (10) percent of each size single duct terminal unit (but no less than one unit of each size on the Project) will be tested at the Project Site for casing leakage and damper leakage. Fan powered terminals units will be tested for damper leakage and for conformance to this Specification. Contractor shall allow sufficient time during construction for the TAB Firm to perform all testing as may be required.

B. Unit Non-Performance:

1. If results of the shipment testing show that any of the units do not perform as specified, then an additional ten (10) percent of each size unit (but no less than one unit of a size, unless 100 percent of the size has been tested) shall be tested.

2. If this testing, in the Owner's opinion, shows that ten (10) percent or more of the units tested do not perform as specified, then 100 percent of all unit sizes shall be tested for conformance with these Specifications.

3. The results of that testing shall be reviewed carefully between the Contractor, manufacturer, Owner, and Engineer. A method of repair or replacement of units will be negotiated. The Owner, however, shall maintain the right of final approval of any proposed solution.

C. Should for any reason, the testing as described in this Section prove that any of the units do not perform as specified, Contractor shall be responsible for all subsequent labor, travel, travel expenses and incidental expenses, penalties, or other costs attendant to any additional testing as described in this Section, or as required to prove that the units perform as specified. This shall include, but not be limited to, the labor, travel and reasonable incidental expenses of not only the Contractor and TAB Firm, but also those incurred by the Owner as may be specifically required for this purpose.

1.06 WARRANTY

A. Provide one year manufacturer's warranty under provisions of Division 01.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.02 MANUFACTURERS

A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum three (3) years documented experience.

B. The same manufacturer shall provide all products supplied and/or installed under this Section.

C. Manufacturers:

~~1.Nailor Industries.~~

~~2.~~**1.** Titus.

~~3.~~**2.** Krueger.

~~4.~~**3.** Metal Aire.

~~5.~~**4.** Price.

~~6.~~**5.** Trane.

2.03 GENERAL CONSTRUCTION

A. This section applies to single duct, dual duct, and fan powered terminal unit configurations as described within this Specification.

B. Casing Construction:

1. Units shall be constructed of 20 gage galvanized steel.

2. All interior features of the boxes (such as mixing baffles, damper housings, etc.) shall be secured within the casing to avoid excessive movement or rattling with air movement or externally generated vibration.

3. All external features of the terminal units shall be designed not to extend beyond the ends of the unit. For example, the actuator mounting brackets, etc. shall not extend beyond the plane of the inlet "bulkhead." The only exception shall be flow sensors installed in the inlet duct connections. Note that if a separate flow station is installed within a frame within the casing, then it shall be so installed not to allow airflow to bypass the flow measurement station.

C. Ductwork Connections:

1. Construct units with inlet and discharge ductwork connections. The inlet ductwork connections shall extend a minimum of 4 inches from the unit casing including an allowance for the installation of airflow station(s) or probe(s).

2. The discharge connection shall include flange connection for use by the Contractor to secure the discharge ductwork or appurtenances to the unit and shall be reinforced to provide a rigid assembly.

3. External insulation shall be as specified in the Contract Documents for duct insulation with full vapor barrier.

D. Single Duct Casing Leakage: Assembled units shall be constructed such that casing leakage does not exceed 1.0 percent of terminal unit rated airflow at 4 inches w.g. of inlet static pressure.

E. Casing Liners:

1. Liners for Administrative and Non-Critical Patient Care and Laboratory Applications:

a. Terminal unit casing shall lined with a 4 lb density, rigid board, non-porous insulation with reinforced foil covering that does not support bacterial or fungal growth. Liner shall be attached to the unit casing by insulation adhesive and full-seam-length Z-strips to enclose and seal the insulation cut edges.

b. Insulation shall meet requirements of UL181 and NFPA 90A, and achieve an equivalent R value of 4.

c. Edges and seams shall be sealed or "captured" using sheet metal, formed to hold the insulation. Insulation shall be neatly installed with no rough edges to interrupt the smooth flow of air through the unit.

d. Casing shall be insulated throughout its interior.

~~2.Liners for Critical Patient Care Applications (Doublewall):~~

~~a.Terminal unit casing shall be double wall lined with 1-inch thick, 1.5 lb density fiberglass insulation enclosed between the unit casing and a non-perforated, internal sheet metal cover. The interior wall cover shall be 22 gage galvanized steel. The interior wall cover shall extend over the fiberglass insulation and cover the liner cut edges. The exterior cover shall be 20 gage galvanized steel.~~

~~b.Insulation shall meet requirements of UL181 and NFPA 90A.~~

~~c.Casing shall be insulated throughout its interior.~~

~~d.Critical Patient Care Applications include, but are not limited, to the following:~~

~~1)All inpatient rooms, including airborne infection isolation rooms and protective environment rooms.~~

~~2)All operating and procedure rooms.~~

~~3)Surgery prep and post-anesthesia care units (PACU), recovery rooms.~~

~~4)Laboratories not being served by laboratory air valves.~~

F. Damper:

1. Damper blades shall be minimum 18 gage galvanized steel or equivalent aluminum and shall be securely riveted or bolted through the damper shafts to assure no slippage of the blades. The damper shafts shall operate in rustproof self-lubricating bearings. Damper shafts penetrating the unit casings shall be sealed against leakage and bearings shall be installed for protection against wear in the casing penetration. Damper shafts shall be formed of, or cut from solid stock; no hollow shafts will be allowed. The dampers shall seat against gasketed stops or the dampers shall have gasketed edges. The dampers shall be constructed with the proper rigidity to prevent deformation of the damper blade. The damper actuator linkage, if used, shall be constructed of material of sufficient strength to avoid buckling under extreme loads. Also, linkages shall not allow play greater than 5 degrees of damper movement. The controls for the dampers shall cause the dampers to fail in the position of last control (freeze in place), or fail to the open position.

2. Damper Leakage: Units shall be tested for inlet leakage with 4 inches w.g. static pressure imposed. The maximum percent leakage from all tests shall be reported. The following table provides the maximum allowable damper leakage for the various size diameter inlets at 4 inches w.g. differential pressure.

INLET DIAMETER (INCHES)	MAXIMUM ALLOWABLE CFM (AREA X 2000 FPM)	MAXIMUM ALLOWABLE CFM DAMPER LEAKAGE
6	393	6.0
8	698	11.0
10	1091	17.0
12	1571	20.0
14	2138	30.0

3. Flow Measurement: Airflow through the unit shall be accomplished by the use of a multi-port velocity pressure cross sensor or multi-axis flow ring devices with a minimum of four (4) radial distribution pick-up points connected to a center averaging chamber. The chamber is to be designed with adequate internal passages to prevent restrictions that can possibly contribute to control 'hunting'. Calibration of each terminal unit with the building automation system (BAS) Provider's controller is to be performed by the manufacturer prior to shipping the terminal unit to the Project Site.

4. [Thermal Anemometry: Terminal Unit Velocity Sensors (Applicable only to a Single Point Probe): The probe shall utilize thermal anemometry as the sensing technique. Velocity range shall be 0 to 3250 feet per minute (fpm) and with an installed accuracy of ± 25 fpm. The velocity probe shall include an insertion type-mounting bracket that mounts flush to the supply duct. The velocity probe shall be mounted parallel to the damper shaft with 1/3 or 2/3 penetration into the duct. The velocity probe shall be mounted a minimum of two duct diameters upstream of the terminal inlet for the pneumatic system. For the BAS, both sensors shall be mounted immediately upstream of the terminal unit.]Electronic probes shall be temperature compensated.

G. Access Plenum:

1. Single duct units with hot water coils shall be provided with an access section or plenum between the single duct terminal and the coil for coil inspection. Plenum construction shall be equal to the quality of materials and workmanship of the terminal unit.

2. Access plenum may also be used as a transition. Construct with a transition angle not to exceed 15 degrees.

3. Access plenum shall contain a minimum of a 12 inch diameter or 12 inch x 12 inch (or full unit width if less than 12 inches) access door as specified in Section 23 33 00.

4. Door frame may be bolted, screwed, or flanged and sealed to the casing. Door shall be gasketed and shall be doublewall construction or insulated similar to main casing. Door shall be held in place with latches or other captive retainer devices.

H. Hot Water Heating Coil:

1. Hot water coils installed in conjunction with terminal units as scheduled on the Drawings shall be factory installed having one or two tube rows and a maximum of 10 aluminum fins per inch. Airside pressure drop shall be limited to 0.2 inches w.g. at unit rated cold airflow water pressure drop shall not exceed five feet water gauge. Construct and test coils in accordance with UL and/or ARI Standards.

2. Provide full fin collars for accurate fin spacing and maximum fin-to-tube contact. Tubes shall be ½ inch diameter seamless copper with minimum wall thickness of 0.015 inches, leak tested at 300 psig air pressure under water.

3. Provide male sweat-type water connections.

4. Side and end plates shall be minimum 20 gage galvanized sheet metal construction.

5. Protect tube ends with tube end caps of sheet metal similar to casing material. Insulate within the caps. Contractor shall insulate tube sheets and coil casings in same manner as adjacent ductwork.

6. Electric Heating Coil: Electric heating coils installed in conjunction with terminal units as scheduled on the Drawings shall be factory-installed. Heaters shall be UL listed for zero clearance and meet all applicable requirements of the NEC. Resistance wire shall be 80 percent nickel and 20 percent chromium. Furnish heater with airflow switch, SCR power to heating elements or magnetic contactors, fan relay, control voltage transformer, high limit thermal cut-out, and a NEMA 1 electrical enclosure.

I. Unit Controls:

1. General Performance: Flow stations, control transformers, disconnect switch, and controls enclosure shall be furnished, mounted and adjusted by the terminal unit manufacturer to assure their proper placement within the units. If DDC controls of another manufacturer (not the terminal unit manufacturer) are provided for the Project, the terminal unit manufacturer shall be responsible only for construction of the terminal unit and installation of internal control components installed at the manufacturer's factory and shall not be responsible for installation of controls not installed at the terminal unit manufacturer's factory, nor shall the manufacturer be responsible for the performance of the DDC controls. The performance of DDC controls in connection with terminal units shall be the responsibility of the BAS Provider.

2. Control Performance: Assemblies shall be able to be reset to any airflow between zero and the maximum CFM shown on Drawings. To allow for maximum future flexibility, it shall be necessary to make only simple screwdriver or keyboard adjustments to arrange each unit for any maximum airflow within the ranges for each inlet size as scheduled on the Drawings. The control devices shall be designed to maintain the desired flow regardless of inlet flow deflection.

3. Control Sequences: The control sequence arrangements shall be as described on the Drawings. Terminal units shall be shipped from the manufacturer with all necessary control devices to accomplish each sequence, except as may be prohibited by the BAS Provider. The desired sequence shall be adjustable according to space usage or a change in space conditions.

J. DDC Controls Protocol/Description:

1. BAS Provider will be responsible for providing all damper actuators, linkages, flow transducers, controllers, room temperature sensors, and any other devices required for unit control, except as specified below.

2. BAS Provider will be responsible for calibrating the actuator and its controller through TAB work for scheduled airflow rates. Units shall be capable of field calibration and readjustment with external gauge taps.

3. Unit manufacturer shall provide unit inlet flow sensor and pneumatic tubing for BAS Provider's use.

4. Unit manufacturer shall factory install all devices furnished by BAS Provider to result in a complete functioning unit. Unit manufacturer shall be responsible for reviewing compatibility of devices furnished by BAS Provider to units provided.

K. Pressure and Leakage Certification:

1. Manufacturer shall certify that each unit used on the Project will perform as specified. Each unit shall bear a tag or decal listing the following specified information:

a. Test pressure.

b. Leakage CFM (damper).

c. Leakage CFM (casing except fan-powered units).

d. Date of manufacture.

e. Name of person performing test.

2.04 SINGLE DUCT VARIABLE OR CONSTANT VOLUME TERMINAL UNIT

A. Pressure independent, single duct variable or constant air volume control assemblies with integral attenuator, of the sizes, capacities and configurations as scheduled on the Drawings.

B. Unit pressure drop across the assembly with an equivalent 2000 fpm inlet velocity through the inlet shall not exceed 0.15 inches water gauge.

C. Sound Ratings: All sound power levels shall be obtained from testing in accordance with ARI Standard 880.

~~2.05DUAL DUCT VARIABLE OR CONSTANT VOLUME TERMINAL UNITS~~

~~A.Pressure independent, dual duct variable or constant air volume control assemblies with attenuator-mixers of the sizes, capacities and configurations as scheduled on the Drawings.~~

~~B.Unit Pressure Drop: For dual duct units with an integral attenuator-mixer, but with no other accessories, the static pressure across the assembly with an equivalent 2000 fpm inlet velocity through one inlet shall not exceed 0.50 inches water gauge, with the total flow through either inlet.~~

~~C.Mixing:~~

~~a.Dual duct terminal units as specified herein shall provide mixing within the units and not rely upon the discharge ductwork to provide for completion of the mixing process.~~

~~b.The horizontal average temperature of the air as it leaves the terminal unit shall not vary more than 1 degree F for each 10 degrees F of temperature difference between the two inlet air supplies.~~

~~1)For example, if the cold supply air is 55 degrees F and the hot supply air is 95 degrees F, the difference is 40 degrees. The allowable temperature variation of the discharge air is, thus, 4 degrees F.~~

~~c.The temperature of the discharge air shall be measured using a pattern of four (4) vertical, evenly spaced columns and three horizontal, evenly spaced rows.~~

~~d.The rows and columns shall be spaced so that the resulting 12 points shall be at the centers of equal areas. The plane of the points shall be perpendicular to the direction of airflow, within four (4) inches of the discharge of the terminal unit, within the discharge ductwork. The three readings in each column shall be averaged to determine compliance with the 1 degree F criteria.~~

~~2.06FAN POWERED CONSTANT VOLUME TERMINAL UNITS~~

~~A.Pressure independent, series fan-powered, constant volume terminal units with primary variable air volume damper that controls primary air quantity in response to a temperature control signal. Units shall be of the sizes, capacities and configurations as scheduled on the Drawings.~~

~~B.Assembly: Units shall be designed and built as a single unit with variable volume controls, heating coils, equipped with power circuit fusing, and disconnect switch. Terminal units equipped with electric heating coils shall have separate fused and disconnect electrical power circuits. Provide a filter rack with a 1-inch thick throwaway filter to be used during the Project construction phase. Replace filter with new filter prior to Owner acceptance.~~

~~C.Fan Assembly:~~

~~1.Forward curved centrifugal type fan of metal construction. Motor shall be General Electric ECM DC brushless; no exceptions. Motor must be complete with and operated by a single phase integrated controller/inverter that operates the wound stator and senses rotor position to electrically commutate the stator. All motors must be designed for synchronous rotation. Motor rotor must be permanent magnet type with near zero rotor losses. Motor must have built in soft start and soft speed change ramps. Motor must be able to be mounted with shaft in horizontal or vertical orientation. Motor must be permanently lubricated with ball bearings. Sleeve bearings will not be acceptable. Motor shall be direct coupled to the blower. Motor must maintain a minimum of 70 percent efficiency over its entire operating range.~~

~~2.Terminal unit manufacturer must set the fan CFM at the factory. Fan CFM must be constant within +/-5 percent regardless of changes in static whether upstream or downstream of the terminal unit after it is installed. Fan CFM shall be set with a potentiometer. Neither SCRs nor rheostats are acceptable means of setting fan CFM. A speed adjustment device must be included with the motor for field adjustment should construction or design changes become necessary.~~

~~3.Internally suspend and isolate fan/motor assembly from casing on rubber isolators to prevent noise and vibration transmission from the fan/motor assembly to the casing.~~

~~4.Provide fan/motor assembly with a service life of 15 years.~~

~~5.Provide non-overloading type system with fan/motor assembly sized to supply all downstream static pressure requirements.~~

~~6.The unit casing shall have a bottom access panel which allows removal of fan/motor assembly and servicing of all interior components without disturbing duct connections.~~

~~D.Wiring:~~

~~1.Factory mounts and wires controls. Mount electrical components in control box with removable cover. Incorporate single point electrical connection to power source.~~

~~2.Provide an appropriately sized [120] [277] volt control power 24 VAC transformer and terminal strip in control box for field wiring of controls and power source. Factory mounts the transformer on electronically controlled terminal units. Contractor shall inform terminal manufacturer of the primary voltage in order to provide the correct step down control transformer.~~

~~3.Factory wire fan to terminal strip.~~

~~4.Provide factory installed disconnect switch.~~

~~E.Sound Performance Criteria:~~

~~1.The following chart reflects maximum allowable radiated sound power level for fan powered terminal units.~~

~~2.All sound power levels shall be obtained from testing in accordance with ARI Standard 880.~~

~~Single Wall Unit Fan Powered Unit~~			~~Maximum Radiated Sound Power Level (dB) at Band Number and Center Frequency (Hz)~~					
~~Unit Size~~	~~Inlet Diameter~~	~~Fan and 100% Primary CFM~~	~~2 125~~	~~3 250~~	~~4 500~~	~~5 1,000~~	~~6 2,000~~	~~7 4,000~~
~~4~~	~~8~~	~~250 to 500~~	~~55~~	~~55~~	~~50~~	~~42~~	~~39~~	~~31~~
~~4~~	~~10~~	~~501 to 800~~	~~63~~	~~60~~	~~56~~	~~49~~	~~44~~	~~37~~
~~4~~	~~12~~	~~801 to 1,150~~	~~70~~	~~65~~	~~61~~	~~55~~	~~49~~	~~43~~
~~6~~	~~12~~	~~1,151 to 1,400~~	~~68~~	~~64~~	~~58~~	~~53~~	~~47~~	~~42~~
~~6~~	~~14~~	~~1,401 to 1,600~~	~~71~~	~~66~~	~~60~~	~~56~~	~~50~~	~~44~~
~~6~~	~~16~~	~~1,601 to 2,050~~	~~73~~	~~61~~	~~53~~	~~47~~	~~47~~	~~47~~
~~Single Wall Unit Fan Powered Unit~~			~~Maximum Discharge Sound Power Level (dB) at Band Number and Center Frequency (Hz)~~					
~~Unit Size~~	~~Inlet Diameter~~	~~Fan and 100% Primary CFM~~	~~2 125~~	~~3 250~~	~~4 500~~	~~5 1,000~~	~~6 2,000~~	~~7 4,000~~
~~4~~	~~8~~	~~250 to 500~~	~~62~~	~~57~~	~~55~~	~~51~~	~~47~~	~~47~~
~~4~~	~~10~~	~~501 to 800~~	~~68~~	~~64~~	~~59~~	~~58~~	~~55~~	~~55~~
~~4~~	~~12~~	~~801 to 1,150~~	~~73~~	~~69~~	~~64~~	~~63~~	~~61~~	~~61~~
~~6~~	~~12~~	~~1,151 to 1,400~~	~~72~~	~~63~~	~~63~~	~~62~~	~~60~~	~~60~~
~~6~~	~~14~~	~~1,401 to 1,600~~	~~74~~	~~66~~	~~65~~	~~64~~	~~63~~	~~60~~
~~6~~	~~16~~	~~1,601 to 2,050~~	~~76~~	~~66~~	~~63~~	~~58~~	~~60~~	~~55~~

~~Notes: All ratings at 1.0 inches w.c. Inlet Static Pressure and 0.25 inches w.c. Discharge Static Pressure~~
~~Up to +2 dB variation allowed.~~
~~Radiated sound power is breakout noise transmitted through the unit casing.~~
~~Discharge sound power is the noise emitted from the unit discharge into the downstream ductwork. No reductions shall be considered for duct, room, arrangement, ceiling volume etc.~~

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. All installation shall be in accordance with manufacturer's published recommendations.

C. Provide clearance for inspection, repair, replacement, and service. Ensure accessibility to all terminal unit electrical control panel doors, controllers and operators are located a minimum of 30 inches from all obstructions (walls, pipe, etc.).

D. Provide ceiling access doors or locate units above easily removable ceiling components.

E. Install terminal units with a minimum of four (4) diameters of straight duct directly prior to the entry into each terminal unit connection.

F. Support units individually from structure. Do not support from adjacent ductwork. For terminal units that are not internally isolated, refer to Section 20 05 48 for terminal unit vibration isolation requirements. Terminal units shall be supported using units hanger brackets and threaded rods.

G. Connect to ductwork in accordance with Section 23 31 00.

H. Install heating coils in accordance with Section 23 82 16.

I. Wiring and controller compartments, electronic motors and damper motors shall have a minimum 24 inch clear wide and deep working space readily accessible from lift out ceiling tiles or access panels.

END OF SECTION 23 36 00

SECTION 23 37 00 – AIR OUTLETS AND INLETS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 SUMMARY

A. Perform all Work required to provide and install diffusers, diffuser boots, registers/grilles, louvers, louver penthouses, roof hoods, and goosenecks indicated by the Contract Documents with supplementary items necessary for proper installation.

1.03 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:

1. AMCA 500 - Test Method for Louvers, Dampers and Shutters.

2. ANSI/NFPA 90A - Installation of Air Conditioning and Ventilating Systems.

3. ARI 890 – Rating of Air Diffusers and Air Diffuser Assemblies.

4. ASHRAE 70 - Method of Testing for Rating the Air Flow Performance of Outlets and Inlets.

5. SMACNA 1035 - HVAC Duct Construction Standards - Metal and Flexible.

1.04 QUALITY ASSURANCE

A. Test and rate performance of air outlets and inlets in accordance with ASHRAE 70.

B. Test and rate performance of louvers in accordance with AMCA 500.

1.05 SUBMITTALS

A. Product Data:

1. Submit product data and Shop Drawings, indicating type, size, location, application, noise level, finish, and type of mounting.

2. Review requirements of outlets and inlets as to size, finish, and type of mounting prior to submitting product data.

B. Operation and Maintenance Data:

1. Submit manufacturer's installation instructions under provisions of Division 01.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

B. Grilles, registers and diffusers shall be as scheduled on the Drawings Grilles, registers and diffusers shall be provided with sponge rubber or soft felt gaskets where noted on the Drawings Grilles, slot diffusers and laminar flow bars shall not be internally insulated. If a manufacturer other than the one scheduled is used, the sizes shown on the Drawings shall be checked for performance, noise level, face velocity, throw, pressure drop, etc., before the submittal is made. Selections shall meet the manufacturer's own published data for the above performance criteria. The throw shall be such that the velocity at the end of the throw in the five (5) foot occupancy zone will not exceed 50 fpm nor be less than 25 fpm except where indicated otherwise. Noise levels shall not exceed those published in ASHRAE for the type of space being served (NC level). In the vicinity of lab hoods, terminal velocity at face of hood shall not exceed 20 fpm.

C. Locations of air distribution devices on Drawings are approximate and shall be coordinated with other trades to make symmetrical patterns and shall be influenced by the established general pattern of the lighting fixtures or architectural reflected ceiling plan, but primarily located to maintain proper air distribution. Where called for on Drawings, grilles, registers and diffusers shall be provided with deflecting devices and manual dampers. These grilles, registers, and diffusers shall be the standard product of the manufacturer, and subject to review by the Architect.

D. Provide a frame compatible with the type of ceiling or wall in which the devices are installed. Refer to Architectural Drawings for exact type of ceiling specified.

E. Coordinate color and finish of the devices with the Architect.

2.02 MANUFACTURERS

A. Grilles, Registers, and Diffusers:

1. Krueger Manufacturing Company.

2. Titus Products.

3. Price Industries.

4. Nailor Industries.

5. MetalAire

~~B.Louvers:~~

~~1.American Warming and Ventilating.~~

~~2.Ruskin.~~

~~3.Greenheck.~~

~~4.Arrow.~~

~~C.Roof Hoods:~~

~~1.Greenheck.~~

~~2.Cook.~~

~~3.Acme.~~

~~2.03ROUND CEILING DIFFUSERS~~

~~A.Round, adjustable pattern, stamped or spun, multicore type diffuser to discharge air in 360-degree pattern, with sector baffles where indicated.~~

~~B.Project diffuser collar above ceiling face and connect to duct with duct ring. In plaster ceilings, provide plaster ring.~~

~~C.Fabricate of aluminum, unless otherwise noted, with factory baked enamel, off-white finish.~~

~~D.Provide multi-louvered equalizing grid where noted on Drawings.~~

~~2.04~~**2.03** RECTANGULAR CEILING DIFFUSERS

A. Rectangular, full louvered face, directional, removable multi-core type diffuser to discharge air in 360-degree pattern. Neck size shall be as scheduled on the Drawings. Provide filler panels, where required, for directional throw diffusers.

B. Fabricate frame and blades of extruded aluminum with factory baked enamel, off-white finish.

C. Provide multi-louvered equalizing grid .where noted on Drawings

D. Provide round neck connection as scheduled on Drawings.

~~2.05~~**2.04** PERFORATED FACE CEILING DIFFUSERS

A. Perforated face with fully adjustable pattern and removable face.

B. Fabricate of aluminum with factory baked enamel, off-white finish.

C. Provide multi-louvered equalizing grid where noted on Drawings.

D. Provide round neck connection as scheduled on Drawings.

~~2.06~~**2.05** SQUARE PANEL FACE SUPPLY AND RETURN AIR CEILING DIFFUSER

A. Architectural diffuser with a square panel centered within a square housing similar to the Titus OMNI model. Drawings that depict two-way and three-way throw options are achieved with the use of filler panel (where required) for directional throw diffusers.

B. Opposed blade volume dampers shall be provided with the diffuser, if scheduled on the Drawings. The volume damper design shall be similar to the Titus AG-75.

C. Although the manufacturers show this model being used only as a supply air device, this same diffuser can also be used as a return air device. The neck connection shall be the largest available neck size provided by the manufacturer.

D. Provide round neck connection as scheduled on Drawings.

~~2.07~~**2.06** CEILING EXHAUST AND RETURN REGISTERS/GRILLES

A. Streamlined blades, depth of which exceeds 3/4-inch spacing, with spring or other device to set blades, vertical face.

B. Fabricate 1-inch margin frame with concealed mounting.

C. Fabricate of steel with minimum 20 gage frames and minimum 22 gage blades, steel and aluminum with minimum 20 gage frame, or aluminum extrusions, with factory baked enamel finish.

D. Opposed blade damper with removable key operator, operable from face shall only be provided with the grille when it is scheduled on the Drawing.

~~2.08~~**2.07** PERFORATED FACE RETURN/EXHAUST GRILLES

A. Perforated face with back pan, removable face, and neck sizes as indicated on Drawings.

B. Provide frame type as indicated on Drawings.

C. Fabricate completely of 22 gage steel with a baked enamel off-white finish.

~~2.09LIGHT TROFFER DIFFUSERS~~

~~A.Single plenum type constructed independent of light troffers with volume and pattern controllers with oval top or side air inlet as scheduled.~~

~~B.Match diffusers to light troffers and connect in airtight connection without tools.~~

~~C.Fabricate of galvanized steel with welded or soldered joints and finish matte black inside.~~

~~2.10~~**2.08** PERFORATED FACE CEILING EXHAUST AND RETURN REGISTERS/GRILLES.

A. 0.0375-inch stainless steel non-aspirating perforated panels with stainless steel plenum for low-velocity applications.

B. Provide quick-opening fasteners with safety chains.

C. Provide multi-louvered equalizing grid where noted on Drawings.

~~2.11CEILING EGG CRATE EXHAUST AND RETURN REGISTERS/GRILLES~~

~~A.Fixed series of cubes comprised of 1/2 x 1/2 x 1-inch aluminum strips.~~

~~B.Fabricate one-inch margin aluminum frame.~~

~~C.Fabricate of aluminum with factory baked enamel finish.~~

~~D.Provide square uniform height plenum for ducted return and exhaust application of scheduled neck size.~~

~~2.12CEILING LINEAR SLOT DIFFUSERS~~

~~A.Continuous linear flow bar slot with adjustable vanes for left, right, or vertical discharge, with volume control. Provide slot width, length and number of slots as scheduled on the Drawings.~~

~~B.Fabricate of aluminum extrusions with factory baked enamel finish.~~

~~C.Provide support clips and gasket as required for ceiling system.~~

~~D.Provide alignment strips for hairline joints and end caps where the slot terminates. Provide mitered corners.~~

~~E.Provide black matte finish for all interior exposed-to-view components.~~

~~F.Provide externally insulated supply air plenum by diffuser manufacturer.~~

~~G.Provide return slot diffuser same as supply, except without the adjustable vane control. Provide return air plenum for ducted return where indicated on Drawings.~~

~~2.13PLENUM SLOT SUPPLY AND RETURN DIFFUSERS~~

~~A.Supply or return plenum slot, 3/4-inch, with single extruded aluminum curved deflector blade to create a tight horizontal airflow pattern across the ceiling. Provide slot width, length, and number of slots as scheduled on the Drawings.~~

~~B.Diffusers shall discharge air horizontally through two outside sections and vertically through a center down-blow section.~~

~~C.Standard nominal lengths shall be 2, 3, 4, or 5 feet. Units shall be constructed of 24 gage steel. Maximum height of the unit's plenum shall be 7-inches. Inlets shall have a minimum of 1-1/2-inch depth for duct connection. The standard finish shall be black on the face of the diffuser and pattern deflectors.~~

~~D. Diffuser shall be similar to Titus N-1-R diffuser.~~

~~2.14PERIMETER SLOT SUPPLY AND RETURN DIFFUSERS~~

~~A.High induction supply and return plenum slot, the supply is a 3/4-inch fixed slot width that produces a horizontal discharge pattern, and a return air slot with a maximum 1-1/2-inch slot width. Provide length as scheduled on the Drawings.~~

~~B.Standard nominal lengths shall be 2, 3, 4, or 5 feet. Units shall be constructed of 24 gage steel. Maximum height of the units shall be 7-inches. Inlets shall have a minimum of 1-1/2-inch depth for duct connection. The standard finish shall be black on the face of the diffuser and pattern deflectors.~~

~~C. Diffuser shall be similar to the Titus N-1-R diffuser.~~

~~2.15~~**2.09** CEILING LINEAR EXHAUST AND RETURN GRILLES

A. Streamlined blades with 90-degree one-way deflection, 1/8-inch x 3/4-inch on 1/4-inch centers.

B. Fabricate 1-inch margin frame with countersunk screw mounting.

C. Fabricate of steel with 22 gage minimum frames and 22 gage minimum blades, steel and aluminum with 20 gage minimum frame, or aluminum extrusions, with factory baked enamel finish.

D. Opposed blade damper with removable key operator, operable from face shall only be provided with the grille when it is scheduled on the Drawing.

~~2.16WALL SUPPLY REGISTERS/GRILLES~~

~~A.Streamlined and individually adjustable curved blades to discharge air along face of grille with two-way deflection.~~

~~B.Fabricate 1-inch margin frame with countersunk screw, concealed mounting and gasket.~~

~~C.Fabricate of aluminum extrusions with factory clear anodized finish.~~

~~D.Provide multi-louvered equalizing grid where noted on Drawings.~~

~~2.17WALL EXHAUST AND RETURN REGISTERS/GRILLES~~

~~A.Streamlined blades, depth of which exceeds ¾ inch spacing, with spring or other device to set blades, vertical or horizontal face as scheduled.~~

~~B.Fabricate one-inch margin frame with concealed mounting.~~

~~C.Fabricate of aluminum with 20 gage minimum frame, or aluminum extrusions, with factory baked enamel finish.~~

~~2.18LINEAR BAR WALL DIFFUSERS~~

~~A.Streamlined blades with 0 to 15 degree deflection, as scheduled, 1/8-inch x 3/4-inch or 1/4-inch centers.~~

~~B.Fabricate of aluminum extrusions, with factory clear anodized finish.~~

~~C.Fabricate 1/2-inch margin frame with concealed mounting and gasket.~~

~~D.Provide concealed fastening, straightening grids and alignment bars.~~

~~E.Provide externally insulated plenums by diffuser manufacturer.~~

~~F.Provide return bar diffusers same as supply with return air plenum.~~

~~G.Silhouette finish.~~

~~2.19LINEAR FLOOR SUPPLY REGISTERS/GRILLES~~

~~A.Streamlined blades with zero degree deflection, 7/32-inch x 3/4-inch on 1/2-inch centers.~~

~~B.Fabricate of high-grade aluminum extrusions with factory clear anodized finish.~~

~~C.Fabricate 3/16-inch margin heavy margin frame with concealed mounting and gasket and mounting frame. Frameless flange for floor installation. Silhouette finish.~~

~~D.Provide concealed fastening, straightening grids and alignment bars.~~

~~2.20~~**2.10** LABORATORY RADIAL AIR SUPPLY DIFFUSERS

A. High-volume, low velocity performance.

B. Diffuser shall provide non-aspirating radial air pattern and shall be configured with air supply plenums with inlet collars to assure uniform velocity over the diffuser face.

C. Furnish stainless steel back pan and stainless steel faced diffusers for animal holding rooms.

D. Furnish aluminum back pan and aluminum-faced diffusers for laboratories.

E. Performance face drops below ceiling, single-pane back pan and single piece lower chamber. Sectioned diffuser is not acceptable.

~~2.21WALL EXHAUST AND RETURN REGISTERS/GRILLES – SEVERE DUTY~~

~~A.Streamlined 40-degree fixed blades, at 1/2-inch spacing, with horizontal front blades.~~

~~B.Fabricate 1-1/4-inch margin frame with vandal-proof screws.~~

~~C.Fabricate totally of steel with minimum 18-gage frames and minimum 14-gage blades with factory baked enamel finish.~~

~~2.22DOOR GRILLES~~

~~A.V-shaped louvers of 20 gage steel, 1-inch deep on 1/2-inch centers.~~

~~B.Provide 20 gage steel frame with auxiliary frame to give finished appearance on both sides of door, with factory prime coat finish.~~

~~2.23LOUVERS~~

~~A.Provide 6-inch deep louvers with blades on 45-degree slope with center baffle and return bend, heavy channel frame, birdscreen on interior side with 1/2-inch square mesh for exhaust and 3/4-inch for intake.~~

~~B.Fabricate of 12 gage extruded aluminum, welded assembly, with factory prime coat finish.~~

~~C.Furnish with exterior angle flange for installation.~~

~~D.Fabricate louver penthouses with mitered corners and reinforce with structural angles.~~

~~E.Pass 750 feet per minute free velocity with less than 0.10 inches of water pressure drop, based in accordance with AMCA 500. Water penetration less than 0.025 ounce of water per foot of free area at 900 feet per minute. Provide a minimum of 45 percent free area.~~

~~2.24ROOF HOODS~~

~~A.Fabricate air inlet or exhaust hoods in accordance with SMACNA 1035, 1-inch classification Duct Construction Standards.~~

~~B.Fabricate of galvanized steel, minimum 16 gage base and 20 gage hood, or aluminum, minimum 16 gage base and 18 gage hood; suitably reinforced; with removable hood; birdscreen with 1/2-inch square mesh for exhaust and 3/4 inch for intake, and factory prime coat finish.~~

~~C.Roof curb shall be coordinated with Owner and roofing Contractor.~~

~~D.Hood outlet area shall be minimum two times the throat area.~~

~~2.25GOOSENECKS~~

~~A.Fabricate in accordance with SMACNA 1035, 1-inch classification, of minimum 18 gage galvanized steel.~~

~~B. Roof curb shall be coordinated with Owner and roofing Contractor.~~

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. All installation shall be in accordance with manufacturer's published recommendations.

C. Check location of air outlets and inlets and make necessary adjustments in position to conform to architectural features, reflected ceiling plans, symmetry, and lighting arrangement.

D. Install air outlets and inlets to ductwork with airtight connection.

E. Provide balancing dampers on duct take-off to diffusers, grilles and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly. The use of extractors or scoops at duct take-off to diffusers, grilles and registers is not allowed.

F. Paint ductwork visible behind air outlets and inlets matte black. Refer to Division 09.

G. Provide all specialties and frames for air distribution devices as required for proper installation in ceiling type as indicated on Architectural Drawings. Provide all cutting and patching of T-bars, gypsum board, and other ceiling systems as required for installation of air devices.

END OF SECTION 23 37 00

SECTION 23 82 16 – DUCT MOUNTED AIR COILS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 SUMMARY

A. Perform all Work required to provide and install duct-mounted or stand-alone hydronic, steam and electric coils indicated by the Contract Documents with supplementary items necessary for proper installation. Specifications for air handling unit coils are in the Air Handling Unit Specifications.

1.03 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:

1. ANSI/ARI 410 - Forced-Circulation Air-Cooling and Air-Heating Coils.

2. SMACNA - HVAC Duct Construction Standards, Metal and Flexible.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this Section with minimum three (3) years documented experience.

1.05 SUBMITTALS

A. Product Data:

1. Submit product data including performance and materials of construction.

B. Record Documents:

1. Submit Shop Drawings indicating coil and frame configurations, dimensions, materials, rows, connections and rough-in dimensions.

2. Submit manufacturer's certificate that coils are tested in accordance with and rated in accordance with ARI 410.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect and handle products to the Project Site under provisions of Division 01 and Division 20.

B. Accept products on Site in factory-fabricated protective containers or covered to protect from weather and construction debris. Inspect for damage and make any necessary repairs at no expense to the Owner.

C. Store in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components. Replace damaged equipment.

D. Protect coils from entry of dirt and debris with pipe caps or plugs.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

~~2.02STEAM COILS~~

~~A.All steam coils shall be non-freeze 1-inch outside diameter seamless copper outer tubes having 0.035-inch minimum wall thickness. Inner tube shall be 5/8-inch outside diameter seamless copper tubes having 0.025-inch minimum wall thickness.~~

~~B.Coil shall have 0.008-inch thick aluminum fins suitable for use with steam at a maximum temperature of 400 degrees F and a maximum pressure of 200 psig.~~

~~C.Coils shall be steam-distributing type. Coil headers shall be cast iron or I.P.S. brass or as specified hereinafter for hydronic cooling coils. Coils shall have a maximum of 8 fins per inch.~~

~~2.03~~**2.02** HYDRONIC HEATING COILS

A. Hydronic coil capacities, pressure drops and selection procedures shall be certified for the capacity scheduled in accordance with ARI Standard 410. Non-certified coils will not be accepted. Heating coil face velocity shall not exceed 700 fpm unless noted otherwise on the Drawings.

B. Heating coils shall be of the extended surface type and shall have same-end supply and return connections unless otherwise indicated. Coils shall be constructed of copper tubes 5/8-inch outside diameter with 0.020-inch thick minimum wall thickness and aluminum fins permanently bonded to the tubes by mechanical expansion. Coils shall have a maximum of 10 fins per inch. Aluminum fin thickness shall be 0.006-inches.

C. Coil headers and connections shall be of I.P.S. brass or heavy gage seamless hard drawn copper tubing with penetrations for connection of core tubing by die-formed intrusion process with resulting contact depth between the header wall and core tubing of not less than 0.090-inches.

D. Joints between core tubing and header shall be of recess swage design to allow a large mating area for build up of brazing materials to give increased strength to the joint. Supply and return connection of brass or copper shall be terminated with National Pipe Threads with wrench flats.

E. Provide each coil section with a galvanized steel frame/casing, including tube sheets, no lighter than 20 gage. Frame members shall extend over the ends and edges of the coils and shall be constructed with formed holes for tubes, permitting free expansion and contraction of coil sections while supported by an extended surface of the frame. Furnish casing with a slip and drive receiving flange on each end for connection to ductwork.

F. Coils shall be leak tested with air pressure under water at 300 psig, and designed for operation at 250 psig design working pressure at up to 300 degrees F. Provide stainless steel nameplate on each coil indicating:

1. Manufacturer.

2. Model number.

3. Coil designation.

4. Coil medium.

5. Coil test pressure.

6. Coil maximum operating temperature and pressure.

~~2.04HYDRONIC COOLING COILS~~

~~A.Hydronic coil capacities, pressure drops and selection procedures shall be certified for the capacity scheduled in accordance with ARI Standard 410. Non-certified coils will not be accepted. Cooling coil face velocity shall not exceed 375 fpm for constant volume applications and 400 fpm for variable volume applications fpm, unless noted otherwise on the Drawings.~~

~~B.Cooling coils shall be of the extended surface type and shall have same-end supply and return connections unless otherwise indicated. Coils shall be constructed of copper tubes 5/8-inch outside diameter with 0.035-inch thick minimum wall thickness and copper fins permanently bonded to the tubes by mechanical expansion. Coils with spiral wound copper fins will be acceptable provided coils have been solder dipped. Coils shall have a maximum of 8 fins per inch and a maximum of 6 rows per coil. If additional capacity is necessary, provide an additional coil with an additional access section between the coils. Pipe the coils in series, counterflow to the direction of airflow. Copper fins on plate coils shall be 0.006-inch thick. Copper fins on spiral wound coils shall have an average thickness of 0.010-inch from root to tip.~~

~~C.Coil headers and connections shall be of I.P.S. brass or heavy gage seamless hard drawn copper tubing with penetrations for connection of core tubing by die-formed intrusion process with resulting contact depth between the header wall and core tubing of not less than 0.090-inch. Joints between core tubing and header shall be of recess swage design to allow a large mating area for build up of brazing materials to give increased strength to the joint. Supply and return connection of brass or copper shall be terminated with National Pipe Threads with wrench flats.~~

~~D.Each coil section shall be provided with a Type 304 stainless steel frame/casing, including tube sheets, no lighter than 16 gage. Frame members shall extend over the ends and edges of the coils and shall be constructed with formed holes for tubes, permitting free expansion and contraction of coil sections while supported by an extended surface of the frame. Intermediate tube support sheets of Type 304 stainless steel shall be provided in all coils having tube lengths in excess of 48-inches. On long coil sections, coil support spacing shall not exceed 48-inches. All intermediate supports shall be welded to coil frame members and fabricated with formed tube holes to support the penetrating tubes.~~

~~E.Coils shall be leak tested with air pressure under water at 325 psig, and designed for operation at 300 psig design working pressure at up to 300 degrees F. Provide stainless steel nameplate on each coil indicating:~~

~~1.Manufacturer.~~

~~2.Model number.~~

~~3.Coil designation.~~

~~4.Coil medium.~~

~~5.Coil test pressure.~~

~~6.Coil maximum operating temperature and pressure.~~

~~F.Provide drain pan and drain connection with trap for cooling coils. Fabricate drain pan from minimum 18 gage 304 stainless steel. Extend three (3) inches from face of coil entering air side, 18 inches from face of coil leaving air side. Pipe drain pans individually to floor drain with water seal trap.~~

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. All installation shall be in accordance with manufacturer's published recommendations.

C. Install access door in ductwork immediately upstream of each coil.

D. Install in ducts and casings in accordance with SMACNA HVAC Duct Construction Standards, Metal and Flexible.

E. Support coil sections independent of piping on steel channel or double angle frames and secure to casings. Provide frames for maximum three (3) coil sections. Arrange supports to avoid piercing drain pans. Provide airtight seal between coil and duct or casing.

F. Protect coils to prevent damage to fins and flanges. Comb out bent fins.

G. Install cleanable tube coils with 1:50 pitch.

H. Make connections to coils with unions and flanges.

I. On hydronic coils, provide shut-off valve on supply line and lockshield balancing valve on return line. Locate water supply at bottom of supply header and return water connection at top. Provide float operated automatic air vents at high points complete with stop valve. Ensure hydronic coils are drainable and provide drain connection at low points.

J. On hydronic heating coils and cooling coils, connect water supply to leaving airside of coil (counterflow arrangement).

K. In steam coils, install vacuum breaker in steam line at header. Install steam traps with outlet minimum 12 inches below coil return connection.

L. Insulate headers located outside airflow path as specified for piping.

M. Pipe condensate from hydronic cooling coils to the nearest convenient floor drain or to location shown on Drawings. Insulate per piping insulation Section. Provide minimum 8 inch deep trap in this drain line to prevent the escape or entry of air through the drain piping. Ensure coil is installed at sufficient height for proper trapping.

END OF SECTION 23 82 16

SECTION 25 00 10 – BUILDING AUTOMATION SYSTEMS (BAS) GENERAL - RETROFIT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 SUMMARY

A. Section includes:

1. Description of Work.

2. Quality Assurance.

3. System Architecture.

4. Distributed Processing Units/Quantity and Location.

5. Demolition and Reuse of Existing Materials and Equipment.

6. Sequence of Work.

B. Furnish and install a direct digital control and building automation system (BAS). The new BAS shall utilize electronic sensing, microprocessor-based digital control, and electronic actuation of dampers and valves (except where noted otherwise) to perform control sequences and functions specified. The BAS for this Project will generally consist of monitoring and control of systems described herein. Reference shall also be made to control Drawings, Sequence of Operation, and points lists.

C. The HVAC systems being controlled are ~~[describe the type of mechanical systems included in the Project].~~**supply air and exhaust air laboratory terminal units and laboratory pressurization control.** This Section defines the manner and method by which these controls function.

1.03 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:

1. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE).

2. ASHRAE 135: BACnet - A Data Communication Protocol for Building Automation and Control Networks. American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. and all current addenda and annexes.

3. Electronics Industries Alliance:

   a. EIA-709.1-A-99: Control Network Protocol Specification.

   b. EIA-709.3-99: Free-Topology Twisted-Pair Channel Specification.

   c. EIA-232: Interface between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange.

   d. EIA-458: Standard Optical Fiber Material Classes and Preferred Sizes.

   e. EIA-485: Standard for Electrical Characteristics of Generator and Receivers for use in Balanced Digital Multipoint Systems.

   f. EIA-472: General and Sectional Specifications for Fiber Optic Cable.

   g. EIA-475: Generic and Sectional Specifications for Fiber Optic Connectors and all Sectional Specifications.

   h. EIA-573: Generic and Sectional Specifications for Field Portable Polishing Device for Preparation Optical Fiber and all Sectional Specifications.

   i. EIA-590: Standard for Physical Location and Protection of Below-Ground Fiber Optic Cable Plant and all Sectional Specifications.

4. NEMA Compliance:

   a. NEMA 250: Enclosure for Electrical Equipment.

   b. NEMA ICS 1: General Standards for Industrial Controls.

5. NFPA Compliance:

   a. NFPA 90A: "Standard for the Installation of Air Conditioning and Ventilating Systems" where applicable to controls and control sequences.

   b. NFPA 70: National Electrical Code (NEC).

6. Institute of Electrical and Electronics Engineers (IEEE):

   a. IEEE 142: Recommended Practice for Grounding of Industrial and Commercial Power Systems.

   b. IEEE 802.3: CSMA/CD (Ethernet – Based) LAN.

   c. IEEE 802.4: Token Bus Working Group (ARCNET – Based) LAN.

   d. IEEE 519: Recommended Practices and Requirements for Harmonic Control in Electric Power Systems.

1.04 QUALITY ASSURANCE

~~**USE "A" TO DEFINE ANY SPECIFIC QUALIFICATIONS NEEDED; OTHERWISE LEAVE "RESERVED".**~~

A. [Reserved].

B. Apogee Product Line Demonstrated History: The product line being proposed for the Project must have an installed history of demonstrated satisfactory operation for a length of one (1) year since date of final completion in at least ten (10) installations of comparative size and complexity. Documents with references shall be submitted verifying this requirement has been met at Owner's request.

C. Siemens Installers Field Coordinator and Sequence Programmer Qualifications: Individual(s) shall specialize in and be experienced with control system installation for not less than five (5) years. Proposed field coordinator shall have experience with the installation of the proposed product line for not less than two (2) projects of similar size and complexity. Installer shall submit the names of the proposed individual and at least one alternate for each duty at Owner's request. Proposed individuals must show proof of the following training:

1. Product Line Training: Individuals overseeing the installation and configuration of the proposed product line must provide evidence of the most advanced training offered by the manufacturer on that product line for installation and configuration.

2. Programming Training: Individuals involved with programming the Site-specific sequences shall provide evidence of the most advanced programming training offered by the vendor of the programming application offered by the manufacturer.

D. The BAS and components shall be listed by Underwriters Laboratories (UL 916) as an Energy Management System.

E. The BAS shall be listed by Underwriters Laboratories (UUKL 864) for Supervised Smoke Control.

1.05 SUBMITTALS

A. General: Submit documents under provisions of Division 01. Two (2) copies of the materials shall be delivered directly to MD ANDERSON Monitoring Services staff, in addition to the copies required by other Sections. In addition, an electronic version of the completed materials shall be provided on CD or DVD. Refer to Section 25 08 10 for additional Commissioning submittal requirements.

B. Electronic Submittals: While all requirements for hard copy submittal apply, control submittals and operation and maintenance (O&M) information shall also be provided in electronic format as follows:

1. Drawings and Diagrams: Shop Drawings shall be provided on electronic media as an AutoCAD drawing per Owner's CAD standards. All 'x reference' and font files must be provided with AutoCAD files.

2. Other Submittals: All other submittals shall be provided in Adobe Portable Document Format.

C. Product Data: Submit manufacturer's technical product data for each control device, panel, and accessory furnished, indicating dimensions, capacities, performance and electrical characteristics, and material finishes. Include installation and start-up instructions.

D. Record Documents:

1. Siemens shall submit separately and directly to Owner a pricing breakdown of all cost associated to Project for review. This is to include but not be limited to material quantity, description, unit list price, multiplier, cost, extended cost, material costs adjustment less Owner's discount price, outside material price totaled and itemized, itemized subcontract price associated to Project, and total Project support price.

a. Siemens labor hours quantities shall be itemized by mechanical labor, electrical labor, and design and management labor. Hour quantities shall be itemized by journeyman rate, technician rate and design/management rate with quantity of hours listed separately.

b. All estimated overtime shall be disclosed. Profit for Project shall be disclosed. Total Project price shall not exceed the sum of the listed itemized costs.

c. Provide an accurate spreadsheet breakdown of physical point counts of all analog inputs, analog outputs, digital inputs, digital outputs, building controllers and application specific controllers. The total point count for the project shall be itemized in a logical manner to allow the owner to confirm point count accuracy. Below is an example.

Project Physical Point Count	Drawing M-006	Drawing M-007	Drawing M-008	Drawing M-010	Drawing M-014	Drawing M-015
Physical Digital Input(s)						
Physical Digital Output(s)						
Physical Analog Input(s)						
Physical Analog Output(s)						
Building Controller(s)						
Application Specific Controller(s)						
TOTALS						

d. All subcontracts greater than $10K shall be competitively priced by a minimum of two owner approved subcontractors. Both subcontract proposals shall be fully disclosed.

e. This pricing summary, including any attachments, is intended only for the Owner and contains confidential and/or privileged information. Any unauthorized review; use, disclosure or distribution is prohibited.

2. Qualifications: Manufacturer, installer, and key personnel qualifications as indicated for the appropriate item above.

3. Shop Drawings: Submit Shop Drawings electronically on AutoCAD software for each control system, including a complete drawing for each air handling unit, system, pump, device, etc. with all point descriptors, addresses and point names indicated. Shop Drawings shall contain the following information:

   a. System Architecture and System Layout:

      1) One-line diagram indicating schematic locations of all control units, workstations, LAN interface devices, gateways, etc. Indicate network number, device ID, address, device instance, MAC address, drawing reference number, and controller type for each control unit. Indicate media, protocol, baud rate, and type of each LAN. All optical isolators, repeaters, end-of-line resistors, junctions, ground locations etc. shall be located on the diagram.

      2) Provide floor plans locating all control units, workstations, servers, LAN interface devices, gateways, etc. Include all WAN and LAN communication wiring routing, power wiring, power originating sources, and low voltage power wiring. Indicate network number, device ID, address, device instance, MAC address, drawing reference number, and controller type for each control unit. Indicate media, protocol, baud rate, and type of each LAN. All optical isolators, repeaters, end-of-line resistors, junctions, ground locations etc. shall be located on the floor plans. Wiring routing as-built conditions shall be maintained accurately throughout the construction period and the drawing shall be updated to accurately reflect accurate, actual installed conditions.

   b. Schematic flow diagram of each air and water system showing fans, coils, dampers, valves, pumps, heat exchange equipment and control devices. Include written description of sequence of operation.

   c. All physical points on the schematic flow diagram shall be indicated with names, descriptors, and point addresses identified as listed in the point summary table.

   d. With each schematic, provide a point summary table listing building number and abbreviation, system type, equipment type, full point name, point description, Ethernet backbone network number, network number, device ID, object ID (object type, instance number). If this information is not available at the time of Shop Drawings submittals, furnish with O&M manual documentation for Owner review and approval. See Section 25 15 10 for additional requirements.

   e. Label each control device with setting or adjustable range of control.

   f. Label each input and output with the appropriate range.

   g. Provide a Bill of Materials with each schematic. Indicate device identification to match schematic and actual field labeling, quantity, actual product ordering number, manufacturer, description, size, voltage range, pressure range, temperature range, etc. as applicable.

h. With each schematic, provide valve and actuator information including size, Cv, design flow, design pressure drop, manufacturer, model number, close off rating, etc. Indicate normal positions of spring return valves and dampers.

i. Indicate all required electrical wiring. Electrical wiring diagrams shall include both ladder logic type diagram for motor starter, control, and safety circuits and detailed digital interface panel point termination diagrams with all wire numbers and terminal block numbers identified. Provide panel termination Drawings on separate Drawings. Ladder diagrams shall appear on system schematic. Clearly differentiate between portions of wiring that is existing, factory-installed and portions to be field-installed.

j. Details of control panels, including controls, instruments, and labeling shown in plan or elevation indicating the installed locations.

k. Sheets shall be consecutively numbered.

l. Each sheet shall have a title indicating the type of information included and the HVAC system controlled.

m. Table of Contents listing sheet titles and sheet numbers.

n. Legend and list of abbreviations.

o. Record copies of product data, as built control Shop Drawings and final sequence of operation updated to reflect the final installed condition.

p. Provide as-built network architecture Drawings showing all nodes including a description field with specific controller identification, description and location information.

q. Provide record riser diagram showing the location of all controllers. Indicate device instance, MAC address and drawing reference number.

E. Operation and Maintenance Data:

1. Submit maintenance instructions and spare parts lists for each type of control device, control unit, and accessory.

2. Submit BAS User's Guides (Operating Manuals) for each controller type and for all workstation hardware and software and workstation peripherals.

3. Submit BAS advanced Programming Manuals for each controller type and for all workstation software.

4. Manufacturer's Certificates: For all listed and/or labeled products, provide certificate of conformance.

5. Product Warranty Certificates: Submit manufacturer's product warranty certificates covering the hardware provided.

1.06 SYSTEM ARCHITECTURE

A. The communication speed between the controllers, LAN interface devices, CSS, and operator interface devices shall be sufficient to ensure fast system response time under any loading condition. Contractor shall submit guaranteed response times with Shop Drawings including calculations to support the guarantee. In no case shall delay times between an event, request, or command initiation and its completion be greater than those listed herein. Contractor shall modify their BAS control design as necessary to accomplish these performance requirements. Generally requirements do not apply when a remote connection must be established via modem:

1. 5 seconds between a Level 1 (critical) alarm occurrence and enunciation at operator workstation.

2. 10 seconds between a Level 2 alarm occurrence and enunciation at operator workstation.

3. 20 seconds between a Level 3-5 alarm occurrence and enunciation at operator workstation.

4. 10 seconds between an operator command via the operator interface to change a set point and the subsequent change in the controller.

5. 5 seconds between an operator command via the operator interface to start/stop a device and the subsequent command to be received at the controller.

6. 10 seconds between a change of value or state of an input and it being updated on the operator interface.

7. 10 seconds between an operator selection of a graphic and it completely painting the screen and updating at least ten (10) points.

B. Interruptions or fault at any point on any Primary Controller LAN shall not interrupt communications between other BAS nodes on the network. If a LAN is severed, two (2) separate networks shall be formed and communications within each network shall continue uninterrupted.

1.07 DELIVERY, STORAGE AND HANDLING

A. Provide factory-shipping cartons for each piece of equipment and control device. Maintain cartons during shipping, storage and handling as required to prevent equipment damage, and to eliminate dirt and moisture from equipment. Store equipment and materials inside and protect from weather.

1.08 WARRANTY

A. Contractor shall warranty all products and labor for a period of [insert Warranty Period] after Substantial Completion.

B. The Owner reserves the right to make changes to the BAS during the Warranty Period. Such changes do not constitute a waiver of warranty. Contractor shall warrant parts and installation work regardless of any such changes made by Owner, unless the Contractor provides clear and convincing evidence that a specific problem is the result of such changes to the BAS. Any disagreement between Owner and Contractor on such matters shall be subject to resolution through the Contract 'Disputes' clause.

1. At any time during the Warranty Period that Contractor is on the Project Site for maintenance, emergency, or normal service, Contractor shall notify Owner via MD ANDERSON Monitoring Services and the local building operating personnel.

2. Contractor shall notify said personnel of all work anticipated being involved for the service work. In addition, no work affecting system operation shall commence until express permission is granted.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.02 MANUFACTURERS

A. The BAS and digital control and communications components installed as Work of this Contract shall be an integrated distributed processing system of the following manufacturer or communication protocol. No other products will be considered as substitutions.

1. Siemens Building Technologies - APOGEE: Provide control products and systems that completely integrate and operate from the existing APOGEE system currently in operation at the institution. All access, programming, alarming, and system configuration shall be utilized from the existing system software and database without any third party programs or gateways.

2. Substitutions: None

2.03 MATERIALS AND EQUIPMENT

A. Materials shall be new, the best of their respective kinds without imperfections or blemishes, and shall not be damaged in any way. Used equipment shall not be used in any way for the permanent installation except where Drawings or Specifications specifically allow existing materials to remain in place.

2.04 UNIFORMITY

A. To the extent practical, all equipment of the same type serving the same function shall be identical and from the same manufacturer.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. All installation shall be in accordance with manufacturer's published recommendations.

C. Refer to additional requirements in other Sections of this Specification.

3.02 SURGE PROTECTION

A. Contractor shall furnish and install any power supply surge protection, filters, etc. as necessary for proper operation and protection of all BCs, AAC/ASCS operator interfaces, printers, routers, gateways and other hardware and interface devices. All equipment shall be capable of handling voltage variations 10 percent above or below measured nominal value, with no affect on hardware, software, communications, and data storage.

3.03 CONTROL POWER SOURCE AND SUPPLY

A. BAS Provider shall extend all power source wiring required for operation of all equipment and devices provided under Division 25 and the Drawings if not specified under Division 26.

B. General requirements for obtaining power include the following:

1. All control power for a given stand alone controller and all associated controls for this stand alone controller shall originate from the same circuit.

2. All mechanical equipment which is supplied with emergency power shall have the DDC controller supplied with emergency power.

3. Provide an uninterruptible power supply (UPS) as indicated on the Drawings or as necessary. UPS shall protect against blackouts, brownouts, surges and noise.

a. UPS shall include LAN port and modem line surge protection.

b. UPS shall be sized for a 7-minute full load runtime, 23-minute 1/2 load runtime, with a typical runtime of up to 60 minutes. Transfer time shall be 2-4 milliseconds.

c. UPS shall provide a 480-joule suppression rating and current suppression protection for 36,000 amps and provide 90 percent recharge capability in 2-4 hours. Suppression response time shall be instantaneous. UPS low voltage switching shall occur when supply voltage is less than 94 volts.

d. Provide a Maintenance Bypass Switch that allows input voltage to bypass the UPS and directly power the connected equipment if an abnormal condition prevents the UPS from supporting the load, or if the UPS is required to be taken out of service.

e. Provide all software, cables, peripherals etc. for a complete system.

END OF SECTION 25 00 10

SECTION 25 11 10 – BAS BASIC MATERIALS, INTERFACE DEVICES, AND SENSORS -(RETROFIT)

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them. Building automation system requirements may be specified, but not limited to, the following Sections when applicable:

1. Packaged engine generator system.
2. Fuel oil piping system.
3. Hot water boilers.
4. Computer room air conditioning units.
5. Automatic transfer switch.

1.02 SUMMARY

A. Section Includes:

1. Wiring.
2. Control Valves and Actuators.
3. Control Dampers and Actuators.
4. Control Panels.
5. Sensors.
6. Electric Control Components (Switches, EP Valves, Thermostats, Relays, etc.).
7. Transducers.
8. Current Switches.
9. Nameplates.
10. Testing Equipment.

B. Refer to Section 25 00 10 for general requirements.

C. Refer to other Division 20 and Division 23 Sections for installation of instrument wells, valve bodies, and dampers in mechanical systems; not Work of this Section.

D. Provide the following electrical Work as Work of this Section, complying with requirements of Division 26 sections:

1. Control wiring between field-installed controls, indicating devices, and unit control panels.

2. Interlock wiring between electrically interlocked devices, sensors, and between a hand or auto position of motor starters as indicated for all mechanical and controls.

3. Wiring associated with annunciator and alarm panels (remote alarm panels) and connections to their associated field devices.

4. All other necessary wiring for fully complete and functional control system as specified.

1.03 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within all references.

1.04 WORK BY OTHERS

A. Control Valves furnished under this Section shall be installed under the applicable piping Section in accordance with the valve manufacturer's published installation instructions under the direction of the BAS Provider who will be fully responsible for the proper operation of the valve.

~~B.Control Dampers furnished under this Section shall be installed under the applicable air distribution or air handling equipment Section under the direction of the BAS Provider who will be fully responsible for the proper operation of the damper.~~

~~C.~~**B.** Water Pressure Taps, Thermal Wells, Flow Switches, Flow Meters, etc. that will have wet surfaces, shall be installed under the applicable piping Section under the direction of the BAS Provider who will be fully responsible for the proper installation and application.

~~D.Variable Frequency Drives furnished under section 23 05 13 shall be provided with serial communication protocol information specific to the selected BAS Provider. BAS Provider shall be fully responsible to interface and make available VFD information in the building automation system as monitor only information. Control of the VFD shall meet controller standalone requirements of Section 25.~~

~~E.~~**C.** Controlled Equipment Power Wiring shall be furnished and installed under Division 26. Where control involves 120 volt (V) control devices controlling 120V equipment, Division 26 Contractor shall extend power wiring to the equipment. BAS Provider shall extend it from the equipment to the control device.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.02 MATERIALS AND EQUIPMENT

~~A.Control Air Supply: Contractor may reuse existing control air in buildings where pneumatic controls will be reused~~

~~1.Branch Air Piping (to include main air between field control panels and field devices:~~

~~a.Seamless copper tubing, Type K or L, ASTM B 88; with cast bronze solder joint fittings, ANSI B1.18; or wrought copper solder joint fittings, ANSI B16.22; except brass compression type fittings at connections to equipment. Solder shall be 95/5 tin antimony, or other suitable lead free composition solder.~~

~~b.Virgin polyethylene non-metallic tubing type FR, ASTM D 2737 encased in EMT. Tubing outside diameter size shall be not less than the larger of ¼ inch or the instrument connection size~~

~~2.Branch Air Piping Termination, Concealed Air Piping, And Tubing Within Control Panels:~~

~~a.Virgin polyethylene non-metallic tubing type FR, ASTM D 2737. Use compression or push-on brass fittings. Branch air piping terminations length shall not exceed 24 inches.~~

~~B.~~**A.** General: Provide electronic and electric control products in sizes and capacities indicated, consisting of valves, dampers, controllers, sensors, and other components as required for complete installation. Except as otherwise indicated, provide manufacturer's standard materials and components as published in their product information; designed and constructed as recommended by manufacturer, and as required for application indicated.

~~C.~~**B.** Communication Wiring and BAS low voltage wiring/cables: All wiring shall be in accordance with the latest edition of the National Electrical Code and Division 26. Wiring/cables shall be provided in a customized color jacketing material. Material color shall be as specified in section 27 05 53 (Identification for Low-Voltage Cables).

1. Contractor shall supply all communication wiring between Building Controllers, Routers, Gateways, AAC's, ASC's and local and remote peripherals outside the MD ANDERSON IT infrastructure. (e.g., operator workstations, printers, and modems).

2. Local Supervisory LAN: For any portions of this network required under this Section of the Specification, Contractor shall comply with Division 27 Communication specifications. Network shall be run with no splices and separate from any wiring over thirty (30) volts.

3. Secondary Controller LANs: Communication wiring shall be individually 100 percent shielded pairs per manufacturer's recommendations for distances installed, with overall PVC cover, Class 2, plenum-rated run with no splices and separate from any wiring over thirty (30) volts. Shield shall be terminated and wiring shall be grounded as recommended by building controller manufacturer.

    a. Wet / Damp Locations – Wiring in underground raceways or raceways which are subject to moderate degrees of moisture shall be listed for installation in wet locations. Direct burial wiring without a raceway is prohibited.

~~D.~~**C.** Signal Wiring: Contractor shall run all signal wiring in accordance with the latest edition of the National Electrical Code and Division 26.

1. Signal wiring to all field devices, including, but not limited to, all sensors, transducers, transmitters, switches, etc. shall be twisted, 100 percent shielded pair, minimum 18-gage wire, with PVC cover. Signal wiring shall be run with no splices and separate from any wiring above thirty (30) volts.

    a. Wet / Damp Locations – Wiring in underground raceways or raceways which are subject to moderate degrees of moisture shall be listed for installation in wet locations. Direct burial wiring without a raceway is prohibited.

2. Signal wiring shield shall be grounded at controller end only unless otherwise recommended by the controller manufacturer.

~~E.~~**D.** Low Voltage Analog Output Wiring: Contractor shall run all low voltage control wiring in accordance with the latest edition of the National Electrical Code and Division 26.

1. Low voltage control wiring shall be 18-gage. Wiring size for RJ-11 and RJ-45 connectors shall be 22-gage, twisted pair, 100 percent shielded, with PVC cover, Class 2 plenum-rated. Low voltage control wiring shall be run with no splices separate from any wiring above thirty (30) volts.

    a. Wet / Damp Locations – Wiring in underground raceways or raceways which are subject to moderate degrees of moisture shall be listed for installation in wet locations. Direct burial wiring without a raceway is prohibited.

~~F.~~**E.** Control Panels: Provide control panels with suitable brackets for wall mounting, unless noted otherwise, for each control system. Locate panel adjacent to systems served. Mount center of control panels [60 inches – confirm with Owner] above finished floor or roof.

1. Interior: Fabricate panels of 16-gage furniture-grade steel, totally enclosed on four sides, with removable perforated backplane, hinged door and keyed lock, with manufacturer's standard shop-painted finish and color. Panel / enclosure shall be sized to provide adequate mounting space for all components plus a minimum of 25% spare backplane capacity. All components shall have a minimum of 2 inch clearance from the four sides of the panel unless factory wired and designed otherwise.

2. Exterior: 16-gage 304 or 316 stainless steel NEMA 4X enclosure. Panel shall have hinged door, keyed lock, and integral, thermostatically controlled heater. Provide hinged deadfront inside panel when flush-mounted control and/or indicating devices are included in panel. Fiberglass or aluminum, as applicable, to be used when gases that are being used in the panel area are corrosive to stainless steel.

3. Provide UL-listed cabinets for use with line voltage devices.

4. Control panel shall be completely factory wired and piped, and all electrical connections made to a terminal strip. Wire nuts are not acceptable in exposed area of panel. High and low voltage cables shall be isolated from each other.

5. All gauges and control components shall be identified by means of nameplates or Owner approved equivalent.

6. Provide a 6 inch x 6 inch minimum wireway (metal wiring/tubing) trough across the entire width of the panel mounted to the top of the panel with close nipples of sufficient size for additional 50 percent wiring and tubing capacity. Wireways shall not be less than 24 inches in length. Control panel wiring shall be installed and distributed in the wireway to minimize routing of wiring and tubing within the control panel. Wireway construction to be the same as the associated control panel.

7. Complete wiring and tubing termination Drawings shall be mounted in, and a second set mounted adjacent to, each panel in a frame with lexan cover of sufficient size to be easily readable.

2.03 CONTROL VALVES

A. General:

1. Provide factory fabricated control valves of type, body material and pressure class indicated on the 'Control Valve Specification Sheet' located at the end of this Section. Control valves for chilled water and heating water coils shall be pressure independent type, Contractor shall utilize the sheet to submit the control valves for the Project.

2. Valves shall be as manufactured by Belimo, Siemens, Fisher Controls International, Valtek Control Products, DeZurik/Copes-Vulcan, Keystone, Leslie Controls Inc., or equal.

3. Where type or body material is not indicated, provide selection as determined by manufacturer for installation requirements and pressure class, based on maximum pressure and temperature in piping system.

4. Provide pressure independent valve size in accordance valve manufacturer's recommendations. Provide pressure dependent valve size in accordance with scheduled or specified maximum pressure drop across control valve.

5. Control valves shall be equipped with heavy-duty actuators and pilot positioners with proper close-off rating and capability for each individual application. Pressure independent control valves shall be provided with actuators manufactured, and warranted by the valve manufacturer. Entire valve/actuator assembly shall be warranted for 5 years; first two years shall be unconditional.

6. Minimum close-off rating shall be as scheduled and adequate for each application, and shall generally be considered at dead head rating of the pump.

7. Pressure independent control valves shall be provided with one (1) service tool or one (1) copy of service software for use in commissioning these valves. Service tool or software shall be provided to TAB contractor, and subsequently transferred to Owner's Representative with job Record Documents. Pressure independent control valve manufacturer shall provide one (1) hour of training in the use of the service tool/service software to TAB personnel and BAS personnel prior to the start of the commissioning process. Pressure independent control valve manufacturer shall provide one (1) hour of training in the use of the service tool/service software to Owner's personnel as part of the required BAS training.

~~2.04CONTROL DAMPERS~~

~~A.General: Provide factory fabricated automatic control dampers of sizes, velocity and pressure classes as required for smooth, stable, and controllable airflow. Provide parallel or opposed blade dampers as recommended by manufacturer's sizing techniques. For dampers located near fan outlets, provide dampers rated for fan outlet velocity and close-off pressure, and recommended by damper manufacturer for fan discharge damper service. Control dampers used for smoke dampers shall comply with UL 555S. Control Dampers used for fire dampers shall comply with UL 555.~~

~~B.For general isolation and modulating control service in rectangular ducts at velocities not greater than 1500 feet per minute (fpm) (7.62 m/s), differential pressure not greater than 2.5 inches w.c. (622 Pa):~~

~~1.Performance: Test in accordance with AMCA 500.~~

~~2.Frames: Galvanized steel, 16-gage minimum thickness, welded or riveted with corner reinforcement.~~

~~3.Blades: Stainless steel in lab exhausts and galvanized steel elsewhere, maximum blade size 8 inches (200 mm) wide by 48 inches (1219 mm) long, attached to minimum 1/2 inch (12.7 mm) shafts with set screws, 16 gage minimum thickness.~~

~~4.Blade Seals: Synthetic elastomer, mechanically attached, field replaceable.~~

~~5.Jamb Seals: Stainless steel.~~

~~6.Shaft Bearings: Oil impregnated sintered bronze, graphite impregnated nylon sleeve or other molded synthetic sleeve, with thrust washers at bearings.~~

~~7.Linkage: Concealed in frame.~~

~~8.Linkage Bearings: Oil impregnated sintered bronze or graphite impregnated nylon.~~

~~9.Leakage: Less than one percent based on approach velocity of 1500 fpm. (7.62 m/s) and 1 inches wg. (249Pa).~~

~~10.Maximum Pressure Differential: 2.5 inches wg. (622 Pa).~~

~~11.Temperature Limits: -40 to 200 degrees F (-40 to 93 degrees C).~~

~~12.Where opening size is larger than 48 inches (1219 mm) wide or 72 inches (1829 mm) high, provide dampers in multiple sections, with intermediate frames and jackshafts appropriate for installation.~~

~~C.For general isolation and modulating control service in rectangular ducts at velocities not greater than 4000 fpm (20.3 m/s), differential pressure not greater than 6 inches w.c. (1493 Pa):~~

~~1.Performance: Test in accordance with AMCA 500.~~

~~2.Frames: Galvanized steel, 16-gage minimum thickness, welded or riveted with corner reinforcement.~~

~~3.Blades: Extruded aluminum hollow airfoil shape, maximum blade size 8 inches (200 mm) wide by 48 inches (1219 mm) long, attached to minimum 1/2 inch (12.7 mm) shafts, 14 gage minimum extrusion thickness.~~

~~4.Blade Seals: Synthetic elastomeric, mechanically attached, field replaceable.~~

~~5.Jamb Seals: Stainless steel.~~

~~6.Shaft Bearings: Oil impregnated sintered bronze sleeve, graphite impregnated nylon sleeve, molded synthetic sleeve, or stainless steel sleeve, with thrust washers at bearings.~~

~~7.Linkage: Concealed in frame.~~

~~8.Linkage Bearings: Oil impregnated sintered bronze or graphite impregnated nylon.~~

~~9.Leakage: Less than 0.1 percent based on approach velocity of 4000 fpm. (20.3 m/s) and 1 inches wg. (249Pa).~~

~~10.Maximum Pressure Differential: 6 inches wg. (622 Pa).~~

~~11.Temperature Limits: -40 to 200 degrees F (-40 to 93 degrees C).~~

~~12.Where opening size is larger than 48 inches (1219 mm) wide or 72 inches (1829 mm) high, provide dampers in multiple sections, with intermediate frames and jackshafts appropriate for the installation.~~

~~D.For general isolation and modulating control service in rectangular ducts at velocities not greater than 4000 fpm, differential pressure not greater than 12 inches w.c.:~~

~~1.Performance: Test in accordance with AMCA 500.~~

~~2.Frames: Galvanized steel, 12-gage minimum thickness, welded or riveted with corner reinforcement.~~

~~3.Blades: Extruded aluminum hollow airfoil shape, maximum blade size 8 inches (200 mm) wide by 48 inches (1219 mm) long, attached to minimum 3/4 inch (19 mm) shafts with set screws.~~

~~4.Shaft Bearings: Oil impregnated sintered bronze or stainless steel, pressed into frame, with thrust washers at bearings.~~

~~5.Linkage: 10-gage minimum thickness galvanized steel clevis type crank arms, 3/16 inch x 3/4 inch (4.76 mm x 19 mm) minimum thickness tie rods.~~

~~6.Linkage Bearings: Oil impregnated sintered bronze or graphite impregnated nylon.~~

~~7.Leakage: Less than 0.2 percent based on approach velocity of 4000 fpm (20.3 m/s) and 1 inches wg. (249Pa) differential pressure.~~

~~8.Maximum Pressure Differential: 12 inches wg. (2984 Pa).~~

~~9.Temperature Limits: -40 to 300 degrees F (-40 to 149 degrees C).~~

~~10.Where opening size is larger than 48 inches (1219 mm) wide or 72 inches (1829 mm) high, provide dampers in multiple sections, with intermediate frames and jackshafts appropriate for the installation.~~

~~E.For general isolation and modulating control service in round ducts up to 40 inches in size at velocities not greater than 2500 fpm (12.7 m/s), differential pressure not greater than 4 inches w.c. (994 Pa):~~

~~1.Performance: Test in accordance with AMCA 500.~~

~~2.Frames: Rolled 12 gage steel strip for sizes 6 inch and smaller, rolled 14 gage steel channel for larger sizes, galvanized or aluminum finish.~~

~~3.Blades: Steel construction, 12 gage minimum thickness for dampers less than 18 inches (457 mm) in size, 10 gage minimum thickness for larger dampers.~~

~~4.Blade Seals: Full circumference neoprene.~~

~~5.Shaft: ½ inch (12.7 mm) diameter zinc or cadmium plated steel.~~

~~6.Shaft Bearings: Oil impregnated sintered bronze or stainless steel, pressed into frame, with thrust washers at bearings.~~

~~7.Leakage: Less than 0.2 percent based on approach velocity of 4000 fpm. (20.3 m/s) and 1 inches wg. (249Pa) differential pressure.~~

~~8.Maximum Pressure Differential: 4 inches wg. (994 Pa).~~

~~9.Temperature Limits: -40 to 300 degrees F (-40 to 149 degrees C).~~

~~F.For general isolation and modulating control service in round ducts up to 60 inches in size at velocities not greater than 4000 fpm (20.3 m/s), differential pressure not greater than 6 inches w.c. (1492 Pa):~~

~~1.Performance: Test in accordance with AMCA 500.~~

~~2.Frames: Rolled 10-gage steel channel for sizes 48 inch and smaller, rolled 3/16 inch (4.76 mm) thick steel channel for larger sizes, galvanized or aluminum finish.~~

~~3.Blades: Steel construction, 10-gage minimum thickness for dampers not greater than 48 inches in size, ¼ inch (6.35 mm) minimum thickness for larger dampers.~~

~~4.Blade stops: ½ inch x ¼ inch (12.7 mm x 6.35 mm) full circumference steel bar.~~

~~5.Blade Seals: Full circumference neoprene.~~

~~6.Shaft: Zinc or cadmium plated steel, angle reinforcing as necessary.~~

~~7.Shaft Bearings: Oil impregnated sintered bronze or stainless steel, pressed into frame, with thrust washers at bearings.~~

~~8.Leakage: Less than 0.4 percent based on approach velocity of 4000 fpm (20.3 m/s) and 1 inches wg. (249Pa) differential pressure.~~

~~9.Maximum Pressure Differential: 6 inches wg. (1492 Pa).~~

~~10.Temperature Limits: -40 to 250 degrees F (-40 to 121 degrees C).~~

~~2.05~~**2.04** ACTUATORS

A. General: Size actuators and linkages to operate their appropriate dampers or valves with sufficient reserve torque or force to provide smooth modulating action or 2-position action as specified. Select spring-return actuators with manual override to provide positive shut-off of devices as they are applied.

B. Actuators:

1. Ambient Operating Temperature Limits: -10 to 150 degrees F (-12.2 to 66 degrees C).

~~2.Two Position Electric Actuators: Line voltage (120 volt, 24 volt) with spring return. Provide end switches as required.~~

~~3.~~**2.** Modulating Electronic Actuators: Provide actuators with spring return for 0-5 Vdc, 0-10 Vdc, 2-10Vdc, and 4-20 mA on valves greater than 1 inch. 3-point floating actuators for terminal units are to fail in place unless specified otherwise. Actuators shall travel full stroke in less than 150 seconds. Actuators shall be designed for a minimum of 60,000 full cycles at full torque and be UL listed. Provide stroke indicator. Actuators shall have positive positioning circuit where indicated. [Parallel actuators on a single valve are allowed only if written approval is given by Owner]. Actuators shall have current limiting motor protection. Actuators shall have manual override. Modulating actuators for valves shall have minimum rangeability of 40 to 1.

a. Close-Off Pressure: Provide the minimum torque required, and spring return for fail positioning (unless otherwise specifically indicated) sized for required close-off pressure. Required close-off pressure for two-way water valve applications shall be the shutoff head of associated pump. Required close-off rating of steam valve applications shall be design inlet steam pressure plus 50 percent for low pressure steam, and 10 percent for high pressure steam. Required close-off rating of air damper applications shall be shutoff pressure of associated fan, plus 10 percent.

b. Subject to compliance with requirements, approved manufacturers are as follows:

1) Siemens.

~~2)Automated Logic.~~

~~3)Belimo.~~

~~4)Johnson Controls.~~

~~5)Delta.~~

~~6)~~**2)** Substitutions: By written approval from Owner.

~~2.06~~**2.05** GENERAL FIELD DEVICES

A. Provide field devices for input and output of digital (binary) and analog signals into controllers (BCs, AACs, ASCs). Provide signal conditioning for all field devices as recommended by field device manufacturers and as required for proper operation in the system.

B. It shall be the Contractor's responsibility to assure that all field devices are compatible with controller hardware and software.

C. Field devices specified herein are generally ‘two-wire’ type transmitters, with power for the device to be supplied from the respective controller. If the controller provided is not equipped to provide this power, is not designed to work with ‘two-wire’ type transmitters, if field device is to serve as input to more than one controller, or where the length of wire to the controller will unacceptably affect the accuracy, the Contractor shall provide ‘four-wire’ type equal transmitter and necessary regulated DC power supply or 120 VAC power supply, as required.

D. For field devices specified hereinafter that require signal conditioners, signal boosters, signal repeaters, or other devices for proper interface to controllers, Contractor shall furnish and install proper device, including 120V power as required. Such devices shall have accuracy and repeatability equal to, or better than, the accuracy and repeatability listed for respective field devices.

E. Accuracy: As stated in this Section, accuracy shall include combined effects of nonlinearity, nonrepeatability and hysteresis.

~~2.07VFD SERIAL COMMUNICATION~~

~~A.VFD Serial communications shall include, but not be limited to monitor the following feedback signals:~~

~~1.Process variable.~~

~~2.Output speed/frequency.~~

~~3.Current~~

~~4.Torque~~

~~5.Power (kW)~~

~~6.Operating hours~~

~~7.Kilowatt hours (kWh)~~

~~8.Relay outputs~~

~~9.Diagnostic warning and fault information~~

~~2.08~~**2.06** TEMPERATURE SENSORS (TS)

A. Sensor Type Selection

1. Certified Control and Monitoring sensors shall require a matching class A RTD and transmitter pair which is factory calibrated and installed for the following application:

a. Dedicated building side immersion CHW supply temperature sensor for each heat exchanger.

b. TECO CHW immersion supply and return temperature sensors.

c. Dedicated averaging final supply air temperature sensor for all AHU greater than 20,000 CFM.

d. CHW and HW temperature sensors used for BTU calculation.

e. Other certified temperature sensors identified in the construction documents.

2. Standard Control and Monitoring sensors shall be utilized for all other sensors not identified as Certified Control and Monitoring sensors.

B. Sensor resolution: When matched with A/D converter of BC, AAC/ASC, or SD, sensor range shall provide a resolution of no worse than 0.2 degrees F (unless noted otherwise). Where thermistors are used, the stability shall be better than 0.25 degrees F over five (5) years.

C. Room Temperature Sensor: Shall be an element contained within a ventilated cover, suitable for wall mounting, unless noted otherwise. Provide insulated base. Sensor color and type shall match surrounding existing sensor when applicable. Following sensing elements are acceptable:

1. Sensing element shall be platinum RTD, thermistor, or integrated circuit, ±0.6 degrees F accuracy at calibration point.

2. Provide setpoint adjustment where indicated. The setpoint adjustment shall be a warmer/cooler indication that shall be scalable via the BAS.

3. Provide an occupancy override button on the room sensor enclosure where indicated. This shall be a momentary contact closure.

4. Provide current temperature indication via an LCD or LED readout, where indicated.

D. Single-Point Duct Temperature Sensor: Application allowed on supply air volumes of 2000 CFM or less and non-critical return air readings. Shall consist of sensing element, junction box for wiring connections and gasket to prevent air leakage or vibration noise. Temperature range as required for resolution indicated.

1. Sensing element shall be 100 Ohm platinum RTD which transmits a 4 to 20 mA output signal. The accuracy of this sensor shall be ± 0.7 degrees F. This type of sensor does not require field calibration and shall be replaced if tolerance of ± 1.4 degrees F is exceeded.

2. 10,000 ohms sensing element shall be allowed for the auxiliary temperature sensor for air terminal application specific controllers. Temperature range 55-95 Deg F. Mid Range Accuracy + (-) 0.5 Deg F. Sensor shall be secured in place with a minimum of a 2x4 metal enclosure.

E. Averaging Duct Temperature Sensor: Shall consist of an averaging element, junction box for wiring connections and gasket to prevent air leakage. Provide sensor lengths and quantities to result in one lineal foot of sensing element for each three square feet of cooling coil/duct face area. Provide a minimum of two sensors when coil/duct face area exceeds 149 square feet. Temperature range as required for resolution indicated.

1. Sensing element shall be class A 100 Ohm platinum RTD which transmits a 4 to 20 mA output signal.

a. Standard Control and Monitoring: The accuracy of this sensor shall be ± 0.7 degrees F. This type of sensor does not require field calibration and shall be replaced if tolerance of ± 1.4 degrees F is exceeded

b. Certified Control and Monitoring" The accuracy of this matched paired sensor shall be ± 0.2 degrees F. This sensor shall be factory calibrated and shall be replaced if field tolerance of ± 0.3 degrees F is exceeded. Provide to owner the manufacturer's matched pair certificate of temperature uncertainty at 25%, 50% and 75% of temperature span of the unit

F. Liquid immersion temperature sensor shall include brass thermowell, sensor and connection head for wiring connections. Temperature range shall be as required to fit the application

1. Sensing element shall be class A100 Ohm platinum RTD which transmits a 4 to 20 mA output signal..

a. Standard Control and Monitoring: The accuracy of this sensor shall be ± 0.6 degrees F. This type of sensor shall be factory calibrated and shall be replaced if tolerance of ± 0.9 degrees F is exceeded.

b. Certified Control and Monitoring: The accuracy of this matched paired sensor shall be ± 0.2 degrees F. This type of sensor shall be factory calibrated and shall be replaced if field tolerance of ± 0.3 degrees F is exceeded. Provide to owner the manufacturer's matched pair certificate of temperature uncertainty at 25%, 50% and 75% of temperature span of the unit.

G. Pipe Surface-Mount Temperature Sensor: Shall be used only where indicated or by written approval by Owner. Sensor shall include metal junction box and clamps and shall be suitable for sensing pipe surface temperature and installation under insulation. Provide thermally conductive paste at pipe contact point.

1. Sensing element shall be 100 Ohm platinum RTD which transmits a 4 to 20 mA output signal. The accuracy of this sensor shall be ± 1.1 degrees F on a range of 30 - 250 degrees F scale. This sensor shall be factory calibrated and shall be replaced if tolerance of ± 0.9 degrees F is exceeded.

H. Outside air sensors shall consist of a sensor, sun shield, utility box, and watertight gasket to prevent water seepage.

1. Sensing element shall be 100 Ohm platinum RTD which transmits a 4 to 20 mA output signal. The accuracy of this sensor shall be ± 0.6 degrees F. This type of sensor does not require field calibration and shall be replaced if tolerance of ± 1.2 degrees F is exceeded.

~~2.09~~**2.07** HUMIDITY TRANSMITTERS

A. Units shall be suitable for their application. Unit shall be two-wire transmitter utilizing bulk polymer resistance change or thin film capacitance change humidity sensor. Unit shall produce linear continuous output of 4-20 mA for percent relative humidity (% RH). A combination temperature and humidity sensor may be used for zone level monitoring. Sensors shall have the following minimum performance and application criteria:

1. Input Range: 0 to 100% RH.

2. Accuracy (% RH): ±2 percent between 20-90% RH at 77 degrees F, including hysteresis, linearity, and repeatability.

3. Sensor Operating Range: As required by application.

4. Long Term Stability: Less than 1 percent drift per year.

B. Acceptable Manufacturers: Units shall be Siemens, Vaisala HM Series, General Eastern, Microline, or Hy-Cal HT Series.

~~2.10~~**2.08** DIFFERENTIAL PRESSURE TRANSMITTERS (DP)

A. Liquid, Steam and Gas:

1. General: Two-wire smart DP cell type transmitter, 4-20 mA linear output, adjustable span and zero, stainless steel wetted parts.

2. Ambient Limits: 0 to 175 degrees F.

3. Process Limits: 0 to 175 degrees F.

4. Accuracy: Less than 0.3 percent.

5. Output Damping: Time constant user selectable from 0 to 36 seconds.

6. Vibration Effect: Less than ±0.1 percent of upper range limit from 15 to 2000 Hz in any axis relative to pipe mounted process conditions.

7. Electrical Enclosure: NEMA 4, 4X, 7, 9.

8. Approvals: FM, CSA.

9. Acceptable Manufacturers: Setra, Rosemount Inc. 3051 Series, Foxboro, Johnson-Yokagawa.

B. General Purpose Low Pressure Air: Generally for each measurement of duct pressure, filter differential pressure or constant volume air velocity pressure measurement where the range is applicable. Sensor shall be in range at all times.

1. General: Loop powered two-wire differential capacitance cell-type transmitter.

2. Output: Two wire 4-20 mA output with zero adjustment.

3. Overall Accuracy: Plus or minus 1 percent.

4. Minimum Range: 0.1 inches w.c.

5. Maximum Range: 10 inches w.c.

6. Housing: Polymer housing suitable for surface mounting.

7. Acceptable Manufacturers: Units shall be Setra,

8. Static Sensing Element: Pitot-type static pressure sensing tips similar to Dwyer model A-301 and connecting tubing.

9. Magnehelic Gauges: Provide Dwyer Series 200 Magnehelic Differential Pressure Gauge (or equal) for each DP transmitter for filter differential pressure. Provide gauge, mounting bracket, ¼ inch aluminum tubing, static pressure tips, and molded plastic vent valves for each gauge connection. Select range for specified recommended filter loading pressure drop to be 75 percent full-scale. For other DP transmitters select range for specified setpoint to be between 25 percent and 75 percent full-scale.

~~2.11~~**2.09** VALVE BYPASS FOR DIFFERENTIAL PRESSURE SENSORS

A. Provide a five valve bypass kit for protection of DP sensors where the static on the pipe can cause on over pressure when connected to one port with the other at atmospheric pressure. Kit shall include high and low pressure isolation valves, high and low pressure vent valves, calibration taps, and a bypass valve contained in a NEMA 1 enclosure.

~~2.12~~**2.10** DIFFERENTIAL PRESSURE SWITCHES (DPS)

A. General Service Auto Reset - Air: Diaphragm with adjustable setpoint and differential and snap acting form C contacts rated for the application. Provide manufacturer's recommended static pressure sensing tips and connecting tubing. Acceptable Manufacturer - Dwyer Series 1900 or approved equal.

B. General Service Manual Reset - Air: Diaphragm with adjustable setpoint and differential and snap acting form C contacts rated for the application. Manual reset shall be readily accessible in reach of personnel installed at height not to exceed 5 feet above finished floor. Provide manufacturer's recommended static pressure sensing tips and connecting tubing. Acceptable Manufacturer - Dwyer Series 1900 or approved equal. The High Static Pressure Safety Switch shall alarm to the Building Automation System upon activation.

C. General Service - Water: Diaphragm with adjustable setpoint, 2 psig or adjustable differential and snap-acting Form C contacts rated for the application. 60 psid minimum pressure differential range and 0 degrees F to 160 degrees F operating temperature range.

~~2.13~~**2.11** PRESSURE SWITCHES (PS)

A. Diaphragm or bourdon tube with adjustable setpoint and differential and snap-acting Form C contacts rated for the application. Pressure switches shall be capable of withstanding 150 percent of rated pressure.

B. Acceptable Manufacturers: Siemens, Square D, ITT Neo-Dyn, ASCO, Penn, Honeywell, and Johnson Controls.

~~2.14CURRENT SWITCHES (CS)~~

~~A.Clamp-On Design Current Operated Switch (for Motor Status Indication):~~

~~1.Range: 3.5 to 135 amps.~~

~~2.Trip Point: Adjustable.~~

~~3.Switch: Solid state, normally open, 0.1A @ 30VAC/DC.~~

~~4.Trip Indication: LED.~~

~~5.Approvals: UL, CSA.~~

~~6.Maximum Cable Size: 350 MCM.~~

~~7.Manufacturers: Veris Industries H-608, H-904, H-908.~~

~~a.Veris Model Number H-608 restricted to constant speed motors rated 40 horsepower or less.~~

~~b.Veris Model Number H-904 required on VFD motors.~~

~~B.Variable Speed Status: Contractor shall utilize programmable status contacts from the VSD where applicable.~~

~~2.15 CURRENT TRANSFORMERS (CT)~~

~~A.Clamp-On Design Current Transformer (for Motor Current Sensing)~~

~~1.Range: 1-10 amps minimum, 20-200 amps maximum.~~

~~2.Trip Point: Adjustable.~~

~~3.Output: 0-5 VDC.~~

~~4.Accuracy: ±0.2 percent from 20 to 100 Hz.~~

~~5.Acceptable Manufacturers: KELE SA100.~~

~~**[ENGINEER MUST REFER TO THE BAS MASTER SPECIFICATION SECTION 25 11 10 FOR THE FOLLOWING APPLICATIONS IF NEEDED:**~~

~~**AIRFLOW MEASURING STATIONS (AFMS)**~~

~~**ULTRASONIC FLOW METER FOR WATER SERVICE**~~

~~**ULTRASONIC FLOW METER FOR STEAM SERVICE**~~

~~**INSERTION TYPE TURBINE METER FOR WATER SERVICE**~~

~~**VORTEX SHEDDING FLOW METER FOR LIQUID, STEAM AND GAS SERVICE**~~

~~**MAGNETIC FLOW METER FOR WATER SERVICE**~~

~~**VENTURI FLOW METER FOR WATER SERVICE**~~

~~**REFRIGERANT MONITOR]**~~

~~2.16CO_2 SENSORS/TRANSMITTERS (CO2)~~

~~A.General: CO_2 sensors shall use silicon based, diffusion aspirated, infrared single beam, dual-wavelength sensor.~~

~~B.Accuracy: ±100 ppm.~~

~~C.Stability: 5 percent over 5 years.~~

~~D.Output: 4-20 mA, 0-10 Vdc or relay.~~

~~E.Mounting: Duct or Wall as indicated.~~

~~F.Acceptable Manufacturer: Vaisala, Inc. GMD20 (duct) or GMW20 (wall).~~

~~2.17~~**2.12** ELECTRIC CONTROL COMPONENTS

A. Limit Switches (LS): Limit switches shall be UL listed, SPDT or DPDT type, with adjustable trim arm. Limit switches shall be as manufactured by Square D, Allen Bradley.

B. Low Temperature Detector ('Freezestat') (FZ): Low temperature detector shall consist of a 'cold spot' element which responds only to the lowest temperature along any one foot of entire element, minimum bulb size of 1/8 inch x 20 feet (3.2mm x 6.1m), junction box for wiring connections and gasket to prevent air leakage or vibration noise, DPDT (4 wire, 2 circuit) with manual reset. Manual reset shall be readily accessible in reach of personnel installed at height not to exceed 5 feet above finished floor. Temperature range 15 to 55 degrees F (-9.4 to 12.8 degrees C), factory set at 38 degrees F. Provide sensor lengths and quantities to result in one lineal foot of sensing element for each five square feet of cooling coil/duct face area. The Low Temperature Detector shall alarm to the Building Automation System upon activation

C. High Temperature Detectors ('Firestat') (FS): High temperature detector shall consist of 3-pole contacts, a single point sensor, junction box for wiring connections and gasket to prevent air leakage of vibration noise, triple-pole, with manual reset. Temperature range 25 to 215 degrees F (-4 to 102 degrees C).

D. Surface-Mounted Thermostat: Surface-mounted thermostat shall consist of SPDT contacts, operating temperature range of 50 to 150 degrees F (10 to 65 degrees C), and a minimum 10 degrees F fixed setpoint differential.

E. Low Voltage Wall Thermostat: Wall-mounted thermostat shall consist of SPDT sealed contacts, operating temperature range of 50 to 90 degrees F (10 to 32 degrees C), switch rating of 24 Vac (30 Vac maximum), and both manual and automatic fan operation in both the heat and cool modes.

F. Control Relays: All control relays shall be UL listed, with contacts rated for the application.

1. Control relays for use on electrical systems of 120 volts or less shall have, as a minimum, the following:

a. Pilot light indication of power-to-coil. Pilot light shall be visible from a standing position of 5 feet AFF.

b. Coil rated for 50 and 60 Hz service.

c. Relays shall be labeled in a professional manner to identify the function or purpose. Coordinate with owner for approved verbiage of labels

d. Acceptable Manufacturers: Relays shall be Functional Devices (RIB), Potter Brumfield, Model KRPA or approved equal.

2. Relays used for across-the-line control (start/stop) of 120V motors, 1/4 horsepower, and 1/3 horsepower, shall be rated to break minimum 10 Amps inductive load. Relays shall be IDEC or approved equal.

3. Relays used for stop/start control shall have low voltage coils (30 VAC or less), and shall be provided with transient and surge suppression devices at the controller interface.

4. All safety circuits shall be installed to operate individual interposing relays located in the associated equipment control panel. Each safety device (i.e. freezestat, DP safety, smoke detector, firestat, etc.) wiring circuit shall be installed with individual homeruns back to the associated control panel. See control Drawings for details.

G. General Purpose Power Contactors: NEMA ICS 2, AC general-purpose magnetic contactor. ANSI/NEMA ICS 6, NEMA 1 enclosure. Manufacturer shall be Square 'D', Cutler-Hammer or Westinghouse.

H. Control Transformers: Furnish and install control transformers as required. Control transformers shall be machine tool type, and shall be US and CSA listed. 120/24 VAC transformers shall be fused in accordance with the NEC. Transformer shall be properly sized for application, and mounted in minimum NEMA 1 air vented enclosure. Multiple transformers in a single enclosure shall have fan aided ventilation whenever ambient temperature exceeds 140 deg F

1. Transformers shall be manufactured by Westinghouse, Square ‘D’, Jefferson or approved equal.

I. Time Delay Relays (TDR): TDRs shall be capable of on or off delayed functions, with adjustable timing periods, and cycle timing light. Contacts shall be rated for the application with a minimum of two (2) sets of Form C contacts, enclosed in a NEMA 1 enclosure.

1. TDRs shall have silver cadmium contacts with a minimum life span rating of one million operations. TDRs shall have solid state, plug-in type coils with transient suppression devices.

2. TDRs shall be UL and CSA listed, Crouzet type.

J. Electric Push Button Switch: Switch shall be momentary contact, oil tight, push button, with number of N.O. and/or N.C. contacts as required. Contacts shall be snap-action type, and rated for minimum 120 Vac operation. Switch shall be 800T type, as manufactured by Allen Bradley or approved equal.

K. Pilot Light: Panel-mounted pilot light shall be NEMA ICS 2 oil tight, transformer type, with screw terminals, push-to-test unit, LED type, rated for 120 VAC. Unit shall be 800T type, as manufactured by Allen-Bradley or approved equal.

L. Alarm Horn: Panel-mounted audible alarm horn shall be continuous tone, 120 Vac Sonalert solid-state electronic signal, as manufactured by Mallory or approved equal.

M. Electric Selector Switch (SS): Switch shall be maintained contact, NEMA ICS 2, oil-tight selector switch with contact arrangement, as required. Contacts shall be rated for minimum 120 Vac operation. Switch shall be 800T type, as manufactured by Allen-Bradley or approved equal.

~~2.18~~**2.13** NAMEPLATES

A. Provide engraved phenolic or micarta nameplates for all equipment, components, and field devices furnished. Nameplates shall be 1/8 inch thick, black, with white center core, and shall be minimum 1 inch x 3 inch, with minimum ¼ inch high block lettering. Nameplates for devices smaller than 1 inch x 3 inch shall be attached to adjacent surface.

B. Each nameplate shall identify the function for each device.

~~2.19~~**2.14** TESTING EQUIPMENT

A. Contractor shall test and calibrate all signaling circuits of all field devices to ascertain that required digital and accurate analog signals are transmitted, received, and displayed at system operator terminals, and make all repairs and recalibrations required to complete test. Contractor shall be responsible for test equipment required to perform these tests and calibrations. Test equipment used for testing and calibration of field devices shall be at least twice as accurate as respective field device (e.g., if field device is ±0.5 percent accurate, test equipment shall be ±0.25 percent accurate over same range).

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. All installation shall be in accordance with manufacturer’s published recommendations.

C. General: Install systems and materials in accordance with manufacturer's instructions, roughing-in Drawings and details shown on Drawings. Install electrical components and use electrical products complying with requirements of the latest edition of the National Electrical Code and all local codes.

D. Control Wiring: The term "control wiring" is defined to include providing of wire, conduit and miscellaneous materials as required for mounting and connection of electric control devices.

1. Wiring System: Install complete wiring system for electric control systems. Conceal wiring exposed in mechanical rooms and areas where other conduit and piping are exposed. Installation of wiring shall generally follow building lines. Install in accordance with the latest edition of the National Electrical Code and Division 26. Fasten flexible conductors bridging cabinets and doors, neatly along hinge side, and protect against abrasion. Tie and support conductors neatly.

2. Control Wiring Conductors: Install control wiring conductors, without splices between terminal points, color-coded. Install in neat workmanlike manner, securely fastened. Install in accordance with the latest edition of the National Electrical Code and Division 26.

3. Communication wiring, signal wiring and low voltage control wiring shall be installed separate from any wiring over thirty (30) volts. Signal wiring shield shall be grounded at controller end only, unless otherwise recommended by the controller manufacturer.

4. All WAN and LAN patch cords shall be approved and installed as directed by owner.

5. BAS low voltage wiring/cables: All cables shall have legible printed sleeve identification labels at each device and the panel termination.

    a. Labels shall be Brady PermaSleeve ™, part number - "BPSPT-187-175-WT" or owner approved equivalent.

    b. Each label shall be identified with the entire BAS point name utilized in the BAS database and the point address.

    c. Install RJ11 modular jack plates for the Owner's spare alarm connection points specified on the drawing. The entire point address printed with black text on ½" high white labels shall be installed to identify each port of the RJ11 modular jack plate. Contractor shall confirm exact wall location with the Owner prior to installing.

6. Terminate all control wiring internal to panels to screw terminals connections or owner approved wire connection equivalent. Wire nuts and/or splices are not allowed in panels. When terminating a wire cable, the cable jacket, cable shielding wire, and cable shielding material shall be finished in a neat consistent workmanlike manner.

7. Install all control wiring external to panels in electric metallic tubing or raceway. Installation of wiring shall generally follow building lines. Provide steel type connectors. Install wiring in galvanized rigid steel conduit at all exterior locations and where subjected to moisture. Install in PVC Schedule 40 conduit if encased in concrete. All conduits penetrating partitions, walls or floors shall be sealed with a submitted and approved fire/smoke sealant to prevent migration of air through the conduit system.

8. Communication wiring, signal wiring and low voltage control wiring may be run without conduit in concealed, accessible locations if noise immunity is ensured.

    a. Contractor shall be fully responsible for noise immunity and rewire in conduit if electrical or RF noise affects performance.

    b. Accessible locations are defined as areas inside mechanical equipment enclosures, such as heating and cooling units, instrument panels etc.; in accessible pipe chases with easy access, or suspended ceilings with easy access. Installation of wiring shall generally follow building lines.

c. Run in a neat and orderly fashion, bundled where applicable, and completely suspended (strapped to rigid elements or routed through wiring rings) away from areas of normal access. Tie and support conductors neatly with suitable nylon ties and not to exceed five (5) foot intervals.

d. Conductors shall not be supported by the ceiling system or ceiling support system. Conductors shall be pulled tight and be installed as high as practically possible in ceiling cavities. Wiring shall not be laid on the ceiling or duct.

e. Conductors shall not be installed between the top cord of a joist or beam and the bottom of roof decking.

9. Secondary LAN Communication cabling shall be provided in an Owner approved color dedicated to the BAS.

10. Number-code or color-code conductors appropriately for future identification and servicing of control system. Code shall be as indicated on approved installation Drawings..

E. Control Valves: Install so that actuators, wiring, and tubing connections are accessible for maintenance. Where possible, install with valve stem axis vertical, with operator side up. Where vertical stem position is not possible or would result in poor access, valves may be installed with stem horizontal. Do not install valves with stem below horizontal, or down.

F. Averaging Temperature Sensors: Cover no more than two square feet per linear foot of sensor length except where indicated. Manufacturer recommended mounting clips shall be used to support and prevent any movement of the sensing probe in the air flow. Generally, where flow is sufficiently homogeneous/adequately mixed at sensing location, consult Engineer for requirements.

G. Fluid Flow Sensors: Install per manufacturer's recommendations in an unobstructed straight length of pipe.

H. Relative Humidity Sensors: Provide element guard as recommended by manufacturer for high velocity installations. For high limit sensors, position remote enough to allow full moisture absorption into the air stream before reaching the sensor.

I. Water Differential Pressure Transmitters: Provide 5 valve bypass arrangement to protect against over pressure damaging the transmitter.

J. ~~Steam Differential Pressure Transmitters: Install as shown on the Drawings per manufacturer's instructions~~.

~~K.Pipe Surface Mount Temperature Sensors: Install with thermally conductive paste at pipe contact point. Where sensor is to be installed on an insulated pipe Contractor shall neatly cut insulation install sensor, repair or replace insulation and vapor barrier and adequately seal vapor barrier.~~

~~L.Flow Switches: Where possible, install in a straight run of pipe at least 15 diameters in length to minimize false indications.~~

~~M.Current Switches for Motor Status Monitoring: Adjust so that set point is below minimum operating current and above motor no load current.~~

~~N.~~**K.** Supply Duct Pressure Transmitters:

1. General: Install pressure tips with at least four (4) 'round equivalent' duct diameters of straight duct with no takeoffs upstream. Install static pressure tips securely fastened with tip facing upstream in accordance with manufacturer's installation instructions. Locate the transmitter at an accessible location to facilitate calibration.

2. VAV System 'Down-Duct' Transmitters: Locate pressure tips as indicated on Drawings or as directed by Owner's TAB Firm.

~~O.~~**L.** Cutting and Patching Insulation: Repair insulation to maintain integrity of insulation and vapor barrier jacket. Use hydraulic insulating cement to fill voids and finish with material matching or compatible with adjacent jacket material.

~~**[FOR CRITICAL SERVICE CONTROL VALVE APPLICATIONS, ENGINEER SHALL COMPLETE THE APPLICABLE FOLLOWING FORMS FOR EACH INDIVIDUAL APPLICATION AND/OR VALVE. CONTROL VALVE SIZING AND SELECTION IS THE INITIAL RESPONSIBILITY OF THE ENGINEER AND NOT LEFT TO THE BAS PROVIDER. THE ITEMS NOTED WITH A * AND *,** SHALL BE COMPLETED BY THE ENGINEER TO LIST THE REQUIREMENTS OF THE VALVES FOR CV, CLOSE OFF, TEMPERATURE RATINGS, CAGE MATERIAL, SEAT MATERIAL, TRIM MATERIAL ETC. FOR EACH INDIVIDUAL APPLICATION. THIS SHOULD BE A RESULT OF ANALYZING THE VALVES PERFORMANCE AND APPLICATION ACROSS THE RANGE OF CONTROL. ENGINEER SHALL CONSULT WITH OWNER PRIOR TO SPECIFYING THESE VALVES.]~~**

END OF SECTION 25 11 10

~~MD Anderson Cancer Center~~									
~~Steam Control Valve Specification Sheet (Globe Body)~~									
~~Project Name~~			~~REVISIONS~~				~~SHEET~~		~~xx of xx~~
			~~NO.~~	~~BY~~	~~DATE~~	~~DESCRIPTION~~	~~SPEC. NO.~~		~~REVISION~~
			~~1~~	-	-	-	~~15951~~		*
			~~2~~	-	-	-	~~CONTRACT~~		~~DATE~~
			~~3~~	-	-	-	~~X~~		~~mm/dd/yy~~
			~~4~~	-	-	-	~~PROJECT NUMBER~~		
			~~5~~	-	-	-	~~XXXX.XX~~		
			~~6~~	-	-	-	~~BY~~	~~CHECKED~~	~~APPROVED~~
			~~7~~	-	-	-	~~XYZ~~	~~XYZ~~	~~XYZ~~
~~GENERAL~~	~~Tag Number~~		*						
	~~Service Description~~		*						
	~~P&ID Sheet Number~~		*						
	~~Line No. or Vessel No.~~		*						
	~~Line Size / Mat'l / Sch.~~		*						
	~~Electrical Class~~	~~Power Supply~~	*			*			
~~PROCESS DATA~~	~~Fluid~~	~~Fluid State~~	~~SATURATED STEAM <125 PSIG~~			~~VAPOR~~			
	~~Operating Condition~~		~~Units~~	~~Minimum~~	~~Normal~~	~~Maximum~~	~~Other~~	-	-
	~~Flow Rate~~		~~LB/HR~~	*	*	*	*	-	-
	~~Inlet Pressure~~		~~PSIG~~	*	*	*	*	-	-
	~~Outlet Pressure~~		~~PSIG~~	*	*	*	*	-	-
	~~Temperature~~		~~DEG F~~	*	*	*	*	-	-
	-		-	-	-	-	-	-	-
	~~Mol. Wt.~~		-	-	-	-	-	-	-
	~~Sp. Wt~~	~~Sp. Grav~~	-		-		-		
	~~Viscosity~~	~~Sp Heat~~	-		-		-		

~~BODY~~	~~Style~~	~~Size~~	~~GLOBE~~	~~xx"~~
	~~End Connection~~	~~Rating~~	~~xx" RF FLANGED~~	~~ANSI CLASS 150~~
	~~Port Size~~	~~Travel~~	*	*
	~~Valve Cv~~	~~Valve C1/Km~~	*	**
	~~Body Matl.~~	~~Bonnet~~	~~ASTM A216 WCB~~	~~ASTM A216 WCB~~
	~~Characteristic~~	~~Trim Number~~	~~EQUAL PERCENTAGE~~	*, **
	~~Cage Matl.~~	~~Retainer Matl.~~	*	*
	~~Seat Matl.~~	~~Seat Ring Matl.~~	*, **	*, **
	~~Plug Matl.~~	~~Stem Matl.~~	*, **	*, **
	~~Flow Action~~		~~DOWN~~	
	~~Gaskets~~		~~SPIRAL METALLIC~~	
	~~Stem Guide~~		**	
	~~Packing~~		~~GLASS FILLED PTFE**~~	
	~~Required Seat Tightness~~		~~ANSI CLASS IV~~	
	~~Max. Allowable Sound Level (dBA)~~		~~<75 dBA~~	
~~ACTUATOR~~	~~Type~~		~~PNEUMATIC~~	
	~~Size~~	~~Bench Set~~	*	*
	~~Push Down To~~	~~Fail Position~~	~~CLOSE*~~	~~CLOSE*~~
	~~Close At~~	~~Open At~~	~~6 PSIG*~~	~~30 PSIG*~~
	~~Handwheel~~		~~NONE*~~	
~~POSITIONER~~	~~Type~~		~~Electronic~~	
	~~Communications Protocol~~		*	
	~~Input Signal~~	~~Output Signal~~	~~4-20 mA~~	-
	~~Air Supply~~		~~80 PSIG NOMINAL*~~	
~~TRANSDUCER~~	~~Type~~		*	
	~~Input Signal~~		*	
	~~Output Signal~~		*	

~~OPTIONS~~	~~Air Set w/ Gauges~~	~~YES*~~
	~~Solenoids~~	~~*~~
	~~Position Switches~~	~~*~~
	~~-~~	~~-~~
~~SELECTION BASED ON~~	~~Manufacturer~~	~~Fisher, Valtek, Dezurik-Copes, Leslie, Belimo~~
	~~Valve Model Number~~	~~*~~
	~~Actuator Model No.~~	~~*~~
	~~Positioner Model No.~~	~~*~~
	~~Filter Regulator~~	~~YES~~
~~NOTES~~	~~*, ** Engineer to consult with and use manufacturer's recommended steam trim for the service, usually a hardened 400 series stainless steel.~~ ~~* Engineer shall fill in to suit application.~~ ~~** Vendor to confirm based on process data provided.~~	

~~MD Anderson Cancer Center~~									
~~Water Control Valve Specification Sheet (Globe Body)~~									
~~Project Name~~			~~Revisions~~				~~SHEET~~		~~xx of xx~~
			~~NO.~~	~~BY~~	~~DATE~~	~~DESCRIPTION~~	~~SPEC. NO.~~		~~REVISION~~
			~~1~~	~~-~~	~~-~~	~~-~~	~~15951~~		~~*~~
			~~2~~	~~-~~	~~-~~	~~-~~	~~CONTRACT~~		~~DATE~~
			~~3~~	~~-~~	~~-~~	~~-~~	~~X~~		~~mm/dd/yy~~
			~~4~~	~~-~~	~~-~~	~~-~~	~~PROJECT NUMBER~~		
			~~5~~	~~-~~	~~-~~	~~-~~	~~XXXX.XX~~		
			~~6~~	~~-~~	~~-~~	~~-~~	~~BY~~	~~CHECKED~~	~~APPROVED~~
			~~7~~	~~-~~	~~-~~	~~-~~	~~XYZ~~	~~XYZ~~	~~XYZ~~
~~GENERAL~~	~~Tag Number~~		~~*~~						
	~~Service Description~~		~~*~~						
	~~P&ID Sheet Number~~		~~*~~						
	~~Line No. or Vessel No.~~		~~*~~						
	~~Line Size / Mat'l / Sch.~~		~~*~~						
	~~Electrical Class~~	~~Power Supply~~	~~*~~			~~*~~			
~~PROCESS DATA~~	~~Fluid~~	~~Fluid State~~	~~WATER~~			~~LIQUID~~			
	~~Operating Condition~~		~~Units~~	~~Minimum~~	~~Normal~~	~~Maximum~~	~~Other~~	~~-~~	~~-~~
	~~Flow Rate~~		~~GPM~~	~~*~~	~~*~~	~~*~~	~~*~~	~~-~~	~~-~~
	~~Inlet Pressure~~		~~PSIG~~	~~*~~	~~*~~	~~*~~	~~*~~	~~-~~	~~-~~
	~~Outlet Pressure~~		~~PSIG~~	~~*~~	~~*~~	~~*~~	~~*~~	~~-~~	~~-~~
	~~Temperature~~		~~DEG F~~	~~*~~	~~*~~	~~*~~	~~*~~	~~-~~	~~-~~
	~~Level~~		~~FEET~~	~~*~~	~~*~~	~~*~~	~~*~~	~~-~~	~~-~~
	~~Mol. Wt.~~		~~-~~	~~-~~	~~-~~	~~-~~	~~-~~	~~-~~	~~-~~
	~~Sp. Wt~~	~~Sp. Grav~~	~~-~~		~~-~~		~~-~~		
	~~Viscosity~~	~~Sp Heat~~	~~-~~		~~-~~		~~-~~		

~~BODY~~	~~Style~~	~~Size~~	~~GLOBE~~	~~xx"~~
	~~End Connection~~	~~Rating~~	~~xx" RF FLANGED~~	~~ANSI CLASS 150~~
	~~Port Size~~	~~Travel~~	~~*~~	~~*~~
	~~Valve Cv~~	~~Valve C1/Km~~	~~*~~	~~**~~
	~~Body Matl.~~	~~Bonnet~~	~~ASTM A216 WCC~~	~~ASTM A216 WCC~~
	~~Characteristic~~	~~Trim Number~~	~~EQUAL PERCENTAGE~~	~~**~~
	~~Cage Matl.~~	~~Retainer Matl.~~	~~*~~	~~*~~
	~~Seat Matl.~~	~~Seat Ring Matl.~~	~~316 STAINLESS STEEL~~	~~316 STAINLESS STEEL~~
	~~Plug Matl.~~	~~Stem Matl.~~	~~316 STAINLESS STEEL~~	~~316 STAINLESS STEEL~~
	~~Flow Action~~		~~DOWN~~	
	~~Gaskets~~		~~PTFE~~	
	~~Stem Guide~~		~~**~~	
	~~Packing~~		~~PTFE~~	
	~~Required Seat Tightness~~		~~ANSI CLASS IV~~	
	~~Max. Allowable Sound Level (dBA)~~		~~<75 dBA~~	
~~ACTUATOR~~	~~Type~~		~~PNEUMATIC~~	
	~~Size~~	~~Bench Set~~	~~*~~	~~*~~
	~~Push-Down To~~	~~Fail Position~~	~~CLOSE*~~	~~CLOSE*~~
	~~Close At~~	~~Open At~~	~~6 PSIG*~~	~~30 PSIG*~~
	~~Handwheel~~		~~NONE*~~	
~~POSITIONER~~	~~Type~~		~~Electronic~~	
	~~Communications Protocol~~		~~*~~	
	~~Input Signal~~	~~Output Signal~~	~~4-20 mA~~	-
	~~Air Supply~~		~~80 PSIG NOMINAL*~~	
~~TRANSDUCER~~	~~Type~~		~~*~~	
	~~Input Signal~~		~~*~~	
	~~Output Signal~~		~~*~~	
~~OPTIONS~~	~~Air Set w/ Gauges~~		~~YES*~~	
	~~Solenoids~~		~~*~~	
	~~Position Switches~~		~~*~~	
	-		-	

~~SELECTION BASED ON~~	~~Manufacturer~~	~~Fisher, Valtek, Dezurik-Copes, Leslie, Belimo~~
	~~Valve Model Number~~	~~*~~
	~~Actuator Model No.~~	~~*~~
	~~Positioner Model No.~~	~~*~~
	~~Filter Regulator~~	~~YES~~
~~NOTES~~	~~** Engineer shall fill in to suit application.~~ ~~*** Vendor to confirm based on process data provided.~~	

~~MD Anderson Cancer Center~~									
~~Water Control Valve Specification Sheet (Globe Body)~~									
~~Project Name~~			~~Revisions~~				~~SHEET~~		~~xx of xx~~
			~~NO.~~	~~BY~~	~~DATE~~	~~DESCRIPTION~~	~~SPEC. NO.~~		~~REVISION~~
			~~1~~	~~-~~	~~-~~	~~-~~	~~15951~~		~~*~~
			~~2~~	~~-~~	~~-~~	~~-~~	~~CONTRACT~~		~~DATE~~
			~~3~~	~~-~~	~~-~~	~~-~~	~~X~~		~~mm/dd/yy~~
			~~4~~	~~-~~	~~-~~	~~-~~	~~PROJECT NUMBER~~		
			~~5~~	~~-~~	~~-~~	~~-~~	~~XXXX.XX~~		
			~~6~~	~~-~~	~~-~~	~~-~~	~~BY~~	~~CHECKED~~	~~APPROVED~~
			~~7~~	~~-~~	~~-~~	~~-~~	~~XYZ~~	~~XYZ~~	~~XYZ~~
~~GENERAL~~	~~Tag Number~~		~~*~~						
	~~Service Description~~		~~*~~						
	~~P&ID Sheet Number~~		~~*~~						
	~~Line No. or Vessel No.~~		~~*~~						
	~~Line Size / Mat'l / Sch.~~		~~*~~						
	~~Electrical Class~~	~~Power Supply~~	~~*~~			~~*~~			
~~PROCESS DATA~~	~~Fluid~~	~~Fluid State~~	~~WATER~~			~~LIQUID~~			
	~~Operating Condition~~		~~Units~~	~~Minimum~~	~~Normal~~	~~Maximum~~	~~Other~~	~~-~~	~~-~~
	~~Flow Rate~~		~~GPM~~	~~*~~	~~*~~	~~*~~	~~*~~	~~-~~	~~-~~
	~~Inlet Pressure~~		~~PSIG~~	~~*~~	~~*~~	~~*~~	~~*~~	~~-~~	~~-~~
	~~Outlet Pressure~~		~~PSIG~~	~~*~~	~~*~~	~~*~~	~~*~~	~~-~~	~~-~~
	~~Temperature~~		~~DEG F~~	~~*~~	~~*~~	~~*~~	~~*~~	~~-~~	~~-~~
	~~Level~~		~~FEET~~	~~*~~	~~*~~	~~*~~	~~*~~	~~-~~	~~-~~
	~~Mol. Wt.~~		~~-~~	~~-~~	~~-~~	~~-~~	~~-~~	~~-~~	~~-~~
	~~Sp. Wt~~	~~Sp. Grav~~	~~-~~		~~-~~		~~-~~		
	~~Viscosity~~	~~Sp Heat~~	~~-~~		~~-~~		~~-~~		

~~BODY.~~	~~Style~~	~~Size~~	~~GLOBE~~	~~xx"~~
	~~End Connection~~	~~Rating~~	~~xx" RF FLANGED~~	~~ANSI CLASS 150~~
	~~Port Size~~	~~Travel~~	~~*~~	~~*~~
	~~Valve Cv~~	~~Valve C1/Km~~	~~*~~	~~**~~
	~~Body Matl.~~	~~Bonnet~~	~~ASTM A216 WCC~~	~~ASTM A216 WCC~~
	~~Characteristic~~	~~Trim Number~~	~~EQUAL PERCENTAGE~~	~~**~~
	~~Cage Matl.~~	~~Retainer Matl.~~	~~*~~	~~*~~
	~~Seat Matl.~~	~~Seat Ring Matl.~~	~~316 STAINLESS STEEL~~	~~316 STAINLESS STEEL~~
	~~Plug Matl.~~	~~Stem Matl.~~	~~316 STAINLESS STEEL~~	~~316 STAINLESS STEEL~~
	~~Flow Action~~		~~DOWN~~	
	~~Gaskets~~		~~PTFE~~	
	~~Stem Guide~~		~~**~~	
	~~Packing~~		~~PTFE~~	
	~~Required Seat Tightness~~		~~ANSI CLASS IV~~	
	~~Max. Allowable Sound Level (dBA)~~		~~<75 dBA~~	
~~ACTUATOR~~	~~Type~~		~~PNEUMATIC~~	
	~~Size~~	~~Bench Set~~	~~*~~	~~*~~
	~~Push-Down To~~	~~Fail Position~~	~~CLOSE*~~	~~CLOSE*~~
	~~Close At~~	~~Open At~~	~~6 PSIG*~~	~~30 PSIG*~~
	~~Handwheel~~		~~NONE*~~	
~~POSITIONER~~	~~Type~~		~~Electronic~~	
	~~Communications Protocol~~		~~*~~	
	~~Input Signal~~	~~Output Signal~~	~~4-20 mA~~	-
	~~Air Supply~~		~~80 PSIG NOMINAL*~~	
~~TRANSDUCER~~	~~Type~~		~~*~~	
	~~Input Signal~~		~~*~~	
	~~Output Signal~~		~~*~~	
~~OPTIONS~~	~~Air Set w/ Gauges~~		~~YES*~~	
	~~Solenoids~~		~~*~~	
	~~Position Switches~~		~~*~~	
	-		-	

~~SELECTION BASED ON~~	~~Manufacturer~~	~~Fisher, Valtek, Dezurik-Copes, Leslie, Belimo~~
	~~Valve Model Number~~	~~*~~
	~~Actuator Model No.~~	~~*~~
	~~Positioner Model No.~~	~~*~~
	~~Filter Regulator~~	~~YES~~
~~NOTES~~	~~** Engineer shall fill in to suit application.~~ ~~*** Vendor to confirm based on process data provided.~~	

MD Anderson Cancer Center									
Water Control Valve Specification Sheet (Pressure Independent, ½"-2")									
Project Name			Revisions				SHEET		xx of xx
			NO.	BY	DATE	DESCRIPTION	SPEC. NO.		REVISION
			1				15951		*
			2				CONTRACT		DATE
			3				X		mm/dd/yy
			4				PROJECT NUMBER		
			5				XXXX.XX		
			6				BY	CHECKED	APPROVED
			7				XYZ	XYZ	XYZ
GENERAL	Tag Number		*						
	Service Description		*						
	P&ID Sheet Number		*						
	Line No. or Vessel No.		*						
	Line Size / Mat'l / Sch.		*						
	Electrical Class	Power Supply	*			*			
PROCESS DATA	Fluid	Fluid State	WATER			LIQUID			
	Operating Condition		Units	Minimum	Normal	Maximum	Other		
	Flow Rate		GPM	*	*	*	*		
	Inlet Pressure		PSIG	*	*	*	*		
	Outlet Pressure		PSIG	*	*	*	*		
	Temperature		DEG F	*	*	*	*		
	Level		FEET	*	*	*	*		
	Mol. Wt.								
	Sp. Wt	Sp. Grav							
	Viscosity	Sp Heat							
BODY.	Style	Size	Pressure Independent				xx"		
	End Connection	Rating	xx" Female NPT				400 PSI		

	Body Matl.	Characteristic.	Forged Brass, Nickel Plated	Equal Percentage
	Char. Disc ½" & ¾"	Char. Disc 1"-2"	Brass	TEFZEL®
	Diaphragm ½" & ¾"	Diaphragm 1"-2"	Silicone and Nomex	Polyester Reinforced Silicone
	Seat Matl.	Seat Ring Matl.	Fiberglass reinforced Teflon® PTFE	Viton®
	Ball Matl.	Stem Matl.	Chrome Plated Brass	Chrome Plated Brass
	Valve Action		Rotary	
	Regulator Components		Stainless Steel, Brass, Delrin 500AF	
	Spring		Stainless Steel	
	Packing		2 EPDM O-Rings	
	Required Seat Tightness		ANSI CLASS IV	
	Max. Allowable Sound Level (dBA)		<75 dBA	
ACTUATOR	Type		Electronic	
	Size	Bench Set	*	*
	Normal Position	Fail Position	CLOSE*	CLOSE*
	Close At	Open At	2 VDC	10 VDC
	Manual Overide		*	
OPTIONS	Feedback		YES*	
	Position Switches		*	
	Service Tool/Software		YES*	
SELECTION BASED ON	Manufacturer		Fisher, Valtek, Dezurik-Copes, Leslie, Belimo	
	Valve Model Number		*	
	Actuator Model No.		*	
NOTES	** Engineer shall fill in to suit application.* *** Vendor to confirm based on process data provided.*			

~~MD Anderson Cancer Center~~									
~~Water Control Valve Specification Sheet (Pressure Independent, 2½"-6")~~									
~~Project Name~~			~~Revisions~~				~~SHEET~~		~~xx of xx~~
			~~NO.~~	~~BY~~	~~DATE~~	~~DESCRIPTION~~	~~SPEC. NO.~~		~~REVISION~~
			~~1~~	~~-~~	~~-~~	~~-~~	~~15951~~		~~*~~
			~~2~~	~~-~~	~~-~~	~~-~~	~~CONTRACT~~		~~DATE~~
			~~3~~	~~-~~	~~-~~	~~-~~	~~X~~		~~mm/dd/yy~~
			~~4~~	~~-~~	~~-~~	~~-~~	~~PROJECT NUMBER~~		
			~~5~~	~~-~~	~~-~~	~~-~~	~~XXXX.XX~~		
			~~6~~	~~-~~	~~-~~	~~-~~	~~BY~~	~~CHECKED~~	~~APPROVED~~
			~~7~~	~~-~~	~~-~~	~~-~~	~~XYZ~~	~~XYZ~~	~~XYZ~~
~~GENERAL~~	~~Tag Number~~		~~*~~						
	~~Service Description~~		~~*~~						
	~~P&ID Sheet Number~~		~~*~~						
	~~Line No. or Vessel No.~~		~~*~~						
	~~Line Size / Mat'l / Sch.~~		~~*~~						
	~~Electrical Class~~	~~Power Supply~~	~~*~~			~~*~~			
~~PROCESS DATA~~	~~Fluid~~	~~Fluid State~~	~~WATER~~			~~LIQUID~~			
	~~Operating Condition~~		~~Units~~	~~Minimum~~	~~Normal~~	~~Maximum~~	~~Other~~	~~-~~	~~-~~
	~~Flow Rate~~		~~GPM~~	~~*~~	~~*~~	~~*~~	~~*~~	~~-~~	~~-~~
	~~Inlet Pressure~~		~~PSIG~~	~~*~~	~~*~~	~~*~~	~~*~~	~~-~~	~~-~~
	~~Outlet Pressure~~		~~PSIG~~	~~*~~	~~*~~	~~*~~	~~*~~	~~-~~	~~-~~
	~~Temperature~~		~~DEG F~~	~~*~~	~~*~~	~~*~~	~~*~~	~~-~~	~~-~~
	~~Level~~		~~FEET~~	~~*~~	~~*~~	~~*~~	~~*~~	~~-~~	~~-~~
	~~Mol. Wt.~~		~~-~~	~~-~~	~~-~~	~~-~~	~~-~~	~~-~~	~~-~~
	~~Sp. Wt~~	~~Sp. Grav~~	~~-~~		~~-~~		~~-~~		
	~~Viscosity~~	~~Sp Heat~~	~~-~~		~~-~~		~~-~~		
~~BODY.~~	~~Style~~	~~Size~~	~~Pressure Independent~~				~~xx"~~		
	~~End Connection~~	~~Rating~~	~~xx" ANSI 125 Flange~~				~~ANSI 125, Standard Class B~~		

	~~Body Matl.~~	~~Characteristic.~~	~~Cast Iron-GG25 and Ductile Iron-GGG50~~	~~Equal Percentage~~
	~~Char. Disc 2"-3"~~	~~Char. Disc 4"-6"~~	~~Stainless Steel~~	~~Stainless Steel~~
	~~Seat Matl.~~	~~Seat Ring Matl.~~	~~PTFE~~	~~PTFE~~
	~~Ball Matl.~~	~~Stem Matl.~~	~~Stainless Steel~~	~~Stainless Steel~~
	~~Valve Action~~		~~Rotary~~	
	~~Packing~~		~~2 EPDM O-Rings~~	
	~~Required Seat Tightness~~		~~ANSI CLASS IV~~	
	~~Max. Allowable Sound Level (dBA)~~		~~<75 dBA~~	
~~ACTUATOR~~	~~Type~~		~~Electronic~~	
	~~Size~~	~~Bench Set~~	~~*~~	~~*~~
	~~Normal Position~~	~~Fail Position~~	~~CLOSE*~~	~~CLOSE*~~
	~~Flow Sensor Type~~		~~Magnetic~~	
	~~Manual Overide~~		~~*~~	
~~OPTIONS~~	~~Feedback~~		~~YES*~~	
	~~Position Switches~~		~~*~~	
	~~Service Tool/Software~~		~~YES*~~	
~~SELECTION BASED ON~~	~~Manufacturer~~		~~Fisher, Valtek, Dezurik-Copes, Leslie, Belimo~~	
	~~Valve Model Number~~		~~*~~	
	~~Actuator Model No.~~		~~*~~	
~~NOTES~~	~~*~~ ~~*Engineer shall fill in to suit application.~~ ~~**~~ ~~*Vendor to confirm based on process data provided.*~~			

SECTION 25 11 19 – BAS OPERATOR INTERFACES - RETROFIT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

C. Refer to Section 25 00 10 for general requirements.

1.02 SUMMARY

A. Section includes:

~~1.Operator Workstations.~~

~~2.~~**1.** Portable Operator Terminal / Remote Workstation.

~~3.Printers.~~

B. ~~Furnish and install all Operator Interfaces and Control System Servers as required for the BAS functions specified. All computers shall be warranted by the manufacturer for a period of one year after final acceptance~~.

1.03 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within all references.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

B. The make and model of ~~personal computers (PC),~~ notebook PC's~~, monitors, and printers~~ shall comply with Owner's current standards for desktop personal computers as of the date of Substantial Completion. Contact Owner for the current computer hardware standards.

C. Operating system for operator workstation shall comply with Owner's current standards for desktop personal computers as of the date of Substantial Completion. Contact Owner for the current computer hardware standards.

~~2.02OPERATOR WORKSTATION (OWS)~~

~~A.Provide a PC that meets or exceeds the minimum requirements of the BAS software and meets or exceeds the minimum requirements of MD ANDERSON. PC shall contain a CD-RW/DVD ROM Combo Drive to meet Owner's current standards.~~

~~B.Provide 19 inch (17.9 inch viewable, 0.25-0.25AG) monitor.~~

~~C.Provide detachable keyboard with standard typewriter layout, function keys, and separate numeric keypad. Provide a USB mouse and mouse pad with the system. Provide one open serial port after configuration of the workstation to meet the requirements of the rest of these Specifications.~~

~~D.Workstation PC shall have the capability of changing serial port interrupt vectors and IOBASE addresses through software.~~

~~E.Provide software, graphics and programming as specified in Section 25 15 10.~~

~~F.Provide network card approved by BAS manufacturer to support Supervisory LAN communications (100 Mbps Ethernet TCP/IP) for OWSs connected to the Local Supervisory LAN and network card or LANID where connected to the Primary Controller LAN.~~

~~G.Provide additional hardware, video drivers, serial port, etc., to facilitate all control functions and software requirements specified for the BAS.~~

~~H.~~**D.** ~~Operator Workstations shall be placed as indicated on the Drawings or as directed by Owner~~.

~~2.03~~**2.02** PORTABLE OPERATOR TERMINAL (POT) / REMOTE WORKSTATION

A. Portable Operator Terminal shall support system management by connection to the controllers, by connection via the Internet, and by dial-up communications while serving as the remote workstation.

B. Provide one notebook personal computer (PC) that meets or exceeds the minimum requirements of the BAS software and that meets or exceeds the minimum requirements of MD ANDERSON. Notebook PC shall contain a 24X/24X/24X/8X CD-RW/DVD ROM Combo Drive.

C. Provide a 10/100 LAN+56K CardBus Type III PC Card if internal adapter is not present.

D. Provide minimum 14.1 inch XGA active matrix display.

E. Provide carrying case and extra battery.

F. Operating system for operator workstation shall meet or exceed the minimum requirements of the BAS software and shall meet or exceed the minimum requirements of MD ANDERSON.

G. Provide software, graphics and programming as specified in Section 25 15 10.

H. Provide additional hardware, video drivers, serial ports, etc., to facilitate all control functions and software requirements specified for the building automation system.

I. Provide all controller configuration and interface software and/or plug ins for all devices applicable. All shall be loaded and functional. Provide all required interface cables required to connect to all networks, routers, controllers, SDs etc.

J. Wherever a POT connection point is not accessible in the same room as the device controlled, Contractor shall provide a wireless system, to permit configuration, testing and operation.

K. Include licensing for all software packages.

1. BAS licensing for this POT shall allow unlimited access to all aspects of the any manufacturer's system including system access, workstations, points, programming, database management, graphics etc.

2. No restrictions shall be placed on the license.

3. All operator interface, programming environment, networking, database management and any other software used by the Contractor to install the system or needed to operate the system to its full capabilities shall be licensed and provided to the Owner.

~~2.04PRINTER~~

~~A.Provide a 600x600 dpi, minimum four (4) sheets per minute color laser printer with 8-1/2 inch x 11 inch and 11 inch x 17 inch paper trays at each new operator workstation (OWS) that meets or exceeds the minimum printer requirements of the institution.~~

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. All installation shall be in accordance with manufacturer's published recommendations.

C. Set up workstations and printers as indicated on the Drawings. Install all software and verify that the systems are fully operational. Ensure licensing is provided for all software.

D. No license, software component, key, etc or any piece of information required for installing, configuring, operating, diagnosing and maintaining the system shall be withheld from the Owner.

E. Install electronic control system Operation and Maintenance Manuals, programming guides, network configuration tools, and control Shop Drawings etc. on each OWS. Provide interface or shortcuts to guide user to the appropriate information.

F. Set up portable operator terminal and configure it as the remote workstation. Install all software and verify that the system is fully operational.

END OF SECTION 25 11 19

SECTION 25 14 10 – BAS FIELD PANELS - RETROFIT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 SUMMARY

A. Section includes:

1. Building Controller (BC).

2. Advance Application Specific Controller (AAC).

3. Application Specific Controller (ASC).

B. Furnish and install DDC Control units and/or Smart Devices required to support specified building automation system functions.

C. Refer to Section 25 00 10 for general requirements.

1.03 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within all references.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.02 STAND-ALONE FUNCTIONALITY

A. General: These requirements clarify the requirement for stand-alone functionality relative to packaging I/O devices with a controller. Stand-alone functionality is specified with the controller and for each Application Category specified in this Section. This item refers to acceptable paradigms for associating the points with the processor.

B. Functional Boundary:

1. Provide controllers so that all points associated with and common to one unit or other complete system/equipment shall reside within a single control unit. The boundaries of a standalone system shall be as dictated in the Contract Documents.

2. Systems specified for the Application Category will dictate the boundary of the standalone control functionality. See related restrictions below.

3. When referring to the controller as it pertains to the standalone functionality, reference is specifically made to the processor.

4. One processor shall execute all the related I/O control logic via one operating system that uses a common programming and configuration tool.

C. The following configurations are considered acceptable with reference to a controller's standalone functionality:

1. Points packaged as integral to the controller such that the point configuration is listed as an essential piece of information for ordering the controller (having a unique ordering number).

2. Controllers with processors and modular back planes that allow plug in point modules as an integral part of the controller.

3. I/O point expander boards, plugged directly into the main controller board to expand the point capacity of the controller.

D. The following configurations are considered unacceptable with reference to a controller's standalone functionality:

1. I/O point expansion devices connected to the main controller board via wiring and as such may be remote from the controller and that communicate via a sub LAN protocol.

2. Multiple controllers enclosed in the same control panel to accomplish the point requirement.

2.03 BUILDING CONTROLLER (BC)

A. The BC(s) shall provide fully distributed control independent of the operational status of the OWSs and CSS. All necessary calculations required to achieve control shall be executed within the BC independent of any other device. All control strategies performed by the BC(s) shall be both operator definable and modifiable through the Operator Interfaces.

B. BCs shall perform overall system coordination, accept control programs, perform automated HVAC functions, control peripheral devices and perform all necessary mathematical and logical functions.

C. BCs shall share information with the entire network of BCs for full global control directly without requiring other BCs, LAN devices, Local Supervisory LAN gateways, routers etc. to assist, perform, or act as an intermediate device for communicating.

D. Each controller shall permit multi-user operation from multiple workstations and portable operator terminals connected either locally or over the Primary Controller LAN. Each unit shall have its own internal RAM, non-volatile memory, microprocessor, battery backup, regulated power supply, power conditioning equipment, ports for connection of operating interface devices, and control enclosure.

E. BCs shall be programmable from an operator workstation, portable operator terminal, or hand held operating device. BC shall contain sufficient memory for all specified global control strategies, user defined reports and trending, communication programs, and central alarming.

F. BCs shall be connected to a controller network that qualifies as a Primary Controlling LAN.

G. All BCs shall be protected from any memory loss due to a loss of power, power surge, or unstable power by one or a combination of the following:

1. Volatile RAM shall have a battery backup using a lithium battery with a rated service life of fifty (50) hours, and a rated shelf life of at least five (5) years. Self-diagnostic routine shall report an alarm for a low battery condition.

2. EEPROM, EPROM, or NOVROM non-volatile memory.

H. In addition, BCs shall provide intelligent, standalone control of HVAC functions. Each BC shall be capable of standalone direct digital operation utilizing its own processor, non-volatile memory, input/output, wiring terminal strips, A/D converters, real-time clock/calendar and voltage transient and lightning protection devices. Refer to standalone functionality specified above.

I. For systems requiring end-of-line resistors those resistors shall be located in the BC.

J. Input-Output Processing:

1. Digital Outputs (DO):

a. Outputs shall be rated for a minimum 24 Vac or Vdc, 1 amp maximum current. Each shall be configurable as normally open or normally closed.

b. Each output shall have an LED to indicate the operating mode of the output and a manual hand off or auto switch to allow for override. Provide feedback to remotely indicate the HOA is not in the Auto position. If these HOA switches are not provided on the main board they shall be provided via isolation relays within the control enclosure.

c. Each DO shall be discrete outputs from the BC's board (multiplexing to a separate manufacturer's board is unacceptable). Provide suppression to limit transients to acceptable levels.

2. Analog Inputs (AI):

a. AI shall be O-5 Vdc, 0-10 Vdc, 0-20 Vdc, and 0-20 mA. Provide signal conditioning, and zero and span calibration for each input.

b. Each input shall be a discrete input to the BC's board (multiplexing to a separate manufacturers board is unacceptable unless specifically indicated otherwise).

c. A/D converters shall have a minimum resolution of twelve (12) bits.

3. Digital Inputs (DI):

a. Monitor dry contact closures.

b. Accept pulsed inputs of at least one per second. Source voltage for sensing shall be supplied by the BC and shall be isolated from the main board.

4. Universal Inputs (UI-AI or DI): To serve as either AI or DI as specified above.

5. Electronic Analog Outputs (AO):

a. Voltage mode: 0-5 Vdc and 0-10 Vdc; Current mode: 4-20 mA. Provide zero and span calibration and circuit protection.

b. Pulse Width Modulated (PWM) analog via a DO and transducer is acceptable only with Owner approval (Generally these will not be allowed on loops with a short time constant such as discharge temperature loops, economizer loops, pressure control loops and the like. They are generally acceptable for standard room temperature control loops.).

c. Where these are allowed, transducer/actuator shall be programmable for normally open, normally closed, or hold last position and shall allow adjustable timing. Each DO shall be discrete outputs from the BC's board (multiplexing to a separate manufacturers board is unacceptable).

d. D/A converters shall have a minimum resolution of ten (10) bits.

6. Analog Output Pneumatic (AOP), 0-20 psi:

a. Pneumatic outputs via an I/P transducer, or digital to pneumatic transducer are acceptable.

b. Multiplexed digital to pneumatic transducers are acceptable provided they are supplied as a standard product and part of the BC and provide individual feedback.

c. Multiplexed pneumatic outputs of a separate manufacturer are unacceptable.

7. Pulsed Inputs:

a. Capable of counting up to eight (8) pulses per second with buffer to accumulate pulse count.

b. Pulses shall be counted at all times.

K. BC Power Loss:

1. Upon a loss of power, power surge, or unstable power to any BC, the other units on the primary controlling network shall not in any way be affected.

2. Upon a loss of power, power surge, or unstable power to any BC, the battery backup shall ensure that the energy management control software, the Direct Digital Control software, the database parameters, and all other programs and data stored in the RAM are retained for a minimum of fifty (50) hours. An alarm diagnostic message shall indicate that the BC is under battery power.

3. Upon restoration of power within the specified battery backup period, the BC shall resume full operation without operator intervention. The BC shall automatically reset its clock such that proper operation of any time dependent function is possible without manual reset of the clock. All monitored functions shall be updated.

4. Should the duration of a loss of power exceed the specified battery back-up period or BC panel memory be lost for any reason, the panel shall automatically report the condition (upon resumption of power) and be capable of receiving a download via the network, and connected computer. In addition, the Owner shall be able to upload the most current versions of all energy management control programs, Direct Digital Control programs, database parameters, and all other data and programs in the memory of each BC to the operator workstation via the local area network, or via the telephone line dial-up modem where applicable, or to the laptop PC via the local RS-232C port.

L. BC Failure:

1. Building Controller LAN Data Transmission Failure: BC shall continue to operate in stand-alone mode. BC shall store loss of communication alarm along with the time of the event. All control functions shall continue with the global values programmable to either last value or a specified value. Peer BCs shall recognize the loss, report alarm and reconfigure the LAN.

2. BC Hardware Failure: BC shall cease operation and terminate communication with other devices. All outputs shall go to their specified fail position.

M. BCs may include LAN communications interface functions for controlling secondary controlling LANs Refer to Section 25 30 10 - BAS System Communications Devices for requirements if this function is packaged with the BC.

N. All BC naming conventions shall adhere to the format as established by the Owner's Standard Acronyms document.

O. I/O Point Expansion Devices communicating to BC via a sub LAN protocol:

1. Utilizing any point from a point expansion device communicating to BC via a sub LAN protocol to support the BC's Stand Alone Functionality requirement is not allowed.

2. Point expansion devices shall be mounted in packaged equipment enclosures, or locking wall mounted enclosure in a readily accessible location. Identify panel enclosure with the entire point address of point expansion device(s) on an engraved phenolic or micarta nameplate.

3. The owner shall approve the location of point expansion devices mounted above finished ceiling prior to installation. An owner approved ceiling tag shall identify the specific location of the point expansion device location.

4. Each point expansion device shall be identified in the database with the location of where the device is physically installed to allow the owner to service these devices when needed. The owner shall approve the final method identifying the locations with the available software options.

2.04 ADVANCED APPLICATION SPECIFIC CONTROLLER (AAC) AND APPLICATION SPECIFIC CONTROLLER (ASC)

A. General Requirements:

1. AACs and ASCs shall provide intelligent, standalone control of HVAC equipment. Each unit shall have its own internal RAM, non-volatile memory and will continue to operate all local control functions in the event of a loss of communications on the ASC LAN or sub-LAN.

2. AACs and ASCs shall include sufficient memory to perform the specific control functions required for its application and to communicate with other devices.

3. Each AAC and ASC must be capable of stand-alone direct digital operation utilizing its own processor, non-volatile memory, input/output, minimum eight (8) bit A to D conversion, voltage transient and lightning protection devices. All volatile memory shall have a battery backup of at least fifty (50) hours with a battery life of five (5) years.

4. All point data; algorithms and application software within an AAC /ASC shall be modifiable from the Operator Workstation.

5. AAC and ASC Input-Output Processing:

a. Digital Outputs (DO): Outputs shall be rated for a minimum 24 VAC or VDC, 1 amp maximum current. Each shall be configurable as normally open or normally closed. Each DO shall be discrete outputs from the AAC/ASC's board (multiplexing to a separate manufacturer's board is unacceptable). Provide suppression to limit transients to acceptable levels.

b. Analog Inputs (AI): AI shall be O-5 Vdc, 0-10Vdc, 0-20Vdc, and 0-20 mA. Provide signal conditioning, and zero and span calibration for each input. Each input shall be a discrete input to the BC's board (multiplexing to a separate manufacturers board is unacceptable unless specifically indicated otherwise). A/D converters shall have a minimum resolution of eight to ten bits depending on application.

c. Digital Inputs (DI): Monitor dry contact closures. Accept pulsed inputs of at least one per second. Source voltage for sensing shall be supplied by the BC and shall be isolated from the main board.

d. Universal Inputs (UI-AI or DI): To serve as either AI or DI as specified above.

e. Analog Outputs (AO) as required by application:

1) Voltage mode, 0-5VDC and 0-10VDC; current mode (4-20 mA). Provide zero and span calibration and circuit protection. Pulse Width Modulated (PWM) analog via a DO and transducer is acceptable only with Owner approval (Generally, PWM will not be allowed on loops with a short time constant such as discharge temperature loops, economizer loops, pressure control loops and the like. They are generally acceptable for standard room temperature control loops.).

2) Where PWM is allowed, transducer/actuator shall be programmable for normally open, normally closed, or hold last position and shall allow adjustable timing. Each DO shall be discrete outputs from the BC's board (multiplexing to a separate manufacturers board is unacceptable).

3) D/A converters shall have a minimum resolution of eight (8) bits.

B. Terminal Unit Controllers:

1. Terminal unit controllers controlling damper positions to maintain a quantity of supply or exhaust air serving a space shall have an automatically initiated function that resets the volume regulator damper to the fully closed position on a scheduled basis.

2. The controllers shall initially be set up to perform this function once every 24 hours. The purpose of this required function is to reset and synchronize the actual damper position with the calculated damper position and to assure the damper will completely close when commanded.

3. The software shall select scheduled terminal units randomly and shall not allow more than 5 percent of the total quantity of controllers in a building to perform this function at the same time. When possible the controllers shall perform this function when the supply or exhaust air system is not operating or is unoccupied.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. All installation shall be in accordance with manufacturer's published recommendations.

C. All Division 25 installation including but not limited to, cable and wiring, grounding, raceway and conduit, electrical circuit and panel identifications, wiring devices, and lighting shall comply with Division 26 installation requirements. In addition to the Division 26 requirements, contractor shall label panel board name and circuit number in an owner approved manner at each BAS field panel, control cabinet, or point of termination in which a 120VAC control circuit is utilized.

3.02 HARDWARE APPLICATION REQUIREMENTS

A. General:

1. The functional intent of this Specification is to allow cost effective application of manufacturers standard products while maintain the integrity and reliability of the control functions.

2. A Building Controller as specified above is generally fully featured and customizable whereas the AAC/ASC refers to a more cost-effective unit designed for lower-end applications. Specific requirements indicated below are required for the respective application. Manufacturer may apply the most cost-effective unit that meets the requirement of that application.

B. Standalone Capability:

1. Each Control Unit shall be capable of performing the required sequence of operation for the associated equipment.

2. All physical point data and calculated values required to accomplish the sequence of operation shall originate within the associated CU with only the exceptions enumerated below. Listed below are functional point data and calculated values that shall be allowed to be obtained from or stored by other CUs or SDs via LAN.

C. Where associated control functions involve functions from different categories identified below, the requirements for the most restrictive category shall be met.

D. Application Category 0 (Distributed Monitoring):

1. Applications in this category include the following:

a. Monitoring of variables that are not used in a control loop, sequence logic, or safety.

2. Points on BCs, AACs, and ASCs may be used in these applications as well as SDs and/or general-purpose I/O modules.

3. Where these points are trended, Contractor shall verify and document that the network bandwidth is acceptable for such trends and is still capable of acceptable and timely control function.

E. Application Category 1 (Application Specific Controller):

1. Applications in this category include the following:

~~a.Fan Coil Units.~~

~~b.~~**a.** Airflow Control Boxes (VAV and Constant Volume Terminal Units).

~~c.Miscellaneous Heaters.~~

~~d.Unitary equipment <15 tons (Package Terminal AC Units, Package Terminal Heat Pumps, Split-System AC Units, Split-System Heat Pumps, Water-Source Heat Pumps).~~

~~e.Induction Units.~~

~~f.~~**b.** ~~Dual Duct Zone Dampers~~.

2. Standalone Capability:

   a. Provide capability to execute control functions for the application for a given setpoint or mode, which shall generally be occupied mode control.

   b. Only the following data (as applicable) may be acquired from other controllers via LANs. In the event of a loss of communications with any other controller, or any fault in any system hardware that interrupts the acquisition of any of these values, the ASC shall use the last value obtained before the fault occurred.

   c. If such fault has not been corrected after the specified default delay time, specified default value(s) shall then be substituted until such fault has been corrected.

Physical/Virtual Point	Default Value
Scheduling Period	Normal
Morning Warm-Up	Off (cold discharge air)
Load Shed	Off (no shedding)
Summer/Winter	Winter
Trend Data	N/A

3. Mounting:

   a. ASCs that control equipment located above accessible ceilings shall be mounted on the equipment in an accessible enclosure and shall be rated for plenum use.

   b. ASCs that control equipment mounted in a mechanical room may either be mounted in, on the equipment, or on the wall of the mechanical room at an adjacent, accessible location.

   c. ASCs that control equipment mounted outside or in occupied spaces shall either be located in the unit or in a proximate mechanical/utility space.

   d. BAS Provider may furnish ASCs to the terminal unit manufacturer for factory mounting.

4. LAN Restrictions: For networks operating at 38.4 kbps or less, limit the number of nodes on the network to meet all system performance criteria and to no more than 80 percent of the maximum recommended by the manufacturer. For networks operating at greater than 38.4 kbps limit the number of nodes on the network to meet all system performance criteria up to the maximum recommended by the manufacturer.

F. Application Category 2 (General Purpose Terminal Controller):

   1. Applications in this category include the following:

~~a.Unitary Equipment >= 15 tons (Air Conditioners, Heat Pumps, Packaged Heating/Cooling Units, and similar).~~

~~b.Small, Constant Volume Single Zone Air Handling Units.~~

~~c.Constant Volume Pump Start/Stop.~~

~~d.Miscellaneous Equipment (Exhaust Fan) Start/Stop.~~

~~c.~~**a.** Miscellaneous Monitoring (not directly associated with a control sequence and where trending is not critical).

2. Standalone Capability:

   a. Only the following data (as applicable) may be acquired from other ASCs via LANs.

   b. In the event of a loss of communications with any other ASCs, or any fault in any system hardware that interrupts the acquisition of any of these values, the AAC/ASC shall use the last value obtained before the fault occurred.

   c. If such fault has not been corrected after the specified default delay time, specified default value(s) shall then be substituted until such fault has been corrected.

Physical/Virtual Point	Default Delay Time	Default Value
Outside Air Temperature	3 minutes	80°F
Outside Air Humidity	3 minutes	60% RH
Outside Air Enthalpy	3 minutes	30 Btu/lb
Trend Data		N/A
Cooling/Heating Requests	3 minutes	None

3. Mounting:

   a. ASCs that control equipment located above accessible ceilings shall be mounted on the equipment and shall be rated for plenum use.

   b. ASCs that control equipment located in occupied spaces or outside shall either be mounted within the equipment enclosure (responsibility for physical fit remains with the Contractor) or in a near by mechanical/utility room in which case it shall be enclosed in a NEMA 1, locking enclosure.

4. LAN Restrictions: Limit the number of nodes servicing any one of these applications on the AAC/ASC LAN to 80 percent capacity on new installed LANs.

~~G.Application Category 3 (Advanced Application Controller):~~

~~1.Applications in this category include the following:~~

~~a.Steam Pressure Reducing Station Control.~~

~~b.Steam Converter Control.~~

~~c.Large Constant Volume Air Handlers.~~

~~d.VAV Air Handlers.~~

~~e.Dual Duct Air Handlers.~~

~~f.Multizone Air Handlers.~~

~~g.Self-Contained VAV Units.~~

~~h.Air Handlers serving critical areas.~~

~~i.Central Cooling Plant.~~

~~j.Central Heating Plant.~~

~~k.Cooling Towers.~~

~~l.Sequenced or Variable Speed Pump Control.~~

~~m.Local Chiller Control (unit specific).~~

~~n.Campus Loop Chilled Water Control.~~

~~2.BCs shall be used in these applications.~~

~~3.~~**5.** ~~LAN Restrictions: Comply with Part Two requirements, Stand-Alone Functionality~~.

3.03 CONTROL UNIT REQUIREMENTS

A. Refer to Section 25 00 10 for requirements pertaining to control unit quantity and location.

END OF SECTION 25 14 10

SECTION 25 15 10 – BAS SOFTWARE AND PROGRAMMING - RETROFIT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 SUMMARY

A. Section includes:

1. Point Structuring.

2. Alarm.

3. Point Structuring.

4. Graphics.

B. Fully configure systems and furnish and install all software, programming and dynamic color graphics for a complete and fully functioning system as specified.

C. Refer to Section 25 00 10, Building Automation System (BAS) General - Retrofit for general requirements as well as requirements for interface with Owner's WAN.

1.03 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within all references.

PART 2 - PRODUCTS

2.01 POINT STRUCTURING AND NAMING

A. General:

1. The intent of this Section is to require a consistent means of naming points across the Owner's WAN. Configure the systems from the perspective of the Owner's WAN, not solely the local Project.

2. The following requirement establishes a standard for naming points and addressing Buildings, Networks, Devices, Instances, and the like.

3. The convention is tailored towards the Owner's WAN and as such, the interface shall always use this naming convention.

4. Native BACnet systems shall also use this naming convention. For non-BACnet systems, the naming convention shall be implemented as much as practical, and any deviations from this naming convention shall be approved by the Owner.

5. Each controller shall have English language descriptors for all system points, variables, parameters etc. located and accessible from the controller memory. All point naming shall match between all system files and record documents.

B. Point Summary Table:

1. The BAS Provider shall coordinate with the Owner's Building Automation System department to compile and submit a proposed Point Summary Table for review prior to any object programming or project startup. The Contractor shall support and not impede direct negotiations between the BAS Provider and the Owner to allow the customizing necessary for structuring the BAS point names to meet the Owner's needs. The MD ANDERSON Manager of Building Automation will provide the format form of the Point Summary Table to be submitted to the BAS Provider upon request. Contactor shall ensure final BAS point names have the approval of the Owner's Manager of Building Automation System prior to any object programming or project startup.

2. The Point Summary Table shall be kept current throughout the duration of the Project by the Contractor as the Master List of all points for the Project. Project closeout documents shall include an up-to-date accurate Point Summary Table. The Contractor shall deliver to the Owner the final Point Summary Table prior to final acceptance of the system. The Point Summary Table shall be used as a reference and guide during the commissioning process.

C. Point Naming Convention

1. All proposed point names shall reference the existing MD ANDERSON BAS Acronym Standards which can be located and viewed on the Apogee BAS Server.

D. Device Addressing Convention:

1. BACnet network numbers and Device Object IDs shall be unique throughout the network.

2. All assignment of network numbers and Device Object IDs shall be coordinated with the Owner.

3. Coordinate with the Owner or a designated representative to ensure that no duplicate Device Object IDs occur.

4. Alternative Device ID schemes or cross project Device ID duplication if allowed shall be approved before Project commencement by the Owner.

PART 3 - EXECUTION

3.01 SYSTEM CONFIGURATION

A. Contractor shall thoroughly and completely configure BAS system software, supplemental software, network communications, CSS, OWS, remote operator workstation, portable operators terminal, printer, and remote communications.

3.02 SITE-SPECIFIC APPLICATION PROGRAMMING

A. Provide all database creation and Site-specific application control programming as required by these Specifications, national and local standards and for a fully functioning system. Provide all initial Site-specific application programming and thoroughly document programming. Generally meet the intent of the written sequence of operation. It is the Contractor's responsibility to request clarification on sequence issues that require such clarification.

B. All Site-specific programming shall be fully documented and submitted for review and approval, both prior to downloading into the panel, at the completion of functional performance testing, and at the end of the Warranty Period. Programs shall utilize comment lines which will also reside in the field panel.

C. All programming, graphics and data files must be maintained in a logical system of directories. All file names shall adhere to the naming convention format as established in the Owner's Standard Acronyms documentation. All files developed for the Project will be the property of the Owner and shall remain on the workstation(s)/server(s) at the completion of the Project.

3.03 ALARMS

A. This Section supersedes and over rules all references to building automation alarms in the Contract Documents, including all sequences of operations and other sections of the BAS Specification in regards to alarms. The Contractor shall support and not impede direct negotiations between the BAS Provider and the Owner to allow the customizing necessary for customizing alarms and alarm parameters to meet the Owner's needs.

B. The BAS Provider is required to submit a point summary to confirm building automation point names as specified herein The BAS Provider shall submit this point summary with the addition of identifying all alarms which includes detail information on the alarm parameters to the MD ANDERSON Manager of Building Automation for approval prior to the beginning of any commissioning process of the building automation system.

C. The MD ANDERSON Manager of Building Automation will provide the format form to the BAS Provider upon request. The Owner shall grant approval of alarms to be verified through commissioning by issuing the approved alarms to the Contractor. The approved alarms issued to the Contractor shall be used for the Functional Test Procedures alarms tested. The Contractor shall initiate the start of this process immediately after building automation submittal have been approved and monitor the progress to ensure the construction schedule is not delayed.

D. Analog Input Alarms:

1. Duct Static Pressure:

   a. Alarm @ +(-) 0.3 inches from set point for 5 minutes @ Priority 3.

   b. Normal @ +(-) 0.2 inches from set point for 5 minutes.

   c. Alarm is active after fan is proven ON for the minimum time necessary to allow the sensor to be within the alarm parameter.

   d. Alarm is deactivated after fan is proven OFF.

2. Duct Air Temperatures:

   a. Alarm @ +(-) 2.0 degrees F from set point for 5 minutes @ Priority 3.

   b. Normal @ +(-) 1.0 degrees F from set point for 5 minutes.

   c. Alarm is active after fan is proven ON for the minimum time necessary to allow the sensor to be within the alarm parameter.

   d. Alarm is deactivated after fan is proven OFF.

3. Space or Room Temperature:

   a. Typically will not be alarmable.

   b. Submit as not alarmable and Owner will confirm.

4. Duct or Space Humidity:

   a. Alarm @ (+) 15 percent from set point (60 percent) for 5 minutes @ Priority 3.

   b. Alarm @ (-) 20 percent from set point (60 percent) for 5 minutes @ Priority 3.

   c. Normal @ 5 percent from offset alarm parameters for 5 minutes.

   d. Point is always ready to alarm.

5. Water temperature sensors which are inputs to control loops:

   a. Submit reasonable alarm parameter to prevent nuisance alarming Priority 3.

   b. Owner will confirm alarm.

6. All other Analog Inputs:

   a. BAS Provider shall utilize their expertise and recommend not less than three (3) analog input alarms which protect the Owner's best interests.

   b. Submit at Priority 3 with recommended alarm parameters.

   c. Identify recommended alarms in submittal.

d. Owner will confirm alarm.

E. Digital Inputs Alarms:

1. Proofs (current sensor, air flow switches, water differential pressure switches etc).

a. Digital inputs paired with BAS digital output will have the ability to alarm at all times @ Priority 3.

b. Alarm will delay for the reason time needed when the state of the digital output changes to prevent nuisance alarms.

c. Point is in alarmed condition when the value of the digital input does not equal the value of the digital output after the time delay.

d. Point is in the Normal condition when the value of the digital input equals the value of the digital output after the time delay.

e. Digital input proofs without a paired digital output shall not alarm and be for monitoring purposes only.

~~2.Safeties (high static cutout, freeze condition, excessive vibration, high humidity cutout, VFD fault, etc.).~~

~~a.The digital input shall be always ready to alarm without delay.~~

~~b.The digital input shall display "ALARM" at Priority 3 at the Alarm screen when activated.~~

~~c.The digital input shall display "NORMAL" at the Alarm screen when deactivated.~~

~~3.~~**2.** Monitoring Digital Inputs (auxiliary drain pan alarm, Liebert Unit general alarm, water detector, etc) the exception is air filter differential pressure switch.

a. All digital inputs which "deactivated" is the normal state of planed operations shall alarm when the normal state of planed operation changes.

b. The digital input shall display "ALARM" at Priority 3 at the Alarm screen when activated.

c. The digital input shall display "NORMAL" at the Alarm screen when deactivated.

~~4.Air Filters:~~

~~a.Typically will not be alarmable.~~

~~b.Submit as not alarmable and Owner will confirm.~~

~~c.The digital input shall display "DIRTY" when activated.~~

~~d.The digital input shall display "CLEAN" when deactivated~~

F. Analog Outputs Alarms:

1. All Analog Outputs:

a. BAS Provider shall utilize their expertise and recommend any analog output alarms which protect the Owner's best interests.

b. Identify recommended alarms in submittal.

c. Owner will confirm any alarms.

G. Digital Outputs Alarms:

1. Refer to digital inputs paired with digital outputs as specified herein.

2. All Digital Outputs:

a. BAS Provider shall utilize their expertise and recommend any digital output alarms which protect the Owner's best interests.

b. Identify recommended alarms in submittal.

c. Owner will confirm any alarms.

H. All alarms shall be enhanced to alarm and display the alarm Priority level at the alarm screen table of the specific Owner approved BAS workstations

I. Priority 2 Critical Alarms: All incubator temperature alarms, ultra low temperature alarms, and any other alarm that the Owner deems critical shall report to the Owner specified destinations as a Priority 2 alarm. The Contractor, with Owner approved time delays and triggered points, shall enhance the alarm to prevent nuisance alarming.

J. Priority 3 Mechanical Critical Alarms: All mechanical equipment alarms, which has been identified by the Owner and is achievable with the I/O point available in the Project, shall report to the Owner specified destinations as a Priority 3 alarm. The Contractor, with Owner approved time delays and triggered points, shall enhance the alarm to prevent nuisance alarming.

K. Priority 4 Mechanical Alarms: Dirty air filters alarms and non critical alarms, which has be identified by the Owner and is achievable with the I/O point available in the Project, shall report to the Owner specified destinations as a Priority 4 alarm. The Contractor, with Owner approved time delays and triggered points, shall enhance the alarm to prevent nuisance alarming.

L. Nuisance Alarms: All alarms which have been identified by the Owner as a nuisance alarm due to numerous times in and out of alarm shall be addressed and corrected by the Contractor in a manner that the Owner has approved.

M. Contractor shall review Owner's current and typical BAS existing alarms. The Contractor shall use this data as a guideline in identifying all alarmable points for this Project. The Contractor shall submit all virtual and physical points involved in the Project with all alarmable points identified for the Owner to review. Contractor is responsible for complying with all alarming requests by the Owner that is achievable with the I/O point available in the Project, with existing BAS database, and with the creation of any necessary virtual points.

3.04 GRAPHIC SCREENS

~~**[ENGINEER MUST PROVIDE ELECTRONIC CONTROL DESIGN FLOOR PLANS TO THE CONTRACTOR.]**~~

A. Background resolution shall be 1280 x 1024 for all graphics.

B. Floor Plan Screens: The Contract Document Drawings will be made available to the Contractor in AutoCAD LT 2002 format upon request. These Drawings may be used only for developing backgrounds for specified graphic screens; however the Owner does not guarantee the suitability of these Drawings for the Contractor's purpose. Graphic Screens shall be submitted for approval.

1. Provide graphic floor plan screens for each floor [wing] [tower] [other] of each building.

a. Indicate the location of all equipment that is not located on the equipment room screens.

b. Indicate the location of temperature sensors associated with each temperature-controlled zone (i.e., VAV terminals, fan-coils, single-zone AHUs, etc.) on the floor plan screens.

c. Display the space temperature point adjacent to each temperature sensor symbol. Use a distinct line symbol to demarcate each terminal unit zone boundary. Use distinct colors to demarcate each air handling unit zone.

d. Mechanical floor plan Drawings will be made available to the Contractor upon request for the purpose of determining zone boundaries. Indicate room numbers as provided by the Owner.

e. Provide a drawing link from each space temperature sensor symbol and equipment symbol shown on the graphic floor plan screens to each corresponding equipment schematic graphic screen.

f. The Owner may approve the substitution of tabular graphics in lieu of floor plan graphics as circumstances apply. Contractor shall verify with Owner whether to create tabular or floor plan graphics.

2. If multiple floor plans are necessary to show all areas, provide a graphic building key plan. Use elevation views and/or plan views as necessary to graphically indicate the location of all of the larger scale floor plans. Link graphic building key plan to larger scale partial floor plans. Provide links from each larger scale graphic floor plan screen to the building key plan and to each of the other graphic floor plan screens.

3. Provide a graphic for each system of the Project. Contact Owner to identify all systems requiring a graphic. An example of the AHU system is:

    a. Provide graphic screens for each air handling system to include but not limited to describe area served and any information the Owner has identified as pertinent.

    b. Link screens for air handlers to the heating system and cooling system graphics.

    c. Link screens for supply and exhaust systems if they are not combined onto one screen.

4. Provide a graphic for each system of the Project. Contact Owner to identify all systems requiring a graphic. An example of the CHW system is:

    a. Provide a cooling system graphic screen showing all points associated with the chillers, cooling towers and pumps.

    b. Indicate outside air dry-bulb temperature and calculated wet-bulb temperature.

    c. Link screens for chilled water and condenser water systems if they cannot fit onto one cooling plant graphic screen.

5. Link graphic screens to all pertinent graphics and/or pertinent data/ information the Owner has requested.

    a. Link the appropriate sequence of operations to graphics. (.rtf format).

    b. Link approved as-built schematic control drawing to graphic. (.pdf format)

6. Submit all graphics per Section 25 00 10 for Owner approval.

END OF SECTION 25 15 10

SECTION 25 30 10 – BAS COMMUNICATION DEVICES - RETROFIT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 SUMMARY

A. Section includes:

1. Local Supervisory LAN Gateways/Routers.

~~2.Chiller Controls Interface Device (CID).~~

~~3.Variable Frequency Drives (VFD's).~~

B. Provide all interface devices and software to provide an integrated system connecting BCs, AACs, ASCs and Gateways to the Owner's Wide Area Network (MD ANDERSON WAN).

1.03 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within all references.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.02 LOCAL SUPERVISORY LAN GATEWAYS/ROUTERS

A. The Supervisory Gateway shall be a microprocessor-based communications device that acts as a gateway/router between the Supervisory LAN CSSs or OWS and the Primary LAN.

B. The Gateway shall perform information translation between the Primary LAN and the Local Supervisory LAN, which is 100 Mbps Ethernet TCP/IP and shall use BACnet over IP.

C. The gateway shall contain its own microprocessor, RAM, battery, real-time clock, communication ports, and power supply as specified for a BC in Section 25 14 10. Each gateway/router shall be mounted in a lockable enclosure unless it is a PC that also serves as an OWS.

D. The gateway/router shall allow centralized overall system supervision, operator interface, management report generation, alarm annunciation, acquisition of trend data, and communication with control units. It shall allow system operators to perform the following functions from the CSS, OWSs, and POTs:

1. Configure systems.

2. Monitor and supervise control of all points.

3. Change control setpoints.

4. Override input values.

5. Override output values.

6. Enter programmed start/stop time schedules.

7. View and acknowledge alarms and messages.

8. Receive, store and display trend logs and management reports.

9. Upload/Download programs, databases, etc. as specified.

E. Upon loss of power to the Gateway, the battery shall provide for minimum 100 hour backup of all programs and data in RAM.

F. The Gateway shall be transparent to control functions and shall not be required to control information routing on the Primary LAN

~~2.03CHILLER CONTROLS INTERFACE DEVICE (CID)~~

~~A.The CID shall be a microprocessor-based communications device that acts as a gateway between the control protocol and the applicable chiller controller.~~

~~B.The CID shall contain its own microprocessor, RAM, battery, communication ports and, power supply.~~

~~C.Each CID shall support full bi-directional communications translation as more fully specified in Section 25 15 10.~~

~~D.The following points shall be mapped as a minimum:~~

~~1.CHW Supply and Return Temperatures.~~

~~2.CW Supply and Return Temperatures.~~

~~3.Power Consumption (kW).~~

~~4.Percent of Power Consumption (compared to maximum).~~

~~5.Bearing Temperature.~~

~~6.Suction and Head Pressures.~~

~~7.Suction and Head Temperatures.~~

~~8.All available alarms; common alarm as minimum.~~

~~9.Chiller Status.~~

~~10.Enable/Disable.~~

~~11.Current Limit Percent.~~

~~12.CHW Setpoint and Setpoint Reset.~~

PART 3 - EXECUTION

3.01 PREPARATION

A. Examine areas and conditions under which control systems are to be installed. Do not proceed with Work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.02 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. All installation shall be in accordance with manufacturer's published recommendations.

C. Provide all interface devices and software to provide an integrated system.

D. Closely coordinate with the Owner, or designated representative, to establish IP addresses and communications to assure proper operation of the building automation system with Owner's WAN.

END OF SECTION 25 30 10

SECTION 26 01 00 - BASIC ELECTRICAL REQUIREMENTS

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 SUMMARY

A. Drawings are necessarily diagrammatic by their nature and are not intended to show every connection in detail or every pipe or conduit in its exact location. Carefully investigate structural and finish conditions and coordinate the separate trades in order to avoid interference between the various phases of Work. Organize and lay out Work so that it will be concealed in furred chases and suspended ceilings, etc., in finished portions of the building, unless specifically noted to be exposed. Install all Work parallel or perpendicular to building lines unless otherwise noted.

B. The intent of the Drawings is to establish the types of systems and functions; not to set forth each item essential to the functioning of the system. Install the Work complete, including minor details necessary to perform the function indicated. Review pertinent Drawings and adjust the Work to conditions shown. Where discrepancies occur between Drawings, Specifications, and actual field conditions, immediately notify the Owner's Project Manager for Owner's interpretations.

C. Coordinate the actual locations of electrical outlets and equipment with building features and equipment as indicated on architectural, structural, mechanical, and plumbing Drawings. Review any proposed changes in electrical wiring devices or equipment location with the Owner's Project Manager. Owner may direct relocation of outlets before installation, up to five (5) feet from the position indicated, without additional cost. Remove and relocate outlets placed in an unsuitable location when requested by the Owner, at no additional cost to the Owner.

D. All dimensional information related to new structures shall be taken from the appropriate Drawings. All dimensional information related to existing facilities shall be taken from actual measurements made by the Contractor on the Site.

E. Existing Structures: The building floor slabs, structure, and outer walls are generally existing to remain. The only existing penetrations are openings where indicated on the Drawings. This Contract requires the Contractor to core drill all other floor or wall penetrations as required. All floor penetrations shall include a sleeve that extends two (2) inches above the floor. ~~Bus duct penetrations shall have a minimum 4 inch high curb as per NEC requirement or per drawing, whichever is higher.~~

1.03 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the Contract Documents.

1.04 DEFINITIONS

A. Concealed: Concealed areas are those areas that cannot be seen by building occupants.

B. Exposed: Exposed areas are all areas that are exposed to view by building occupants, including areas below counter tops, inside cabinets and closets, inside all equipment rooms, and areas outside the building exterior envelope, exposed to the outdoors.

1.05 QUALITY ASSURANCE

A. Regulations: Work, materials and equipment shall comply with the latest rules and regulations specified in National Fire Protection Association (NFPA).

B. Discrepancies: The Drawings and Specifications are intended to comply with listed codes, ordinances, regulations and standards. Where discrepancies occur, immediately notify the Owner's Project Manager in writing and ask for an interpretation. Should installed materials or workmanship fail to comply, the Contractor is responsible for correcting the improper installation at no additional cost to the Owner. Additionally, where sizes, capacities, or other such features are required in excess of minimum code or standards requirements, provide those specified or shown.

C. Contractor Qualifications: An acceptable Contractor for the Work under this Division must have personnel with experience, training and skill to provide a practical working system. The Contractor shall furnish acceptable evidence of having installed not less than three systems of size and type comparable to this Project. All personnel installing equipment under this Division shall possess valid City of Houston and State of Texas licenses for their skill level. Each Journeyman shall supervise no more than two apprentice helpers. Refer also to Owner's Special Conditions.

1.06 SUBMITTALS

A. Product Data: Provide coordination Drawings with submittals as required by Division 01.

B. Record Documents: In addition to hard copy format, all material submitted as final record products, including approved Shop Drawings and submittals, shall be submitted to the Owner in its original electronic file format on compact disc or DVD. Material may be scanned into electronic file format where necessary.

1.07 DELIVERY, STORAGE AND HANDLING

A. All equipment and materials shall be delivered to the Project Site clean and sealed for protection.

B. Moisture: During construction, protect switchgear, transformers, motors, control equipment, and other items from insulation moisture absorption and metallic component corrosion by appropriate use of strip heaters, lamps or other suitable means. Apply protection immediately upon receiving the products and maintain continually.

C. Damage: Take such precautions as are necessary to protect apparatus and materials from damage. Failure to protect materials is sufficient cause for rejection of the apparatus or material in question.

D. Finish: Protect factory finish from damage during construction operations until acceptance of the Project. Restore any finishes that become stained or damaged to Owner's satisfaction.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

B. Equipment and control systems should match, integrate, communicate or cooperate with Owner's existing systems, such as power monitoring systems, building automation, fire alarm, motor control centers, switchgears, breakers, transformers, and lighting dimming systems.

C. Conditions: Provide new products of manufacturers regularly engaged in production of such equipment. Provide the manufacturer's latest standard design for the type of product specified. Products shall be U.S. made. Owner reserves the right to approve or disapprove foreign-made products.

D. NEC and UL: Products shall conform to requirements of the National Electrical Code. Where Underwriters' Laboratories have set standards, listed products and issued labels, products used shall be listed and labeled by UL.

E. Space Limitations: Equipment selected shall conform to the building features and shall be coordinated with all components. Do not provide equipment that will not meet arrangement and space limitations. Contractor shall submit room layouts with submitted items shown drawn to scale. Submittals will be rejected without floor plan Drawings showing submitted items.

F. Factory Finish: Equipment shall be delivered with a hard surface, factory-applied finish so that no additional field painting is required except for touch-up.

G. Common Source: Equipment specified in Sections 26 22 13, ~~26 23 00~~, 26 24 16, ~~26 24 19~~, 26 28 17, ~~26 29 14~~, 26 43 13 shall be provided by the same manufacturer.

H. Series Ratings: Overcurrent devices shall have fully rated interrupting capacity. Series rating of devices is unacceptable.

2.02 EQUIPMENT AND DEVICE MARKING

A. Designations: Externally mark all equipment, devices, feeders, branch circuits and similar items with nameplates with the same designations as indicated on the Contract Documents.

B. Nameplates shall be black laminated rigid phenolic with white core. Emergency nameplates shall be red laminated phenolic with white cores. Nameplate minimum size shall be 1 inch high by 3 inches long with 3/16 inch high engraved white letters. Supply blank nameplates for spare units and spaces.

C. Nameplate Fasteners: Fasten nameplates to the front of equipment only by means of stainless steel self-tapping screws. Stick-ons or adhesives are not acceptable unless the NEMA enclosure rating is compromised, then only epoxy adhesive shall be used to attach nameplates.

D. Nameplate Information: The general naming convention shall consist of the following segments:

1. Building name in abbreviated form where equipment is located;

2. Building floor where electrical equipment is located;

3. Electrical system type: NP (normal power), EP (emergency power), LS (life safety branch), CB (critical branch), EB (equipment system branch);

4. System voltage: M (medium voltage), H (277/480V) or L (120/208V);

5. Individual equipment identification: A, B, C, etc.

E. In general, provide the following information for the types of electrical equipment as listed:

1. Switchgears, Switchboards, Distribution Panels and Motor Control Centers: On mains, identify the piece of equipment, the source, and voltage characteristics (i.e., 480/277V 3PH 4W). For each branch circuit protective device, identify the load served.

2. Transformers, Individual Starters, Contactors, Disconnect Switches, Transfer Switches and Similar Equipment: Identify the device designation, voltage characteristics source and load served.

3. Panelboards: Identify panelboard designation, voltage characteristics, and source designation.

F. Panelboards: Prepare a neatly typed circuit directory behind clear heat-resistant plastic in a metal frame tack welded to the inside of the door for each panelboard. Identify circuits by equipment served and by building room numbers where room numbers exist. Indicate spares and spaces with light, erasable pencil marking. Adhesive mounted directory pocket is not acceptable. Removing and attaching panel schedules from the Drawings is not acceptable.

G. Panelboards, Pull, Junction and Outlet Boxes:

1. With ½ inch high permanent lettering, identify conduits connected to panelboards, pull, junction and outlet boxes with the complete circuit number of the conductors contained therein. Neutral conductors shall be identified by wire marker tags in the panelboards, pull, junction and outlet boxes. Where multiple circuits are contained in a box, identify the circuit conductors with permanent tags which indicate circuit designation.

2. Emergency circuit junction boxes and their covers shall be painted red. Circuit identification shall be marked on the junction box cover.

3. Fire alarm circuits (only) shall be marked with half red covers and “Fire Alarm” marked on the face.

~~H. Equipment and raceways over 600 Volts: Provide “WARNING - HIGH VOLTAGE - KEEP OUT” signs on all equipment. With 2 inch-high lettering, mark all exposed raceways containing conductors operating in excess of 600 volts every 100 feet and at each wall or floor penetration with the words "WARNING - HIGH VOLTAGE”.~~

~~I.~~**H.** Power receptacles, wall switches and dedicated outlets. Identify circuits as per Specification Section 26 27 26.

~~J.~~**I.** Dedicated outlets: Dedicated is understood to be specific equipment listed by equipment number in the panel schedules or identified on the Drawings. Dedicated also includes computer outlets.

~~K.~~**J.** Remote Ballasts: For remote ballasts not within five (5) feet of their associated lighting fixture, provide appropriate permanent lettering on both the ballasts and the light fixture to identify which are mated to the other.

~~2.03 INDUSTRIAL CONTROL PANELS~~

~~A. The scope of the work does not intend to cover the Integrated Automation System, neither the design for a functional process control system. It is not intended to apply to the wirings that form an integral part of the equipment, such as motors, controllers, or factory assembled control equipment or listed utilization equipment. It intends to provide the guideline for constructing Industrial Control Panels defined by NFPA 70 Article 409.~~

~~B. The electrical requirements pertaining to, but not limited to, branch circuits, luminaires, motor circuits and controllers, air-conditioning and refrigerating equipment, hazardous locations, short-circuit and ground-fault protection, overcurrent/overload protection, industrial machinery, etc. shall be in accordance with the applicable requirements from the specific articles in NFPA 70 Article 409 Table 409.3.~~

~~C. Industrial Control Panels shall be built in accordance with the requirements of Division 25 Integrated Automation System, and shall utilize components that are UL listed, UL recognized, or specified by MDACC specifications. Component manufacturers shall have an established network of product distribution for parts replacement. The nearest distribution point shall be within 50 miles of the Project Site.~~

~~D. Multi-section industrial control panels shall be bonded together with an equipment grounding conductor or an equivalent equipment grounding bus sized in accordance with NFPA 70 Article 250. Equipment grounding conductors shall be connected to this equipment grounding bus or to equipment grounding termination point provided in a single-section industrial control panel.~~

~~E. NFPA 70 Article 110 Table 110.20 shall be used as the basis for selecting industrial control panel enclosures for use in specific locations other than hazardous (classified) locations. Industrial control panel enclosures shall not be used as junction boxes, auxiliary gutters, or raceways for conductors feeding through or tapping off to other switches or overcurrent devices or other equipment, unless the conductors fill less than 40 percent of the cross-sectional area of the wiring space.~~

~~F. The phase arrangement on 3-phase horizontal common power and vertical buses shall be A, B, C from front to back, top to bottom, or left to right, as viewed from the front of the industrial control panel.~~

~~G. Spacing between live bare metal parts in feeder circuits shall not be less than specified in NFPA 70 Article 430 Table 430.97.~~

~~H. Control panel internal wiring shall be installed neatly in panduit system.~~

PART 3 - EXECUTION

3.01 DEMOLITION

A. Unless otherwise noted, remove all electrical materials and equipment from areas indicated for demolition. Removal of equipment shall not interfere with existing operations.

B. Remove conduit and wire back to panelboards or to nearest junction box that is not being removed and needs to remain in service. Wire shall be removed back to point of origin. Turn off circuit breakers or switches serving abandoned circuits and tag breaker or switch and label in panel schedule as “Spare”.

C. Materials and equipment to be removed, except items specifically noted to be relocated or delivered to the Owner, become property of the Contractor and shall be immediately removed from the Project Site. If the Owner identifies other items during construction, those items become Owner property and will be turned over to the Owner.

D. Electrical services and controls to items being removed shall be disconnected and removed from the Project Site.

E. All fluorescent lighting fixtures being removed from the Project Site that will not be turned over to the Owner shall have any PCB-containing ballasts removed from the fixtures for environmental disposal. Ballasts shall remain intact with wire leads at least twelve (12) inches long.

F. ~~Contractor shall ensure that light switches within the Work area remain operational.~~ Where temporary 120 volt light strings are installed, a switch shall be provided for the light strings near the Project entry door.

3.02 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. Installation shall be in accordance with manufacturer’s published recommendations.

C. Cooperation with Other Trades: Cooperate with trades of adjacent, related or affected materials or operations, and with trades performing continuations of this Work in order to effect timely and accurate placing of Work and to coordinate, in proper and correct sequence, the Work of such trades.

D. Workmanship: Work shall be performed by competent workers skilled in their trade. This installation must be complete.

E. Housekeeping Pads: Unless otherwise noted. Install 3 1/2 inch thick concrete foundation pads for indoor floor-mounted equipment, except where direct floor mounting is required. Pour pads on roughened floor slabs, sized so that outer edges extend a minimum of 3 inches beyond equipment. Trowel pads smooth and chamfer edges to a 1 inch bevel. Secure equipment to pads as recommended by the manufacturer.

F. Setting of Equipment: Equipment must be leveled and set plumb. Sheet metal enclosures mounted against a wall must be separated from the wall not less than 1/4 inch by means of corrosion-resistant spacers or by 3 inches of air for freestanding units. Use corrosion resistant bolts, nuts and washers to anchor equipment. Provide Drawings and layout Work showing exact size and location of sleeves, openings or inserts for electrical equipment in slabs, walls, partitions and chases in sufficient time to be coordinated with Work under other divisions.

G. Sealing of Equipment: Seal openings into equipment to prevent entrance of animals, birds and insects.

H. Motors: Electrical Work includes the electrical connection of all motors, except those that are wired as a part of equipment.

I. Concealed Work: Conceal all electrical Work in walls, floors, chases, under floors, underground, and above ceilings except:

1. Where shown or specified to be exposed. Exposed is open to view.

2. Where exposure is necessary to the proper function.

3. Where size of materials and equipment preclude concealment.

J. Application: Unless otherwise indicated, power will be utilized as follows:

1. 480 volts, three phase: Motors ¾ horsepower and larger and electric heating equipment.

2. 120 volts, single phase: Motors ½ horsepower and smaller.

3. 120 volts, single phase: Incandescent lighting and fluorescent task lighting.

4. 277 volts, single phase: Fluorescent and high-intensity-discharge lighting and electric heating equipment.

5. 120 volts, single phase: Convenience outlets.

6. 208 volts, single and three phase: Power outlets.

K. Transformers: Use transformers to change the service to the required utilization voltages.

L. Provide final electrical connections to equipment furnished under other divisions and by the Owner. Furnish detailed Shop Drawings of equipment indicating the exact number and location of rough-in points. Such final Shop Drawings may indicate adjustments in total number and exact location of rough-in points, and in equipment dimensions. Making adjustments to field conditions is considered a part of the Work required.

1. Roughing-in: When roughing-in electrical branch circuits to various items of equipment, terminate at proper points as indicated on detailed equipment Shop Drawings or as directed by Owner. Do not rely on Drawings accompanying these Specifications for rough-in locations, only for general routing of circuiting.

2. Final Connections: Laboratory casework, medical equipment, and food service equipment will include service fittings such as switches, duplex receptacles, lighting fixtures, etc., on the casework or equipment. Provide branch circuit connections to meet service fitting requirements.

M. Refer to Divisions 07 and 09 for sealing and firestopping requirements where raceways penetrate smoke, fire, and sound rated walls.

N. All unused openings such as but not limited to, knockouts on panels and boxes, surface wireway openings, busway openings, circuit breaker empty slots shall be covered with approved cover plates.

O. Temporary power equipment and distribution for construction shall not occupy building spaces or block pathways that are designated for permanent installation of other trades according to design drawings.

3.03 TESTING

A. Test Conditions:

1. Place circuits and equipment into service under normal conditions, collectively and separately, as may be necessary to determine satisfactory operation. Perform specified tests in the presence of the Owner's representative(s). Furnish all instruments, wiring, equipment and personnel required for conducting tests. Demonstrate that the equipment operates in accordance with requirements of the Contract Documents. Special tests on certain items are specified hereinafter.

2. Testing shall be performed by an independent testing company that is Owner approved, and National Electrical Testing Association (NETA) certified. Submit copies of test reports.

3. Prior to testing, Contractor shall submit to Owner for approval, installation verification Prefunctional Checklists and Functional Performance Test procedures. These shall be used for documentation as part of the commissioning process.

4. All instruments required for conducting the tests shall be NIST (National Institute for Standard and Technology) certified or traceable, and calibrated at the time of testing.

B. Test Dates: Schedule final acceptance sufficiently in advance of the Contract date to permit completion of any necessary adjustment or alterations within the number of days allotted for completion of the Contract. Provide written notification to Owner at least fourteen (14) calendar days in advance of Functional Performance Test dates.

C. Retests: If retesting is required due to initial failure, conduct retests of such time duration as may be necessary to assure proper functioning of adjusted or altered parts or items of equipment. Any resultant delay as a result of such necessary retests does not relieve the Contractor of Contractor’s responsibility under this Contract.

D. Circuit Verification: All 120-volt single-phase circuits shall be verified to match the Drawings and panel schedules by “ringing out" each circuit in the presence of the Owner’s representative(s).

E. Refer to Commissioning Specification Sections for additional start-up, prefunctional and operational checkout, and for functional performance test procedures.

END OF SECTION 26 01 00

SECTION 26 01 05 - ELECTRICAL DEMOLITION

PART 1 - GENERAL

1.01 WORK INCLUDED

1.02 ELECTRICAL DEMOLITION FOR RENOVATION AND EXPANSION OF EXISTING SYSTEMS AND FACILITIES.

A. Electrical demolition in preparation for new construction.

1.03 RELATED WORK

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 and 02 Specification Sections, apply to this Section.

B. This Section shall be used in conjunction with Selective Demolition specifications, demolition Drawings, and related Contract Documents to establish the total requirements for minor electrical demolition.

C. In the event of conflict regarding minor electrical demolition requirements between this Section and other Sections, the provisions of this Section shall govern. In the event of conflict between this Section and another section regarding administrative procedures and requirements, the provisions of the Division 00 and Division 01 specification(s) shall govern.

1.04 EXISTING FACILITIES

A. The Contractor shall be responsible for loss or damage to the existing facilities caused by him and his workmen, and shall be responsible for repairing or replacing such loss or damage. The Contractor shall send proper notices, make necessary arrangements, and perform other services required for the care, protection and in service maintenance of electrical services for the new and existing facilities. The Contractor shall erect temporary barricades, with necessary safety devices, as required to protect personnel from injury, removing temporary protection upon completion of the work.

B. Provide temporary or new services to existing facilities as required to maintain their proper operation when normal services are disrupted as a result of the work being accomplished under this project.

C. Where existing construction is removed to provide working and extension access to existing utilities, the Contractor shall remove doors, piping, raceway, conduit, outlet boxes, wiring, luminaires, air conditioning ductwork and equipment, etc., to provide this access and shall reinstall same upon completion of work in the areas affected.

D. Where partitions, walls, floors, or ceilings of existing construction are indicated to be removed, remove and reinstall in locations approved by the Architect/Engineer and the Owner's Representative the devices and outlets required for the operation of the various systems installed in the existing construction. This is to include but is not limited to temperature controls, system devices, electrical switches, relays, luminaires, fixtures, piping, conduit, raceway, boxes, etc.

E. Outages of services as required by the demolition work and new construction will be permitted but only at a time approved by the Owner. The Contractor shall allow the Owner 21 working days in order to schedule required outages. The time allowed for outages will not be during normal working hours unless otherwise approved by the Owner. Costs of outages, including overtime charges, shall be included in the contract amount. Coordinate outages of the electrical distribution system with the serving utility company, CenterPoint Energy (CPE).

F. Existing facilities include vivarium, laboratories, academic facilities, and related spaces in which research is in progress that is sensitive to disruption by noise and by vibrations transmitted through structure. Coordinate work among the various trades to minimize disruption to processes, procedures, instruction, and equipment in vivarium, laboratories, academic facilities, and related spaces adjacent to areas of demolition and renovation work. Coordinate with Owner's Representative to schedule work producing noise or structure born vibrations, including but not limited to cutting, drilling, coring, and use of impact tools. Powder actuated anchors are prohibited.

G. Demolition and renovation will be performed in phases. Refer to architectural drawings for phases of construction.

PART 2 - PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. Materials and equipment for patching and extending work: as specified in individual Sections.

B. Provide materials necessary for work.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Demolition and modifications to existing systems shall be coordinated through the Owner's Representative. Demolition Drawings are based on casual field observation and existing record documents. Therefore the accuracy or exactness of the Drawings is not guaranteed. The Contractor shall verify that field measurements and circuiting arrangements are as shown on Drawings, and that abandoned wiring and equipment serve only abandoned facilities. The Contractor shall be responsible for reporting discrepancies to the Owner's Representative before disturbing the existing installation.

B. Beginning of demolition means Contractor accepts existing conditions.

3.02 PREPARATION

A. Disconnect electrical systems in walls, floors, and ceilings as scheduled or indicated for removal. Provide temporary wiring and connections to maintain remaining systems in service during demolition and/or modification. Owner reserves the right up to 24 hours prior to scheduled event to delay or suspend shutdowns or outages to more convenient times at no additional cost to Owner.

B. Existing Electrical Service: Maintain existing system in service until new system is complete and ready for service. No work shall begin without proper permits and authorizations. Disable system only to make switchovers and connections. Obtain permission from Owner's Representative at least 21 working days before partially or completely disabling system. Schedule work so as to minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area.

C. Existing Fire Alarm System: Maintain existing system in service until new system is accepted. Disable system only to make switchovers and connections. Notify Owner at least 21 working days before partially or completely disabling system. Schedule work so as to minimize outage duration. Provisions for manual fire watch shall be provided in areas where services are interrupted. Make temporary connections to maintain service in areas adjacent to work area.

D. Existing Telephone and Voice/Data Communications System: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Notify Owner at least 21 working days before partially or completely disabling system. Schedule work so as to minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area.

E. Existing Security System: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Notify Owner at least 21 working days before partially or completely disabling system. Schedule work so as to minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area.

F. Lighting: Contractor shall ensure that light switches within the work area remain operational. Where temporary 120 volt light strings are installed, provide a switch for the light strings near the Project entry door.

3.03 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

A. Remove, relocate, and extend existing installations to accommodate work as indicated on Drawings. Unless otherwise noted, remove electrical materials and equipment from areas indicated for demolition. Removal of equipment shall not interfere with existing operations.

B. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes for their full length from source to device. Cut embedded or concealed conduit flush with walls and floors, and patch surfaces.

1. Remove abandoned conduit to the extent necessary to accommodate new work and where conduit is visible above the floor line. Abandoned conduit shall be removed, except where specifically indicated to remain in place. Seal existing conduits that remain in place behind walls or in floor slabs. Remove wiring from conduit to be demolished.

2. Remove abandoned conduit and wire back to panelboard or to nearest junction box that is not being demolished. Where the circuit is no longer used, remove wire back to panelboard, or point of origin, and remove conduit back to nearest junction box. Cut conduit flush with walls and floors, and patch surfaces. Turn off circuit breakers or switches serving abandoned circuits and tag breaker or switch and label in panelboard schedule as “SPARE”.

3. Where circuits indicated for demolition extend to areas or serve equipment outside the areas indicated on the Drawings for demolition, maintain in operating condition the existing circuits and devices to remain. Remove conduit and wire back to nearest junction box that is not being demolished. Provide label at box indicating panelboard and circuit number, and room or area served. Where branch circuit conductors remain after removal of wiring devices from wall-boxes, provide blank device plate. Stencil device plate to indicate panelboard and circuit number, and room or area served. Where power is required to be interrupted to areas not indicated or scheduled for demolition in order to effect the work under this project, coordinate with the Owner’s Representative to schedule required outages and interruptions.

4. Abandoned wiring shall not remain in place. Abandoned wiring, whether exposed or installed in raceway, shall be removed from the jobsite and properly disposed. Where abandoned wiring is discovered within the work area, removal and disposal of this wiring shall be the responsibility of the Contractor. Coordinate with Owner and with Divisions 27 and 28 for removal of abandoned technology wiring for communications, audio-visual, security, CATV, fire alarm, and similar systems.

C. Disconnect and remove abandoned devices. Remove abandoned outlets where conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets that are not removed.

D. Disconnect and remove abandoned panelboards and distribution equipment.

E. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed. Electrical services and controls to items being removed shall be disconnected and removed as a requirement of this Section.

F. Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories.

G. Repair adjacent construction and finishes damaged during demolition and extension work.

H. Maintain access to existing electrical installations that remain active. Modify installation or provide access panel as appropriate.

I. Extend existing installations using materials and methods compatible with existing electrical installation, structure, and finishes, or as specified.

J. Where equipment is indicated to be removed and returned to Owner, the Contractor shall include the delivery of this equipment to the Owner's site storage area. Remove with care equipment to be relocated. Repair or replacement of equipment damaged by the Contractor is the responsibility of the Contractor.

K. Where existing circuits serving areas to remain extend through areas indicated for demolition, maintain those existing circuits and devices in operating condition. Coordinate outages and interruptions of existing circuits with Owner’s Representative to minimize interruption of ongoing operations and instruction. Provide raceway and supports to reconnect existing circuits to remain. Promptly reconnect and restore circuits following outages and interruptions.

3.04 CLEANING AND REPAIR

A. Trash and Debris. The Contractor shall follow the requirements of the General and Supplementary Conditions, Division One, including Owner’s clean work policy, and shall include the removal of trash and demolished material from the building or work area at the end of the each day and removal from the site once a week.

B. Incidental Work and Repair. The Contractor shall be responsible for repairing adjacent construction and finishes damaged during demolition and/or modification. The Contractor shall be responsible for the removal of ceiling tiles required in the demolition work. The Contractor shall be responsible for the replacement of damaged tiles and reinstallation of the ceiling prior to final acceptance.

C. Existing Panelboards to Remain.

1. Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates (“blanks”) for vacant positions.

2. Prepare a neatly typed, computer-generated circuit index/directory showing revised circuiting arrangement inside the front door of each branch circuit panelboard and each distribution panelboard identifying each circuit. Adhesive mounted directory pocket is not acceptable. Where changes are made, the schedule shall reflect the changes. At the end of the job, these schedules shall be neat, clearly-typed, and reflect as-built record conditions.

   a. Each panelboard schedule / index / directory shall include the following information:

   b. Panelboard No.: Panelboard identification name/number assigned on Drawings.

   c. Room No.: Room number in which panelboard is located.

   d. Served From: Number of transformer or distribution panel that feeds panelboard.

   e. Date Published: Date panelboard information was published.

   f. Circuit Number: Each circuit number identified. Arrange circuit numbers on panelboard schedule to match physical arrangement of circuit breakers in panelboard.

   g. Description: Identify circuits by equipment served and by room numbers or other unique location identifier. Indicate equipment name (e.g., printer, VAV box, security cameras) if applicable, or device type (e.g., Receptacle, Floor Box, Furniture, SPD). Circuits serving more than one room need only indicate the room in which the homerun begins.

   h. Indicate spares and spaces with light, erasable pencil marking.

D. Luminaires: Remove existing luminaires for cleaning. Use mild detergent to clean exterior and interior surfaces, rinse with clean water and wipe dry. Replace lamps, replace ballasts as required, and replace broken electrical parts.

3.05 DISPOSITION OF MATERIAL AND EQUIPMENT

A. Review with the Owner's Representative the materials that have been removed and are no longer required, to determine which materials the Owner may desire to keep. Deliver those materials that the Owner desires to the Owner's specified location.

B. For those materials not required by the Owner, dispose of them in accordance with applicable regulations.

C. Materials and equipment to be removed, except items specifically listed to be relocated or delivered to the Owner, become the property of the Contractor and shall be immediately removed from the project site. Where the Owner identifies other items during construction, those items become Owner property and will be turned over to the Owner.

D. Fluorescent luminaires being removed from the Project Site that will not be turned over to the Owner shall have any PCB-containing ballasts removed from the fixtures for environmental disposal. Ballasts shall remain intact with wire leads at least twelve (12) inches long.

E. Salvage and recycle materials as directed by the Owner's Representative. Refer to LEED criteria per USGBC documents.

END OF SECTION 26 01 05

SECTION 26 05 19 – CABLE, WIRE AND CONNECTORS, 600 VOLT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 SUMMARY

A. This Section specifies the requirements for 600-volt cable, wire and connectors. It consists of but is not limited to power distribution circuitry, control system circuitry, lighting circuitry, appliance, equipment and motor-branch circuitry and outdoor power and lighting circuitry.

1.03 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:

1. NEMA WC 3: Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

2. NEMA WC 5: Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

3. Where application of National Electrical Code, appears to be in conflict with the requirements of this section, the Owner shall be asked for an interpretation.

1.04 SUBMITTALS

A. Product Data:

1. Submit manufacturer's data on cable and wire connectors.

1.05 DELIVERY, STORAGE AND HANDLING

A. Provide factory-wrapped waterproof flexible barrier material for covering wire and cable wood reels, where applicable; and weather resistant fiberboard containers for factory-packaging of cable, wire and connectors, to protect against physical damage in transit. Damaged cable, wire or connectors shall be removed from the Project Site.

B. In their factory-furnished coverings, store cable, wire and connectors in a clean, dry indoor space which provides protection against the weather.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

B. Provide factory-fabricated wire of the size, rating, material and type as indicated for each service. Where not indicated, provide proper selection as required to comply with installation requirements and with NEC standards. The minimum size wire to be used for power or lighting circuits shall be #12 copper stranded with insulation as noted below. Minimum size for control circuits shall be #14 copper stranded.

2.02 MANUFACTURERS

A. Interstate Wire Company.

B. American Insulated.

C. Okonite.

D. Southwire.

E. Encore Wire.

2.03 BUILDING WIRE

A. NEMA WC 70 – Nonshielded 0-2kV Cables

B. Feeders and Branch Circuits all sizes: 98 percent conductivity copper, stranded conductor, 600-volt insulation, THHN/THWN. Use XHHW insulation for all isolated power circuits.

C. Control Circuits: 98 percent conductivity copper, stranded conductor, 600 volt insulation, THHN, THWN.

D. Color Coding:

1. Branch Circuit and Feeders:

	280Y/120 Volts	480Y/277 Volts	~~120/240 Volts~~
Phase A	Black	Yellow	~~Black~~
Phase B	Red	Brown	~~Red~~
Phase C	Blue	Orange	~~—~~
Neutral	White with tracer	Gray with tracer	~~White with tracer~~
Ground	Green	Green	~~Green~~

2. The above colors shall be used unless requirements of code require different colors. When connecting to existing circuits, existing color coding shall be utilized. The neutral tracer color shall match the phase conductor color that it is associated with. Lighting circuits with shared grounding conductor are not required to have tracer colors on the wire.

~~3. Secondary conductors from isolation transformers shall be: Conductor 1-orange and conductor 2-brown.~~

~~4.~~**3.** Conductors No. 8 AWG and larger shall be identified by colored plastic tape that marches the circuit phase color at all visible points when colored insulation is unavailable. Colored tape shall be located and of such a quantity to readily indicate the conductor phase.

E. Type AC and MC cable assemblies shall be permitted only with proper cable management via cable trays and with Owner's prior written approval.

2.04 REMOTE CONTROL AND SIGNAL CABLE

A. Control Cable for Class 1 Remote Control and Signal Circuits: 98 percent conductivity copper conductor, 600-volt insulation, rated 60 degrees C, individual conductors twisted together, shielded and covered with a PVC jacket.

B. Control Cable for Class 2 or Class 3 Remote Control and Signal Circuits: 98 percent conductivity copper conductor, 300-volt insulation, rated 60 degrees C, individual conductors twisted together, shielded and covered with a nonmetallic jacket; UL listed for use in air handling ducts, hollow spaces used as ducts, and plenums.

PART 3 - EXECUTION

3.01 PREPARATION

A. Installer must examine the areas and conditions under which cable, wire and connectors are to be installed and notify the Contractor and Owner in writing of conditions detrimental to the proper and timely completion of the work.

B. Inspect wire and cable for physical damage. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. All installation shall be in accordance with manufacturer's published recommendations.

C. General wiring methods:

1. Install electrical cable, wire and connectors as indicated. All installations, temporary or permanent, shall be in accordance with the manufacturer's written instructions, the applicable requirements of NEC, and as required ensuring that products serve the intended functions.

2. Coordinate cable and wire installation work with electrical raceway and equipment installation work, as necessary for proper interface.

3. Cables shall be selected on the basis of their purpose and UL listing. Generally, use Types THWN, XHHW and THNN in building interiors and other dry locations. Outdoors and in underground in raceways, use Type THWN or THHN. Conductors subject to abrasion, such as in lighting poles, shall be Type THWN or THHN.

4. No conductor smaller than No. 12 wire shall be used for branch circuit wiring. In the case of "homeruns" over 50 feet in length (100 feet for 277 volt), no conductor smaller than a No. 10 wire shall be used. The tap conductor from the J-box in the ceiling to the receptacle may be No. 12. Each 120-volt phase conductor shall have a neutral conductor of the same size. The sizing of all wire except remote control wire shall be accomplished in the case of both feeder and branch circuits by conforming to the following provisions.

    a. 480 Volt Branch Circuits: The voltage drop in the case of 277/480 volt circuits shall not exceed 1.0 percent at maximum load and 70.0 percent power factor.

    b. 120/208 Volt Branch Circuits: The voltage drop in the case of 120/208 volt circuits shall not exceed 2.0 percent at maximum load and 70.0 percent power factor.

5. Remote control wires shall be no smaller than No.14 AWG stranded copper conductors and shielded with drain. Control wires shall be run in separate conduits. Departures from the sizes so determined shall be made only in those cases in which the National Electrical Code requires the use of larger conductors. The sizes as determined from these tables shall be regarded as the acceptable minimum under all other circumstances. In no case, however, shall there be a voltage drop greater than that specified in any feeder or branch circuit. This voltage drop shall be based on the full load, 70 percent power factor, the total impedance drop with 60-hertz alternating current and with the reactance drop in the respective metal conduits duly considered. The Contractor may, if Contractor deems it necessary or advisable, use larger sized conductors than those shown. Under no circumstances, however, shall the Contractor use any conductors sized in a manner which does not conform to the above mentioned tables without having first secured the written approval of the Owner's duly authorized representative.

D. Wiring Installation Raceways:

1. Wire and cable shall be pulled into clean dry conduit.

2. Pull conductors together where more than one is being installed in a raceway.

3. Use UL listed pulling compound or lubricant, when necessary; compound must not deteriorate conductor and insulation. No pulling compound shall be used when pulling isolated power circuits utilizing XHHW insulation.

4. Install wire in raceway after interior of building has been physically protected from the weather and all mechanical work likely to injure conductors has been completed. Wires with damaged insulation shall be replaced at no cost to the Owner.

5. Place an equal number of conductors for each phase of a circuit in same raceway.

6. No more than three phase conductors shall be installed in same conduit. Line conductors shall not share the same conduit with load conductors.

E. Wiring Connections and Terminations:

1. Splicing cable or wire is not allowed unless it is explicitly designed by the Engineer, or for equipment connection per equipment manufacturer's recommendation. Where splices are to be implemented, approval of the Owner must be obtained before installation is made. Provide electrical boxes where splices are made.

2. Thoroughly clean wires before installing lugs and connectors.

3. Terminate indoor spare conductors with electrical tape in a box.

4. Conductors installed outdoors or in garages, whether in use or spare, shall be terminated in boxes that are rated for outdoor use with listed connectors that are rated for watertight/rain tight applications. The use of indoor wire nuts with electrical tape is prohibited for installations outdoors or in garages.

F. Field Quality Control:

1. Torque test conductor connections and terminations to manufacturer's recommended values.

2. Perform continuity test on all conductors. Verify proper phasing connections and phase rotation, where applicable.

3. Conductors in vertical conduits or raceways shall be supported in the manner set forth in the appropriate section of the latest revision of the National Electrical Code. Lighting fixtures shall not be used for raceways for circuits other than series wiring of fixtures.

4. Conductors may be run parallel on sizes 1/0 to 500 kcMIL inclusive provided all parallel conductors are the same size manufacturer, length and type of insulation. Except as otherwise shown on Drawings, no more than three (3) conductors may be run in parallel, and they shall be so arranged and terminated as to ensure equal division of the total current between all conductors involved. Where parallel connection is contemplated, approval of the Owner must be obtained before installation is made.

3.03 TESTING

A. Before final acceptance, the Contractor shall make voltage, insulation and load tests, necessary to demonstrate to the Owner the satisfactory installation and proper performance of all feeder circuits.

B. Test feeder conductors to determine the conductors are clear of faults, high resistance connections and megger test same at 600 volts DC. Test results below 30 mega ohms shall be cause for rejection of the wiring installation. Replace and retest all such rejected conductors.

END OF SECTION 26 05 19

SECTION 26 05 26 – GROUNDING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 SUMMARY

~~A. Ground the electrical service system neutral at service entrance equipment to grounding counterpoise loop. Electrical systems that are grounded shall be connected to earth in a manner that will limit the voltage imposed by lightning, line surges, or unintentional contact with higher-voltage lines and that will stabilize the voltage to earth during normal operations. Provide a completely grounded system in accordance with Article 250 of the NEC.~~

~~B.~~**A.** Metal water piping system(s) installed in or attached to a building or structure shall be bonded to the service equipment enclosure, the grounded conductor at the service. Where installed in or attached to a building or structure, a metal piping system(s), including gas piping, that is likely to become energized shall be bonded to the service equipment enclosure, the grounded conductor at the service. The bonding jumper(s) shall be sized in accordance with Article 250 of the NEC.

~~C. Ground each separately-derived system neutral to separate ground buses that are installed in nearest electrical rooms. Transformers, UPS systems, power conditioners, inverters, or other power supplies that are separately derived systems. Standby or emergency generators are separately derived systems if the neutral is bonded to the generator frame and if there is no direct connection of the generator neutral conductor to the service neutral conductor.~~

~~D. Concrete reinforcing bars shall be permitted for grounding. Connect the structural metal frame to the reinforcing bars of concrete-encased electrode. Concrete-encased electrodes of existing buildings or structures shall not be required to be part of the grounding electrode system where the steel reinforcing bars or rods are not accessible for use without disturbing the concrete.~~

~~E. Provide communications system-grounding conductor at point of service entrance and connect to Telecommunications Main Grounding Busbar (TMGB). Bond together the communications system grounding.~~

~~F. Bond together system neutrals, service equipment enclosures, exposed non-current carrying metal parts of electrical equipment, metal raceway systems, metal cable trays, auxiliary gutters, meter fittings, boxes, cable armor, cable sheath, ground bus in electrical rooms, metal frame of the building or structure, ground ring, lightning down lead conductor, grounding conductor in raceways and cables, receptacle ground connectors, and metallic plumbing systems.~~

~~G.~~**B.** The major components of the Telecommunications Grounding and Bonding infrastructure are as follows:

1. The Telecommunications Main Grounding Busbar (TMGB).
2. The Telecommunications Grounding Busbar (TGB).
3. The Telecommunications Bonding Backbone (TBB).
4. The Telecommunications Bonding Conductor (TBC).
5. Grounding Equalizer (GE).

1.03 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All design, materials, installation and testing pertaining to grounding and bonding system shall comply with the latest edition of applicable requirements and standards addressed within the following references:

1. ANSI/IEEE Standard 142 - Recommended Practices for Grounding of Industrial and Commercial Power Systems.
2. UL 467 - Grounding and Bonding Equipment.
3. IEEE 81 - Guide for Measuring Earth Resistivity, Ground Impedance and Earth Surface Potentials of a Ground System.
4. IEEE 1100 - Recommended Practice for Powering and Grounding Electronic Equipment (IEEE Emerald Book).
5. NFPA 70 - National Electrical Code (NEC).
6. NFPA 780 - Standard for the Installation of Lightning Protection Systems.
7. LPI (Lightning Protection Institute) 175- Standard of Practice for the Design - Installation - Inspection of Lightning Protection Systems.
8. UL 96 - Lightning Protection Components.
9. UL 96A - Standard for Safety Installation Requirements for Lightning Protection Systems.
10. BICSI Telecommunications Distribution Methods Manual (TDMM), Latest Edition.
11. ANSI J-STD-607-A – Commercial Building Grounding and Bonding Requirements for Telecommunications.
12. IEEE C2 - National Electrical Safety Code (NESC).

13. UL 497 - Protectors for Paired-Conductor Communications Circuits.

14. UL 497A - Secondary Protectors for Communications Circuits.

15. UL 497B - Protectors for Data Communications and Fire-Alarm Circuits.

16. UL 1449 - Standard for Safety Surge Protective Devices.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.02 MATERIALS AND EQUIPMENT

A. Grounding system components shall be as required to comply with the design and construction of the system indicated. Components shall be as indicated in manufacturer's submittal data.

B. Ground Conductors:

1. Materials:

a. Provide 600-volt insulated conductors having a green-colored insulation for grounding electrode and equipment grounding conductors. Use stranded conductors.

b. Conduit grounding conductors shall be insulated copper conductor, green in color to size #6 AWG. Insulated conductors larger than #6 AWG shall be same as phase conductors but identified with green tape at each accessible opening or location in raceway.

c. Provide bare conductors for bonding jumpers.

d. Cable tray grounding conductors shall be a minimum of 1/0 bare copper conductors.

C. Connections:

1. Materials:

a. Unless otherwise noted, for below-grade connections provide exothermic welded type.

b. For above-grade connections provide mechanical bolted-type connections utilizing high conductive copper alloy or bronze lugs or clamps.

c. Where required, provide plated connectors that will not cause electrolytic action between the conductor and the connector.

D. Grounding clips shall be O-Z Gedney, Steel City (Thomas & Betts) Type G.

~~E. Grounding Electrodes:~~

~~1. Grounding electrodes shall not be smaller than ¾-inch diameter, with minimum length ten (10) feet.~~

~~2. Grounding electrodes shall be copper-clad steel for corrosion protection.~~

~~F.~~**E.** Grounding Busbar:

1. Where a field-provided ground bus or ground bar is required, use round-edge copper bar with 98 percent International Annealed Copper Standard (IACS) conductivity.

2. Size the bus for not less than 25 percent of the cross-sectional areas of the related feeder. A minimum size of ¼-inch thick by 2-inch depth by 6-inch length (minimum) is required.

   a. The ground bar shall be a predrilled copper busbar provided with standard NEMA bolt hole sizing and spacing for the type of connectors to be used.

   b. The ground bar shall be tin-plated for reduced contact resistance.

   c. The ground bar shall be insulated from its support. A minimum of 2 inches separation is required. Mount the grounding busbars on insulated standoffs to ensure isolation from ground potential or stray potentials.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. All installations shall be in accordance with manufacturer's published recommendations.

C. Install ground system as indicated, in accordance with the applicable requirements of the NEC. ~~Coordinate installation of grounding and lightning protection system components with structural and civil Drawings and placement of building structure.~~

D. Install grounding conductors continuous, without splice or connection, between equipment and grounding electrodes.

E. Size: When grounding and bonding conductors are not sized on Drawings, size the grounding conductors in accordance with NEC. Size bonding jumper so that minimum cross-sectional area is greater than or equal to that of the equivalent grounding conductor as determined from NEC.

F. Connect grounding electrode conductors to metal water pipe using suitable ground clamp. Make connections to flanged piping at street side of flange. Provide bonding jumper around water meter.

G. Exothermic welding shall be utilized for ground connections where they are concealed, or inaccessible.

H. Strap grounding clamps shall not be used. A connection requiring bolting shall be made up with Monel metal bolts, washers and nuts. Connections shall be made only after surfaces have been cleaned, or ground to expose virgin metal.

I. Supplementary Grounding Electrode: Use effectively grounded metal frame of the building.

~~J. Provide grounding and bonding at Utility Company's metering equipment in accordance with Utility Company's requirements.~~

~~K.~~**J.** Conduit and raceway systems shall not be considered a ground path. Provide an internal insulated grounding conductor in all conduits and raceways. Size grounding conductors in accordance with the NEC. Where grounding conductor sizes are shown in excess of code requirements, provide conductor sizes as indicated.

~~L.~~**K.** In feeder and branch circuits, provide a separate, green, insulated equipment-grounding conductor with the circuit conductors. Terminate each end of the grounding conductor on a grounding lug, bus, or bushing.

~~M.~~**L.** Ground each outlet by the use of an approved grounding clip attached to the junction box in such a position to be readily inspected on removal of the cover plate, or by the use of an approved grounding yoke type receptacle.

~~N.~~**M.** Install an insulated grounding conductor internally to all flexible metal conduits. All flexible metal conduit containing power circuits shall utilize grounding bushings. The grounding bushing shall contain a bonding jumper and shall be terminated at the equipment ground bus. The grounding conductor shall terminate at the equipment ground bus. Install external ground wire on liquid tight flexible metal conduit. Provide suitable grounding bushing at each end of liquid tight flexible metal conduit at transformers. External ground wire shall be in addition to grounding conductors installed internal to raceway system.

~~O.~~**N.** Where accessible, conductor connections shall be made by means of solder-less connectors such as serrated bolted clamps or split bolt and nut type connectors.

~~P. Measure ground resistance from neutral connection at service entrance to ground reference point using suitable grounding testing equipment. Resistance shall not exceed 5 OHMS.~~

3.02 FIELD QUALITY CONTROL

~~A. System Neutral: Where a system neutral is used, bond the system neutral to the grounding electrode system in accordance with NEC. Ground the system neutral only at the point of service and isolate it from ground at all other points in the system.~~

~~B. Separately Derived Systems: Ground neutrals of separately derived systems such as generators, transformers, etc., in accordance with NEC.~~

~~C.~~**A.** The neutral of each transformer shall be bonded to system ground at one point only. This point shall be ahead of the first secondary protective device.

~~D.~~**B.** Size: Size the system grounding electrode conductors to comply with NEC.

~~E.~~**C.** Connect grounding electrode conductor pigtails at each grounding electrode to building structural steel, as indicated.

~~F.~~**D.** Connect main grounding electrode conductor pigtails to power system neutral, as indicated on Drawings.

~~G.~~**E.** Inspect grounding and bonding system conductors and connections for tightness and proper installation.

3.03 EQUIPMENT GROUND

~~A. Manholes:~~

~~1. Provide a No. 1/0 AWG bare stranded copper ground bus in all manholes. Mount bus 12 inches above floor using one-hole pipe straps three (3) feet on center.~~

~~2. Connect bus to ground rod with a No. 1/0 AWG conductor. Bond all metallic components and electrical grounding conductors to the bus using lugs or clamps.~~

~~B. Transformer Rooms, Electric Rooms, Switchgear Rooms, and Generator Rooms:~~

~~1. Provide 4/0 copper ground wire loop in each room for bonding and grounding.~~

~~2. Mount ground loop 12 inches below suspended ceiling or structural ceiling and around the perimeter of room.~~

~~3. Connect ground loop to vertical ground bus (cable) riser grounding plate. Bond all non-current carrying metallic parts of electrical equipment in the room to the ground loop by bonding jumper(s) sized in accordance with Article 250 of the NEC.~~

~~C.~~**A.** Raceway Systems and Equipment Enclosures:

1. Ground cabinets, junction boxes, outlet boxes, motors, controllers, raceways, fittings, switchgear, transformer enclosures, other electrical equipment and metallic enclosures. Ground equipment and enclosures to the continuous-grounded metallic raceway system in addition to any other specific grounding shown.

2. Provide bonding jumpers and ground wire throughout to ensure electrical continuity of the grounding system,

3. Provide grounding-type insulated bushings for metal conduits 1-1/2 inches and larger terminating in equipment enclosures containing a ground bus and connect the bushing to the ground bus.

4. Provide a green insulated equipment-grounding conductor for each feeder and branch circuit.

~~D.~~**B.** Taps and Connections: Make grounding (earth) conductor approximately 2 inches longer than the ungrounded (phase) conductors at both ends.

3.04 TELECOMMUNICATIONS GROUNDING AND BONDING INFRASTRUCTURE

A. Isolated (Single Point) Ground:

1. Purpose:

a. An isolated single point grounding system is employed for installations utilizing sensitive electronic, data processing or communications equipment.

b. This single ground bus is not connected in electrical loops, but in a radial configuration between the various electronic equipment locations.

c. The single ground bus is then connected to the building electrical service equipment ground. This grounding arrangement thus provides only a single path to ground for any circulating ground currents, which will minimize electromagnetic interference with sensitive electronic equipment.

2. Equipment Requiring Isolated Grounding: Equipment typically grounded to the isolated single point grounding system includes communications and coaxial cable shields, telephone termination block earth grounds, radio transmitter chassis grounds, and electronic equipment signal grounds which are isolated from the equipment chassis.

3. Grounding Busbars:

a. Install a local isolated ground busbar in each room or area where indicated on the Drawings. Ground all sensitive electronic equipment in the room or area to the local isolated ground bus.

b. Install a master isolated ground busbar for the entire building or plant structure. Connect radial isolated ground leads from each local isolated ground bus to the master isolated ground bus.

4. Grounding Conductors:

a. Conductors from individual equipment and cable shields shall be a minimum No. 6 AWG, type THW stranded copper with green insulation. The conductor from each local isolated ground bus to the master isolated ground bus shall be a minimum of No. 2/0 AWG, type THW stranded copper with green insulation. The conductor from the master isolated ground bus to the facility ground rod array shall be a minimum of No. 2/0 AWG, type THW stranded copper with green insulation. Grounding cable with aluminum conductors is not acceptable.

b. Conductors shall be routed to provide the minimum possible number of cable bends. The radius of any cable bend shall be not less than 8 inches, and the included angle of any bend shall be a minimum of 90 degrees.

5. Grounding Connectors:

a. Connections from individual equipment and cable shields shall use crimp-type connectors of copper or tinned copper construction. Individual equipment connections to local isolated ground buses shall use copper alloy or bronze machine bolts and lock washers.

b. No. 2/0 cable connections from local isolated ground buses to the mater ground bus shall utilize an exothermic weld or brazing process. No. 2/0 cable connections from the master ground bus to the facility ground rod array shall utilize an exothermic weld or brazing process.

c. Paint-piercing grounding washers shall be used.

d. Connectors utilizing aluminum or steel alloys are not acceptable.

6. Connections to Isolated Grounding Systems: Use insulated equipment grounding conductor and connect only to service grounding electrode. Where isolated grounding system is associated with a separately derived system, bond isolated grounding conductor to system neutral at source of separately derived system in accordance with NEC.

B. General:

1. All bonding conductors and connectors shall be listed for the purpose intended and approved by a Nationally Recognized Testing Laboratory (NRTL).

2. All bonding conductors shall be green-insulated copper conductor. The minimum bonding conductor size shall be a No. 6 AWG. Leave a minimum of 10 feet slack conductor at termination board.

3. Route ground conductors to provide the shortest, most direct path from point to point. Telecommunications ground must be bonded to the lightning protection system grounding and may need additional bonding depending on: spacing, building dimensions, and construction.

4. Bonding conductors should not be placed in ferrous metallic conduit. If it is necessary to place bonding conductors in ferrous metallic conduit that exceeds 3 feet in length, the conductors shall be bonded to each end of the conduit with a conductor sized as a No. 6 AWG, minimum (this makes the conduit a parallel path with the cable).

5. A continuous ground path shall be provided in all telecommunications raceways. Grounded cable trays shall be considered continuous ground path.

6. At each TR all equipment and raceways shall be bonded to the TGB.

7. Any grounding or bonding conductor that is run through a metallic conduit shall be bonded to the conduit.

8. Gas pipes shall not be used as a grounding electrode.

9. Provide dedicated Telecommunications Bonding Backbone (TBB) to interconnect the TRs and related equipment.

~~C. Telecommunications Entrance Facility (TEF) Telecommunications Main Grounding Busbar (TMGB):~~

1. ~~The Telecommunications Main Grounding Busbar (TMGB) serves as the dedicated extension of the building grounding electrode system for the telecommunications infrastructure. The TMGB also serves as the central attachment point for telecommunications bonding backbones (TBB) and equipment, and is located such that it is accessible to telecommunications personnel.~~

2. ~~The TEF is the desirable location for the TMGB. This TMGB may serve as the TGB for collocated equipment in the TEF. The TMGB shall be bonded to electrical service equipment ground.~~

3. ~~Where an electrical panelboard is located in the same room or space as the TMGB, the ground or enclosure of that electrical panelboard shall be bonded to the TMGB. Locate the TMGB as close to the electrical panelboard as practical to maintain clearances required by applicable electrical codes.~~

4. ~~Locate the TMGB near the TBB cabling and associated terminations. The connections of the bonding conductors for telecommunications, and the TBBs to the TMGB shall utilize listed two-hole compression lugs.~~

5. ~~Telecommunications primary protector grounding conductor shall be bonded to the TMGB. A minimum of 1 foot separation shall be maintained between this insulated conductor and any DC power cables, switchboard cables, or high frequency cables, even when placed in metal raceway.~~

6. ~~The TMGB shall have minimum dimensions of ¼ inch thick x 4 inch wide and 12 inch in length with 18 attachment points (two rows of 9 each). The length may need to be adjusted longer to meet the application requirements with consideration of future growth. The busbar shall be UL Listed as grounding and bonding equipment.~~

7. ~~The TMGB shall be a predrilled solid copper busbar provided with standard NEMA bolt hole sizing and spacing for the type of connectors to be used. The hole pattern for attaching grounding lugs shall meet the requirements of ANSI-J-STD – 607-A and shall accept 15 two-hole grounding lugs with 5/8" hole centers and 3 two-hole lugs with 1" hole centers. The busbar shall include wall-mount stand-off brackets, assembly screws and insulators creating a 4" standoff from the wall.~~

8. ~~All metallic raceways for telecommunications cabling located within Equipment Room (ER) shall be bonded to the TMGB. However for metallic raceways containing grounding conductors where the raceway is bonded to the ground conductor, no additional bonding to the TMGB is required.~~

9. ~~In buildings where the backbone telecommunications cabling incorporates a shield or metallic member, this shield or metallic member shall be bonded to the TMGB where the cables are terminated or where pairs are broken out.~~

10. ~~In a metal frame (structural steel) building, where the steel framework is readily accessible within or external to the ER; each TMGB shall be bonded to the vertical steel metal frame.~~

~~D.~~**C.** Telecommunications Room (TR) Telecommunications Grounding Busbar (TGB):

1. The TGB is the grounding connection point for telecommunications systems and equipment in the location served by that TR or ER. Each TR and ER shall contain a TGB. Multiple TGBs may be installed within the same TR or ER to aid in minimizing bonding conductor lengths and terminating space. In all cases, multiple TGBs within the same ER shall be bonded together with a conductor the same size as the TBB.

2. The TGB shall be located near the TBB cabling and associated terminations.

3. The bonding conductor between a TBB and TGB shall be continuous and routed in the shortest possible straight-line path. The bonding conductor shall be the same size as the TBB.

4. The TGB shall have minimum dimensions of ¼-inch thick x 2-inch wide and 10-inch in length with 7 attachment points (one row). The length may need to be adjusted longer to meet the application requirements with consideration of future growth. The busbar shall be UL Listed as grounding and bonding equipment.

5. The TGB shall be a predrilled copper busbar provided with standard NEMA bolt hole sizing and spacing for the type of connectors to be used. The hole pattern for attaching grounding lugs shall meet the requirements of ANSI-J-STD – 607-A and shall accept 4 two-hole grounding lugs with 5/8” hole centers and 3 two-hole lugs with 1” hole centers. The busbar shall include wall-mount stand-off brackets, assembly screws and insulators creating a 4” standoff from the wall.

6. All metallic raceways for telecommunications cabling located within TR shall be bonded to the TGB. However for metallic raceways containing grounding conductors where the raceway is bonded to the ground conductor, no additional bonding to the TGB is required.

7. In buildings where the backbone telecommunications cabling incorporates a shield or metallic member, this shield or metallic member shall be bonded to the TGB where the cables are terminated or where pairs are broken out.

8. In a metal frame (structural steel) building, where the steel framework is readily accessible within or external to the TR; each TGB shall be bonded to the vertical steel metal frame. When practicable because of shorter distances and other considerations, and where horizontal steel members are permanently electrically bonded to vertical column members, TGBs may be bonded to these horizontal members in lieu of the vertical column members.

~~8.~~**9. Refer to telecommunication drawings for additional information.**

~~E.~~**D.** Telecommunications Bonding Backbone (TBB):

1. A TBB is a conductor that interconnects all TGBs with the TMGB. A TBB’s basic function is to reduce or equalize potential differences between telecommunications systems bonded to it. A TBB is not intended to serve as the only conductor providing a ground fault current return path.

2. A TBB shall be designed with consideration given to the type of building construction, building size, the telecommunications requirements, and the configuration of the telecommunications pathways and spaces. Specifically, the design of a TBB shall:

   a. Be consistent with the design of the telecommunications backbone cabling system.

   b. Permit multiple TBBs as dictated by the building size.

   c. Address routing to minimize the lengths of the TBB.

3. Whenever two or more TBBs are used within a multistory building, the TBBs are to be bonded together with a Grounding Equalizer (GE) at the top floor and at every third floor in between. The GE is sized the same as the TBB.

4. TBB conductors shall be installed without splices. Where splices are required, they shall be kept to the minimum quantity necessary, shall be accessible and located in telecommunications spaces. Joined segments of a TBB shall be connected using irreversible compression-type connectors, exothermic welding, or accepted substitution. All joints shall be adequately supported and protected from damage.

~~F.~~**E.** Telecommunications Bonding Conductors (TBC):

1. Provide conductors used to bond components to the TMGB and the TGBs as follows:

   a. The minimum size for this conductor shall be 6 AWG green-insulated, stranded copper cable.

   b. Avoid unnecessary connections or splices in TBCs. When necessary, use an approved connection and position it in an accessible location.

   c. Typical connections are made by using: bolts or crimps (connectors, clamps, or lugs). Where possible, use irreversible compression-type connections and two-hole lugs. Always use listed hardware that has been laboratory tested.

2. Bonding conductor sizing. The following table applies to Telecommunications Bonding Backbone (TBB), Grounding Equalizer (GE) and Telecommunications Bonding Conductor (TBC).

Bonding Conductor Length (ft)	Bonding Conductor Size (AWG)
Less than 13	6
14 - 20	4
21 – 26	3
27 – 33	2
34 – 41	1
42 – 52	1/0
53 – 66	2/0
Greater than 66	3/0

~~G.~~**F.** Testing Telecommunications Grounding and Bonding Infrastructure

1. Inspect grounding and bonding system conductors and connections for tightness and proper installation.

2. Measure ground resistance from longest grounding path to MTGB or TGB in TR or ER. Resistance shall not exceed 0.1 ohms.

END OF SECTION 26 05 26

SECTION 26 05 29 - METAL FRAMING AND SUPPORTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, Including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 SUMMARY

A. This Section specifies the furnishing and installing of metal framing, including channels, fittings, clamps, hardware, electrical accessories and brackets, and supports for raceway, pull boxes, junction boxes and enclosure for electrical equipment.

1.03 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. Reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. Materials, installation and Workmanship shall comply with the applicable requirements and standards addressed within the following references:

1. ASTM A653 G90 SS Gr. 33 - Specification for Steel Sheet, Zinc Coated (Galvanized) by the Hot Dipped Process.

2. ASTM B633 - Specification for Electrodeposited Coatings of Zinc on Iron and Steel.

3. ASTM C531 - Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical Resistant Mortars, Grouts, Monolithic Surfaces, and Polymer Concretes.

4. ASTM C642 - Test Method for Specific Gravity, Absorption, and Voids in Hardened Concrete.

5. ASTM C672 - Test Methods for Scaling Resistance of Concrete Surfaces Exposed to Deicing Chemicals.

6. ASTM D412 - Test Methods for Vulcanized Rubber and Thermoplastic Elastomers – Tension.

7. ASTM D395 - Standard Test Methods for Rubber Property – Compression Set.

8. ASTM D573 - Test Method for Rubber – Deterioration in an Air Oven.

9. ASTM D746 - Test Method for Brittleness Temperature of Plastics and Elastomers by Impact.

10. ASTM D2240 - Test Method for Rubber Property – Durometer Hardness.

11. NFPA 70 - National Electrical Code.

12. Underwriters Laboratories Standards and Listings.

13. NFPA 99 – Standard for Health Care Facilities

1.04 SUBMITTALS

A. Make submittals in accordance with Section 26 01 00, Basic Electrical Requirements, and Division 1 for submittal requirement.

B. Provide product data for roof supports. Include written certification by roof supplier of compatibility between roof supports and roofing system.

C. Provide product data for fiberglass channels and stainless steel channels.

1.05 QUALITY ASSURANCE

A. Rubber/steel pipe supports shall be manufactured under a strict quality control program assuring quality product delivered to the jobsite. Pipe supports that are damaged shall not be installed.

B. Workmanship:

1. Conduit supports shall be installed by a qualified Contractor and installed in accordance with manufacturer's recommendations.

2. Work shall comply with applicable federal, state, and local codes and laws having jurisdiction.

3. Work shall conform to accepted industry and trade standards for conduit installations.

C. Support and sleeve materials and installation shall not interfere with the proper functioning of equipment.

D. Contractor shall be responsible for structural integrity of hangers, supports, anchors, guides, inserts and sleeves. Structural hanging materials shall have a minimum safety factor of live.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Support Channel:

1. Non-corrosive locations: Hot-dip galvanized steel.

2. Corrosive locations: Fiberglass or stainless steel. Corrosive shall mean outdoors or where exposed to weather or indoors where exposed to corrosive chemicals or materials.

B. Hardware:

1. Non-corrosive locations: fabricate channels, fittings, clamps, electrical accessories and brackets from hot-dip galvanized steel.

2. Corrosive locations: Stainless steel threaded rod, attachments, and fasteners shall be used with fiberglass and stainless steel supports.

C. Threaded Rod:

1. Non-corrosive locations: Use for rack support from structure above; carbon steel, 3/8-inch minimum diameter.

2. Corrosive locations: Stainless steel threaded rod, 3/8-inch minimum diameter.

D. Fasteners:

1. Non-corrosive locations: Fabricate threaded fasteners of carbon steel. Electroplate threaded steel fasteners with cadmium.

2. Corrosive locations: Fabricate threaded fasteners of stainless steel.

E. Non-Ferrous: Use non-ferrous materials in rooms with equipment employing magnetic device with elevated gauss fields, such as Nuclear Magnetic Resonance (NMR) and Magnetic Resonance Imaging (MRI) equipment. Use non-ferrous materials where gauss fields extend into adjacent spaces, and in other locations as indicated on Drawings.

2.02 SIZES

A. Provide channels fabricated from not less than 12-gage sheet steel, 1-5/8 inch wide and not less than 1-5/8 inch deep.

2.03 RATINGS

A. Support systems shall be adequate for weight of equipment and conduit, including wiring, which they carry. Support systems shall be sized adequately to support an additional 25% for future loads.

B. Cable Tray: Refer to Division 27.

2.04 COATINGS

A. Galvanizing: Hot-dip galvanize all steel components.

B. PVC: At the factory, apply a minimum 10-mil-thick PVC coating, bonded to metal.

C. Electroplating: Electroplate threaded steel fasteners with cadmium.

2.05 ROOF SUPPORTS

A. Base: Manufacture curb base using 100% recycled rubber and polyurethane prepolymer with a support capacity of 2500 pounds per linear foot of support. Each base shall have a reflective yellow stripe.

B. Dimensions: 6 inches wide by 4 inches tall by 9.6 inches long.

C. Extendible Height Support: 12-inch adjustable height to suit application. Maximum load: 200 pounds.

D. Channel/Frame: Stainless steel or aluminum, minimum 14 gauge strut.

E. Attaching hardware: Fabricate fasteners of stainless steel.

F. Physical and performance characteristics:

1. Density: 0.6 oz/cu in per ASTM C642.

2. Durometer Hardness: 65A ±7 per ASTM D2240.

3. Tensile Strength: 210 psi minimum per ASTM D412.

4. Compression Deformation: 10% at 70psi and 68ºF per ASTM D395.

5. Brittleness at Low Temp. -40ºF per ASTM D746.

6. Freeze and Thaw. No loss after 50 cycles when exposed to deicing chemicals, per ASTM C672.

7. Coefficient of Thermal Expansion. 8 x 10-6 in/in/ºF (minimum), per ASTM C531.

8. Weathering: 70 hours at 12ºF per ASTM D573.

   a. Hardness retained: 100% (±5%).

   b. Compressive strength: 100% (±5%).

   c. Tensile strength: 100% (±5%).

   d. Elongation retained: 100% (±5%).

2.06 MANUFACTURER

A. Framing:

1. Unistrut Corp.

2. Thomas & Betts.

3. Power Strut/Power Engineering, Inc.

4. Erico, Inc.

B. Roof Supports: Cooper B-Line, Inc. C-PORT design, CE-series.

C. Substitution: Other manufacturers equal in design and function will be considered upon submittal of manufacturer's data. Refer to Section 26 01 00 and Division 1 requirements for substitution of materials.

PART 3 - EXECUTION

3.01 DELIVERY, STORAGE, AND HANDLING

A. Deliver products individually wrapped on pallets, or in factory-fabricated containers.

B. Store products in a clean and dry space, elevated above grade, and protected from weather and sunlight.

C. Products shall not be used as work tables, scaffolds, or ladders.

D. Handle products carefully to avoid damage to material components and finish, breaking, denting, and scoring. Damaged products shall be rejected and not be installed on project.

E. Refer to Section 26 01 00, Basic Electrical Requirements.

3.02 COORDINATION

A. Conduct a pre-installation meeting prior to commencing Work of this Section to verify Project requirements, coordinate with other trades, establish condition and completeness of substrate, review manufacturer's installation instructions and manufacturer's warranty requirements.

B. Coordinate with other trades where conduit and cable tray supports are in the same location as piping, ductwork, and work of other trades and where supports are furnished and installed under other Divisions. Supporting from the work or supports of other Contractors shall not be allowed except where specifically indicated on Drawings, or by express, written permission of the Owner.

C. Coordinate with other electrical work, including raceway and wiring work, as necessary to interface installation of supporting devices with other work.

3.03 APPLICATION

A. General: Provide metal framing to support large or heavy wall-mounted equipment, wall-mounted raceways and equipment, and raceways and equipment ceiling-hung or supported from structure.

B. Type: Provide support channels suitable for the areas to be installed and suitable for the equipment or systems to be supported.

1. Use hot-dipped galvanized steel support channels in conditioned areas.

2. Use fiberglass or stainless steel support channels where exposed to the weather or where located in a corrosive atmosphere.

3. Use stainless steel components where indicated on drawings or specifications.

C. Install hangers, anchors, sleeves and seals as indicated, in accordance with manufacturer's written instructions and with recognized industry practices to ensure supporting devices comply with requirements. Comply with requirements of NEC for installation of supporting devices. Install supports with spacing in compliance with NEC requirements.

D. Coordinate work among the various trades to minimize disruption to occupied spaces adjacent to area of demolition and renovation work. Coordinate with Owner's Representative to schedule work producing noise or structure-born vibration, including but not limited to, cutting, drilling, coring, and use of impact tools. Powder-actuated anchors are prohibited.

E. Provide for vertical adjustments after erection and during commissioning, where feasible, to ensure raceway and equipment is at design elevation and slope.

F. Install hanger so that rod is vertical under operating conditions.

G. Supports, hangers, anchors, and guides shall be fastened to the structure only at such points where the structure is capable of restraining the forces imposed by the raceway and equipment.

H. The load and spacing on each hanger and/or insert shall not exceed the safe allowable load for any component of the support system, including the concrete that holds the inserts. Reinforcement at inserts shall be provided as required to develop the strength required. Contractor shall be responsible for engaging a structural engineer as required for design and review at support systems.

I. Adjustable clevis hangers shall be supported at rods with a nut above and below the hanger.

J. Hanger rods shall be trimmed neatly so that 2 inches of excess hanger rod protrudes beyond the hanger nut. In the event a rod is intentionally but temporarily left excessively long, the Contractor shall take appropriate measures to protect the raceway, equipment, and other materials from damage.

K. Install hangers to provide minimum ½ inch space between finished covering and adjacent structures, materials etc.

L. Steel Beams: Where pipes and loads are supported under steel beams, approved type beam clamps shall be used.

M. Sleeve Seal Installation: Select type and number of sealing elements required for conduit material and size. Position conduit in center of sleeve. Assemble sleeve seals and install in annular space between conduit and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

N. Inserts:

1. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

2. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

3. Install anchors in concrete after concrete is placed and completely cured. Install anchors according to manufacturer's written instructions.

O. Non-Ferrous: Use non-ferrous materials in rooms with equipment employing magnetic devices with elevated gauss fields, such as Nuclear Magnetic Resonance (NMR) and Magnetic Resonance Imaging (MRI) equipment. Use non-ferrous materials where gauss fields extend into adjacent spaces, and in other locations as indicated on Drawings.

3.04 ANCHOR BOLTS

A. Use minimum 3/8-inch diameter by 3-inch long expansion bolts to attach framing to concrete. Space bolts a maximum of 24 inches on center, with not less than two bolts per piece of framing.

3.05 SUPPORTS

A. Provide metal framing to support large or heavy wall-mounted equipment, wall-mounted raceways and equipment, and raceways and equipment ceiling-hung or supported from structure.

B. Support raceway, cable tray, and pull and junction boxes with support system designed to secure the weight imposed upon the system, as recommended by the manufacturer.

C. Fasten hanger rods, conduit clamps, and outlet and junction boxes to building structure using precast insert system, expansion anchors, or beam clamps. Do not use spring steel clips and clamps. Make calculations as necessary to select proper support materials for electrical equipment, raceway, and cable tray supports. Provide cable tray supports for cable tray filled to 125 percent capacity per NEC. Refer to Division 27 for additional requirements pertaining to support of cable tray.

D. Use toggle bolts or hollow wall fasteners in hollow masonry, plaster, or gypsum board partitions and walls; expansion anchors in solid masonry walls; or concrete surfaces; sheet metal screws in sheet metal studs; and wood screws in wood construction.

E. Fabricate supports from structural steel or steel channel, rigidly welded or bolted to present a neat appearance. Use hexagon head bolts with spring lock washers under all nuts.

F. Do not fasten supports to piping, ductwork, mechanical equipment, or conduit.

G. Do not drill or core through structural steel members without written permission from the Structural Engineer and the Owner's Representative.

H. Supports in contact with floor using stanchion type support shall be solidly bolted to the permanent structural floor.

I. Conduit and Raceway Supports:

1. Securely fasten and support conduit to structure or metal framing using hot-dipped galvanized, malleable iron pipe straps or other approved means.

2. Branch circuit raceways which are 1 inch or smaller may be attached to wall studs by use of manufactured clips.

3. Boxes. Provide conduit support within 36 inches of conduit termination at box. Conduit support shall be independent of box support.

4. Multiple Conduit and Raceway:

a. Install two or more conduits parallel to or at right angles to the structure or building lines. Where parallel conduits are strapped, fastened or anchored, the support devices used shall be of the same type and installed on the same plane, whether vertical or horizontal.

b. Install multiple conduits parallel and supported on metal framing constructed of trapeze hangers supported at each end on all-thread rod attached to the structure with coupling nuts and expansion bolts or beam clamps:

1) Use conduit straps or other devices specifically designed for the purpose to secure conduits to the metal framing.

2) Install conduits only on the top surface of metal framing. Hanger rods shall not extend more than 1 inch past trapeze hanger.

3) Provide trapeze hangers along horizontal runs of conduit. Trapeze hangers shall be minimum 1-5/8 inch channel with minimum 3/8-inch diameter all-thread rods. Conduits shall be placed on top of the trapeze hangers and braced with appropriate clamps.

4) Where conduits support from the bottom of metal framing is accepted by the A/E and the Owner's Representative, use single-piece conduit clamps. Two-piece conduit clamps are not acceptable for supporting conduit from the bottom of metal framing

5) Space anchorage of channel along conduit run as recommended by framing supplier and approved by the Owner's Representative and the Structural Engineer, not to exceed 96 inches.

c. Provide trapeze supports with a minimum of two anchorages:

1) Up to 24-inch nominal width. Anchorage shall be 3/8-inch minimum all-thread, supporting 1-5/8 inch channel.

2) Over 24-inch nominal width. Anchorage shall be 1/2-inch minimum all-thread, supporting 3-1/4 inch back-to-back channel. Space anchorage of channel along conduit run at a maximum interval of 60 inches.

d. Cantilevered support of conduits is not acceptable unless supported on trapeze containing two anchors or supports, and approved by the Owner's Representative.

5. Single Conduit: Install single conduits suspended from the structure on all-thread rods with Mineralac clamps or Payne hangers, or clamped to the structure with manufactured clamps. Use 1/4-inch all-thread rod for conduits up to and including trade size 2 inches. Use 3/8-inch all-thread rod for conduits of trade size 2-1/2 inch and larger. Single conduits may be secured as follows:

a. Wood screws on wood.

b. Toggle bolts on hollow masonry.

c. Bolts and expansion anchors in concrete or brick.

d. Machine screws, threaded rods and clamps on steel.

e. Conduit clamps on steel joists.

f. Code sizes up to 1-1/4 inch. 1/4-inch diameter expansion anchor by 2-1/4 inch long, rod coupling, all-thread, hardware, and Minerlac clamp.

g. Code sizes up to 2-1/2 inch. 3/8-inch diameter expansion anchor by 2-3/4 inch long, rod coupling, all-thread, hardware, and Minerlac clamp.

6. Provide spacing between supports in accordance with the National Electrical Code, not to exceed 10 feet.

7. Supports not permitted:

a. Wire ties.

b. Hanger wires.

c. Plastic anchors.

d. Lead expansion anchors.

e. Powder-actuated anchors, except where specifically approved in writing by the Owner's Representative.

f. Support from other systems, such as piping and ductwork.

g. Support from other raceway or boxes.

h. Conduit supports connected to the same support serving boxes, enclosures, etc. (Spider brackets). Conduit support shall be independent of box support.

J. Conduit supports shall have the bottom support member constructed of double strut. This horizontal member shall be double-nutted, and the supporting all-thread rod shall be trimmed to one inch below lowest nut. Use single-piece clamps for conduits supported from the bottom of metal framing. Two-piece conduit clamps shall only be installed on the top surface of the metal framing. Refer to Section 26 05 33.

K. Conduit entering/exiting cable tray shall be supported by means of unistrut bolted to the cable tray support, and standard manufacturer's accessories. Conduit shall enter/exit tray horizontally, and shall be supported within 12 inches of the tray. Conduit shall be terminated with a grounding bushing, and bonded to the tray ground wire. Terminate conduit within 8 to 12 inches vertically and within 3 inches horizontally of the cable tray side rail.

L. Pull, Junction, and Fixture Box Supports:

1. Single box up to 144 cubic inches. Single 1/4-inch expansion anchor by 2-1/4 inch long, with rod coupling, althread nuts, and washers.

2. Single or multiple boxes over 144 cubic inches. Provide unistrut support securely anchored to structure.

3. Support for conduits terminating at pull, junction, and fixture boxes shall be independent of box support.

M. Panelboards and Cabinets:

1. Bridge studs top and bottom with channels to support recessed mounted cabinets and panelboards in stud walls.

2. Install surface mounted cabinets and panelboards with a minimum of four anchors. Provide strut channel supports to stand cabinet 1-5/8 inch off wall. Utilize "Post Bases" where support channel is attached to structural floor.

N. Provide metal inserts, embedded bolts, and fittings in concrete equipment pads as recommended by the manufacturer of the supported equipment.

O. Transformers supported from structure. Provide spring-type isolators in suspension system sized to support the transformer weight. Refer to Sections 26 22 13 and 26 22 14.

P. Luminaires: Refer to Section 26 51 00, Interior and Exterior Lighting.

3.06 ROOF SUPPORTS

A. Install roof supports in accordance with manufacturer’s instructions and recommendations, and in accordance with the requirements for conduit support specified in this Section.

B. For modified bituminous roof with gravel top, remove gravel from around and under roof support.

C. Coordinate with roofing supplier and Division 7 for roof membrane compression capacities. Where necessary, provide a compatible sheet of roofing material (rubber pad) under rooftop support to disperse concentrated loads and add further membrane protection.

D. Use properly sized clamps to suit conduit sizes.

E. Provide minimum of 12 inches clearance between top of roof surface and bottom of supported conduit, raceway, and equipment.

F. Where raceway is routed in proximity to and parallel to mechanical piping or ductwork, coordinate with Division 23 to provide common roof support system. Install raceway on top of support channels.

3.07 TOUCH-UP

A. Touch up scratches and cuts on steel components with an approved zinc chromate or a 90 percent zinc paint. Use a PVC compound on PVC-coated components.

END OF SECTION 26 05 29

SECTION 26 05 33 – RACEWAYS, CABLE TRAYS, AND BOXES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 SUMMARY

A. This Section specifies the requirements for raceways, conduits and boxes.

1.03 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:

1. ANSI C80.1 - Rigid Steel Conduit, Zinc-Coated.

2. ANSI C80.3 - Electrical Metallic Tubing, Zinc Coated.

3. ANSI/NEMA FB 1 - Fittings and Supports for Conduit and Cable Assemblies.

4. ANSI/NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers and Box Supports.

5. ANSI/UL 1 - Flexible Metal Conduit.

6. ANSI/UL 5 - Surface Metal Raceways and Fittings.

7. ANSI/UL 360 - Liquid-tight Flexible Steel Conduit.

8. ANSI/UL 467 - Electrical Grounding and Bonding Equipment.

9. ANSI/UL 797 - Electrical Metallic Tubing.

10. ANSI/UL 870 - Wireways, Auxiliary Gutters and Associated Fittings.

~~11. ANSI/UL 884 - Underfloor Raceways and Fittings.~~

~~12.~~**11.** NEMA VE I - Metallic Cable Tray Systems.

~~13.~~**12.** NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

~~14.~~**13.** UL6 - Standard for Safety, Rigid Metal Conduit.

~~15.~~**14.** UL514B - Standard for Safety, Fittings for Conduit and Outlet Boxes

~~16. ANSI/UL 651 - Schedule 40 and 80 Rigid PVC Conduit.~~

1.04 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

1.05 SUBMITTALS

A. Product Data:

1. Submit manufacturer's product data for raceways, conduits, outlet boxes, and wireways.

B. Shop Drawings:

1. Submit Shop Drawings of the complete metal surface raceway system.

2. Shop Drawings shall include sizes and lengths of raceways as verified with laboratory furniture Shop Drawings, inside corners, outside corners, end caps, raceway cover spacing, grounding, branch circuiting and wiring including locations of service entrances, receptacle types and manufacturers, receptacle spacing, and receptacle labeling with proper voltage, phase, circuit and panelboard designations as indicated on the Drawings.

3. Submit firestopping installation Shop Drawings to cover the following scope, but not limited to. The Contractor shall obtain Owner’s approval prior to installation.

a. Product data sheet from a manufacturer that is specified by ~~Section~~ **Division** 07 ~~84 13~~ Penetration Firestopping.

b. Dimensioned installation Shop Drawing detail(s) with UL listed firestopping assembly number that is associated to the same material manufacturer.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.02 WIREWAYS AND TERMINAL BOXES

A. Wireways and terminal boxes shall be of steel construction, oil-tight with knockouts.

B. Size shall be minimum 4 x 4 inches or as indicated on the Drawings.

C. Cover shall be hinged.

D. Fittings shall be so constructed to continue the ”lay in" feature throughout the entire installation.

E. Provide all sheet metal parts with a rust-inhibiting phosphatizing primer coating and finished in gray enamel. All hardware shall be cadmium plated to prevent corrosion.

F. Inside Terminal Boxes: Provide 25-ampere, 300-volt industrial rated terminal blocks with marking strip. Mark strip with black ink identifying circuit connection. Provide nameplate on exterior of each terminal box indicating panelboard served.

2.03 CONDUIT AND FITTINGS

A. Manufacturers:

1. Conduit and Electrical Metallic Tubing: Allied Tube & Conduit or equal.

2. Fittings: Appleton Electric, Midwest Electric Products or O-Z/Gedney.

3. Expansion Fittings: O-Z/Gedney Type DX, Crouse-Hinds Type XC, or equal by Midwest Electric Products or Appleton Electric.

4. Flexible Metal Conduit and Fittings: Anaconda Sealtite, Type UA.

B. Application:

1. Conduit and fittings for all electrical systems on this Project shall include the following:

~~a. Service entrance.~~

~~b.~~**a.** Electrical power and lighting feeders.

~~c.~~**b.** Electrical power and lighting circuits.

~~d.~~**c.** Building automation systems (BAS).

~~e.~~**d.** Fire alarm and signaling systems.

~~f. CCTV rough-in system.~~

~~g.~~**e.** Telecommunications rough-in system (minimum 6-inch bending radius for telecommunications conduits).

~~h. Nurse call system.~~

~~i.~~**f.** Security systems.

~~j.~~**g.** Other electrical systems, as identified on the Drawings.

C. For each electrical wireway system indicated, provide a complete assembly of conduit, tubing or duct with fittings including, but not necessarily limited to, connectors, nipples, couplings, locknuts, bushings, expansion fittings, and other components and accessories as needed to form a complete system of the type indicated.

D. Conduit fittings shall be designed and approved for the specific use intended. Conduit fittings, including flexible, shall have insulated throats or bushings. Rigid conduits shall have insulated bushings, unless grounding bushings are required by NEC Article 250-28. Grounding bushings shall have insulated throats.

E. Rigid metal conduit shall be hot-dipped galvanized. Fittings shall be threaded type.

F. Electrical metallic tubing shall be galvanized. Fittings shall be all steel set screw deep socket UL marked and approved for the application. Compression fittings uses shall be in, not limited to, wet damp and environmental areas type.

G. Flexible metal conduit and fittings shall be zinc-coated steel.

H. Liquid-tight flexible conduit and fittings shall consist of single strip, continuous, flexible interlocked, double-wrapped steel, galvanized inside and outside, forming smooth internal wiring channel with liquid-tight covering of flexible polyvinyl chloride (PVC).

I. Crimp type fittings are not acceptable.

J. Raceways such as electrical nonmetallic tubing (ENT) and liquid-tight flexible nonmetallic conduit (LFNC) are not acceptable for use on any Project.

2.04 WALL AND CEILING OUTLET BOXES

A. Manufacturers: Appleton Electric, RACO-Hubbell, Thomas & Betts - Steel City, Cooper Crouse-Hinds.

B. Galvanized steel interior outlet wiring boxes of the type, shape and size, including depth of box, to suit each respective location and installation; constructed with stamped knockouts in back and sides, and with threaded holes with screws for securing box covers or wiring devices. Minimum switchbox depth shall be 2 inches. Outlet boxes for electrical power shall be 2-1/8 inches deep. Outlet boxes for communication (voice and data) shall be minimum 3-1/2 inches deep.

1. Provide outlet box accessories as required for each installation, including mounting brackets, wallboard hangers, extension rings, fixture studs, cable clamps and metal straps for supporting outlet boxes.

2. Accessories shall be compatible with outlet boxes being used and shall meet requirements of individual situations.

~~C. Corrosion-resistant cast-metal weatherproof exterior outlet wiring boxes of the type, shape and size, including depth of box, with threaded conduit ends, cast metal faceplate with spring-hinged waterproof cap and corrosion-proof fasteners.~~

~~D.~~**C.** ~~Outlet boxes in poured concrete shall be plenum type without holes and with reset knockouts. Where extension rings are used to offset conduit between wall reinforcing steel, joint between extension ring and box shall be sealed to prevent concrete from entering box during pour.~~

~~2.05 FLOOR BOXES~~

~~A. Manufacturers: RACO-Hubbell, Wiremold, FSR.~~

~~B. Boxes shall be NEMA OS 1, fully adjustable, minimum 1-1/2 inch depth for electrical power only; 4-1/2 inch minimum depth for communication.~~

~~C. Boxes shall conform to regulatory requirements for concrete-tight floor boxes.~~

~~D. Service fittings shall be as specified on Drawings.~~

~~E. Poke-thru box fittings shall maintain a minimum two-hour fire rating.~~

~~2.06~~**2.05** PULL AND JUNCTION BOXES

A. Boxes shall be galvanized sheet metal with screw-on cover and welded seams, stainless steel nuts, bolts, screws and washers.

B. Boxes larger than 12 inches in any dimension shall be panelboard code gauge galvanized steel with hinged cover.

C. Boxes shall be sized In accordance with NEC.

~~2.07~~**2.06** CABLE TRAY AND FITTINGS

A. Manufacturers: Square D, B-Line, Chalfant.

B. Material: Hot rolled, carbon steel strip, hot-dipped galvanized after fabrication with either hot-dipped galvanized or cadmium-plated fasteners.

~~B.~~**C. Refer to telecommunication drawings and specifications.**

~~C. Dimensions: (exceptions as noted on Drawings):~~

~~1. Depth: 6 inches or as indicated otherwise.~~

~~2. Width: 24 inches or as indicated otherwise.~~

~~3. Radius: 36 inches or as indicated otherwise.~~

~~D. Type: Ladder.~~

~~E. Covers: Where indicated on the Drawings, provide trough-type cable tray with galvanized bolt-on covers.~~

~~2.08~~**2.07** SURFACE METAL RACEWAYS

A. Manufacturers: The Wiremold Company 3000 or 4000 Single-Channel System. Systems of other manufacturers may be considered equal if they meet all performance standards as specified herein. Wiremold 4000 shall be used for communication applications.

B. Raceway base and cover sections shall be UL Listed, manufactured of cold rolled steel, and finished in gray enamel.

1. Raceway shall be a two-piece design with a metal base and a snap-on metal cover.

2. Surface metal raceways installed in controlled environmental and ~~cold~~ **animal** rooms. Install gasket flip type weather resistant cover plates in lieu of stainless cover plates for receptacles.

C. Furnish with all entrance fittings, elbows, end caps, covers, and device brackets and plates as indicated on the Drawings for a complete system.

1. Fittings shall be finished in enamel to match the raceway.

2. Fittings shall be supplied with a base where applicable to eliminate mitering.

D. Provide couplings, elbows, connectors, boxes, extension rings and outlet covers specifically designed for use with surface raceway system.

E. Provide factory fittings for vertical raceway riser connection to horizontal raceway runs. Such directional change fittings must accommodate required radius flex for Category 6a communication cable under both load and no load conditions.

F. All internal exposed surfaces within the raceway, including joints and covers shall be free of nicks, cuts, sharp edges, and other imperfections.

G. Grommets shall be used to accommodate building automation system cabling to critical equipment or as noted on Drawings.

H. Multiple raceways shall be provided for normal power, emergency power, and communication / critical alarm as noted on the Drawings.

1. Raceway lengths shall be as shown on the Drawings.

I. Multi-Outlet Assembly Devices:

1. Provide hospital grade, duplex receptacles mounted 12 inches on center unless noted otherwise. Unless otherwise noted, alternate circuits between receptacles.

2. In laboratory applications, normal power receptacles shall have alternating colors for different circuits:

a. Phase A = gray

b. Phase B = brown

c. Phase C = white

3. Exceptions to the color would be single circuit raceway, which shall be white.

4. Receptacles serving emergency circuits shall be red in color.

5. Isolated ground receptacles shall be orange in color.

PART 3 - EXECUTION

3.01 INSTALLATION - GENERAL

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. All installation shall be in accordance with manufacturer's published recommendations.

C. Concrete metal hit anchor and fastener is an unacceptable fastening system for concrete, brick and block.

D. Where raceways or cable trays penetrate fire-rated floors or roofs, sleeve and seal opening around raceways and cable trays with UL listed firestop assemblies equal to fire rating of floors or roofs. Seal penetrations through all floors or roofs to provide and maintain a watertight installation. Conduit sleeves, where required, shall be two (2) trade sizes larger for proper sealing and extend 2 inches above the surface. Refer to Section 07 84 13 Penetration Firestopping and Section 09 29 00 Gypsum Drywall for sealing and firestopping requirements where raceways penetrate smoke, fire, and sound rated walls. The installation shall be in compliance with UL listed firestopping assembly.

E. Support all conduits and J-boxes above ceilings from the building structure. All J-boxes being installed above suspended ceilings must have a minimum of 12-inch working clearance between the bottom of J-boxes and the top of the ceiling grid except where approved by the Owner in writing prior to installation.

F. No raceways, metallic or non-metallic, flexible or rigid, shall be installed in any floor slab elevated above slab on grade. The only exception may be for the lighting grid in the parking deck areas of a parking garage.

G. Bushings and throats shall be installed for fittings, raceways, boxes or other enclosures prior to installing cables and wiring systems.

H. Provide raceway support in intervals not exceeding the maximum spacing per NEC.

~~H.~~I. Non-Ferrous. Use non-ferrous materials in rooms with equipment employing magnetic devices with elevated magnetic fields, such as NMR and MRI equipment. Use non-ferrous materials where magnetic fields extend into adjacent spaces, and in other locations as indicated on drawings.

3.02 INSTALLATION - CONDUIT

A. Install raceway and conduit system from point of origin in outlets shown, complete with offsets, pull boxes, junction boxes and fittings.

B. Installation of all new conduits must be minimum 12 inches from ceiling grid except where approved by Owner.

C. No raceway shall be run horizontally inside of walls or partitions. Exceptions: building perimeter walls under windows, clerestory panel walls, and where structural conditions do not allow vertical access to tops of walls. The contractor shall obtain written approval from the Owner for exceptions prior to installation.

D. Install rigid wall hot-dipped galvanized steel conduit. Minimum size shall be ½-inch unless noted otherwise on the Drawings. Minimum size for communication shall be 1-inch. The following exceptions are permitted:

1. Electrical Metallic Tubing (EMT): In sizes ½-inch up to and including 4 inches, may be used inside dry locations where not subject to mechanical damage. ½-inch EMT may only be used for connections between distribution J-boxes in the ceiling and J-boxes in the walls within the same room, serving 15-20 Amp single phase receptacles, lighting occupancy sensors, switches, dimmers, and fire alarm respectively. In such application the length of ½-inch EMT shall not exceed 25 feet. EMT shall be used in air-conditioned spaces, such as accessible ceilings, and dry wall partitions. EMT shall not be used outside, in concrete, underground, in underfloor spaces, in masonry walls and in locations likely to be damp. EMT shall not be used for circuits with system voltage over 480 volts.

2. Liquid-tight Flexible Metal Conduit:

a. Install liquid-tight flexible metal conduit for connections to rotating, vibrating, moving or movable equipment, including dry-type transformers. Install internal ground wire on flexible conduit with grounding bushings.

b. Maximum length shall be four (4) feet, minimum two (2) feet; minimum size shall be ½-inch.

3. Flexible Metal Conduit:

   a. Where required, install standard flexible steel metal conduit (not liquid-tight) with internal ground wire, in spaces above ceilings.

   b. Install flexible conduit connection such that vibrations are not transmitted to adjoining conduit or building structure. Maximum length shall be four (4) feet, minimum two (2) feet; minimum size shall be ½-inch.

   c. Communication flexible conduit size in walls shall be minimum 1-inch.

   d. Flexible conduit for lay-in fixtures may be 3/8-inch factory whip assemblies (6 feet maximum).

   e. Flexible conduit for receptacles in office applications can be used in the walls as long as the flexible conduit length does not exceed 12 feet and the flexible conduit run is not horizontal. Where fished in existing walls, the length shall not exceed 12 feet.

~~4. PVC Conduit:~~

   ~~a. Utilize PVC conduit for underground outdoor installations, minimum size 1-inch. All PVC conduit runs shall have PVC coated rigid steel stub outs from the ground, including the last 90 degree bend.~~

   ~~b. All underground PVC conduit shall be installed in concrete with 12-inch x 12-inch x 3-inch concrete markers at every 100 feet and at every turn in direction.~~

   ~~c. All underground conduits shall be encased in concrete and shall have their locations identified by a warning tape that is placed in the trench at least 12 inches above the underground installation. Provide trace wire for major underground feeders.~~

   ~~d. Warning tape. Underground cable and conduit detectable marking tape shall be 6 inches wide, red with black letters, imprinted with "CAUTION – BURIED ELECTRIC CABLE BELOW" or similar. Tape shall be installed a minimum of 12 inches above the underground installation, and not more than 12 inches below finished grade. Warning tape shall be visible at the point where the conduit emerges above ground at the service stubs. Where fiber optic cable is to be installed in the conduit, an underground cable marking tape with a metallic detection strip shall be imprinted with 'CAUTION – BURIED FIBER OPTIC CABLE BELOW' or similar. Splicing of the tape shall be accomplished with metal clips to maintain electrical continuity along the length of the tape. Splices shall be wrapped with a waterproof adhesive tape.~~

~~5. PVC Coated Rigid Steel Conduit:~~

   ~~a. PVC coated rigid steel conduit may be direct burial for underground installation when concrete encasement is not required.~~

~~b. The PVC coated conduit shall be hot dip galvanized inside and out. The PVC coated conduit factory-cut threads shall be protected with hot galvanized threads and a clear urethane coating. Thread protectors shall be used on the exposed threads of the PVC coated conduit. The PVC coating must have been investigated by UL as providing the primary corrosion protection for the rigid galvanized steel conduit. The PVC coated rigid galvanized steel conduit must be certified and authorized to wear the ETL Verification Mark.~~

~~c. Ferrous fittings for general service locations must be UL Listed with PVC as the primary corrosion protection.~~

~~d. A PVC sealing sleeve extending one pipe diameter or two inches, whichever is less, shall be formed at every female fitting opening, except unions. The inside sealing sleeve diameter shall be matched to the outside diameter of the conduit.~~

E. Multiple Conduit Installation:

1. Install all conduits parallel to or at 90 degrees to the structure. Multiple conduits shall not be installed using a single rod support. Multiple conduits running the same direction with spacing 48 inches apart or less shall be installed on the same trapeze. Conduits shall be installed on metal framing constructed trapeze hangers that have minimum 24-inch width. Trapeze hangers shall be supported on minimum 3/8-inch diameter all-thread rod attached to the structure with coupling nuts and expansion bolts or beam clamps. Conduit straps or other devices specifically designed for the purpose shall be used to secure conduits to the metal framing. Wire ties and hanger wires are not permitted. Conduits shall only be installed on the top surface of the metal framing, with multiple layered trapeze supports if required. Hanger rods shall not extend more than 1 inch past the lower trapeze metal framing. Use double nuts for all-thread rods.

2. Where parallel conduits are strapped, fastened or anchored, the devices used shall be of the same type and installed on the same plane whether vertical or horizontal.

3. Conduit hangers from drop rod (like Caddy B18 Series) are acceptable only upon prior written approval from the Owner.

F. Single Conduit Installation:

1. Install single conduits parallel to or at 90 degrees to the structure and suspended from the structure on all thread rods (1/4-inch minimum) or clamped and/or clipped to the structure with manufactured clamps/clips. When single conduits are suspended from all thread rods, conduit clamps with bolts and nuts shall be used. Through partition wall penetration shall not be construed as a means of conduit support. Wire ties and hanger wires are not permitted. No powder actuated, compressed air, propane or similar powered “shot” anchor systems shall be installed under any circumstance. Wire ties and hanger wires are not permitted. Single conduits may be secured as follows:

   a. Wood screws on wood.

   b. Toggle bolts on hollow masonry.

   c. Bolts and expansion anchors in concrete or brick.

   d. Machine screws, threaded rods and clamps on steel.

   e. Conduit clips on steel joists.

f. Plastic anchors are not allowed.

g. Conduit hangers from drop rod (like Caddy B18 Series) are acceptable only upon prior written approval from the Owner.

G. Fittings shall be approved for grounding purposes or shall be jumpered with a copper grounding conductor of appropriate ampacity. Leave termination of such jumpers exposed. Conduit and wireway systems shall not serve as branch circuit grounding conductors.

H. Install expansion fittings in metal conduit as follows:

1. Conduit Crossing Building Expansion Joints:

a. EMT all sizes.

b. Rigid Galvanized Steel (RGS) all sizes.

2. Conduits entering environmental rooms and other locations subject to thermal expansion and as required by NEC.

3. Provide conduit expansion fitting with an integral bonding braid, as in Crouse-Hinds Type XC.

4. Expansion fittings are not required where offsets, expansion loops, or flexible conduit are placed in conduit runs.

I. Install conduit concealed in walls, partitions and above ceilings. Install exposed in overhead conduit (at structure) of mechanical rooms and in other similar rooms where ceilings are not provided.

J. Avoid moisture traps where possible; where unavoidable, provide junction box with drain fitting at conduit low point.

K. Use suitable conduit caps to protect installed conduit against entrance of dirt and moisture.

L. Install pull wires in empty conduits. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Jetline 232 or equal by Greenlee. Leave at least 12 inches of slack at each end of pull wire.

M. Cap ends of spare conduits and extend into space above accessible ceiling a minimum of 18 inches. Label conduit as spare.

N. Do not daisy chain conduit installations in or on walls, provide a single conduit wall drop per device.

O. The support means for conduit installation, whether threaded rods, trapeze or other system, shall not be shared with non-electrical system. Any deviation from this standard due to space constrain shall be submitted to the Owner. Owner's review does not necessarily guarantee an approval; therefore the Contractor is advised not to start installation prior to final approval.

~~O.~~**P. Vivarium areas: provide gas-tight electrical installation which allows decontamination of the the area and prevents vermin harborage in and transmission through the electrical systems. Conduit openings and junction and outlet boxes which open into a vivarium area shall be completely sealed and gasketed, both inside and out. Gaskets, seals and similar silicone beads shall prevent air, dust, dirt, moisture and vermin from leaking to or from the outside environment through the raceway, box and device.**

3.03 INSTALLATION - WIREWAYS AND TERMINAL BOXES

A. Bolt wireways and terminal boxes to steel channels fastened to the wall or in self-supporting structure. Install level.

B. Gasket each joint in oil-tight wireway.

C. Mount rain-tight wireway in horizontal position only.

3.04 INSTALLATION - BOXES

A. Provide electrical boxes as shown on Drawings, and as required for wire pulling, equipment connection, and code compliance. Electrical box locations shown on Drawings are approximate unless dimensioned. Verify location of outlets prior to rough in. Locate and install boxes to allow access and clearances per NEC.

B. J-boxes shall be provided for branch circuits in excess of 100 feet.

C. Provide outlet box accessories as required for each installation, including mounting brackets, wallboard hangers, extension rings, fixture studs, cable clamps, and metal strap for supporting outlet boxes. Accessories shall be compatible with outlet boxes being used and shall meet requirements of individual situations.

D. Do not install boxes back-to-back in walls. Provide minimum 6-inch separation in non-fire-rated walls. Provide minimum 24-inch horizontal separation in acoustic-rated walls.

E. Membrane penetration of minimum 1-hour, up to maximum 2-hour fire rating walls and partitions by recessed steel electrical boxes that do not exceed 16 square inches in area are permitted, provided the aggregate area of the openings does not exceed 100 square inches in any 100 square feet of wall area. The annular space between the wall membrane and the box shall not exceed 1/8 inch. Such boxes on opposite sides of the wall or partition shall be either separated by a horizontal distance of not less than 24 inches or separated by protecting both boxes by listed putty pads or other listed materials and methods.

F. Secure boxes rigidly to the substrate upon which they are being mounted, or solidly imbed boxes in concrete or masonry. Boxes shall not be permitted to move laterally. Boxes shall be secured between two studs. Boxes connected to one stud are not permitted.

G. Provide knockout plugs for unused openings.

H. Use multiple-gang boxes where more than one device is mounted together; do not use sectional boxes. Provide barriers to separate wiring of different voltage systems.

I. Install boxes in walls without damaging wall insulation.

J. Outlet boxes in plaster partitions shall be “shallow-type” set flush in wall so there is at least 5/8-inch plaster covering back of box.

K. Switch boxes shall not be used as junction boxes.

L. Typical outlet box centerline heights shall be as listed in the following table. Coordinate outlet heights with Architectural Drawings, millwork details, casework details and equipment installation. Where discrepancies occur, ask for an interpretation from the Architect/Engineer and Owner.

Function	Receptacles	Telecommunications
Offices	18-inches	18-inches
Corridors	18-inches	48-inches
Exam Rooms	48 or 18-inches	48 or 18-inches
Millwork	Coordinate with millwork	Coordinate with millwork
Casework	Coordinate with millwork	Coordinate with millwork
Headwalls	Refer to Architectural Drawings	Refer to Architectural Drawings
Mechanical/Electrical Equipment Rooms	48-inches	48-inches
Laboratories	Coordinate with casework	Coordinate with casework

M. In inaccessible ceiling areas, position outlets and junction boxes within 6 inches of recessed luminaires, to be accessible through luminaire ceiling opening.

N. Outlet boxes supporting fixtures shall be securely anchored in place in an approved manner. Support outlet boxes and fixtures in acoustic ceiling areas from building structures with separate supports, not from acoustic ceiling or ceiling tile wire. Lighting fixture outlets shall be coordinated with mechanical and architectural equipment and elements to eliminate conflicts and to provide a workable neat installation.

O. Locate pull boxes and junction boxes above accessible ceilings or in unfinished areas.

P. Support pull and junction boxes independent of conduit. Combination box/conduit hangers from drop rod (like Caddy B18 Series) are acceptable only upon prior written approval from the Owner.

Q. Use cast floor boxes for installations in slab on grade; formed steel boxes are acceptable for other installations. Set floor boxes level, and adjust floor box flush with finish flooring material.

~~Q.~~**R. Vivarium Facilities : where device boxes and conduits are recessed mounted, fully seal the box to the adjacent wall, ceiling or floor surface. Use a continuous bead of silicone caulk or other approved means. Fully seal openings in boxes to be airtight. Boxes with pre-punched knockouts are not allowed. Ensure recessed devices are flush with the surface after installation.**

3.05 INSTALLATION - CABLE TRAY

A. Coordinate cable tray installation with piping ductwork and light fixture installation. Maintain clearance inside cable tray for installation of cables. Install according to manufacturer's instructions. Provide "Caution - Do Not Use As Walkway" signs suitably displayed as designated by the Owner.

B. Avoid proximity to light fixture ballast (minimum 12-inch clearance) since electronic fields can cause interference with some telecommunication signals.

3.06 INSTALLATION - SURFACE METAL RACEWAYS

A. All raceway systems shall be installed complete, including insulating bushings and inserts where required by manufacturer's installation sheets. All unused raceway openings shall be closed.

B. Install raceways above ceilings, exposed, on walls and casework parallel to or at right angles to structure and casework. Securely support raceway at intervals not exceeding 10 feet or in accordance with manufacturer's recommendations.

C. The number of conductors installed in any raceway shall not be greater than the number for which the raceway is approved.

D. Maintain grounding continuity between raceway components to provide a continuous grounding path by means of separate insulated code-size grounding conductors.

1. Each equipment grounding conductor in a conduit homerun entering the raceway shall be connected to the ground terminals of the receptacles.

END OF SECTION 26 05 33

SECTION 26 09 23 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.01 SUMMARY

A. This Section specifies the furnishing and installing of lighting controls, including dimmers, lighting contactors, occupancy sensors, photocells and timers.

1.02 REFERENCE STANDARDS

A. Americans with Disabilities Act (ADA).

B. ANSI/IEEE 62.41 - Guide for Surge Voltages in Low-Voltage AC Power Circuits.

C. ANSI/UL 20 - General-Use Snap Switches.

D. ANSI/UL 943 - Ground Fault Circuit Interrupters.

E. NEMA WD 1 - General Requirements for Wiring Devices.

F. NEMA WD 2 - Semiconductor Dimmers for Incandescent Lamps.

G. NEMA WD 5 - Specific-Purpose Wiring Devices.

H. Texas Accessibility Standards (TAS).

I. UL 924 - Emergency Lighting and Power Equipment.

J. UL 1449 - Transient Voltage Surge Suppressors.

K. UL 1472 - Solid State Dimming Controls.

L. NFPA 70 - National Electrical Code (NEC).

M. NFPA 101 - Life Safety Code.

1.03 RELATED WORK

A. Section 26 01 00, Basic Electrical Requirements.

B. Section 26 27 26, Wiring Devices.

C. Section 26 51 00, Lighting Fixtures.

1.04 LISTING

A. Devices shall be UL listed, offer a 5-year warranty, and meet applicable state and local code requirements.

1.05 SUBMITTALS

A. Provide product data on dimmers, lighting contactors, timers, occupancy sensors, relays, power packs, photocells, wiring devices and device plates.

B. Substantiate conformance to this specification by submittal of performance data, wiring diagrams, and other documents as necessary to substantiate conformance. Deviations from the requirements of this specification shall be clearly indicated in the submittal.

C. Shop Drawings:

1. Occupancy Sensors: Include with submitted product data plan drawings scaled to 1/8 inch scale which indicate coverage patterns for types of occupancy sensors proposed for use on the project.

2. Details of component mounting and connections shall be included on separate detail drawings and submitted as a complete package of shop drawings included with submittals for product data. Manufacturer's catalog numbers and generic identification shall be indicated for components shown on the Drawings.

D. Include with submittal data schematic diagrams for the following. Where schematic diagrams are submitted in conjunction with plan drawings, schematic diagrams shall be keyed to applicable locations on plan drawings:

1. Automatic lighting control systems, including ballast and line-voltage wiring for luminaires connected to automatic lighting control systems.

2. Ballast and line-voltage wiring for luminaires connected to dimming systems or devices.

3. Dimming and lighting control systems, including line voltage and low-voltage connections to system components and accessories. Connections to luminaires may be indicated as “typical”.

E. Field Testing: Submit written procedures and forms to be used for field testing to demonstrate compliance with these specifications, as required under Part 3 of this Section. Testing procedures and forms shall include range of permissible values for each recorded parameter. Include list of test instruments and materials to be used for field testing, to include manufacturer, model, accuracy, and applicable steps of field testing procedures.

F. Refer to Division One and Section 26 01 00 for additional submittal requirements.

PART 2 - PRODUCTS

2.01 GENERAL

A. Lighting controls, including timers, photocells, and lighting contactors are specified by type and manufacturer on the electrical legend on the Drawings.

B. Wall Switches and Devices. Coordinate color and style with room or area architectural finish. Refer to Section 26 27 26, Wiring Devices.

C. Device Plates:

1. Finished Spaces: Refer to Section 26 27 26.

2. Exposed Boxes in Dry Interior Spaces: Make plates of heavy cadmium-plated sheet steel. Edges of plates must be flush with edges of boxes.

D. Hose-down and Exterior Areas:

1. Use weatherproof nonmetallic enclosure. Refer to Section 26 27 26.

2. Manufacturer. TayMac No. 71204, or accepted substitution.

E. Device Color: Supply wiring devices in white, unless shown otherwise on Drawings: Refer to Section 26 27 26 for other device colors.

2.02 OCCUPANCY SENSORS

A. General:

1. Provide occupancy sensor-based lighting control systems and device(s) which automatically extinguish lighting after a programmable, user adjustable time delay when personnel vacate a room or area.

2. The occupancy sensor based lighting control shall accommodate the conditions of space utilization and irregular work hours and habits.

3. Sensors shall be capable of operating normally with electronic ballasts, PL lamp systems and rated motor loads.

4. Coverage of sensors shall remain constant after sensitivity control has been set. No automatic reduction shall occur in coverage due to the cycling of air conditioning or heating fans.

5. Sensors shall have readily accessible, user adjustable controls for time delay and sensitivity. Controls shall be recessed to limit tampering. Controls shall be accessible without special tools or removal of the device from the wall or ceiling.

6. In the event of failure, a bypass manual override shall be provided on each sensor. When bypass is utilized, lighting shall remain on constantly or control shall divert to a single–pole wall switch until sensor is replaced. This manual override shall be recessed to prevent tampering.

7. Sensors shall provide a method of indication to verify that motion is being detected during testing and that the unit is working.

8. Where specified, sensor shall have an additional internal, isolated relay with Normally Open, Normally Closed and Common outputs for use with HVAC/EMS/DDC control, data logging and similar control options.

9. Sensors shall have UL rated, 94V-0 plastic enclosures. Adjustments and mounting hardware shall be concealed under a removable, tamper-resistant cover to prevent tampering of adjustments and hardware.

B. Passive Infrared (PIR) Sensors:

1. To avoid false ON activations and to provide high sensitivity to minor motion, pulse count processing and detection signature analysis shall be used to examine the frequency, duration and amplitude of the signal received by the sensor to ensure response only to those signals caused by human motion.

2. Sensor shall utilize a temperature compensated, dual element sensor and a multi-element Fresnel lens.

3. PIR sensors shall have a multiple segmented Fresnel lens, in a multiple-tier configuration, with grooves facing inward for elimination of dust and residue build-up.

4. Vandal-resistant Fresnel lenses shall be made of hard, 1.0mm Poly IR2 material that offers superior performance in the infrared wavelengths and filter short wavelength infrared, such as those emitted by the sun and other visible light sources.

5. PIR sensors shall utilize customized Application Specific Integrated Circuit (ASIC) technology specifically designed for PIR sensor detection signature analysis to provide high immunity to false triggering caused by radio frequency interference (RFI, e.g., walkie talkies, mobile telephones, pagers, etc.) and electromagnetic interference (EMI, i.e., power line electrical noise).

6. Sensor shall have a built-in light level feature that is DIP switch or program-adjustable from 8 to 180 foot-candles that holds lighting off when the desired foot-candle level is present. Potentiometers and similar rotary-dial type adjustments are not acceptable.

7. Where specified, PIR and dual technology sensors shall offer daylighting foot-candle adjustment control and be capable of dual level lighting control (i.e., bi-level switching).

8. Manufacturer:

   a. Watt Stopper.

   b. Novitas.

C. Ultrasonic Sensors:

1. The ultrasonic occupancy sensors shall be capable of detecting presence in the control area by detecting doppler shifts in transmitted ultrasound.

2. Sensors shall be motion detectors which provide full coverage without gaps within the detection area. Sensors shall be selected for the size and use of the area in which they will be used. Sensors shall be capable of detecting minor motion in the area covered (such as picking up telephone or turning a page in a book) so that lighting is maintained in occupied areas.

3. Coverage shall remain constant in occupied rooms after sensitivity control has been set. No automatic or inadvertent reduction in coverage shall occur when air-conditioning is in operation.

4. Ultrasonic operating frequency shall be crystal controlled to within plus or minus 0.005% tolerance to assure reliable performance and eliminate sensor cross-talk. Ultrasonic sensors shall be available with different operating frequencies to allow individual control of adjacent areas.

5. Frequency. Active or passive sensors which operate within the audible range of human hearing are not acceptable. For the purposes of this Section, the audible range of human hearing is defined as 20 Hz to 20,000 Hz (i.e. 20 kHz).

6. Sensor shall have a retrigger feature in which detection by either technology shall retrigger the lighting system on within a user-selectable time period after being switched off. Default time period shall be 5 seconds, set at the factory.

7. Manufacturer:

   a. Watt Stopper.

   b. Novitas.

D. Ceiling-Mounted Sensor:

1. Sensors shall be suitable for Class 2 wiring.

2. Sensors shall be designed for parallel wiring to allow coverage of large areas.

3. Sensors shall operate on power supplied by switching power supplies (power packs).

4. Sensors shall provide sufficient switching capability to activate multiple power packs, as indicated on Drawings.

5. Ceiling-mounted sensors shall not protrude more than 1.25 inches beyond surface of ceiling and shall blend in aesthetically with the ceiling.

6. Settings shall be selected by either a concealed detent to activate program mode through device touch-plate, or by concealed DIP switch. The DIP switch or program selection shall be concealed behind device plate to prevent tampering of adjustments and hardware. Potentiometers and similar rotary-dial type adjustments are not acceptable, except where accepted in writing by the Architect/Engineer.

7. Ceiling-mounted sensors shall include an isolated, un-powered relay contact for connection by Division 23 to HVAC controls in the same area or space, to signal when the space is vacant or unoccupied.

8. Manufacturer. Refer to appropriate paragraph for sensor type (i.e., PIR, ultrasonic or dual technology).

E. Wall-Mounted Sensor:

1. Wall-box mounted occupancy sensors shall provide internal contacts for automatic switching of connected luminaires at line voltage.

2. Type:

   a. Passive Infrared, unless otherwise indicated.

   b. Refer to the appropriate paragraphs for PIR, ultrasonic, and dual technology of this Section for sensor requirements according to type.

3. Sensor shall provide user-selectable automatic-ON or manual-ON operation:

   a. In automatic-ON mode, the wall sensor shall automatically switch ON controlled luminaires upon detection of motion in the covered area or room.

b. In manual-ON mode, the user must activate the lights with the touchplate on the sensor, after which the sensor shall maintain controlled luminaires ON until expiration of the preset time delay after the room or area is vacated.

4. Leakage Current:

a. PIR Sensor. Sensor shall have no leakage current to load, in manual and in Auto/Off mode, and shall have voltage drop protection. Sensor shall utilize zero crossing circuitry to close load contacts at power supply zero voltage level, thereby increasing the sensor relay life and longevity.

b. Ultrasonic Sensor. Sensor shall have no leakage current to load. Provide sensors equipped with a neutral wire and neutral connection.

5. Ratings:

a. 120 VAC, 800 watt incandescent.

b. 120 VAC, 800 VA fluorescent electronic ballast.

c. 277 VAC, 1200 VA fluorescent electronic ballast.

6. Features:

a. Compatible with electronic ballast.

b. Dry-contact output relay for control of load with positive air-gap when off. Units which utilize a solid state switch for control of lighting are not acceptable.

c. Adjustable delayed-off setting between 30 seconds and 30 minutes.

d. Adjustable sensitivity setting.

e. Sensors that automatically adjust delay and sensitivity to accommodate occupancy patterns will be considered upon submission of manufacturer's product data substantiating conformance to specifications and design intent as indicated by device selections and locations on Drawings.

f. Adjustable ambient light override setting between 2 foot-candles and full brightness (200 foot-candles).

g. Settings shall be selected by either a concealed detent to activate program mode through device touch-plate, by concealed DIP switch, or similar concealed adjustment. The switch or program selection shall be concealed behind the device faceplate to prevent tampering of adjustments and hardware.

h. UL listed.

7. Color: Refer to Section 26 27 26, Wiring Devices. Occupancy sensors mounted directly on luminaires shall match the finish of the luminaire, unless otherwise indicated or scheduled on Drawings.

8. Manufacturer. Refer to appropriate paragraph for sensor type (i.e. PIR, ultrasonic or dual technology).

9. Manufacturer:

   a. Basis of Design: Watt Stopper, model WS-250.

   b. Novitas.

F. Low Voltage Control:

1. Ceiling-mounted occupancy sensors and selected wall-mounted sensors shall control luminaires through control units (i.e., switching power supplies, switch packs, power packs).

2. Switching Power Supplies:

   a. Control Units: For ease of mounting, installation and future service, control unit(s) shall be suitable for mounting to the exterior of a standard electrical enclosure and be an integrated, self-contained unit consisting internally of an isolated load switching control relay and a transformer to provide low-voltage power. Control unit shall provide power to a minimum of two sensors.

   b. Relay contacts shall have minimum ratings of:

Contact Rating Line Voltage	(Amperes)
120 VAC Tungsten	13
120 VAC Ballast	20
277 VAC Ballast	20

   c. Control units shall be capable of parallel wiring without regard to AC phases on the primary.

   d. Control units shall be suitable for use as a stand-alone, low voltage switch. Control units shall also be suitable for wiring to an occupancy sensor for automatic control of connected luminaires and other equipment.

   e. Slave packs: where indicated on Drawings provide switching relays that operate in conjunction with (master) control units. Slave packs shall be suitable for mounting to the exterior of a standard electrical enclosure and be an integrated, self-contained unit consisting internally of an isolated load switching control relay and a low-voltage input to the relay coil. Slave pack input voltage shall be compatible with control voltage output of (master) control unit. Slave pack control wiring shall be suitable for connection in parallel with low voltage occupancy sensors and similar low voltage sensors and control devices (e.g. timer switches).

3. Control wiring between sensors and controls units shall be Class II, 18-24 AWG, stranded UL classified, PVC insulated or Teflon jacketed cable suitable for use in plenums, where applicable. Use larger wire size as required for longer runs.

4. Provide control units that are compatible with low-voltage wall switch timers. Control units and low-voltage sensors shall be of the same manufacturer, unless specifically accepted by the Architect/Engineer.

5. Manufacturer:

   a. Watt Stopper.

   b. Novitas.

   c. Lutron.

   d. Lithonia.

   e. Hubbell.

   f. Leviton.

2.03 WALL SWITCH TIMERS

A. General: Provide a programmable digital time switch to turn lights off after a preset time delay. Electro-mechanical, spring-wound wall-box mounted timer switch is not acceptable.

B. Control circuitry shall employ zero crossing relay closure to increase the relay life, protect from the effects of inrush current, and increase sensor longevity.

C. Time switch shall be a 3-wire, completely self-contained control system that replaces a standard wallbox toggle-type switch. Time switch shall have a ground wire for safety. Time switch shall be compatible with electronic ballasts, compact fluorescent lamps, motor loads, and other inductive loads. Switching mechanism shall be a latching air gap relay. Triac and similar harmonic generating devices shall not be allowed as the output or switching device of the time switch.

D. Voltage:

   1. Line voltage. Time switch shall operate at either 120 VAC or 277 VAC.

   2. Low Voltage. Where indicated on the Drawings, provide time switches suitable for low voltage switching of controlled luminaires. Low voltage switching shall be accomplished through control units (i.e., switching power supplies, switch packs, power packs). Refer to paragraph 2.2G of this Section for requirements for low voltage switching and control devices. Provide control units that are compatible with low voltage wall switch timers.

E. Operation:

   1. Time scroll feature shall allow manual overriding of the preset time-out period. Selecting time scroll ON shall allow time-out period to scroll up throughout the timer possibilities to the maximum. Time scroll OFF shall allow time-out period to scroll down to minimum.

   2. Time switch shall have the option for a one-second light flash warning at one minute before timer runs out.

   3. Time switch shall have the option for a beep warning that shall sound every 5 seconds once the time switch countdown reaches one minute.

   4. Time switch shall have manual feature for timer reset where pressing the ON/OFF switch for more than 2 seconds resets the timer to the programmed time-out period.

   5. Time switch shall be capable of operating as an ON/OFF switch.

6. Time switch shall have an electroluminescent backlit liquid crystal display which shows the timer countdown.

7. Time switch shall fit behind a decorator style faceplate.

8. Settings shall be selected by either a concealed detent to activate program mode through device touch-plate, or by concealed DIP switch. The DIP switch or program selection for setting time-out, time scroll, one-second light flash and beep warning shall be concealed behind device plate to prevent tampering of adjustments and hardware. Potentiometers and similar rotary-dial type adjustments are not acceptable, unless specifically accepted in writing by the Architect/Engineer.

F. Safety:

1. For safety, the time switch shall have a 100 percent OFF override switch with no leakage current to the load.

2. For safety, in the event there is an open circuit in the AC line such as a ballast or lamp failure, the time switch shall automatically switch to OFF mode.

G. Device Color:

1. White, unless otherwise specified, indicated, or scheduled on Drawings.

2. Provide black devices where located in audio-visual (A/V) rooms or areas.

3. Coordinate device finish with architectural finish for the room or space. Refer to Section 26 27 26 for additional device colors.

H. Manufacturer:

1. Line Voltage:

a. Watt Stopper InteliSwitch model TS-400.

b. Tork.

c. Novitas.

2. Low Voltage.

a. Watt Stopper InteliSwitch model TS-400-24.

b. Accepted substitution. Other manufacturers equal in design and function will be considered upon submittal of manufacturer's data.

2.04 WALLBOX DIMMING DEVICES

A. General:

1. Provide wall-box mounted, low-profile electronic dimmers as indicated on the Drawings, complete, with linear slide-type solid-state dimming controls. Rotary-style and universal dimmers are not acceptable.

2. Provide electronic dimmers that are compatible with the connected luminaires, as indicated on the Drawings. Electronic dimmers shall be compatible with fluorescent dimming ballasts. Refer to Section 26 51 00, Lighting Fixtures.

B. Performance:

1. Devices shall be capable of operating at rated capacity without adversely affecting design lifetime.

2. Devices shall operate in an ambient temperature range of 32°F (0°C) to 104°F (40°C).

3. Dimmers and switches shall incorporate power-failure memory. Should power be interrupted and subsequently returned, the lights will come back on to the same levels set prior to the power interruption. Restoration to some other default level is not acceptable.

4. Dimmers and switches shall not be susceptible to damage or loss of memory due to static discharge.

5. Dimmer control shall be linear slide. Dimmer shall provide a smooth and continuous Square Law dimming curve.

6. Dimmers shall incorporate an air-gap switch. Dimmers shall be UL listed and CSA accepted for the type of load controlled, and shall be listed under the UL Standard most stringent for that particular type of load.

7. Dimmers shall meet the UL Standard 1472, limited short circuit test requirement.

8. Dimmers shall meet ANSI/IEEE Std. C62.41-1980, tested to withstand voltage surges of up to 4000V and current surges of up to 200A without damage.

9. Dimmers shall be voltage compensated to minimize effects of changing line voltage, and shall incorporate an RFI filter to minimize interference with electrical equipment.

10. Devices shall mount individually in a single-gang U.S. switchbox.

11. Contractor shall derate dimmer capacity when dimmers are ganged.

C. Operation:

1. Dimmers shall provide full-range, continuously variable control of light intensity.

2. Dimmer shall produce an IES square-law response from blackout to full brightness. Dimmer rise time shall be restricted to prevent interference with professional quality audio or video equipment.

3. Dimmers shall incorporate a slide-to-off feature, turning the dimmer on to the level set by the slider, or off. The off feature shall activate a mechanical air-gap switch to totally disconnect power from the load during OFF condition.

D. Description: NEMA WD 1, Type II semiconductor dimmer for incandescent lamps or fluorescent dimming ballasts, as appropriate.

E. Voltage:

1. Dimmers for incandescent luminaires: 120 volts.

2. Dimmers for fluorescent luminaires: 277 volts.

F. Power Rating: Match load shown; 1000 watts minimum, larger size as required to accommodate connected loads greater than 1000 watts. Load to 80 percent of device capacity, maximum.

G. Provide dimmers compatible with luminaires and dimming ballasts, as applicable.

H. Device Color:

1. White, unless otherwise specified, indicated, or scheduled on Drawings.

2. Provide black devices where located in audio-visual (A/V) rooms or areas.

3. Coordinate device finish with architectural finish for the room or space. Refer to Section 26 27 26 for additional device colors.

I. Device Plates:

1. Refer to Section 26 27 26.

2. Multi-gang device plates shall provide a continuous, seamless cover for up to six ganged dimmer, switch, fan-speed control and/or receptacle combinations with no exposed hardware or screws.

J. Manufacturer:

1. Basis of Design: Lutron Nova-T series.

2. Leviton.

3. Hubbell.

PART 3 - EXECUTION

3.01 DELIVERY, STORAGE, AND HANDLING

A. Deliver products individually wrapped, on pallets or in factory-fabricated containers.

B. Store products in a clean and dry space and protected from weather.

C. Handle products carefully to avoid damage to material components, enclosure and finish. Damaged products shall be rejected and not be installed on project.

D. Refer to Section 26 01 00, Basic Electrical Requirements.

3.02 COORDINATION

A. Verify that the occupancy sensors are compatible with the specified ceiling systems as indicated on the architectural Drawings. Advise the Architect/Engineer of discrepancies before placing the device order.

B. Verify that the fluorescent dimmers are compatible with the specified dimming ballasts, as indicated on Drawings and specified in Section 26 51 00.

C. Verify circuit and contactor ratings for circuits supplying 120 volt and 277 volt luminaires.

D. Contractor shall closely coordinate ceiling-mounted lighting controls with mechanical Drawings and sensor manufacturer instructions to ensure proper sensor operation. Sensors which do not function, and do not control areas per the design intent shall be relocated, hard ceilings repaired, and sensors recommissioned prior to substantial completion.

3.03 INSTALLATION

A. Install and connect devices as indicated on Drawings and in accordance with manufacturer instructions, NEC and local code and Owner requirements.

B. Install wiring devices in accordance with applicable requirements of the NEC, NEMA, ANSI, and the product manufacturer recommendations. Refer to Section 26 27 26, Wiring Devices.

C. Devices must be completely wired and installed. Provide hot, neutral, ground, switched leg, and other connections of appropriate voltage as required for proper device and luminaire function. Luminaires and lighting controls must be operating properly at final completion.

D. Provide hangers and support members for devices as required for proper installation. Provide appurtenances which include stud supports, stems, mounting brackets, frames and plaster rings. Refer to Section 26 05 29, Metal Framing and Supports.

E. Flexible metal conduit from junction box to device shall not touch the ceiling as finally installed. Provide flexible metal conduit whips for connection to luminaires and devices per Section 26 05 33, Raceways, Conduits, and Boxes and Section 26 51 00, Lighting Fixtures.

3.04 WALL DEVICES

A. Location: Set wall devices in a suitable outlet box centered at the height of 44 inches from the floor, except as otherwise shown on the Drawings. Install switch on the strike side of the door as finally hung.

B. Position: Install wall switches and devices in a uniform position so the same direction of operation will open and close the circuits throughout the job, generally up for the ON position.

C. Refer to Sections 26 05 33 and 26 27 26 for mounting heights and locations of devices.

3.05 DEVICE PLATES

A. Type: Provide device plates for each device of the type required for service and device involved. Refer to Section 26 27 26 for device plates. Refer to Section 26 05 53 for Electrical Identification.

B. Ganged Devices: Mount ganged devices under single, one-piece, device plate.

C. Engraving: Engrave designated plates with 1/8-inch-high black letters.

3.06 OCCUPANCY SENSORS

A. Furnish and install occupancy sensors as specified in this Section. Provide box for mounting of each device, in accordance with Section 26 05 33.

B. Install occupancy sensors in the correct location and aim as required for complete and proper volumetric coverage within the range of coverage of controlled areas per the manufacturer's recommendations. Rooms shall have 90 to 100 percent coverage of each controlled area to accommodate the occupancy habits of single or multiple occupants within the rooms. The locations and quantities of sensors shown on the Drawings are diagrammatic and indicate only the rooms which are to be provided with sensors. The Contractor shall provide additional sensors as required to properly and completely cover the respective room.

1. Dual technology occupancy sensors shall be corner mounted to avoid detection outside the controlled area when doors are left open.

2. The Contractor shall arrange a pre-installation meeting with the manufacturer's factory authorized representative, at the Owner's facility, to verify placement of sensors and installation criteria.

C. Proper judgment shall be exercised in executing the installation to ensure optimum installation in the available space, and to overcome local difficulties caused by space limitations or interference with structural components.

D. Where luminaires are connected to life-safety branch lighting circuits, connect master control unit power packs to the same life-safety branch circuit. Provide slave power packs to control normal power lighting in the same area, and connect line terminals to the normal power branch lighting circuit designated for normal power lighting. Connect low-voltage control wiring for slave power packs to the low-voltage control output of the master control unit power pack serving the same space or area.

E. Locate and position ceiling-mounted occupancy sensors so that sensor range is not blocked by surface mounted fixtures, EXIT signs, or other ceiling-mounted elements.

3.07 WALL-BOX DIMMING DEVICES

A. Devices shall be installed utilizing manufacturers recommended application, wiring and installation instructions.

B. De-rate ganged dimmers as instructed by manufacturer. Do not use common neutral.

C. Compatibility: Where dimmers are connected to fluorescent lights, verify with ballast manufacturer and dimmer manufacturer the suitability of the ballast for dimming applications.

D. Test: Test dimmers per manufacturer’s instructions. Demonstrate that unit’s function as specified. Where remote dimmers are provided, demonstrate that unit’s function properly as master and remote.

E. Burn-in: Where dimmers are connected to fluorescent luminaires, operate at full brightness for the full burn-in duration as specified or recommended by the lamp manufacturer, nominally on high for 100 hours before dimming.

3.08 VIVARIUM AND ASSOCIATED SPACES

A. Do not install occupancy sensors with ultrasonic elements in or adjacent to vivarium animal holding rooms and procedure rooms. Do not install occupancy sensors with ultrasonic elements in hallways and corridors adjacent to vivarium animal holding rooms and procedure rooms. Do not install occupancy sensors with ultrasonic elements in rooms, closets, and spaces adjacent to vivarium animal holding rooms and procedure rooms. Provide passive infrared (PIR) occupancy sensors, digital time switches, and other lighting controls as indicated on Drawings.

B. Lighting control for vivarium animal rooms and procedure rooms shall be accomplished through the Edstrom animal monitoring system. Coordinate work between Division 26, Division 13, and Edstrom animal monitoring system supplier to provide a complete and functioning lighting control system throughout the renovation area within the scope and boundaries of this project.

3.09 TESTING

A. Use field testing procedures, forms, instruments, and materials as submitted and accepted in accordance with paragraph 1.05E, this Section.

B. The Contractor shall demonstrate to the Owner the proper operation of systems, devices, and equipment specified in this Section. The Contractor shall adjust, repair or replace as necessary components that do not perform as specified, until able to demonstrate proper operation of equipment in normal, automatic, manual, emergency, power-loss, and power-restored modes of operation, as applicable.

3.10 TRAINING

A. The Contractor shall provide, at the Owner's facility, the training necessary to familiarize the Owner's personnel with the operation, use, adjustment, and problem-solving diagnosis (troubleshooting) of the following systems:

1. Occupancy sensing devices and systems.

2. Wall switch timers.

3. Dimming controls.

4. Lighting contactors and interface with Direct Digital Controls/Building Automation System/Energy Management System (DDC/BAS/EMS) for control of interior lighting, as designated and indicated on Drawings.

5. Lighting control panel(s) not specified elsewhere.

END OF SECTION 26 09 23

SECTION 26 22 13 – NON-K-FACTOR DRY-TYPE TRANSFORMERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 SUMMARY

A. This Section specifies the furnishing and installation of non-K-factor dry-type transformers with 600 volt and below primary and rated 500 kVA and smaller. All K-factor transformers are indicated on the Drawings as K-factor.

1.03 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:

1. ANSI/NEMA ST 20 - Dry-Type Transformers for General Applications.

2. ANSI/UL 506 - Specialty Transformers.

1.04 SUBMITTALS

A. Product Data:

1. Provide product data on each transformer, vibration isolators, and accessories. Include the following minimum information:

a. Manufacturer.

b. Rated kVA, number of phases and frequency.

c. Primary voltage and connections.

d. Secondary voltage and connections.

e. Number and percent taps.

f. Outline dimensions.

g. Total weight of unit.

1.05 DELIVERY, STORAGE AND HANDLING

A. Store units in a clean, dry space, protected from weather.

B. Units shall not be used as work surfaces, scaffolds, or ladders.

C. Handle units carefully to avoid damage to material components, enclosure, and finish. Use only lifting eyes and brackets provided for that purpose. Damaged transformers shall be rejected and shall not be installed.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.02 MANUFACTURERS

A. General Electric.

B. Square D.

C. Cutler Hammer/~~Westinghouse~~.

~~C.~~**D. Siemens**

2.03 NON-K-FACTOR DRY-TYPE TRANSFORMERS

A. Required kVA, voltages, phases and winding configurations are indicated on the Drawings. Transformers must be rated for 60-hertz operation, self-cooled NEMA Class AA.

B. Coil windings: Copper wire (bar stock. Aluminum foil windings are not acceptable.

C. Taps: Furnish transformers with full load rated taps in the primary winding as follows:

kVA Rating	Taps
3-15 kVA, single phase; 9-15 kVA, three phase	Two (2) percent taps below normal rated voltage.
25-100 kVA single phase; 30-300 kVA, three phase	Six (6) 2-½ percent taps, four (4) below normal and two (2) above normal rated voltage.
167-250 kVA, single phase; 500 kVA, three phase	Four (4) 2-½ percent taps, two (2) below and two (2) above rated voltage.

D. Provide a 220 degrees C insulation system for rated kVA and temperature rise as follows:

kVA Rating	Rise (Degrees C)
3-10 kVA, single phase	115
15-167 kVA, single phase	150
3-30 kVA, three phase	115
45-500 kVA, three phase	150

E. Average sound levels must not exceed the following values as measured in accordance with NEMA ST 20-4.12.

kVA	dB
0-9	40
10-50	45
51-150	50
151-300	55
301-500	60

F. Enclosure: Unless otherwise specified or indicated, install transformers in metal enclosures designed to provide air-cooling and to prevent accidental contact with live conductors.

G. Wiring Compartment: Locate the wiring compartment below the core and coil. Have the compartment cooled by air circulation or insulated from the core and coil with a suitable thermal barrier.

H. Grounding: Ground the core of the transformer to the enclosure with a flexible grounding conductor sized according to NEC requirements.

I. Mounting Brackets: Furnish mounting brackets, as required, for wall (15 kVA and less) or structure (45 kVA and less) mounting of transformers.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. All installation shall be in accordance with manufacturer's published recommendations.

C. Install transformers as indicated ~~in~~**on drawings in** accordance with the applicable requirements of the NEC**,** ~~and~~ the National Electrical Contractor's Association "Standard of Installation"**,NEMA and ANSI.**~~.~~

~~C.~~**D. Installer shall examine the areas and conditions under which dry type transformers are to be installed and notify the Contractor in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.**

~~D.~~**E.** Install floor-mounted transformers on concrete housekeeping pads with vibration isolating pads suitable for isolating the transformer noise from the building structure in accordance with Section 26 01 00, General Electrical Requirements. Maintain a minimum of six (6) inches free air space between enclosure and walls.

1. ~~For floor and trapeze transformer installations, use one pad type Korfund Elasto-Grip, waffle at each corner of the transformer, sized for load of 50 pounds per square inch.~~ **Construct pads of nominal 4-inch thick 2500 pound concrete reinforced with 6" x 6" steel wire mesh. Size concrete pads 3 inches wider than transformer and chamfer edges to a 3/4-inch bevel.**

2. Secure the transformer and vibration isolators to pad as recommended by the manufacturer.

~~1. For wall hung transformer installations (15kVA and less), use spring type Korfund Series P. Provide sound pads at each corner of the transformer sized for ½ inch deflection. Securely anchor wall-mounting brackets to wall to provide adequate support.~~

F. Vibration isolation.

1. For floor and trapeze transformer installations, use one pad type Korfund Elasto-Grip, waffle at each corner of the transformer, sized for load of 50 pounds per square inch.

2. For wall hung transformer installations (15kVA and less), use spring type Korfund Series P, sized to support the transformer weight, one at each corner of transformer lower mounting rails. Provide sound pads at each corner of the transformer sized for ½ inch deflection. Securely anchor wall-mounting brackets to wall framing members to provide adequate support.

~~E.~~**G.** Suspend transformers (45kVA and less) from structure by means of trapeze hangers constructed of ½ inch galvanized all-thread rods and metal framing channels. All-thread coupling shall not be used on hanger rod shorter than 10 feet. The quantity of all-thread coupling, where used, shall not exceed more than one in a 10-foot section. All-thread coupling shall be backed by a ½-inch nut, which is tightened, at each end of the coupling. Make double-nut connections between rods and channels. Locate transformers to provide adequate ventilation and accessibility.

~~F.~~**H.** Check for damage and tighten connections prior to energizing transformer.

~~G.~~**I.** Set transformer plumb and level.

J. Verify removal of coil shipping anchor bolts before transformer is energized.

K. Disconnecting Means. Provide disconnecting means at or ahead of electrical supply to transformer, in accordance with NEC-450.14 and as indicated on Drawings. Locate the disconnecting means within sight of the transformer. Where the disconnecting means is installed remote (i.e., not within sight) from the transformer, the disconnecting means shall be lockable, and the location of the disconnecting means shall be marked on the transformer. Refer to Sections 26 28 17 and 26 05 53.

3.02 CONNECTIONS

A. Conduit Connections:

1. Attach incoming and outgoing conduits to the transformer enclosure with flexible metal conduit. Minimum length: 24 inches, maximum length: 48 inches.

2. Make conduit connections to side panel of enclosure using an appropriately sized 90-degree elbow connector. Provide grounding-type coupling at each end of flexible metallic conduit.

3. Install a bonding jumper, sized per NEC Table 250.122 or NEC Table 250.66 as appropriate, on outside of flexible conduit. The exterior bonding jumper shall be provided in addition to the grounding conductor run with the transformer circuit conductors inside the conduit. Where grounding conductor or jumper size is shown larger on Drawings, provide the larger size.

4. Liquid Tight Flexible Metallic Conduit: Where indicated, use liquid-tight flexible conduit for connections to transformer case, maximum length 4 feet, minimum length 2 feet, with slack or dip to attenuate noise transmitted through conduit. Make conduit connections to side panel of enclosure using an appropriately sized 90-degree elbow connector.

a. Provide grounding-type coupling at each end of liquid-tight flexible conduit. Provide a bonding jumper on exterior of liquid-tight flexible conduit, sized per NEC Table 250.122 or NEC Table 250.66 as appropriate. The exterior bonding jumper shall be provided in addition to the grounding conductor run with the transformer circuit conductors inside the conduit. Where grounding conductor or jumper size is shown larger on Drawings, provide the larger size.

B. Cable Connections:

1. Make transformer cable connections with compression-type lugs suitable for termination of 75 degrees C rated conductors.

2. Position lugs so that field connections and wiring will not be exposed to temperature above 75 degrees C.

3. Grounding: Ground the neutral (X0) of the transformer secondary winding in accordance with the requirements of NEC-250.30, Section 26 05 26, and as indicated on Drawings. Connect equipment grounding conductors, system bonding jumper(s), and isolated grounding conductors to transformer neutral (X0) bus. Provide equipment bonding jumper from transformer neutral (X0) bus to transformer metallic enclosure. Expose bare metal of transformer enclosure to ensure proper contact between transformer enclosure and equipment bonding jumper.

~~H.~~**C.**

~~3.02~~**3.03** TESTING

~~A. Tap Setting:~~

~~1. Select the appropriate tap setting on transformer so that the actual secondary voltage is + 1/2 of a tap span at full load.~~

~~2. Record the transformer serial number, kVA rating, selected tap setting and secondary voltage readings.~~

~~3. Submit three (3) copies of the record to the Owner's representative.~~

~~B. Conduit Connections:~~

~~1. Attach incoming and outgoing conduits to the transformer enclosure with 48 inch long flexible metal conduit.~~

~~2. Run a bonding jumper, sized per NEC Article 250, on outside of flexible conduit.~~

~~C. Cable Connections:~~

~~1. Make transformer cable connections with compression-type lugs suitable for termination of 75 degrees C rated conductors.~~

A. ~~Position lugs so that field connections and wiring will not be exposed to temperature above 75 degrees C.~~ **Tap Setting:**

1. **Check for damage and tight connections prior to energizing transformer. Verify removal of shipping anchor bolts and shipping supports prior to energizing transformer.**

2. **Measure primary and secondary voltages and make appropriate tap adjustments.**

3. **Select the appropriate tap setting on transformer so that the actual secondary voltage is + 1/2 of a tap span at full load.**

4. **Record the transformer serial number, kVA rating, selected tap setting and secondary voltage readings.**

5. **Submit three (3) copies of the record to the Owner's representative.**

END OF SECTION 26 22 13

SECTION 26 24 16 – PANELBOARDS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 SUMMARY

A. This Section specifies the requirements for all panelboards including electronic grade panelboards.

1.03 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:

1. NEMA AB 1 – Molded-Case Circuit Breakers, Molded Case Switches, and Circuit-Breaker Enclosures.

2. NEMA PB 1 - Panelboards.

3. NEMA PB 1.1 – General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.

4. Federal Specification W-P-115C – Panel, Power Distribution.

5. W-C-375B – Circuit Breakers, Molded Case; Branch Circuit and Service.

6. National Fire Protection Association NFPA 70 – National Electrical Code.

7. NFPA 75 – Protection of Information Technology Equipment.

8. NFPA 780 – Installation of Lightning Protection Systems.

9. Underwriters Laboratories UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations.

10. UL 67 – Panelboards.

11. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures.

12. UL 943 - Ground-Fault Circuit-Interrupters.

13. UL 1283 – Electromagnetic Interference Filters.

14. UL 1449 - Surge Protective Devices.

15. The specified Electronic Grade Panelboards (EGP) shall be designed, manufactured, tested, and installed in compliance with the following standards, in additional to requirements listed above:

    a. American National Standards Institute and The Institute of Electrical and Electronics Engineers ANSI/IEEE C62.41 - Guide for Surge Voltages in Low-Voltage AC Power Circuits.

    b. ANSI/IEEE C62.45 - Guide on Surge Testing for Equipment Connected to Low-Voltage AC Power Circuits.

    c. Federal Information Processing Standards Publication 94 - Field Grounding and Shielding Application.

16. The EGP shall be UL 1449 listed as a Transient Voltage Surge Suppressor, and UL 67 listed as a Panelboard. Surge protective device shall be both UL 67 listed and UL 1449 listed. The panel mounted suppression/filter system shall be UL 1449 listed as a Transient Voltage Surge Suppression System.

1.04 SUBMITTALS

A. Product Data:

1. Submit manufacturer's product data for panelboards and circuit breakers.

B. Record Documents:

1. Submit dimensioned Drawings showing size, circuit breaker and equipment arrangement and ratings, including but not limited to, voltage, single or three phase, main bus ampacity, circuit breaker short circuit ampere rating.

2. Equipment arrangement must include panelboard schedules. Panelboard schedules must be identical to the schedules in the project documents unless there is a technical reason for a deviation. Reasons for any deviation shall be included in the Submittal.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver panelboards in factory-fabricated water-resistant wrapping.

B. Handle panelboards carefully to avoid damage to material components, enclosure and finish.

C. Store in a clean, dry space and protected from the weather.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.02 MANUFACTURERS

A. Panelboards:

1. General Electric Company.

2. Square D Company.

3. Cutler Hammer/~~Westinghouse.~~

4. Siemens.

B. Electronic Grade Panelboards:

1. Current Technologies.

2.03 PANELBOARD CONSTRUCTION

A. Provide deadfront circuit breaker type panelboards as scheduled.

B. Enclosure shall be NEMA Type 1 unless otherwise indicated on the Contract Documents.

C. Provide cabinet front with full-height hinged door. Cabinet front shall be cleaned and finished with ANSI 49 or ANSI 61 gray enamel over a rust-inhibiting phosphatized coating. One door over the interior and an additional hinged dead front cover over interior and wireway (door-in-door). Full-height front cover hinged to box with concealed trim clamps. Provide flush door locks.

D. Panelboard boxes (cans) shall be galvanized steel with all cut edges galvanized. Boxes shall not have pre-punched knockouts. All conduit knockouts shall be made in the field.

E. Bus shall be tin-plated copper and braced for the maximum available fault current. Minimum bus ampacity shall be 100 amperes.

F. Circuit breaker phase connector straps that connect the main bus to individual circuit breakers shall be tin-plated copper.

G. Provide a 1 inch x ¼ inch tin-plated copper ground bus in all panelboards. The ground bus shall be drilled to accept lugs for all grounding conductors. Mount ground bus on brackets to allow easy installation of bolts, nuts and lockwashers used to attach ground lugs.

H. Provide a tin-plated copper neutral bus with the same ampacity rating as the phase bus. Neutral bus shall be isolated from the ground bus.

I. All lugs for phase, neutral and ground buses shall be copper or tin-plated copper.

J. Provide compression connectors where conductors terminate directly to bus. (MLO panels).

K. Panelboard electrical ratings and configurations are indicated in the Contract Documents.

L. Circuit directory shall be typewritten and mounted behind clear, heat-resistant plastic in a metal frame, tack welded on the inside of each panel door. List the minimum circuit breaker ampere interrupting capacity on the circuit directory. List minimum panel required interrupting capacity.

M. Load center type panelboards are not acceptable. Panelboards shall be full bussed, entire length of panel; 100 ampere panelboard minimum 30-circuits; 225 ampere panelboard minimum 42-circuits.

2.04 SWITCHING AND OVERCURRENT PROTECTIVE DEVICES

A. Provide molded case circuit breakers of manufacturer's standard industrial construction, with integral inverse time delay thermal and instantaneous trip. Provide bolt-on circuit breakers for 208Y/120V, 120/240V panels and 480Y/277V panels.

B. Circuit breakers shall be 125 VDC/240 AC rated for nominal 208Y/120V panels and 480Y/277V rated for nominal 480Y/277V panels. Minimum interrupting ratings shall be 10,000 amperes for 120/208V circuits and 14,000 amperes for 277/480V circuits, unless higher rating noted on the Contract Documents.

C. Breakers 225 ampere through 400 ampere shall have continuously adjustable magnetic pick-ups of approximately five to ten times trip rating.

D. Multi-pole breakers shall be two or three pole as specified. Handle ties are not permitted.

E. Circuit breaker interrupting rating shall be greater than the available short circuit current listed for the panelboard in which the circuit breaker is installed.

F. Panels shall be fully rated. All overcurrent devices shall be capable of interrupting the available fault current.

2.05 ELECTRONIC GRADE PANELBOARD CONSTRUCTION

A. Electronic grade panelboards shall be of same construction and quality as standard panelboards, but with transient voltage surge suppression installed in panelboard enclosure.

B. See Section 26 43 13 for Transient Voltage Surge Suppression (TVSS) requirements.

C. Storage Temperature: Storage temperature range shall be -40 degrees to +85 degrees C (-40 degrees to +185 degrees F).

D. Operating Temperature: Operating temperature range shall be -40 degrees to +60 degrees C (-40 degrees to +140 degrees F).

E. Relative Humidity: Operation shall be reliable in an environment with 5 percent to 95 percent non-condensing relative humidity.

F. Operating Altitude: All EGP's installed in the system shall be capable of operation in altitudes of up to 13,000 feet above sea level.

G. Audible Noise: All EGP's installed in the system shall not generate any audible noise.

H. Magnetic Fields:

1. No appreciable magnetic fields shall be generated.

2. All EGP's installed in the system shall be capable of use directly in computer rooms in any location without danger to data storage systems or devices.

I. The EGP shall be thoroughly factory-tested before shipment. Testing of each EGP shall include but shall not be limited to quality assurance checks, MCOV and clamping voltage verification tests.

J. 200 percent Rated Copper Neutral Bus:

1. The EGP shall include a 200 percent rated tin-plated copper neutral bus designed for the peculiar current demands associated with non-linear loads.

2. The neutral bus shall include copper or tin-plated mechanical solderless-type lugs in sufficient quantity and wire size capacity as indicated on the Drawings.

K. Ground Bus:

1. The EGP shall include a 1 inch x ¼ inch tin-plated copper ground bus with connection points equal to the number of branch breaker positions.

2. The ground bus shall include all copper or tin-plated mechanical solderless-type lugs in sufficient quantity and wire size capacity as indicated on the Drawings.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. All installation shall be in accordance with manufacturer's published recommendations.

C. Anchor enclosures firmly to metal framing (Unistrut). Metal framing shall be structurally secured to walls and structural surfaces, ensuring that they are permanently and mechanically secured.

D. At the completion of the electrical system, check each phase of all panels under full load and arrange so that all phases shall carry the same load as near as possible.

E. Stub 5 (five) empty ¾ inch conduits to an accessible location above the ceiling out of each recessed panelboard.

F. Install panelboards such that the center of the circuit breaker in the highest position will not be more than 6-1/2 feet above the floor.

G. Temporary Doors:

1. Protect panelboard cabinets by a temporary door until the panelboard is energized.

2. Temporary doors shall be ¼ inch thick plywood or equivalent rigid material.

3. Temporary doors shall be installed when the cabinet is installed and shall remain closed at all times except when work is being performed inside the panelboard.

H. Permanent Doors and Trim:

1. Install permanent doors and trim immediately before panelboards are energized.

2. Maintain permanent doors and trim in factory condition after installation.

3. Doors shall remain closed at all times except when the panelboard is de-energized and work is taking place within the panelboard.

I. Cabinets:

1. Maintain cabinet interiors “white glove” clean at all times.

2. Cabinet exteriors shall be maintained free of mud, spray-on insulation, paint spray and all substances not placed on the exterior surface by the panelboard manufacturer.

J. Terminals and breakers:

1. Hardware for connections to interior terminals and breakers shall be installed and torqued per manufacturer’s published recommendations by hand tools. Electric or cordless drills/screwdrivers, which are suspected to be the main cause of the stripped out threads in the screw holes for terminal bars and bolt-on breakers, therefore are prohibited.

2. The use of prohibited tools observed and/or evidence of damaged parts regardless of the cause are subject to rejection and removal from the project immediately per the direction of Owner’s representative.

K. Nameplates:

1. Label each panelboard with a black laminated rigid phenolic nameplate with white core, minimum 3/16 inch high engraved letters.

2. Identify panelboard name, voltage, amperage rating with main lugs only or main circuit breaker, and location of main feed.

3. Emergency panelboard nameplates shall be red with white letters. Identify panel board name, voltage, amperage rating with main lugs only or main circuit breaker, and name and location of emergency generator serving panelboard.

L. Panel cabinets shall not be used as raceways or pull boxes for adjacent equipment. Panel cabinets shall not contain wire splices. Panel wiring shall be installed in a neat and workmanlike manner with wire conforming to the contours of the cabinet. Wire bundles shall be wire tied and installed in a manner to protect wire insulation from cover screws and other sharp edges. All phase conductors shall be labeled with a circuit number, readily visible to the panelboard front without removing the dead front cover. All neutral conductors shall be labeled with the circuit number, which they are associated with, within three inches of their termination point.

END OF SECTION 26 24 16

SECTION 26 27 26 – WIRING DEVICES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 SUMMARY

A. This Section specifies the requirements for wiring devices (wall switches, receptacles, device plate covers, wall dimmers).

1.03 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:

1. NEMA WD 1 - General-Purpose Wiring Devices.

2. NEMA WD 2 - Semiconductor Dimmers for Incandescent Lamps.

3. NEMA WD 5 - Specific-Purpose wiring Devices.

4. Americans with Disabilities Act (ADA).

5. ANSI/UL 20 - General Use Snap Switches.

6. ANSI/UL 498 - Attachment Plugs and Receptacles.

7. ANSI/UL 943- Ground Fault Circuit Interrupters.

1.04 SUBMITTALS

A. Product Data:

1. Submit manufacturer's product data for all wiring devices and floor boxes.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

B. Provide factory fabricated wiring devices in the type and electrical rating for the service indicated. Where type and grade are not indicated provide proper selection to correspond with branch circuit wiring and overcurrent protection.

C. Attachment of wires to devices shall be by screw pressure under the head of binding screws. Arrangements depending on spring pressure or tension are not acceptable. All binding screws shall be brass or bronze.

2.02 MANUFACTURERS

A. Wall Dimmers:

1. Lutron.

2. Leviton.

B. Lighting Occupancy Sensors:

1. Wattstopper.

2. Novitas.

3. Other manufacturers as specifically approved in writing by Owner.

2.03 WALL SWITCHES

A. Type: Quiet type, back and side wired switches as specified herein.

B. Rating: 20 amperes, 120/277 volts.

C. Listing: UL 20 and Federal Specification W-S-896.

D. Manufacturers: Provide devices in the color as specified herein.

Type	Pass & Seymour	Arrow Hart	Leviton
S	20AC1	1991	1221-2
S2	20AC2	1992	1222-2
S3	20AC3	1993	1223-2
S4	20AC4	1994	1224-2

*Provide color designation for designated use.

2.04 RECEPTACLES

A. Type: Hospital Grade, where identified on Drawings. Back and side wired receptacles, as specified herein.

B. Rating: Scheduled on Drawings.

C. Listing: UL 498 and Federal Specification W-C-596.

D. Provide devices in the color as specified herein.

NEMA Configuration	Pass & Seymour	Arrow Hart	Leviton
5-20R (Duplex)	9300-HG	8300	8300
5-20R (Single)	9301-HG	8301	8310
5-20R (Tamper Resistant)	SG-3-H	TR-83	------
GFCI	2091-SHG	GF-8300	6898-HG

*Provide color designation for designated use.

E. All receptacles within six (6) feet of a water source such as sinks shall be a GFCI receptacle. Feed through to non-GFCI receptacles is not permitted.

2.05 DEVICE PLATES

A. Laboratories and Patient Care Areas: Use 302 stainless steel.

B. Finished Office Areas: Nylon in color as selected by Architect.

C. Exposed Boxes in Dry Interior Spaces:

1. Manufacture plates of heavy cadmium-plated sheet steel.

2. Edges of plates must be flush with edges of boxes.

D. Other Areas:

1. Use weatherproof device plates.

2. Provide cast plates with gasketed spring door covers for protection of device.

E. For outlets and switches, provide labeled nameplates listing power source and circuit number. Example: P10 for panel “P” circuit “10”. Label to be tape type black letters on white for normal power and red on white for all generator/emergency circuits.

F. Covers for outlets outdoors shall meet the requirements of latest NEC.

2.06 DEVICE COLOR

A. All switches shall be white except as follows: Red switches shall be used on all equipment and circuits connected to emergency power.

B. Normal power receptacles shall be white and receptacles connected to the emergency electrical circuits shall be red.

C. In laboratories, normal power receptacles shall have alternating colors for different circuits (gray, brown and white).

D. Isolated ground receptacles shall be orange.

2.07 WALL DIMMERS

A. Wall dimmers shall be linear slide type equal to Lutron Nova Series.

B. Dimmers shall be 600 watts minimum, incandescent, larger size as required to accommodate greater connected loads.

2.08 LIGHT OCCUPANCY SENSORS

A. Lighting occupancy sensors shall be installed as a functioning system per the Contract Documents and manufacturer's installation instructions.

B. Proper commissioning shall be completed prior to Substantial Completion.

C. Ultrasonic motion detectors shall not be used in vivarium corridors.

2.09 TELECOMMUNICATION OUTLETS

A. Telecommunication outlets, boxes, sleeves and conduit are part of this Contract.

B. Provide outlet boxes and 1-inch conduit with connector and bushing to accessible location above the ceiling.

C. Provide a pull string in each conduit and tie off pull string above ceiling.

D. For floor outlets, provide 1-inch conduit to accessible location above the ceiling on the floor served by the outlet. Cabling and devices by MD ANDERSON.

PART 3 - EXECUTION

3.01 PREPARATION

A. Contractor must examine the areas and conditions under which wiring devices are to be installed and notify the Owner's Project Manager in writing of conditions detrimental to the proper and timely completion of the Work.

B. Inspect devices for physical damage.

C. Do not proceed with the Work until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. All installation shall be in accordance with manufacturer's published recommendations.

C. Wall switch and receptacle ground wiring shall terminate at the wiring device with an insulated tin-plated copper spade compression terminal. Select a spade terminal compatible with the wiring devices supplied so that device screw terminals can be torqued to the wiring device manufacturer's recommendations

D. Wall receptacles shall be installed with the ground pinhole in the up position, unless instructed otherwise by the Owner.

E. The approximate location of switches and receptacles are indicated on the Drawings. These Drawings, however, may not give complete and accurate information in regard to locations of such items. Determine exact locations by reference to the architectural Drawings and by actual measurements during construction of the building before rough-in, subject to the approval of the Owner's Project Manager.

F. Install wall switches 48 inches above finished floor, OFF position down.

G. Install wall dimmers 48 inches above floor; derate ganged dimmers as instructed by manufacturer; do not use common neutral.

H. Where wainscot is near the 48 inch level, install device in the wall below the top edge of the wainscot and as near the 48 inch level as possible to provide the most pleasing appearance. Do not partially install devices in the wainscot and partially in the wall.

I. Where shown the strike side of doors, install switches and dimmers not less than 2 inches and not more than 12 inches from door trim, but in all cases as close to the 2 inch setback as possible.

J. Verify all doors swings before rough-in and locate switches and dimmers on strike side of door wherever possible.

K. Position the center of convenience, telephone, computer and TV outlets 18 inches above floor or 8 inches above countertops unless otherwise noted. Coordinate with equipment and architectural Drawings. Install outlets vertically on walls and horizontally above countertops.

L. Install specific-use receptacles at heights shown on Drawings.

END OF SECTION 26 27 26

SECTION 26 28 13 – FUSES, 600 VOLT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 SUMMARY

A. This Section specifies the requirements for 600V fuses rated 0-600 amps and rated 601-6000 amps.

1.03 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:

1. ANSI/UL 198E - Class R Fuses.

2. ANSI/UL 198C - High Interrupting-Capacity Fuses, Current Limiting Types, Class L.

1.04 SUBMITTALS

A. Product Data:

1. Submit manufacturer's data on fuses.

1.05 EXTRA MATERIALS

A. Maintenance Stock, Fuses:

1. Furnish one set of spare fuses (3 fuses) of each size and type used on the Project in a keyed lockable fuse cabinet (keyed to Owner's master electrical key).

2. Fuse cabinet to be mounted in main switchgear room of the building as designated by Owner.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.02 MANUFACTURERS

A. Bussman.

B. Gould Shawmut.

2.03 MATERIAL AND EQUIPMENT

A. Furnish fuses in accordance with the following:

1. Motors and Transformers, 0 to 600 amp:

a. 250 volt - Buss LPN-RK, UL Class RK1.

b. 600 volt - Buss LPS-RK, UL Class RK1.

~~2. Lighting Loads, 0 to 600 amp:~~

~~a. 250 volt - Buss LPN-RK, UL Class RK1.~~

~~b. 600 volt - Buss LPS-RK, UL Class RK1.~~

~~3. All applications, 601 to 6000 amp: 600 volt - Buss KRP-C, UL Class L.~~

B. Size fuses serving motor loads actually installed as specifically recommended by motor or equipment manufacturer or 125 percent of motor nameplate rating, or the next standard.

C. Interrupting Rating: 200,000 RMS amps.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. All installation shall be in accordance with manufacturer's published recommendations.

END OF SECTION 26 28 13

SECTION 26 28 17 – MOTOR AND CIRCUIT DISCONNECTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Shop Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 SUMMARY

A. This Section specifies the requirements for disconnect switches, fusible and nonfusible.

1.03 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:

1. Federal Spec. W-S-865 - Switch, Box (Enclosed), Surface Mounted.

2. NEMA KS 1 - Enclosed Switches.

1.04 SUBMITTALS

A. Submit manufacturer's product data.

B. Submit dimensioned Shop Drawings and equipment ratings for voltage, capacity, horsepower, and short circuit.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver switches individually wrapped in factory-fabricated water-resistant type containers.

B. Handle switches carefully to avoid damage to material components, enclosure and finish.

C. Store switches in a clean, dry space protected from weather.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.02 MANUFACTURERS

A. General Electric Company.

B. Square D Company.

C. Cutler Hammer~~/Westinghouse.~~

D. Siemens.

2.03 FABRICATED SWITCHES

A. Depending upon the service indicated, use 250 or 600 volt switches, single throw, fusible, or nonfusible, horsepower rated, heavy duty, designed for locking in “ON” or “OFF” position, in code-gage steel cabinets.

B. Use switches which have number of poles required, dependent upon phase serving equipment.

C. Switches shall be NEMA 1 Underwriters’ approved for duty shown. In wet locations, use NEMA 3R. Where exposed to weather in exterior applications, use NEMA Krylon, corrosion resistant type. NEMA 3R and NEMA Krylon switches shall have weatherproof threaded hubs for all conduit entries into switch.

D. Use fuse clips that are rejecting type to accept Class RK or L fuses.

E. Identify switches, as to equipment served, with engraved laminated phenolic name plates. Refer to Section 26 01 00 for nameplate information.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. All installation shall be in accordance with manufacturer’s published recommendations.

C. Install safety or disconnect switches for all electrical equipment, in accordance with the applicable requirements of NEC and the National Electrical Contractors Association “Standard of Installation.”

D. For all equipment with motors larger than 1/8 horsepower, provide motor rated disconnect switches within sight of the motor.

E. Disconnect switches for such equipment shall be mounted independent of the unit to allow for maintenance access.

END OF SECTION 26 28 17

SECTION 26 43 13 – TRANSIENT VOLTAGE SURGE SUPPRESSORS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 SUMMARY

A. These Specifications describe the requirements for an electrical transient surge suppression filter system integrating both transient voltage surge suppression (TVSS) and electrical high frequency noise filtering for "High Exposure", “Medium Exposure”, and “Low Exposure” locations as defined in ANSI/IEEE C62.41-1991.

B. The unit shall be designed for parallel connection to the facility's wiring system. The suppression filter system shall be designed and manufactured in the USA by a qualified manufacturer of suppression filter system equipment. The qualified manufacturer shall have been engaged in the commercial design and manufacture of such products for a minimum of five (5) years.

1.03 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:

1. ANSI/IEEE C62.41-1991 and C62.45-1992.

2. ANSI/IEEE C62.1 and C62.11.

3. Canadian Standards; (CUL).

4. Federal Information Processing Standards Publication 94.

5. National Electrical Manufacturers Association (NEMA LS1-1992).

6. National Fire Protection Association (NFPA 70 [NEC], 75, and 78).

7. Underwriters Laboratories (UL 1449 Third Edition and 1283).

8. Underwriters Laboratories (UL 489 and UL 198).

D. The unit shall be UL 1449 Third Edition Listed and CUL Approved as a Transient Voltage Surge Suppressor and UL 1283 Listed as an Electromagnetic Interference Filter.

1.04 SUBMITTALS

A. Product Data:

1. Provide data showing UL1449 product listing. Submit certified documentation of applicable Location Category Testing in full compliance with NEMA LS 1-1992, paragraphs 2.2.10 and 3.10.

B. Record Documents:

1. Provide Drawings that show unit dimensions, weights, mounting provisions, connection details and layout diagram of the unit.

2. Provide certified documentation of the unit's Single Pulse Surge Current Capacity based on ANSI/IEEE C62.41-1991 Standards.

3. Provide certified documentation of the unit's Minimum Repetitive Surge Current Capacity Testing based on ANSI/IEEE C62.45-1987 Standards.

4. The unit shall include a Diagnostic Signature Card listing factory-established benchmark suppression voltage values for all modes of protection. The suppression voltage values shall be established during final production line testing utilizing the DTS-2 Diagnostic Test Set. This Diagnostic Signature Card shall provide space for subsequent field-testing allowing comparison of the initial factory benchmark testing with subsequent field-testing suppression voltage values.

C. Operation and Maintenance Data:

1. Provide an equipment manual that details the installation, operation and maintenance instructions for the specified unit.

2. Provide a list of customer-replaceable spare parts. All spare parts shall be quickly and easily field-replaceable.

1.05 WARRANTY

A. The manufacturer shall provide a ten (10) year limited warranty from date of shipment against failure when installed in compliance with applicable national/local electrical codes and the manufacturer's installation, operation and maintenance instructions.

B. Warranty shall commence after the Owner has accepted the testing results and taken possession of the equipment.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.02 MANUFACTURERS

A. Current Technology. High Exposure TVSS - Model SEL250, Medium Exposure TVSS – Model TG150, Low Exposure TVSS – Model Transguard TG80.

B. Liebert.

2.03 ENVIRONMENTAL REQUIREMENTS

A. Storage Temperature: Storage temperature range: -40 degrees to +85 degrees C, (-40 degrees to +185 degrees F).

B. Operating Temperature: Operating temperature range: -40 degrees to +60 degrees C, (-40 degrees to +140 degrees F).

C. Relative Humidity: Reliable operation with 5 percent to 99 percent non-condensing relative humidity.

D. Operating Altitude: Capable operation up to 13,000 feet above sea level.

E. Audible Noise: The unit shall not generate any audible noise.

F. Magnetic Fields: No appreciable magnetic fields shall be generated. Unit shall be capable of use in computer rooms without danger to data storage systems or devices.

2.04 ELECTRICAL REQUIREMENTS

A. Unit Operating Voltage shall be as shown on Drawings.

B. Maximum Continuous Operating Voltage (MCOV) shall be greater than 115 percent of nominal voltage.

C. Operating Frequency: Operating frequency range shall be 47 to 63 Hz.

D. Protection Modes: All protected modes are defined per NEMA LS 1-1992, paragraph 2.2.7. Following IEEE Standard 1100-1992, Section 9.11.2 recommendations, units shall provide protection in all modes. WYE configured system shall provide Line-to-Neutral, Line-to-Ground, Line-to-Line and Neutral-to-Ground protection. DELTA configured systems shall provide Line-to-Line protection. Line-to-Line and Line-to-Ground protection shall be provided for all corner grounded DELTA systems.

E. Rated Single Pulse Surge Current Capacity: The rated single pulse surge current capacity, in amps, for each mode of protection of the unit shall be no less than as follows and in accordance with UL 1449:

1. High Exposure TVSS Rated Single Pulse Surge Current Capacity:

L-N	L-G	N-G	L-L
250,000 A	250,000 A	250,000 A	250,000 A

2. Medium Exposure TVSS Rated Single Pulse Surge Current Capacity:

L-N	L-G	N-G	L-L
150,000 A	150,000 A	150,000 A	150,000 A

3. Low Exposure TVSS Rated Single Pulse Surge Current Capacity:

L-N	L-G	N-G	L-L
80,000 A	80,000 A	80,000 A	80,000 A

F. Tested Single Pulse Surge Current Capacity: In compliance with NEMA LS 1-1992, paragraphs 2.2.7, 2.2.9 and 3.4.8.

1. The test shall include an ANSI/IEEE C62.41-1991 Category C1 surge defined as a 1.2 X 50 µ sec, 6000V open circuit voltage waveform and an 8 X 20 µ sec, 3000A short circuit current waveform to benchmark the unit's suppression voltage, followed by a single pulse surge of maximum rated surge current (for units rated over 200,000A per mode, components or sub-assemblies are tested) magnitude with an approximated 8 X 20 µ sec waveform.

2. To complete the test, another Category C1 surge shall be applied to verify the unit's survival. Survival is achieved if the suppression voltage measured from the two category C1 surges does not vary by more than 10 percent.

G. Minimum Repetitive Surge Current Capacity: Per ANSI/IEEE C62.41 and ANSI/IEEE C62.45-1992, all suppression filter systems shall be repetitive surge current capacity tested in every mode utilizing a 1.2 x 50 µ sec, 20 KV open circuit voltage, 8 x 20 µ sec, 10 KA short circuit current Category C3 bi-wave at one minute intervals without suffering either performance degradation or more than 10 percent deviation of clamping voltage at a specified surge current.

1. High Exposure TVSS Repetitive Surge Current Capacity-Number of Impulses:

L-L	L-N	L-G	N-G
>12,000	>12,000	>12,000	>12,000

2. Medium Exposure TVSS Repetitive Surge Current Capacity-Number of Impulses:

L-L	L-N	L-G	N-G
>5,500	>5,500	>5,500	>5,500

3. Low Exposure TVSS Repetitive Surge Current Capacity-Number of Impulses:

L-L	L-N	L-G	N-G
>3,500	>3,500	>3,500	>3,500

H. NEMA LS1-1992 Clamping (Let-Through) Voltage Data. Maximum clamping (Let Through) voltages for units with an integral fused disconnect are as follows:

1. High Exposure TVSS With Fused Disconnect:

System Voltage	Mode	B3 Ringwave	B3/C1	C3
120/240	L-N	350	425	750
120/208	L-G	425	475	800
	N-G	325	450	725
	L-L	475	825	1225
277480	L-N	575	875	1200
	L-G	850	875	1200
	N-G	675	875	1200
	L-L	725	1700	2175

2. Medium Exposure TVSS With Fused Disconnect:

System Voltage	Mode	B3 Ringwave	B3/C1	C3
120/240	L-N	350	425	725
120/208	L-G	425	425	725
	N-G	375	425	700
	L-L	450	825	1150
277480	L-N	550	850	1150
	L-G	875	850	1150
	N-G	700	850	1150
	L-L	725	1650	2100

3. Low Exposure TVSS With Fused Disconnect:

System Voltage	Mode	B3 Ringwave	B3/C1	C3
120/240	L-N	300	400	550
120/208	L-G	400	400	600
	N-G	325	475	800
	L-L	425	725	900
277480	L-N	500	875	1050
	L-G	825	825	1025
	N-G	650	875	1200
	L-L	700	1625	1825

I. UL1449 Ratings: All suppression filter system products are UL1449 rated and listed.

J. High Frequency Extended Range Power Filter: EMI-RFI noise rejection or attenuation values are in compliance with test and evaluation procedures outlined in NEMA LS-1-1992, paragraphs 2.2.11 and 3.11.

High Exposure TVSS Attenuation Frequency Insertion Loss (dB)			
100 kHz	1 MHz	10 MHz	100 MHz
41	31	36	53

Medium Exposure TVSS Attenuation Frequency Insertion Loss (dB)			
100 kHz	1 MHz	10 MHz	100 MHz
44	33	36	53

Low Exposure TVSS Attenuation Frequency Insertion Loss (dB)			
100 kHz	1 MHz	10 MHz	100 MHz
50	37	38	53

1. Note: Standardized insertion loss data obtained utilizing MIL-STD-E220A 50 ohm insertion loss methodology.

K. The Suppression Filter System shall function in conjunction with other suppression filter devices of the same manufacturer via coordinated filters within the facility-wide suppression filter system that provide minimum noise attenuation as follows:

1. High, Medium, and Low Exposure TVSS:

Attenuation Frequency Insertion Loss (dB)			
100 kHz	1 MHz	10 MHz	100 MHz
83	68	67	84

a. Note: Standardized insertion loss data obtained utilizing MIL-STD-E220A 50 ohm insertion loss methodology, based on a minimum of 100 ft. of #4 AWG conductor between the two devices.

L. Overcurrent Protection: The unit shall be installed with coordinated UL 489 or UL 198 listed or recognized overcurrent protection devices. Suppression filter systems that utilize fusing as overcurrent protection shall incorporate non-encapsulated, field-replaceable fuses.

2.05 HIGH PERFORMANCE SUPPRESSION SYSTEM

A. Units shall include an engineered solid-state high performance suppression system utilizing a predetermined number of selenium cells and arrays of non-linear voltage dependent metal oxide varistors with similar operating characteristics.

B. The suppression system components shall optimally share surge currents in a seamless, low-stress manner assuring maximum performance and proven reliability. The suppression system shall not utilize gas tubes, spark gaps, silicon avalanche diodes or other components which might short or crowbar the line, thus leading to interruption of normal power flow to or system upset of connected loads. The suppression system shall not incorporate non-field replaceable encapsulated fusing or any other components that may degrade performance or long-term reliability of the suppression system. Suppression system shall reduce transient levels and provide protection for sensitive electronics susceptible to catastrophic or long-term damage. Clamp voltages are specified herein.

C. The unit shall include a high frequency extended range power filter and shall be UL 1283 listed as an Electromagnetic Interference Filter. The filter shall reduce fast rise-time, high frequency, error-producing transients and electrical line noise to harmless levels, thus eliminating disturbances, which may lead to electronic system upset. The filter shall provide minimum noise attenuation values as specified herein.

D. All internal wiring associated with the suppression filter system and subject to surge currents shall utilize low-impedance copper bus bar. For internal wiring, minimum wire size is shown in table below. All internal connections associated with the suppression filter system and subject to surge currents shall be made with compression or mechanical solderless-type lugs and shall be bolted to the bus bars in order to reduce overall system impedance. No plug-in component modules, quick-disconnect terminals, non-field replaceable fusing or printed circuit boards shall be used in surge current-carrying paths.

1. High and Medium Exposure TVSS Minimum Wire Size:

   a. #2 AWG Copper.

2. Low Exposure TVSS Minimum Wire Size:

   a. #8 AWG Copper.

2.06 FIELD CONNECTIONS

A. The unit shall include mechanical or compression lugs for each phase, neutral and ground, if applicable. Recommended wire size range is as follows:

Phase	Neutral	Ground
High Exposure TVSS:		
#2-1/0 AWG Copper	#2-1/0 AWG Copper	#2-1/0 AWG Copper
Low and Medium Exposure TVSS:		
#8-#2 AWG Copper	#8-#2 AWG Copper	#8-#2 AWG Copper

2.07 UNIT STATUS INDICATORS

A. The unit shall include long-life, solid state, externally visible status indicators that monitor the on-line status of each phase of the unit.

2.08 INTEGRAL TEST POINT

A. The unit shall incorporate an integral test point allowing easy off-line diagnostic testing verifying the operational integrity of the unit's suppression filter system.

B. Field-testing shall permit proactive testing to ensure performance and long-term reliability.

C. Testing shall include injection of an impulse into the off-line suppression filter system to verify the suppression performance values established at final factory testing and recorded on the Diagnostic Signature Card.

D. Indicator lights monitoring fuse condition or power available which inform the user of failure after the fact do not meet the intent of this Specification.

2.09 ENCLOSURE

A. Standard unit shall be supplied in a NEMA 4 metallic enclosure.

2.10 FUSED DISCONNECT SWITCH

A. Units shall include an integral fused and safety interlocked disconnect switch with an externally mounted manual operator.

1. The switch shall disconnect all ungrounded circuit conductors from the distribution system to enable testing and maintenance without interruption of power to the facility's distribution system.

2. The switch shall be rated for 600 Vac.

3. Each current-carrying ungrounded circuit conductor connected to the facility's distribution system shall be individually fused with 200,000 AIC rated class J fuses in order to provide maximum fault current protection.

B. Units shall include a battery-powered audible alarm that detects and provides notification of any single or multiple phase failure of the suppression filter system. The unit shall also include a status indicator for each phase that extinguishes to indicate a failure mode and an LED that flashes to indicate any alarm condition.

1. The alarm shall have a silence switch and a test switch for ensuring positive function and shall have an alarm disable LED that illuminates when the alarm is disabled.

2. The monitoring unit shall have an easily replaceable, commonly available battery for backup to ensure audible alarm function in the event of a total power failure.

3. The unit shall have a battery backup monitor light, which shall illuminate when the battery requires replacement.

4. To monitor on-line status, the monitoring package shall also include two sets of form C dry contacts (normally open or normally closed) to facilitate connection to a building management system.

5. The contacts shall be normally open or normally closed and shall change state upon the failure of the suppression system or power loss in any combination of all three phases.

6. The unit for WYE distribution systems with a neutral shall include two (2) solid-state eight (8) digit liquid crystal displays that discriminate between and exhibit both common mode (L-G) and normal mode (L-N) disturbances.

7. The unit for DELTA distribution systems shall include one (1) solid state eight (8) digit liquid crystal display that exhibits normal mode (L-L) disturbances.

8. The Display Event Counters shall utilize self-contained lithium batteries with a nominal life of ten (10) years.

9. Reset function shall be secure and remotely located.

2.11 DIAGNOSTIC TEST SET

A. The Diagnostic Test Set shall be self-contained and portable and shall provide complete assurance of suppression capability without stressing the suppression system or posing detriment to continued operation.

B. Testing shall be achieved by injecting a high voltage low current transient to test the function of each mode of the suppression filter system.

C. Use of a low current transient shall ensure there is no damage or degradation to the suppression filter system.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. All installation shall be in accordance with manufacturer's published recommendations.

C. Connect unit to electrical system with 100 amp, 3-pole circuit breaker.

3.02 TESTING

A. Each unit shall be factory tested at the applicable MCOV to assure proper field operation.

B. Each unit shall be thoroughly factory tested before shipment. Testing of each unit shall include but shall not be limited to UL manufacturing and production-line tests, quality assurance checks, MCOV and clamping voltage verification tests.

C. Upon completion of installation, a factory-certified local service technician shall provide testing services. The following tests shall be performed:

1. Voltage measurements from Line-to-Ground, Line-to-Neutral, Line-to-Line and Neutral-to-Ground (no neutral in DELTA configurations) at the time of the testing procedure.

2. Impulse injection to verify the system suppression voltage tolerances for all suppression paths. Impulse testing shall be completed while the unit is off-line to isolate the unit from the distribution system.

D. Test results should be recorded and compared to factory benchmark test parameters supplied with each individual unit. A copy of the Start-up test results and the factory benchmark testing results shall be supplied to the Engineer and the Owner for confirmation of proper suppression filter system junction. In addition, the integrity of the neutral-ground bond should be verified through testing and visual inspection.

3.03 APPLICATION

A. The following matrix indicates types of transient voltage surge exposures based on the power distribution system. For actual TVSS installation locations, refer to the Drawings.

	Service Entrances	Large Distribution Panels	Non-Service Entrance Distribution Panels	Heavy Equipment (UPS, Elevators)	Panels Feeding Variable Speed Drives	Branch Panels with Upstream Protection	Branch Panels with Sensitive Electronic Loading	Branch Panels Located Deep Within a Facility
High Exposure	X							
Medium Exposure		X	X	X	X			
Low Exposure						X	X	X

END OF SECTION 26 43 13

SECTION 26 51 00 – LIGHTING FIXTURES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 SUMMARY

A. This Section specifies requirements for indoor and outdoor lighting fixtures, exit signs, lamps and ballasts.

1.03 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:

1. NFPA 101 - Code for Safety to Life from Fire in Buildings and Structures.

2. NEMA WD1 - General-Purpose Wiring Devices.

3. ANSI C82.1 - Specification for Fluorescent Lamp Ballasts.

4. ANSI C82.4 - Specifications for High-Intensity-Discharge Lamp Ballasts (Multiple Supply Type).

5. NEMA LE - H-I-D Lighting System Noise Criterion (LS-NC) Ratings.

6. NFPA 90-A – Standard for the Installation of Air-Conditioning and Ventilating Systems

7. ANSI/ASHRAE/IESNA Standard 90.1 – Energy Standard for Buildings Except Low-Rise Residential Buildings.

1.04 SUBMITTALS

A. Product Data:

1. Submit a 3-ring binder with manufacturer's data on lighting fixtures in booklet form, with a separate sheet for each fixture, assembled by luminaire "type" in alphabetical order, with the proposed fixture and accessories clearly labeled. Ballast and lamp product data shall accompany fixture submittals.

B. Record Documents:

1. Submit dimensioned drawings and performance data including coefficients of utilization, candela distribution, spacing to mounting height ratio, efficiency and visual comfort probability for each fixture, assembled by luminaire type in alphabetical order.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver lighting fixtures individually wrapped in factory-fabricated fiberboard type containers. Parabolic louvers shall be shipped in thermally sealed polyethylene wrapper.

B. Handle lighting fixtures carefully to prevent breakage, denting and scoring the fixture finish. Do not install damaged lighting fixtures.

C. Store product in a clean, dry space protected from weather.

1.06 EXTRA MATERIALS

A. Maintenance Stock:

1. Furnish a stock of replacement lamps in the original cartons or packing sleeves, amounting to 10 percent (but not less than two (2) lamps in each case) of each type and size lamp used in each fixture type.

2. Deliver replacement stock as directed to Owner's storage space

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

B. Lighting fixtures and accessories shall comply with the design and functional requirements of the Project. Design characteristics shall be as noted in manufacturer's submittal data.

C. Provide lighting fixtures of the size, type and rating as scheduled, complete with, but not limited to, lamps, lamp holders, reflectors, ballasts, and wiring.

2.02 MANUFACTURERS

A. Emergency Exit Signs:

1. Lithonia.

2. Surelite.

3. Emergi-Lite.

B. Lamps:

1. Philips.

2. Osram/Sylvania.

3. General Electric Company.

C. Ballasts:

1. Universal Lighting Technologies.

2. Advance.

3. Osram/Sylvania.

4. Lutron.

5. Robertson Transformer.

2.03 INTERIOR LIGHTING FIXTURES

A. Linear Fluorescent Fixtures:

1. Lenses shall be minimum 0.140-inch-thick virgin acrylic. Lens pattern shall be KSH 20 or approved substitution.

2. Parabolic louvers shall have a low iridescent diffuse silver finish, 3-inch deep, 6-cells per 4-foot lamp.

3. Frames shall be flush or regressed, aluminum, steel hinged and equipped with rotary-action cam latches. Spring latches are not acceptable. Frames shall be reversible and capable of latching either side.

B. Compact Fluorescent Fixtures:

1. Reflectors shall be clear, with integral white trim ring, unless noted otherwise.

2. Open reflectors shall be 7-inch minimum diameter.

3. Fixtures installed outdoors and over food handling areas shall be lensed.

4. Fixtures installed in shower locations shall be provided with flush type plastic reflector with opal lens.

~~C. Incandescent downlight fixtures shall be prewired equipped with integral thermal protection.~~

~~D.~~**C.** Special Application and Function:

1. Teleconferencing areas shall have fixtures which match, and are compatible with existing facility installations, including lamp type, lamp color, fixture and lens type, controls, and minimum lighting levels for the vertical and horizontal planes. Coordination shall be with Owner's Telehealth Services section of UTTV.

2. Low voltage fixtures utilizing MR16 lamps shall be lensed.

3. 'Clean-room' type fixtures for high purity areas and special laboratory functions shall be triple gasketed, with sealed cam latches.

4. Warning signs (In Use, Beam On, X-Ray In Use, etc.) shall be LED illuminated with housing and face color as specified.

5. Task lights shall be equipped with an integral rocker switch. Where two or more task lights are located in a room, a wall switch shall be installed at the entry door for control.

~~2.04 ENVIRONMENTAL ROOMS AND EXTERIOR LIGHTING FIXTURES~~

~~A. Enclosures shall be complete with gaskets to form weatherproof seal and UL approved for wet locations.~~

~~B. Provide low temperature ballasts with reliable starting to 0 degrees F.~~

~~C. In-ground or buried fixture and ballast systems are not approved for use.~~

~~D. Exterior fixtures shall match Owner's existing style and types, particularly bollard, pole top, parking garage, soffit, roadway, perimeter area lights and landscaping types. Exterior fixtures shall be compatible with Texas Medical Center (TMC) standards as applicable.~~

~~2.05 RETURN AIR TROFFER~~

~~A. The return air troffer where indicated on Drawings, shall have white enamel finish, 0.140 inch clear prismatic acrylic lens, and shall be recessed in inverted "T" bar ceiling. Lens pattern K SH 20 or approved substitution.~~

~~B. The return air troffer shall have the capacity to handle 200 CFM of return air through the side slots of the nominal 4-foot long fixture (without return air attachment) with a total pressure drop from the rooms to the return air ceiling plenum not to exceed 0.05 inches w.g.~~

~~2.06~~**2.04** EMERGENCY EXIT SIGNS

A. Provide exit signs with red LED illumination.

B. Exit signs shall have covers that are composed of a black face and body, smooth red diffusion material, with 6 inch-high red letters on black background, directional arrows as indicated. Individual LED's shall not be visible through the diffusion material.

C. Fixtures shall have minimum five (5) year warranty.

D. Fixtures shall be UL924 and Energy Star compliant.

E. Exit signs shall be rated for dual voltage; 120/277.

~~2.07~~**2.05** LAMPS

A. Incandescent lamps shall not be used.

B. Pin-based compact fluorescent lamps shall be quad or triple tube, 13, 18, 26 or 32 watt similar to NEMA lamp type CFQ13W/G24Q/835 or CFTR26W/GX24Q/835. 'Long' compact fluorescent lamps in nominal 39 and 40 watt sizes are acceptable. Compact fluorescent lamps shall be 3500K color temperature. Original equipment manufacturer lamps that are only available from a single manufacturer are not acceptable.

C. Linear fluorescent rapid, or instant-start lamps shall be medium bi-pin equal to or better than Philips T-8 lamps, minimum CRI of 85. General use four foot lamps shall be equal to or better than Philips Energy Advantage F32T8/ADV841/XEW/ALTO. If different lamp manufacturers are submitted, no noticeable difference in color temperature shall be allowed and performance shall be equal to or better than the base lamp. T-8 fluorescent lamps shall have a color temperature of 4100 K and be specified in 2 foot, 3 foot and 4 foot lengths only. U-bent (6 inch, 3 inch, 1-5/8 inch) and circline lamps are not acceptable. Linear four foot lamps used in open fixtures in environments below 70 degrees F, or in operation rooms, shall be full wattage type.

~~D. Metal halide HID lamps shall be ceramic metal halide type, clear, unless noted otherwise, with mogul or medium bases. Acceptable medium base lamp sizes are 50, 100 and 150 watts. Double-ended lamps are not acceptable. Any base type other than medium or mogul shall be submitted for Owner review and approval in advance. Metal halide fixtures shall be lensed or utilize a lamp (PAR type) which does not require special arc tube protection.~~

~~E. Cold cathode, neon, T-5 and T-2 systems are not approved for use.~~

~~F.~~**D.** LED, induction and fiber optic lighting systems may be approved for special applications when submitted for Owner review and approval in advance.

~~G.~~**E.** Lamps, including linear fluorescent **and**~~,~~ compact fluorescent ~~and high intensity discharge,~~ shall be low mercury type and shall pass all federal TCLP (Toxicity Characteristic Leaching Procedure) test requirements at the time of manufacture.

~~2.08~~**2.06** BALLASTS FOR FLUORESCENT T-8 LAMPS

A. High frequency (20 kHz or greater) electronic type.

B. THD (total harmonic distortion) of less than 10 percent.

C. Power factor greater than or equal to 95 percent.

D. Ballasts shall operate with 265 MA lamps.

E. Unless noted otherwise (i.e. dual switching, etc.), provide one ballast per fixture.

F. All ballasts shall be rated for 277-volt operation except for under-counter, patient headwall, and patient room night light fixtures that shall be rated for 120-volt operation.

G. Ballasts shall be Class P thermally protected.

H. Ballasts shall include a 5-year manufacturer's warranty.

I. Ballasts shall meet FCC requirements governing electromagnetic and radio frequency interference.

~~2.09~~**2.07** BALLASTS FOR COMPACT FLUORESCENT LAMPS

A. All ballasts shall be of the high power factor type and be capable of independent switching if two ballasts are provided with a fixture.

B. Ballasts shall include a 5-year manufacturer’s warranty.

C. Dimming ballasts shall be electronic and compatible for line voltage or control wire dimming systems as specified on the Contract Documents.

D. Ballasts shall be magnetic for 2-pin lamp application. Electronic ballasts for other applications shall be submitted for Owner approval in advance.

~~2.10 BALLASTS FOR HID LAMPS~~

~~A. HID ballast shall be of the lead-peak autotransformer type for metal halide lamps. Ballast shall start and operate the lamp at ambient temperatures ranging from minus 20 degrees F to 105 degrees F. All ballasts shall have automatic thermal protection, and high power factor, minimum of 90 percent. Ballasts for interior applications shall be encased and potted, or be of the electronic type.~~

~~B. HID ballasts for M90, M110, M130, M139 and M140 rated lamps shall be electronic, and shall include a five (5) year manufacturer's warranty.~~

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. Install light fixtures in accordance with the manufacturer's written instructions, the applicable requirements of NEC and the National Electrical Contractors Association's "Standard of Installation".

C. If a fixture type designation is omitted, furnish fixture of the same type as shown for rooms of similar usage. Verify with Owner's Project Manager before purchase and installation.

D. Check the building electrical system requirements and architectural finishes. Regardless of the catalog number prefixes and suffixes shown, furnish fixtures with the proper trim, frames, supports, hangers, ballasts, voltage rating, and other miscellaneous appurtenances to properly coordinate with Project conditions. Verify with Owner's Project Manager prior to ordering.

E. Check the type of ceilings to be installed in each room and verify that the recessed light fixtures are proper for the type of ceiling to be installed before ordering fixtures. Provide a frame compatible with the type of ceiling in which the recessed lighting fixture is installed. Refer to the Architectural Room Finish Schedule for the specified ceiling type.

F. Fixtures shall be securely attached to the ceiling-framing members by mechanical means. Clips identified for use with the type of ceiling framing member(s) and fixture(s) shall also be permitted. Fasten lighting fixtures in areas where there is no ceiling securely to the structure.

G. Immediately before final observation, clean all fixtures, inside and out, including plastics and glassware, and adjust all trim to properly fit adjacent surface, replace broken or damaged parts, and lamp and test all fixtures for electrical as well as mechanical operation.

H. Protect installed fixtures from damage during the remainder of the construction period.

I. Wiring methods:

1. Lighting fixtures shall be connected to a typical metal conduit, junction box, and wire lighting grid system. MC (Metal-Clad Cable) and FMC (Flexible Metal Conduit), where are permitted to be used, shall be concealed to prevent physical damage. Exposed MC and FMC installations are not acceptable.

2. Modular cabling, flexible whip assemblies, feed through wiring, 'daisy-chain' feeds, tandem wiring and other similar wiring methods are not acceptable for the lighting circuit distribution and wiring system.

3.02 TESTING

A. Upon completion of installation of interior lighting fixtures, and after circuitry has been energized, apply electrical energy to demonstrate capability and compliance with requirements. When possible, correct malfunctioning units at the Project Site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting.

~~B. Incandescent lamps shall be new at time of Final Completion.~~

~~C.~~**B.** Fluorescent lamps may be used in the final finishing of the Project. Those that have exceeded more than 20 percent of their rated life (as established by Owner records) or that have darkened ends shall be replaced with new lamps before Final Completion.

~~D. HID lamps may be used in the final finishing of the Project. Those that have exceeded more than 20 percent of their rated life (as established by Owner records) shall be replaced with new lamps before Final Completion.~~

~~E.~~**C.** All existing fixtures in work area that are re-used or relocated shall be cleaned inside and out, broken or damaged parts replaced and new lamps installed.

3.03 LIGHTING FIXTURE SCHEDULE

A. Refer to Lighting Fixture Schedule on Drawings for list of specified manufacturers for each fixture proposed.

END OF SECTION 26 51 00

SECTION 27 00 00 - COMMUNICATIONS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them, including but not limited to the following:

1. Division 07 - Penetration Fire stopping
2. Section 27 05 26 - Grounding and Bonding for Communications Systems
3. Section 27 05 28 - Pathways for Communications Systems
4. Section 27 05 43 - Underground Ducts and Raceways for Communications Systems
5. Section 27 05 53 - Identification for Low-Voltage Cables
6. Section 27 11 00 - Communications Equipment Room Fittings
7. Section 27 13 00 - Communications Backbone Cabling
8. Section 27 15 00 - Communications Horizontal Cabling

1.02 SUMMARY

A. This section includes general communications design requirements, administration topics, and installation for communications systems.

1.03 REFERENCE STANDARDS:

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. The publications listed below form a part of this specification. The publications are referred to in the text by basic designation only.

D. Specific reference in specifications to codes, rules, regulations, standards, manufacturer's instructions, or requirements of regulatory agencies shall mean reference to the latest printed edition of each in effect at the date of contract.

E. Conflicts:

1. Drawings and specifications are to be used in conjunction with one another and to supplement one another. In general the specifications determine the nature and quality of the materials and tests, and the drawings establish the quantities, details, and give characteristics of performance that should be adhered to in the installation of the communications system components.

2. If there is an apparent conflict between the drawings and specifications, or between specification sections, the items with the greater quantity or quality shall be estimated and installed.

3. Clarification with the Owner and/or Owner's Representative about these items shall be made prior to the ordering and installation.

F. Codes and Standards (Most recent editions with addenda/TSB, etc.) All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:

1. ANSI/TIA/EIA-568-C, Commercial Building Telecommunications Wiring Standard.

   a. ANSI/TIA-568-C.0, "Generic Telecommunications Cabling for Customer Premises", published 2009

   b. ANSI/TIA-568-C.1,"Commercial Building Telecommunications Cabling Standard", published 2009

   c. ANSI/TIA-568-C.2,"Balanced Twisted-Pair Telecommunication Cabling and Components Standard", published 2009

   d. ANSI/TIA-568-C.3,"Optical Fiber Cabling Components Standard", published 2008, errata issued in October, 2008

2. ANSI/TIA-569-B Commercial Building Standard for Telecommunications Pathways and Spaces.

3. ANSI/TIA-606-A Administration Standard for Commercial Telecommunications Infrastructure

4. ANSI-J-STD-607-A Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications.

5. ANSI/TIA-758-A, Customer-Owned Outside Plant Telecommunications Infrastructure Standard.

6. ANSI/TIA – 1179 Healthcare Facility Telecommunications Infrastructure Standard

7. BICSI: Comply with the most current editions of the following BICSI manuals:

   a. BICSI - Telecommunications Distribution Methods Manual

   b. BICSI – Installation Transport Systems Information Manual

   c. BICSI – Network Design Reference Design Manual

   d. BICSI – Outside Plant Design Reference Manual

   e. BICSI – Wireless Design Reference Manual

   f. BICSI -Electronic Safety and Security Design Reference Manual

   g. Infocomm/BICSI – AV Design Reference Manual

8. Underwriters Laboratories (UL) Cable Certification and Follow-Up Program.

9. National Electrical Manufacturers Association (NEMA)

10. American Society for Testing Materials (ASTM)

11. National Electrical Code (NEC) 2008

12. National Electrical Safety Code (NESC) 2009

13. Institute of Electrical and Electronic Engineers (IEEE)

14. UL Testing Bulletin

15. Building Industry Consulting Services International (BICSI) Information Transport Systems Methods Manual (ITSMM)

16. Local, county, state and federal regulations and codes in effect as of date of installation.

17. Equipment of foreign manufacture must meet U.S. codes and standards. It shall be indicated in the proposal the components that may be of foreign manufacture, if any, and the country of origin.

1.04 SCOPE OF WORK :

A. This section establishes a communications infrastructure to be used as signal pathways for voice and high-speed data transmission. Contractor shall:

1. Comply with all Master Specifications documents and the following requirements for a complete project installation.

2. Provide a structured cabling system as described hereafter that includes, but is not limited to, supplying, installing, labeling and testing of: fiber backbone, fiber and voice riser cable; data copper, fiber, and voice copper horizontal cabling, cable connectors, communications outlets and terminations, and equipment racks/cabinets for networking hardware and patch panels.

3. Furnish all labor, materials, tools, equipment and services for the installation described herein. Provide add/deduct unit pricing for all components as part of the bid response. Assume an average cable length of 150 linear feet for comparative purposes. All requirements and specifications will be enforced. Cable pathways and runs to individual outlets are not shown in their entirety, but shall be provided as if shown in their entirety.

4. Coordinate with electrical tradespersons to verify conduit routing does not cause cabling to exceed specified electrical length.

5. Follow industry standard installation procedures for communications cable to assure that the mechanical and electrical transmission characteristics of this cable plant and equipment are maintained.

B. Work of this section covers a complete installation of both permanent and channel links for a data and voice communications network utilizing copper and fiber transmission media that includes, but is not limited to the following. The Contractor shall:

1. Provide and install fabric and/or either plenum, PE or PVC Innerduct, rated appropriately for the installation environment.

2. Provide, install, terminate, test, label and document all fiber backbone, fiber and copper riser cable.

3. Provide, install, terminate, test, and document all fiber, copper voice, and data horizontal cable.

4. Provide and place all termination devices such as, but not limited to, modular patch panels, termination blocks, information outlets (jacks and plates), phone jacks, fiber distribution panels, bulkheads, connectors, and fiber fan out kits.

5. Provide in quantities specified interconnect components such as, but not limited to, copper patch cords, fiber patch cables and data station cables.

6. Provide and place horizontal and vertical cable support devices such as, but not limited to, rack and wall-mounted horizontal and vertical cable management, cable runway, telecommunications cable runway, and all required mounting hardware, unless otherwise noted.

7. Provide and install all equipment mounting racks, cabinets and/or brackets.

8. Provide and install UL-approved firestopping systems in all communication pass-throughs, conduits and cable trays, and ceiling, wall and floor penetrations in coordination with General Contractor.

9. Provide all appropriate consumable items required to complete the installation.

10. Grounding and bonding in MC and TR rooms to grounding bus provided by Division 26.

11. Provide complete documentation and demonstration of work.

12. Completion of all punch list deficiencies within 10 working days.

13. Provide indexed and organized complete Test Results of all copper and fiber cable and their components.

14. Provide Submittals as outlined below.

15. Conduct a final document handover meeting with client, consultant, and PM to review, discuss and educate the Owner on the test results and As-Built Drawings.

16. Provide a Manufacturer's Extended Product Warranty and System Assurance Warranty for this wiring system.

1.05 PRODUCTS AND WORK BY OTHERS (NIC) INCLUDES:

A. The Owner may separately purchase and/or provide certain equipment and miscellaneous items that will be installed during the course of the installation process. Such items may not be indicated in the documents. Contractor shall coordinate with the Owner and his suppliers when considering:

1. Provision and installation of phone systems, computer hardware, and related networking software and equipment.

2. Provision and installation of multi-port routers, hubs, and UPS in communications rooms.

3. Communications grounding busbars and grounding wires connecting to the main building electrode system.

4. Dedicated power panels, ground busbars, circuits and utility outlets.

5. Installation and finishing of plywood backboards.

6. Building mechanical ductwork, cooling/heating system, and environmental control sensors.

7. Communication pathway devices such as, but not limited to, cable tray and flex-tray in corridors, office spaces and open areas, conduits, conduit sleeves, and penetrations in walls and floors.

1.06 MEASUREMENT PROCEDURES:

A. The Contractor shall

1. Verify dimensions in areas of installation by field measurements before fabrication and indicate measurements and scale on shop drawings.

2. Coordinate fabrication schedule with construction progress to avoid delaying the work.

3. Where field measurements cannot be made without delaying the work, establish dimensions and coordinate with the General Contractor.

4. When approved, proceed with fabricating units without field measurements.

5. Coordinate supports, adjacent construction, and fixture locations to ensure actual dimensions correspond to established dimensions.

1.07 ALTERNATES:

A. If an alternate material is proposed that is equal to or exceeds specified requirements, Contractor shall provide manufacturers' specifications in writing for Owner approval prior to purchase and installation.

B. Substitutions of material by the Contractor shall be in writing complete with written manufacturers' specifications. The material substituted shall not void, alter or change manufacturers' structured cabling system warranty.

C. Contractor shall:

1. Provide a complete cabling infrastructure according to these written specifications and drawings. If the Owner changes the scope of work to be performed by the Contractor, it shall be in writing.

2. Respond to these changes with a complete material list, including pricing, labor, and taxes in writing presented to the Owner for approval.

3. Not proceed with additional scope of work without a signed approval by the Owner.

D. Owner will not pay for additional work performed by the Contractor without signed approval of these changes. Contractor will submit a copy of signed change order upon billing.

1.08 SUBSTITUTION PROCEDURES

A. Substitution may be considered when a product becomes unavailable through no fault of the Contractor.

B. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents. Include in each request for substitution:

1. Product identification, manufacturer's name and address.

2. Product Data: Description, performance and test data, reference standards, finishes and colors.

3. Samples: Finishes

4. Complete and accurate drawings indicating construction revisions required (if any) to accommodate substitutions.

5. Data relating to changes required in construction schedule.

6. Cost comparison between specified and proposed substitution.

C. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.

D. The Owner will be the final judge of acceptability, with review by Owner's Representative and the distribution of the acceptance by the Architect. No substitute shall be ordered, installed or utilized without the Architect's prior written verification of acceptance from the Owner.

E. Related Documents:

1. Drawings and General provisions of the contract, including Uniform General Conditions, Supplementary General Conditions, architectural plans and specifications, requirements of Division 1, electrical, mechanical, plumbing, audio visual, security and telecommunications specifications and plans apply to the telecommunications section, and shall be considered a part of this section. The Contractor shall read all sections in their entirety and apply them as appropriate for work in this section.

2. In order to accomplish the conditions of this agreement, the Contractor shall perform the specific duties listed herein.

3. Drawings and specifications are to be used in conjunction with one another and to supplement one another. In General the specifications determine the nature and quality of the materials, and the drawings establish the quantities, details, and give characteristics of performance that should be adhered to in the installation of the communications system components. Clarification with the Owner about these items shall be made prior to ordering and installation.

4. The Contractor shall procure, submit for review, and maintain for the duration of this agreement insurance against claims for injuries to persons or damages to property which may arise from, or in connection with, the performance of work hereunder by the Contractor, his agents, representatives, employees or subcontractor. The Contractor shall pay the cost of such insurance. The Owner, its directors, officers, representatives, agents and employees, respectively, shall have no responsibility to the Contractor with respect to any insurance in accordance with the provisions set forth herein.

5. Refer to the General Contractor contract documents and/or master specifications issued by Architect for Project and cost payment details.

6. The Contractor will respect and protect the privacy and confidentiality of Owner, its employees, processes, products, and intellectual property to extent necessary, consistent with the legal responsibilities of the Owner policies.

7. Contractors shall sign a non-disclosure agreement and abide by the requirements to keep confidential all information concerning bid documents and this project.

8. Use of Subcontractors: Successful bidder shall inform the Owner's contact and General Contractor in writing about the intention to use Subcontractors and the scope of work for which they are being hired. The Owner or Owner's designated contact must approve the use of Subcontractors in writing prior to the Subcontractor's hiring and start of any work.

9. The Contractor's designated project manager will be recognized as the single point of contact. The Project manager shall oversee all work performed to ensure compliance with specifications as outlined in bid documents (which includes all specifications and drawings) to ensure a quality installation.

1.09 DEFINITIONS:

A. Abbreviations:

1. BET Building Entrance Terminal

2. BD: Building Distributor also referred as MDF

3. C/W: Complete With

4. CBC: Coupled Bonding Conductor

5. CFCI: Customer Furnished Customer Installed

6. Div.1: Division 1 General and Performance Requirements

7. Div. 23: Division 23 Heating, Ventilating, and Air Conditioning

8. Div. 22: Division 22 Plumbing

9. Div. 26: Division 26 Electrical

10. Div. 27: Division 27 Communications and Audio Visual

11. Div. 28: Division 28 Electronic Safety and Security

12. E.E. Electrical Engineer

13. EMI: Electromagnetic Interference
14. FD: Floor Distributor also referred as HC
15. GE: Ground Equalizer
16. HC: Horizontal Cross-Connect (IDF)
17. IC: Intermediate Cross-Connect
18. IDC: Insulation Displacement Connector
19. IDR: Intermediate Distribution Room
20. I/O: Information Outlet or Work Area Information Outlet
21. LAN: Local Area Network
22. MC: Main Cross-Connect
23. MDR: Main Distribution Room
24. N/A: Not Applicable
25. NIC: Not In Contract
26. OFCI: Owner Furnished Contractor Installed
27. OFOI: Owner Furnished Owner Installed
28. OTDR: Optical Time Domain Reflectometer
29. RCDD: Registered Communications Distribution Designer
30. RFI: Radio Frequency Interference
31. TBB: Telecommunications Bonding Backbone
32. TBC: Telecommunications Bonding Conductor
33. TBD: To Be Determined
34. TGB: Telecommunications Ground Bus Bar
35. TMBC: Telecommunications Main Bonding Conductor
36. TMGB: Telecommunications Main Grounding Bus Bar
37. TR: Telecommunications Room
38. UON: Unless Otherwise Noted
39. UTP: Unshielded Twisted Pair
40. WA: Work Area

1.10 SYSTEM DESCRIPTION:

A. The objective of this project is to provide a complete communications cabling infrastructure system installation including, but not limited to: fiber backbone, riser system, horizontal data and voice cabling with associated terminations, mounting equipment, cable pathway and management systems, testing and other items/materials, as specified in drawings, these specifications, and contract documents.

1.11 SUBMITTALS:

A. The Contractor:

1. Shall not perform any portion of the work requiring submittal and review of shop drawings, product data, or samples until Owner has approved the respective submittal. Such work shall be in accordance with approved submittals.

a. Shop drawings as required by the owner or as a minimum to include a minimum of two sets of a plan view and elevations of all work to be installed. The Contractor shall make any corrections required by the owner or the owner's representative or consultant team, file with him two corrected copies and furnish such other copies as may be needed. The consultant's approval of such drawings or schedules shall not relieve the Contractor from responsibility for deviations from drawings or specifications, unless he has in writing called the Architect's attention to such deviations at the time of submission, nor shall it relieve him from responsibility for errors of any sort in shop drawings or schedules.

2. Shall not perform any portion of the work requiring approval of the System Assurance Warranty manufacturer's warranty registration qualification procedures that would disqualify any part or all of the wiring system from that warranty qualification.

B. The Contractor shall provide a copy of the Certified Test Data Sheet, available from the delivering distribution warehouse for either a full run or cut piece from the Master Reel of the fiber cable to be installed

1. The Certified Test Data Sheet shall include the Master Reel number, cable description, a passing test result with details, test equipment description, date certified, and a certificate of compliance stamp, and shall be included in the O&M Manual as a component of the final deliverables submittal package.

C. The Contractor shall provide the appropriate documentation from the certifying manufacturer showing the project is registered and qualified for the System Assurance Warranty. All subsequent work shall be in accordance with approved submittals.

D. The Contractor's BICSI Registered Communications Distribution Designer (RCDD) supervisor shall review, approve and stamp all documents prior to submitting. The Contractor's RCDD shall warrant in writing that 100% of the installation meets the requirements specified herein upon completion of all work.

E. Product Certificates shall be signed by manufacturers of cables, connectors, and terminal equipment certifying that products furnished comply with requirements.

F. Contractor shall submit the required Field Test Reports in the format and media specified, upon completion of testing the installed system.

G. Contractor shall deliver manufacturer's signed long-term Warranty of installed cabling system to include all components that comprise the complete cabling system. Delivery to be effected within two weeks of the time of final punch list review. Failure of any component to pass system component tests shall be promptly corrected, repaired or replaced to meet standards compliance. Contractor shall coordinate with manufacturer for warranty paperwork and procedures prior to the start of the project.

H. Cable Testing Plan:

1. The Contractor shall:

a. Provide a complete and detailed test plan for approval of the cabling system specified herein, including a complete list of test equipment for copper and fiber optic components and accessories prior to beginning cable testing. The following minimal items shall be submitted for review:

1) All testing methods that clearly describes procedures and methods.

2) Product data for test equipment

3) Certifications and qualifications of all persons conducting the testing.

4) Calibration certificates indicating that equipment calibration meets National Institute of Standards and Technology (NIST) standards and has been calibrated at least once in the previous year of the testing date.

5) Examples of test reports, including all graphs, tables, and charts necessary for display of testing results.

b. Include validation, and testing. Owner will require that the telecommunications cabling system installed by the Contractor be fully certified to meet all necessary requirements to be compliant with referenced IEEE and TIA specifications and vendor's warranty.

c. Will determine the source/cause of test failure readings and correct malfunctioning component and/or workmanship within each channel or permanent link and retest to demonstrate compliance until corrected failure produces a passing result.

I. Cable Testing Reports: The Contractor shall submit cable test reports as follows:

1. Submit certified test reports of Contractor-performed tests.

a. The tests shall clearly demonstrate that the media and its components fully comply with the requirements specified herein.

b. Three (3) set(s) of electronic and hardcopy versions of test reports shall be submitted together and clearly identified with cable identification.

c. Cable inventory data shall be submitted for all fiber, copper, and coaxial cabling and termination equipment. Submit data electronically on CD-ROM, listing products furnished, including:

1) Manufacturer's name.

2) Manufacturer's part numbers.

3) Cable numbers.

4) Location and riser assignments.

5) Product Data:

2. Equipment and materials shall be standard products of a manufacturer regularly engaged in the manufacture of telecommunications cabling products and shall be the manufacturer's latest standard design in satisfactory use for at least one year prior to bid opening.

J. Shop Drawings:

1. The Contractor shall:

a. Submit catalogue cut-sheets that include manufacturer, trade name, and complete model number for each product specified. Model number shall be handwritten, marked with an arrow or underlined to indicate exact selection.

b. Identify applicable specification section reference for each product performance for each component specified for approval prior to purchase and installation.

c. Submit for approval diagrams showing room layouts, rack layouts (including elevations), riser layouts, etc.

K. Samples:

1. For workstation outlet connectors, jack assemblies, housings and faceplates for color selection and evaluation of technical specifications and requirements. Confirm with Architect, interior designer, and Owner representative for color before purchasing materials. Face plates shall match electrical face plates in color and material type.

L. Qualifications:

1. The Contractor shall provide the appropriate documentation to comply with the requirements described in SECTION 1.12- QUALITY ASSURANCE, included with, and at the time of, bid submittal.

M. Closeout Submittals (As-built Drawings):

1. Communications Design drawings are to be supplied to the Architect to prepare the master "As-Built" drawings.

2. As-Built drawings shall be in AutoCAD format, same version as used by Architect and consultant. Dimensions and scale of the drawing sheets submitted shall match the size of the drawing used for the contract documents, and shall include the cable numbers labeled in accordance with this document.

3. Utilize normal recognized drafting procedures that match AutoCAD standards, Architect and consultant guidelines and methodology.

4. The As-Built drawings shall incorporate all changes made to the building identified in, but not limited to, addendum, change notices, site instructions or deviations resulting from site conditions.

a. Contractor shall:

1) Clearly identify any resubmitted drawing sheets, documents or cut sheets either by using a color to highlight or cloud around resubmitted information.

2) Maintain drawing numbering or page/sheet scheme consistency as per previously issued drawings/documents.

3) Provide dimensioned plan and elevation views of networking components, showing:

a) All communications data/voice outlet locations complete with outlet/cable labeling.

b) Cable routing paths of communications cables to identified infrastructure pathways.

c) All rack and cabinet locations and labeling there of.

d) One-line diagram of equipment/device interconnecting data/voice cabling of the data and voice systems.

e) Standard or typical installation details of installations unique to Owner's requirements.

f) Graphic symbols and component identification on detail drawing shall conform to the latest ANSI/TIA 568-C, ANSI/TIA 569-B, ANSI/TIA 606-A and ANSI/NECA/BICSI 607-A conventions.

4) Submit one soft (compatible with Microsoft software) and hard copy with project deliverables within three weeks subsequent to substantial completion.

5) Hard copy of floor plans for record shall be plotted to a standard, saleable, identified drawing scale.

1.12 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Contractor shall supply all city, county, and state telecommunication cabling permits required by appropriate governing agency.

2. Contractor shall be state-licensed and/or bonded as required for telecommunications/low voltage cabling systems.

B. Certifications:

1. Contractor shall submit an up-to-date and valid certification verifying qualifications of the Contractor and installers to perform the work specified herein at time of bid submission.

2. Contractor shall have a complete working knowledge of low voltage cabling applications such as, but not limited to data, voice and video network systems.

3. Contracting firm shall have installed similar-sized systems in at least ten (10) other projects in the last five years prior to this bid and be regularly engaged in the business of installation of the types of systems specified in this document. Certification shall include, but not be limited to, items such as name and location of project contacts and numbers, total square footage, total number of cables/drops, types of media, etc

4. Contractor shall provide certificates for the appropriate insurance coverage as defined in contract documents.

5. All installer personnel that will be assigned to this project shall be listed in the qualification questionnaire document. 25% shall have a minimum of 3 years experience in the installation of the types of systems, equipment, and cables specified in this document prior to this bid. Any personnel substitutions shall be noted in writing to Owner prior to commencement of work.

6. Contractor shall submit evidence of compliance with these requirements prior to beginning work on the project.

7. Cabling installers shall be trained and certified by the cable manufacturer for telecommunication cabling installations and maintenance of said materials. Refer also to General Conditions.

C. Administrative Requirements and Coordination:

1. The Contractor shall:

a. Provide a specified contact person (name and contact number) for coordination to attend project meetings with the telecommunication consultant, the Owner and others.

b. Coordinate work of this section with Owner's telephone system specifications, workstations, equipment suppliers, and installers.

c. Coordinate installation work with other crafts (examples include ceiling grid contractors, HVAC and sheet metal contractors, etc) to resolve procedures and installation placement for cable trays and cable bundle pathways. The goal of this coordination will be to establish priority pathways for critical data/voice network cable infrastructure, materials, associated hardware, as well as mitigate delays to the project and to allow service access for communications and HVAC components. Damage by Contractor to the craftwork of others will be remedied at the Contractor's expense in a timely manner.

d. Exchange information and agree on details of equipment arrangements and installation interfaces. Record agreements reached in meetings and distribute record to other participants, Owner and telecommunication consultant.

e. Adjust arrangement and locations of distribution frames, patch panels, and cross-connect blocks in equipment rooms and racks to accommodate and optimize arrangement and space requirements of any service provider equipment, telephone system, and LAN equipment. Tasks shall be coordinated with Owner or his representative, and other trades' installation representatives.

f. Where installed, confirm exact locations and method of mounting outlets in modular furniture. Follow furniture manufacturers' written instructions for installing cable and devices in modular partitions. Obtain modular furniture and power pole locations from the General Contractor. Wiring locations noted in plans along walls for modular furniture are approximate and will have to be determined by Contractor at time of installation. Field condition adjustments for installation may have to be made and coordination efforts with the electrical contractor for pathway must take place early on in the project to comply with maximum 40% conduit fill factor requirements.

g. When requested by Owner or Owner's representative, furnish extra materials that match specified products and that are factory packaged with protective covering for storage and identified with labels describing contents.

D. Contract Administration:

1. Change orders shall be submitted to the Owner/Project Manager complete with price breakdown and description for approval before any work is done.

2. Owner's Representative will provide job field reports upon inspection of Contractor's installation, materials, supporting hardware, coordination with other trades and progress to schedule to the client.

3. Job Field Report outline:

a. General installation progress in relation to scheduled work made by the Contractor up to that date.

b. All deficiencies noted in the cable installation to be corrected by the Contractor.

E. Pre-Installation Meetings - Contractor shall:

1. Attend and/or arrange a scheduled pre-installation conference prior to beginning any work of this section.

a. Agenda: This venue is to ask and clarify questions in writing related to work to be performed, scheduling, coordination, etc. with consultant and/or project manager/Owner representative.

b. Attendance: Communications project manager/supervisor shall attend meetings arranged by General Contractor, Owner's representatives, and other parties affected by work of this document.

c. All individuals who will be installers of communication cables and equipment in an on-site supervisory capacity, including project managers and lead installers, shall be required to attend the pre-installation conference. Individuals who do not attend the conference will not be permitted to supervise the installation of, or install, terminate, or test communications cables on the project. This includes supervisors, project managers, and lead installers of this project.

F. Post-Installation Meetings:

1. At the time of substantial completion, or shortly thereafter, the Contractor shall call and arrange for a post-installation meeting to present and review all submittal documents to include, but not limited to as-built drawings, test reports, warranty documentation, etc. Attendees shall be Owner staff, Owner's Representative, General Contractor, and others that the General Contractor deems appropriate.

2. At this meeting the Contractor shall present and explain all documentation, and asking for feedback on its completeness. Any discrepancies or deviations noted by and agreed to by participants shall be remedied by Contractor and resubmitted within one week of meeting.

1.13 DELIVERY, STORAGE, AND HANDLING:

A. Coordination with delivery companies, drivers, site address, and contact person(s) will be the responsibility of the Contractor.

B. Contractor Shall:

1. Be responsible for prompt material deliveries to meet contracted completion date.

2. Coordinate deliveries and submittals with the General Contractor to ensure a timely installation.

3. No equipment materials shall be delivered to the job site more than three weeks prior to the commencement of its installation.

4. Equipment shall be delivered in original packages with labels intact and identification clearly marked.

5. Equipment shall not be damaged in any way and shall comply with manufacturer's operating specifications.

6. Equipment and components shall be protected from the weather, humidity, temperature variations, dirt, dust, or other contaminants. Equipment damaged prior to system acceptance shall be replaced at no cost to the Owner.

7. Contractor shall be responsible for all handling and control of equipment. Contractor is liable for any material loss due to delivery and storage problems.

C. Owner/General Contractor shall supply a list of security requirements for Contractor to follow.

1.14 PROJECT/SITE CONDITIONS

A. For all environmental recommendations, refer to master Architectural section.

B. For all security recommendations, refer to related Division 01.

C. After completing system installation, including outlet fittings and devices, inspect exposed finish. Contractor will remove burrs, dirt, and construction debris. If applicable, the Contractor will repair damaged finishes, including chips, scratches, and abrasions.

D. Contractor shall provide daily a clean work environment, free from trash/rubbish accumulated during and after cabling installation.

E. Contractor shall keep all liquids (drinks, sodas, etc.) off finished floors, carpets, and tiles. If any liquid or other detriment (cuts, soils, stains, etc.) damages the above finishes, Contractor shall provide professional services to clean or repair scratched/soiled finishes, at Contractor's expense.

1.15 WARRANTY

A. Contractor shall provide a minimum one (1) year warranty on installation and workmanship PLUS an Extended Product Warranty and System Assurance Warranty for this wiring system and shall commit to make available local support for the product and system during the Warranty period.

1. The Extended Product Warranty shall apply to all passive structured cabling system components and shall cover the replacement or repair of defective products and labor for the replacement or repair of such defective products for a minimum of one (1) year.

2. The System Assurance Warranty provides a complete system and product warranty that will be extended to the end-user, ensuring the structured cabling system will be free of defects in materials and workmanship, will meet or exceed applicable performance requirements defined in the most current version of the Commercial Building Telecommunications Cabling Standards, and support all current and future network applications for a minimum of twenty (20) years.

B. System Certification: Upon successful completion of the installation and subsequent inspection, the customer shall be provided with a numbered certificate, from the manufacturer, registering the installation.

1.16 MAINTENANCE

A. Support Availability: The Contractor shall commit to make available local support for the product and system during the Warranty or Extended Warranty period.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Identification (Labeling) System:

1. Brady

2. Dymo

3. Hellerman-Tyton

4. Acceptable alternate

B. Fire-Stop Systems

1. STI EZ-Path

2. Hilti

3. SpecSeal

4. 3M

5. Acceptable alternate

PART 3 - EXECUTION

3.01 INSTALLERS

A. Submit written proof that the following experience requirements are being met:

B. The Contractor shall be a Siemon Certified Installer and be able to provide the twenty (20) year premium Seimon Cabling System warranty covering products, performance and applications assurance for cabling systems designed and installed by them, and adhere to the industry standard engineering, installation and testing procedures and utilize the authorized manufacturer components and distribution channels in provisioning this project.

C. Provide and pay for all labor, supervision, tools, equipment, test equipment, tests and services to provide and install a complete inside and outside plant fiber and copper infrastructure system. Pay all required sales, gross receipts, and other taxes.

D. All members of the installation team shall be certified by the Structured Cabling System Assurance Warranty provider as having completed the necessary training to complete their part of the installation and are capable of performing an installation that falls under manufacturer's guidelines necessary to obtain the Manufacturer's System Assurance Warranty.

E. Resumes of the entire team shall be provided along with documentation of completed training courses.

F. A BICSI RCDD shall supervise and approve all on-site work as a recognized member of the Contractor's installation team. All installation team members must demonstrate knowledge and compliance with all BICSI, TIA, UL, and NEC methods, standards and codes.

3.02 EXAMINATION:

A. Field Measurements: Verify dimensions in areas of installation by field measurements before fabrication and indicate measurements on shop drawings. Coordinate fabrication schedule with construction progress to avoid delaying the work.

B. Established Dimensions: Where field measurements cannot be made without delaying the work, establish dimensions and proceed with fabricating units without field measurements. Coordinate supports, adjacent construction, and fixture locations to ensure actual dimensions correspond to established dimensions.

3.03 PREPARATION:

A. Contractor's on-site RCDD supervisor shall review, approve and stamp all shop drawings, coordination drawings As Built Drawings and submittal documents.

B. Pre-installation inspection

1. The Contractor shall visually inspect all cables, cable reels, and shipping cartons to detect possible cable damage incurred during shipping and transport. Visibly damaged goods are not acceptable and shall be replaced by the contractor at no additional cost to the Owner.

3.04 INSTALLATION:

A. General

1. Contractor shall install work following specifications, drawings, manufacturer's instructions and approved submittal data.

2. Allowable Cable Bend Radius And Pull Tension:

a. In general, communications cable cannot tolerate sharp bends or excessive pull tension during installation. Refer to cable manufacturer's bend radius recommendations for the maximum allowable limits.

b. After installation, exposed cable and other surfaces must be cleaned free of lubricant residue. Use only lubricants specifically designed for cable installation.

B. Pull Strings:

1. Horizontal Cable

a. The Contractor shall

1) Provide pull strings in all new conduits, including all conduits with cable installed as part of this contract.

2) Pull string shall have a rated average breaking strength of 200 pounds.

3) Data and video cables can be pulled in tandem with pull strings. During pulling sessions, pull strings must move freely to prevent cable jacket/cable damage.

b. Color and cable type designations for UTP and F/UTP cable:

1) MD ANDERSON Owned Buildings: Data and Voice: UTP CAT6A, Blue

2) MD ANDERSON Leased Buildings: Data and Voice: UTP CAT6, Blue

3) Wireless Access Points (WAPS): CAT5E UTP, Orange

4) Kronos clocks and Omninotes: CAT5E UTP, Orange

5) Nurse Call System: Circulating loop between connections: CAT5e F/UTP, Purple

6) Nurse Call System: Dome light to patient room connections: CAT5e F/UTP, Green

7) IP Video Surveillance (Security Cameras): CAT5E UTP, Blue

C. Conduit Fill:

1. Reference manufacturer's Design Installation Guidelines manual.

D. Firestop Procedures:

1. Contractor shall:

a. Install and seal penetrations (conduit, sleeves, slots, chases) into or through fire-rated barriers created by or made for or on the behalf of the Contractor to prevent the passage of smoke, fire, toxic gas, or water through the penetrations.

   1) All through penetrations in a fire rated surface require a sleeve, regardless of penetration diameter or penetrating cable count.

   2) Using a “ring and string” method of installing cabling for membrane penetrations in a wall cavity is acceptable, provided the solution was accepted by the Owner. Code-compliant firestopping rules still apply.

b. Provide approved fire-resistant materials to restore originally-designed fire- ratings to all wall, floor, and ceiling penetrations used in the distribution and installation for communications cabling system. Coordinate firestopping procedures and materials with General Contractor. Following the pathway of others through compliant and non-compliant penetrations does not remove the requirement to maintain code-compliant firestopping.

c. Provide and install , intumescent mechanical systems in floor chases in an approved fashion in all openings .

d. Provide and install , firestop in an approved manner in all openings where there are penetrations through walls.

e. Shall supply Owner with training manuals with instructions on methods of adding or removing cabling to/from firestopped sleeves and chases.

f. Provide manufacturer recommended material for rated protection for any given barrier.

g. Shall laminate and permanently affix adjacent to chases the following information:

   1) Manufacturer of firestop system.

   2) Date of installation/repair.

   3) Part and model numbers of system and all components.

   4) Name and phone numbers of local distributor and manufacturer’s corporate headquarters.

h. Solutions and shop drawings/submittals for firestop materials and systems shall be presented to the General Contractor for written approval of materials/systems prior to purchase and installation.

i. Materials shall be installed per manufacturer instructions, be UL-listed for intended use, and meet NEC and locals codes for fire stopping measures.

j. The material chosen shall be distinctively colored to be clearly distinguishable from other materials, adhere to itself, and maintain the characteristics for which it is designed to allow for the removal and/or addition of communication cables without the necessity of drilling holes in the material.

k. The firestopping material shall maintain/establish the fire-rated integrity of the wall/barrier that has been penetrated.

E. Labeling

1. Cable Labels: Self-adhesive vinyl or vinyl-cloth wraparound tape markers, machine printed with alphanumeric cable designations.

2. Flat-surface labels: Self-adhesive vinyl or vinyl-cloth labels, machine printed with alphanumeric cable designations

3. Contractor shall:

a. Provide transparent plastic label holders, and 4-pair marked colored labels.

b. Install colored labels according to the type of field as per ANSI/TIA 606-A color code designations.

4. Use the MD Anderson color-code guidelines for voice, data, cross-connect, riser, and backbone fields. Otherwise, use the ANSI/TIA 606-A designation strip color-code guidelines for voice, data, cross-connect, riser, and backbone fields. The MD Anderson color-code guidelines are as follows:

F. All materials shall be UL- and/or ETL-approved and labeled in accordance with NEC for all products where labeling service normally applies.

G. Materials and equipment requiring UL 94, 149 or 1863 listing shall be so labeled. Modification of products that nullifies UL labels is not permitted.

H. The installed systems shall not generate nor be susceptible to any harmful electromagnetic emission, radiation, or induction that degrades, or obstructs any equipment.

I. All material and equipment as provided should be the standard Commercial-Off-The-Shelf (COTS) products of a manufacturer engaged in the manufacturing of such products. All shall be typical commercial designs that comply with the requirements specified. All material and equipment shall be readily available through manufacturers and/or distributors.

J. All equipment shall be standard catalogued items of the manufacturer and shall be supplied complete with any optional items required for proper installation.

K. Coordinate the features of materials and equipment so they form an integrated system. Match components and interconnections for optimum future performance and backward compatibility.

L. Expansion Capability: Unless otherwise indicated, provide spare positions in patch panels, cross connects, and terminal strips, and space in cable pathways and backboard layouts to accommodate 20% future increase in campus distribution and active workstations.

M. Backward Compatibility: The provided solution shall be backward compatible with lower category ratings such that if higher category components are used with lower category components, the basic link and channel measures shall meet or exceed the lower channel's specified parameters.

N. Component Compliance: The provided solution's components shall each meet the minimum transmission specifications listed herein such that no individual component will be less than specifications for permanent link and channel, regardless of the fact that tests for link and channel ultimately meet required specifications.

O. In the event of a breach of the representations and warranties contained herein, the Contractor, at their own expense, shall take all measures necessary to make the cabling system work and comply with the applicable manufacturer written technical recommendations and standards.

P. Site Tests:

1. Upon completion of the communications infrastructure systems, including all pathways and grounding, the Contractor shall test the system.

   a. Cables and termination modules shall be affixed, mounted or installed to the designed/specified permanent location prior to testing.

   b. Any removal and reinstallation of any component in a circuit, including faceplates, shall require retesting of that circuit and any other disturbed or affected circuits.

   c. Cable/jack shall be affixed, mounted or installed to the designed/specified permanent location prior to testing. Any removal and reinstallation of any component in the circuit shall require retesting of that circuit.

   d. Approved instruments, apparatus, services, and qualified personnel shall be utilized.

   e. If tests fail, Contractor shall correct as required to produce a legitimate passing test.

   f. Manipulation of tester parameters on a failing test in order to achieve a passing test is unacceptable.

   g. If the Contractor is found to have manipulated any failing test result for any reason (without written notice and approval of the Owner), the Contractor shall be required to employ a Third-Party Testing Agent selected by the Owner to retest the complete cable plant and shall be required to pay all costs associated with this retesting.

2. These specifications will be strictly enforced. The Contractor must verify that the requirements of the specifications are fully met through testing with an approved tester (rated for testing the cable type in use), and documentation as specified below. This includes confirmation of requirements by demonstration, testing and inspection. Demonstration shall be provided at final walk-through in soft copy and printed test data.

3. Notification of the likelihood of a cable exceeding standardized lengths must be made prior to installation of the cable. Without contractor's prior written notice and written approval by the Owner, testing that shows some or all pairs of cable not meeting specifications, shall be replaced at Contractor's expense (including respective connectors).

4. With the Owner's written approval, the over-length cable(s) shall be excluded from requirements to pass standardized tests and shall be explicitly identified.

5. Testing is still required for non-compliant cabling. The tests shall be for wire-mapping, opens, cable-pair shorts, and shorts-to-ground. The test results must be within acceptable tolerances and shall be submitted with the Owner's acceptance document.

6. Third-Party testing of the completed cable infrastructure is an Owner option that can be implemented and completed after (1) all Contractor testing is complete and submitted, and (2) Contractor certifies that cable plant meets or exceeds test result requirements as specified in these and ANSI/TIA test standards. Third-Party testing can be implemented at the Owner's discretion by:

    a. The Owner's preference to independently confirm the submitted Contractor's standards-compliant testing results

        1) Payment of all Third-Party testing shall be by the Owner if the Third-Party testing is requested for confirming Contractor's complete and standards-compliant test results.

        2) Third-Party shall pick a randomized sample of 15% of total installed cable plant. Prior to testing, this party shall develop and submit a test schedule for approval by Owner.

        3) Third-Party testing processes will adhere to the testing protocols delineated in this document under Section 1.11, Parts H and I.

        4) All Third-Party tested cables that test as failed shall be retested by the Third Party to confirm failure.

        5) If Third-Party tests show a failure rate of 1.5% or greater of tests of all completed cabling, this shall force the retesting of the complete cable plant by the Third-Party at the Contractor's expense.

        6) All confirmed failures shall be promptly corrected and retested by Contractor and Third-Party under the same testing protocols and guidelines.

    b. The consequence of the Contractor providing test results that meet the conditions delineated in Section 3.4, Part P.1.g shall force the retesting of the complete cable plant by the Third-Party at the Owner's expense.

        1) Payment of all Third-Party testing shall be by Contractor from Contractor's original accepted bid if Third-Party testing is required under the conditions delineated in Section 3.4, Part P.1.g.

        2) Third-Party shall retest 100% of the total installed cable plant. Prior to testing, this party shall develop and submit a test schedule for approval by Owner.

        3) Third-Party testing processes will adhere to the testing protocols delineated in this document under Section 1.11, Parts H and I.

        4) All Third-Party tested cables that test as failed shall be retested by the Third Party to confirm failure.

        5) All confirmed failures shall be promptly corrected and retested by Third-Party under the same testing protocols and guidelines.

6) Contractor will complete all work and documentation according to manufacturer guidelines to ensure manufacturer's warranty remains in effect. Contractor shall obtain certificates from manufacturer attesting to warranty being in effect and include certificates with other deliverables due at the completion of the project.

7) Owner reserves the right to be present during any or all testing.

3.05 CLEANING

A. Work areas will be kept in a broom clean condition throughout the duration of the installation process.

B. Remove all unnecessary tools and equipment, unused materials, packing materials, and debris from each area where Work has been completed unless designated for storage.

C. The Contractor will damp clean all surfaces prior to final acceptance by Owner.

3.06 ACCEPTANCE

A. Once all work has been completed, test documentation has been submitted, and Owner is satisfied that all work is in accordance with contract documents, the Owner shall notify Contractor in writing of formal acceptance of the system.

B. Contractor must warrant in writing that 100% of the installation meets the requirements specified herein (Standards Compliance & Test Requirements).

C. Acceptance shall be subject to completion of all work, successful post-installation testing which yields 100% PASS rating, and receipt of full documentation soft and hard copies as describe herein.

END OF SECTION 27 00 00

THE UNIVERSITY OF TEXAS
MD Anderson Cancer Center
Making Cancer History

Information Technology & Services

IT Project Management Department

1020 Holcombe Blvd.

Houston, Texas 77030

IDR/MDR Final Acceptance Form

Project:		
FAR #:		
Room number:		
Date of inspection:		
Inspection #:	1 / 2 / 3 / 4 / 5	Date: __ / __ / __

	Name	Signature
Network Services Representative(s):		
Customer Representative(s):		
Contractor Representative(s):		

Accepted by Network Services:	☐ YES Date:	☐ NO Date:
NOTE: Exceptions (If any)	*Signature(s) Required for Final Acceptance	

This form must be completely filled out within 48 hours of the inspection & turned into the Network Infrastructure Designer

IDR Final Acceptance Form 01

Item #	Description	YES	NO	N.A.	Comments
1	All construction work completed within the room?				
2	Fiber Test results turned in to the Network Infrastructure Designer for review?				
3	Copper Test turned in to the Network Infrastructure Designer for review?				
4	Room secured with a Card Reader? (A1-core key can be used as temporary solution)				
5	A/C turned on and working?				
6	Floor Finished? *floor sealant applied				
7	Horizontal cable trays installed correctly? *check for proper support & mounting				
8	Vertical cable trays installed correctly? *check for proper support & mounting				
9	Equipment racks installed correctly? *check for proper support & mounting				
10	Cable trays grounded? *test with tester				
11	Equipment racks grounded? *test with tester				

This form must be completely filled out within 48 hours of the inspection & turned into the Network Infrastructure Designer

Item #	Description	YES	NO	N.A.	Comments
12	Lighting installed proper and functioning? *check for proper support & mounting				
13	Fibers terminations labeled? *check termination points & cable sheath				
14	Horizontal terminations labeled? *check termination points & cable sheath				
15	Horizontal cables properly installed?				
16	Copper backbone cable labeled?				
17	Voice riser(s) properly installed?				
18	Fiber riser(s) properly installed?				
19	Fiber backbone cable labeled?				
20	Faceplates labeled?				
21	Power available and turned-on in rack? *CHECK ENGINEERING POWER LAYOUT TO CONFIRM CURRENT, VOLTAGE, & RECEPTACLE TYPE. *test with tester				

This form must be completely filled out within 48 hours of the inspection & turned into the Network Infrastructure Designer

22	Power available and turned-on in walls? *CHECK ENGINEERING POWER LAYOUT TO CONFIRM				

	CURRENT, VOLTAGE, & RECEPTACLE TYPE. *test with tester				
23	Fire Stopping installed? *check floor & wall penetrations				
24	Room Clean?				
25	Sprinkler head Type & location?				
26	Velcro used to bundle cables?				
27	All WAPS cable drops installed and tested?				
28	Wireless Enclosures installed?				
29	Wireless Access Points installed?				

This form must be completely filled out within 48 hours of the inspection & turned into the Network Infrastructure Designer
IDR Final Acceptance Form 01

SECTION 27 05 26 – GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 REFERENCE STANDARDS AND CODES

A. Refer to Section 27 00 00.

1.03 SCOPE

A. It is the Contractors responsibility to install and commission Grounding and Bonding for all Communications installations.

B. The MTGB in the Equipment Room or TGB in the Telecommunications Rooms will be provided by the electrical contractor.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.02 SUBMITTALS

A. Refer to Section 27 00 00.

2.03 WALL-MOUNT BUSBARS

A. Telecommunications Main Grounding Busbar (TMGB)

1. Telecommunications Main Grounding Busbar (TMGB) shall be constructed of 0.25 inches (6.4 mm) thick solid copper bar.

2. The busbar shall be 4 inches (100 mm) high and 12 inches (300 mm) long and shall have 18 attachment points (two rows of 9 each) for two-hole grounding lugs.

3. The hole pattern for attaching grounding lugs shall meet the requirements of ANSI-J-STD – 607-A and shall accept 15 lugs with 5/8 inch (15. 8 mm) hole centers and 3 lugs with 1 inch (25.4 mm) hole centers.

4. The busbar shall include wall-mount stand-off brackets, assembly screws and insulators creating a 4 inch (100 mm) standoff from the wall.

5. The busbar shall be UL Listed as grounding and bonding equipment.

B. Telecommunications Grounding Busbar (TGB)

1. Telecommunications Grounding Busbar (TGB) shall be constructed of 0.25 inch (6.4 mm) thick solid copper bar.

2. The busbar shall be 2 inch (50 mm) high and 10 inch (250 mm) long and shall have 7 attachment points (one row) for two-hole grounding lugs.

3. The hole pattern for attaching grounding lugs shall meet the requirements of ANSI-J-STD – 607-A and shall accept 4 lugs with 5/8 inch (15.8 mm) hole centers and 3 lugs with 1 inch (25.4 mm) hole centers.

4. The busbar shall include wall-mount stand-off brackets, assembly screws and insulators creating a 4 inch (100 mm) standoff from the wall.

5. The busbar shall be UL Listed as grounding and bonding equipment.

2.04 BONDING ACCESSORIES

A. Compression Lugs

1. Compression lugs shall be manufactured from electroplated tinned copper.

2. Compression lugs shall have two holes spaced on 5/8 inch (15.8 mm) or 1 inch (25.4 mm) centers, as stated below, to allow secure two bolt connections to busbars.

3. Compression lugs shall be sized to fit a specific size conductor, sizes #6 to 4/0, as stated below.

4. Compression lugs shall be UL Listed as wire connectors.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Wall-Mount Busbars

1. Attach busbars to the wall with appropriate hardware according to the manufacturer's installation instructions.

2. Conductor connections to the TMGB or TGB shall be made with 2-Hole Bolt-On Compression Lugs sized to fit the busbar and the conductors.

3. Each lug shall be attached with stainless steel hardware after preparing the bond according to manufacturer recommendations and treating the bonding surface on the busbar with antioxidant to help prevent corrosion at the bond.

4. The wall-mount busbar shall be bonded to ground as part of the overall Telecommunications Bonding and Grounding System.

B. Ground Terminal Block

1. Every rack and cabinet shall be bonded to the TMGB or TGB.

2. Minimum bonding connection to racks and cabinets shall be made with a rack-mount 2-hole ground terminal block sized to fit the conductor and rack and installed according to manufacturer recommendations.

3. Remove paint between rack/cabinet and terminal block, clean surface and use antioxidant between the rack and the terminal block to help prevent corrosion at the bond.

C. Bonding to the metal frame of a building

1. All bonding conductors and connectors for bonding the metal frame of a building shall be listed for the purpose intended and approved by a NRTL.

2. In buildings where metal frames (structural steel) are effectively grounded, each TGB shall be bonded to the metal frame within the room using a No. 6 AWG conductor.

3. Where the metal frame is external to the room and readily accessible the metal frame should be bonded to the TGB with a No. 6 AWG conductor.

4. Where the metal frame is external to the room and readily accessible the metal frame should be bonded to the TMGB with a No. 6 AWG conductor.

5. When practicable because of shorter distances and other considerations, and where horizontal steel members are permanently electrically bonded to vertical column members, TGB's may be bonded to these horizontal members in lieu of the vertical column members.

6. This Standard does not require the steel bars of a reinforced concrete building to be bonded to the TGB or TBB.

3.02 TESTING

A. The Telecommunications Ground and Bonding System shall be tested with an Earth Ground Resistance Tester used in the Two Point Test Method.

B. The following will be needed to test the grounding and bonding.

1. An Earth Ground Resistance Tester with the attachments.

2. All testing should be done with the entire building in operation. Nothing needs to be shut down to test the grounding and bonding with this tester.

3. If the resistance value is less than 0.1 Ohm between the two test points the bonding is adequate.

C. Tests to be conducted:

1. The installer / technician conducting these tests must be certified

2. Test between the TMGB and the service equipment (power) ground.

3. Test between the TMGB and each TGB in the system.

4. Test between the TGB and:

    a. Data racks.

    b. Cable tray.

    c. Telecommunication conduit.

    d. Caging.

    e. Electronic equipment.

5. Tests shall be conducted with the systems in operation.

6. Tests shall be recorded and submitted to the Owner's Representative.

END OF SECTION 27 05 26

SECTION 27 05 28 – PATHWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 SUMMARY

A. This section includes the minimum requirements for communications cable pathway installations.

1. Interbuilding Cable Routing
2. Horizontal Cable Routing
3. Products
4. Common Requirements for Communications Installations
5. Separation from EMI Sources
6. Wire Mesh Cable Tray
7. Sleeve Installation for Communications Penetrations
8. Penetration of Building Surfaces
9. Cutting and Patching
10. Retrofit-Cutover

1.03 REFERENCE STANDARDS AND CODES

A. Refer to Section 27 00 00.

1.04 INTRABUILDING CABLE ROUTING

A. Adequate riser sleeve/slot space shall be available with the ability to ingress the area at a later date in all telecommunications rooms, such that no drilling of additional sleeves/slots are necessary.

B. The backbone cables shall be installed in a star topology, emanating from the main cross-connect to each telecommunications room. An intermediate cross-connect may be present between the main cross-connect and the horizontal cross-connect.

C. Backbone pathways shall be installed or selected such that the minimum bend radius and pulling tension of backbone cables is kept within cable manufacturer specifications both during and after installation.

1.05 INTERBUILDING CABLE ROUTING

A. The backbone subsystem shall include cable installed between buildings via underground, tunnel, direct -buried, aerial or any combination of these from the main cross-connect to an intermediate cross-connect in a multi-building campus.

B. In an underground system, adequate underground conduit space shall be available and accessible at each building via the Entrance Facility or the Maintenance holes. The conduits shall not exceed a fill factor of 40 percent.

C. All underground systems shall be designed to prevent water runoff from entering the building.

D. The backbone cables shall be installed in a star topology, emanating from the main cross-connect to each satellite building telecommunications room.

E. Backbone pathways shall be installed or selected such that the minimum bend radius and pulling tension of backbone cables is kept within cable manufacturer specifications both during and after installation.

1.06 HORIZONTAL CABLE ROUTING

A. All horizontal cables shall not exceed 90 m (295 ft) from the telecommunications outlets in the work area to the horizontal cross connect.

B. Consolidation points shall not be used.

C. Horizontal pathways shall be installed or selected such that the minimum bend radius of horizontal cables is kept within manufacturer specifications both during and after installation.

D. In open ceiling cabling, cable supports shall be provided by means that is structurally independent of the suspended ceiling, its framework, or supports. These supports shall be spaced no more than 1.5 m (5 ft) apart. NOTE: Cable tie-downs should maintain a minimum distance of 0.6 m (2 ft) apart when within 5 m (16 ft) of the termination point. Contact Owner to get project specific requirements on use of “Saddle Bags” type of pathways.

E. For voice or data applications, 4-pair copper balanced twisted-pair cables shall be run using a star topology from the telecommunications room serving that floor to every individual information outlet. The Owner prior to installation of the cabling shall approve all cable routes.

F. The Contractor shall observe the bend radius and pulling strength requirements of the 4 pair copper balanced twisted-pair optic cable during handling and installation.

G. Each run of 4-pair copper twisted-pair cable between horizontal portions of the cross-connect in the telecommunication closet and the information outlet shall not contain splices.

H. In a false ceiling environment, a minimum of 75 mm (3 in) shall be observed between the cable supports and the false ceiling.

I. Continuous conduit runs installed by the contractor should not exceed 30.5 m (100 ft) or contain more than two (2) 90 degree bends without utilizing appropriately sized pull boxes.

J. All horizontal pathways shall be designed, installed and grounded to meet applicable local and national building and electrical codes.

K. The number of horizontal cables placed in a cable support or pathway shall be limited to a number of cables that will not cause a geometric shape of the cables to be altered. Under no circumstances should cables in the horizontal pathway be bundled. This is to minimize “alien” cross talk.

L. Maximum conduit pathway capacity shall not exceed a 40 percent fill. However, perimeter and furniture fill ratio is limited to 60% fill for moves, adds, and changes.

M. Horizontal distribution cables shall not be exposed in the work area or other locations with public access.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.02 SUBMITTALS

A. Refer to Section 27 00 00.

2.03 CABLE PATHWAY SYSTEMS

A. Cable Support: NRTL labeled and designed to prevent degradation of cable performance and pinch points that could damage cable. Also to be installed independently of “Other Trades” support system.

1. Wire Mesh Cable Tray

2. Support brackets with cable tie slots for fastening cable ties to brackets.

3. Basket style cable trays are the preferred method of installation. Telecommunications cable shall be installed in “Saddle bags” type of pathways from the point of departing from main cable trays.

4. Straps and other devices.

B. Approved manufacturers:

1. Snake Tray

2. Cooper B-Line

3. Chatsworth Products, Inc (CPI)

4. Similar products, after approval by Owner

2.04 CABINETS/RACKS/VERTICAL WIRE MANAGEMENT

A. Approved manufacturers:

1. Chatsworth Products, Inc (CPI)

a. CPI Rack Part # 5503-703

b. CPI Concrete Anchor Part # 20067-001

2. Cooper B-Line

a. B-line Rack Part # SB506084XUFB

b. CPI Concrete Anchor Part # 20067-001

2.05 SLEEVES FOR PATHWAYS AND CABLES

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends, with plastic bushings.

B. Sleeves for Rectangular Openings: Galvanized sheet steel.

1. Minimum Metal Thickness:

a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side more than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).

b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches (1270 mm) and 1 or more sides equal to, or more than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

2.06 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.07 FIRESTOPPING

A. Subject to compliance with requirements, provide products of one of the following manufacturers:

1. Hilti Firestop Systems.

2. 3M, Electrical Products Division, St. Paul, Minnesota.

3. Metacaulk; Rectorseal Corp., Houston, Texas

4. Specified Technologies Inc., Somerville, New Jersey.

5. United States Gypsum Company.

B. Provide materials classified by UL to provide fire barrier equal to time rating of construction being penetrated.

C. Provide asbestos free materials that comply with applicable Codes and have been tested in accordance with UL 1479 or ASTM E 814.

D. Fire Rated Cable Pathways: Device modules comprised of steel raceway with intumescent foam pads allowing 0 to 100 percent cable fill, the following products are acceptable:

1. Specified Technologies Inc. (STI) EZ-PATH™ Fire Rated Pathway

2. Or equivalent product from different manufacturer, after approval by Owner.

PART 3 - EXECUTION

3.01 COMMON REQUIREMENTS FOR COMMUNICATIONS INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. All installation shall be in accordance with manufacturer's published recommendations.

C. Install to facilitate service, maintenance, and repair or replacement of components of both communications equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

D. Right of Way: Give to piping systems installed at a required slope.

3.02 SEPARATION FROM EMI SOURCES:

A. Comply with TIAEIA-569-A recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.

B. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:

1. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches.

2. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.

3. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches.

C. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:

1. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches.

2. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.

3. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches.

D. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:

1. Electrical Equipment Rating Less Than 2 kVA: No requirement.

2. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches.

3. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches.

E. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or higher: A minimum of 48 inches.

F. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches.

3.03 WIRE MESH CABLE TRAY

A. Provide all components of the tray system (tray, supports, splices, fasteners, and accessories) from a single manufacturer.

B. Supports will be sized at minimum to match the width of the wire mesh cable tray that is supported. The support may be wider than wire mesh cable tray.

C. Wire mesh cable tray shall be secured independently to the structural ceiling, building truss system, wall or floor using manufacturer's recommended supports and appropriate hardware as defined by local code or the authority having jurisdiction (AHJ).

D. When the pathway is overhead, wire mesh cable tray shall be installed with a minimum clearance of 12 inches above the tray. Leave 12 inches in between the tray and ceiling/building truss structure. Multiple tiers of wire mesh cable tray shall be installed with a minimum clearance of 12 inches in between the trays. When located above an acoustical drop ceiling, wire mesh cable tray shall be installed a minimum of 3 inches above the drop ceiling tiles.

E. When installed under a raised floor, wire mesh cable tray shall be installed with a minimum ¾ inch clearance between the top of the tray and the bottom of the floor tiles or floor system stringers, whichever are lower in elevation. Maintain a 3 inch clearance between trays wherever trays cross over.

F. Wire mesh cable tray shall be supported by manufacturer's specifications. Support wire mesh cable tray on both sides of every change in elevation.

G. Wire mesh cable tray shall be labeled with a sign along its side (6 inches by 12 inches) that states the Telecommunications Room that it serves and shall point to the direction of the nearest telecommunications room that it serves, spaced at intervals of every 25 feet with footage markers showing the total footage in reference to the Telecommunications Room that it serves.

H. Secure wire mesh cable tray to each support with a minimum of one fastener. Follow the manufacturers' recommended assembly, splice and intersection-forming practices.

I. Use installation tools recommended by the manufacturer to field fabricate wire mesh cable tray intersections and changes in elevation. Use shear cutters to cut wire mesh cable tray. Use a bending tool to form the ends of cut sections downward at 90° to allow easy drop-in installation with approved supports.

J. Wire mesh cable tray shall be bonded to the Telecommunications Grounding Busbar (TGB) using an approved ground lug on the wire basket tray and a minimum #6 grounding wire or as recommended by the AHJ. Verify bonds at splices and intersections between individual cable tray sections and supports. Cable pathway should be electrically continuous through bonding and attached to the TGB.

K. The quantity of cables within the tray will not exceed a whole number value equal to 50 percent of the interior area of the tray divided by the cross-sectional area of the cable. Cable fill will not exceed the depth of the cable tray's side rail (2, 4 or 6 inches).

L. The combined weight of cables within the tray will not exceed stated load capacity in manufacturer's specifications.

M. Separate different media type within the tray. Treat each type of media separately when determining cable fill limits.

N. When pathways for other utilities or building services are within 2 feet of the wire mesh cable tray, cover the tray after cables are installed.

3.04 SLEEVE INSTALLATION FOR COMMUNICATIONS PENETRATIONS

A. Communications penetrations occur when pathways, cables, wireways, or cable trays penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

D. Each pipe sleeve, horizontal or vertical, shall have a plastic type "end-bushing" on both ends to protect cables from abrasion when pulled through sleeves. The "end-bushing" shall be installed prior to install cables through sleeve.

E. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

F. Cut sleeves to length for mounting flush with both surfaces of walls with respect to plastic "end-bushings". The plastic "end-bushing" shall be plenum rated if applied in plenum space.

G. Extend sleeves installed in floors 2 inches above finished floor level with respect to plastic "end-bushings". The plastic "end-bushing" shall be plenum rated if applied in plenum space.

H. Size pipe sleeves to provide ¼-inch annular clear space between sleeve and pathway or cable, unless indicated otherwise.

I. Seal space outside of sleeves with grout for penetrations of concrete and masonry. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.

J. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and pathway or cable, using joint sealant appropriate for size, depth, and location of joint.

K. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pathway and cable penetrations. Install sleeves and seal pathway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."

L. Roof-Penetration Sleeves: Weather seal penetration of individual pathways and cables with flexible boot-type flashing units applied in coordination with roofing work.

3.05 SLEEVE-SEAL INSTALLATION

A. Install to seal exterior wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for pathway or cable material and size. Position pathway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pathway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

C. Provide sleeves for new conduit and cable penetrations of building construction.

1. Openings to accept sleeves in new building construction will be formed in building construction by the Contractor for General Construction work. Openings to accept sleeves in existing building construction shall be provided under this division of the Specifications. Refer to Article, CUTTING AND PATCHING in this Section.

2. Use galvanized rigid conduit sleeves for penetrations through exterior masonry/concrete walls and foundations, concrete floor slabs on grade and above grade, and concrete-filled decks.

3. Use only fire-rated listed assemblies for the type of sleeve being installed through CMU walls or gypsum walls for communications penetrations. Sleeve type shall be galvanized rigid conduit.

D. Where conduits are installed before building construction being penetrated, install sleeves loose around conduits. Split, fit, and weld steel sleeves over existing conduits, with respect to anything flammable in the surrounding environment.

E. Secure sleeves firmly in place using filling and patching materials (grout) that match with surrounding construction.

F. In floor penetrations, extend sleeve 4 inches above finished floor unless noted otherwise. In wall penetrations, cut sleeves flush with wall surface and use metal escutcheon plates in finished interior areas.

G. Seal voids between sleeves and building construction with joint sealants. Make allowances for and coordinate the Work with installation of firestopping, conduit insulation, and waterproofing as applicable.

H. The Contractor shall be fully responsible for final and correct location of sleeves. Sleeves which are omitted or incorrectly located in existing building construction, shall be corrected and provided by the Communications Contractor, at no additional costs to the Owner.

3.06 PENETRATION OF BUILDING SURFACES

A. Above Grade Level or Non-waterproof Areas

1. Seal each annular space between conduits or cable and building surfaces. Pack space with Oakum, other rope packing, or backer rod materials and cover with fire-resistant sealant or other protection materials.

2. Provide sleeves as specified in Article, SLEEVE-SEAL INSTALLATION in this Section for conduit and cable penetrations. Seal each space between conduit or cable and sleeve. Sealing shall be as specified in above paragraph.

B. Waterproof Areas (Above and Below Grade)

1. In new and existing construction for penetrations through concrete below grade, ground water level, or in other waterproof areas, provide through-wall and floor seals having galvanized fittings, sealing assemblies, and sleeves as specified.

2. In existing construction when core bore drilled openings are used for conduit penetrations below grade, ground water level, or in other waterproof areas, provide sealing.

C. Fire-resistant Areas

1. Provide through-penetration firestop systems for penetrations through fire-rated walls, floors, and other partitions of building construction. Comply with requirements in Division 07 Section "Penetration Firestopping".

2. In walls or partitions with 2-hour or less fire ratings, provide only metallic outlet or device boxes installed per UL Fire Resistance Director, NEC, and other national building code requirements.

3.07 CUTTING AND PATCHING

A. Provide openings, cutting, coring, and patching of openings in existing building construction as required. Patching includes openings and voids left in existing construction as a result of demolition.

B. The Work shall include necessary assemblies and materials to maintain required fire ratings.

C. Perform cutting as to not impair structural stability of building construction and systems. Do not drill holes or weld attachments to beams and other structural members without prior written approval from the Owner's Representative. Contact the Engineer-of-Record for guidance.

D. The Work shall be done by a craftsperson skilled in the particular trades affected.

E. Patching materials shall match existing materials in type and quality. Patching shall be done in a manner to match appearance of adjacent surfaces.

3.08 RETROFIT-CUTOVER

A. Furnish equipment, materials, labor and services, and perform operations required to retrofit/cutover existing cabling systems. Removals shown are general indications and may not indicate full extent of removals which may be required to complete Work.

B. Furnish equipment, materials, labor and services, and performing operations required to enable continued functioning of existing system until cutover to new system.

C. Remove wiring, punch blocks, cabinets, outlets, raceways, and equipment not required for new system.

1. Abandon flush mounted device and junction boxes and cover with blank plate to match the current room decor.

2. Remove surface telecommunications outlets and pathways unless said removal will damage the existing finish on surfaces, or physically damage the structure.

3. Remove wiring from abandoned conduits and raceways from the work area outlet back to the corresponding termination point in the Telecommunication Room. Place a trailer string in vacated conduits and raceways.

4. Remove labeling at both ends for abandoned cables/wiring.

5. The collected abandoned cables/wiring shall be collected and removed from site by Contractor.

D. Perform the work in neat and workmanlike manner in accordance with the applicable codes, standards and AHJ.

E. Removal and replacement of existing ceilings:

1. Carefully remove existing ceilings as required to perform the work. Store removed tiles in an area designated by the Owner. Modify and augment existing suspension systems as necessary. Restore ceiling systems to their original finish.

2. Repair any damage to ceilings due to modifications, removal, and replacement of same. Replace damaged ceiling tiles, including tiles with holes or openings left as a result of demolition, with materials of like kind.

F. Existing equipment or material shall not be reused without specific approval of the Owner's Representative except as noted below:

1. Existing cable terminal housings may be reused if in good condition.

G. Equipment and materials to be removed and not desired by the Owner shall be removed from site promptly.

H. Equipment and material to be removed and that is desired by the Owner shall be moved to an on-site storage location as directed by the Owner.

3.09 FIRESTOPPING

A. PERFORMANCE REQUIREMENTS

1. Fire rated pathway devices shall be the preferred product and shall be installed in all locations where frequent cable moves, add-ons and changes will occur.

2. Where non- mechanical products are utilized, provide products that upon curing do no re-emulsify, dissolve, leach, breakdown or otherwise deteriorate over time from exposure to atmospheric moisture, sweating pipes, ponding water or other forms of moisture characteristic during or after construction.

3. Where it is not practical to use a mechanical device, openings within floors and walls designed to accommodate telecommunications and data cabling shall be provided with re-enterable products that do not cure or dry.

4. Openings for cable trays shall be sealed using re-enterable firestopping pillows.

B. QUALITY ASSURANCE

1. Products/Systems: Provide firestopping systems that comply with the following requirements:

2. Firestopping tests are performed by a qualified, testing and inspection agency. A qualified testing and inspection agency is UL, or another agency performing testing and follow-up inspection services for firestop system acceptable to authorities having jurisdiction.

3. Firestopping products bear the classification marking of qualified testing and inspection agency.

4. Installer Qualifications: Experience in performing work of this section who is qualified by the firestopping manufacturer as having been provided the necessary training to install firestop products in accordance with specified requirements.

C. PROJECT CONDITIONS

1. Do not install firestopping products when ambient or substrate temperatures are outside limitations recommended by manufacturer.

2. Do not install firestopping products when substrates are wet due to rain, frost, condensation, or other causes.

3. Maintain minimum temperature before, during, and for a minimum 3 days after installation of materials.

4. Do not use materials that contain flammable solvents.

5. Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.

6. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration firestop systems.

7. Schedule installation of firestopping after completion of penetrating item installation but prior to covering or concealing of openings.

END OF SECTION 27 05 28

SECTION 27 05 53 – IDENTIFICATION FOR LOW-VOLTAGE CABLES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to all systems that use low-voltage control and signaling cables.

1.02 SUMMARY

A. This Section specifies the requirements of color identification for low-voltage control and signaling cables that are not integral part of factory manufactured equipment or appliances. It consists of, but is not limited to, fire pump, building automation (BAS), automatic transfer switch (ATS), generator monitoring, power system monitoring, communications, nurse call, patient information computer system (PICIS), code blue phone, medical gas alarm, narcotics alarm (PYXSIS), paging, CCTV. MATV, fire alarm, security, and radio systems.

1.03 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed in the specifications for the respective system.

1.04 SUBMITTALS

A. Product Data:

1. Submit manufacturer's data on low-voltage cable and wire with the color identification in compliance with this Section.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.02 COLOR IDENTIFICATION

A. The following color identification shall be used unless it conflicts with code requirement. When connecting to existing circuits, existing color identification shall be utilized.

Division	System	Subsystem	Color Identification
21	Fire Pump		Red
25	Building Automation		Yellow
26	Automatic Transfer Switches		Gray
26	Generator Monitoring		Gray
26	Power Monitoring		Gray
27	Communications		
		A. Backbone Cabling	
		1. Fiber Cable	
		Single Mode Fiber	See 27 13 00
		Multi Mode Fiber 62.5 micron	See 27 13 00
		Multi Mode Fiber 50 micron 1GB	See 27 13 00
		Multi Mode Fiber 50 micron 10GB	See 27 13 00
		2. UTP and F/UTP Cable	
		Voice Riser - UTP CAT3	See 27 13 00
		Nurse Call System Riser – F/UTP CAT5e	See 27 13 00
		B. Horizontal Cabling and Inserts	
		1. UTP and F/UTP Cable	
		MD ANDERSON Owned Building Data and Voice	See 27 15 00
		MD ANDERSON Leased Building Data and Voice	See 27 15 00
		Wireless Access Points UTP CAT5e	See 27 15 00
		IP Video Surveillance UTP CAT5e	See 27 15 00
		Kronos Clocks and Omninotes	See 27 15 00
		Nurse Call System – F/UTP CAT5e Circulating Loop between Connections	See 27 15 00
		Nurse Call System – F/UTP CAT5e Dome Light to Patient Room Connections	See 27 15 00
		2. UTP and F/UTP Inserts	
		Data, Voice, Security, Fire Alarm	See 27 15 00
		PICIS (Patient Information Computer System)	See 27 15 00
		Command Center	See 27 15 00
		Physiological Monitoring	See 27 15 00
		Anesthesiologist	See 27 15 00
		Refrigerator Monitoring	See 27 15 00
		C. Patch Cores	

Division	System	Subsystem	Color Identification
		1. Copper Patch Cores	
		Data to Desktop	
27	Communications	Network Service	See 27 15 00
		EMR	See 27 15 00
		Hurricane Ride Out	See 27 15 00
		WAPS, BAS, Patient Monitoring, Security	See 27 15 00
		Voice	
		Analog Circuit	See 27 15 00
		Digital Circuit	See 27 15 00
		Special Circuit	See 27 15 00
		VoIP	See 27 15 00
		2. Fiber Patch Cords	
		Single Mode 8.3 micron	See 27 15 00
		Multi Mode 62.5 micron	See 27 15 00
		Multi Mode 50 micron 1GB	See 27 15 00
		Multi Mode 50 micron 10GB	See 27 15 00
27	UTPD Code Blue Phone		White
22	Medical Gas Alarm		TBD
27	Narcotics Alarm/PYXSIS		Blue (as regular data connection)
27	Overhead Paging		White
27	Sprint Network		White
28	CCTV		White
28	MATV		White
28	Fire Alarm		Red
28	Security		Brown
28	Radio		TBD

PART 3 - EXECUTION

3.01 PREPARATION

A. Refer to respective system specifications for requirements.

3.02 INSTALLATION

A. Refer to respective system specifications for requirements.

3.03 TESTING

A. Refer to respective system specifications for requirements.

END OF SECTION 27 05 53

SECTION 27 11 00 – COMMUNICATIONS EQUIPMENT ROOM FITTINGS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them, including but not limited to the following:

1. Division 07 - Penetration Fire stopping

2. Section - 27 00 00 - Communications

3. Section - 27 05 26 Grounding and Bonding for Communications Systems

4. Section - 27 05 28 Pathways for Communications Systems

5. Section - 27 05 43 Underground Ducts and Raceways for Communications Systems

6. Section - 27 05 53 Identification for Low-Voltage Cables

7. Section - 27 13 00 Communications Backbone Cabling

8. Section - 27 15 00 Communications Horizontal Cabling

1.02 SUMMARY

A. Section Includes:

1. This section includes basic communications and equipment room design requirements and fittings including:

a. Equipment cabinets, racks, frames and enclosures

b. Cable management and ladder racks

c. Telecommunications service entrance pathways

d. Rack mounted power protection and power strips

1.03 REFERENCES

A. The publications listed below form a part of this specification. The publications are referred to in the text by basic designation only.

B. Specific reference in specifications to codes, rules, regulations, standards, manufacturer's instructions, or requirements of regulatory agencies shall mean the latest printed edition of each in effect at the date of contract unless the document is shown dated.

C. Conflicts:

1. Refer to section 27 00 00

D. Codes and Standards:

1. ANSI/TIA-568-C, Commercial Building Telecommunications Wiring Standard
2. ANSI/TIA-569-B Commercial Building Standard for Telecommunications Pathways and Spaces
3. ANSI/TIA-606-A Administration Standard for Commercial Telecommunications Infrastructure
4. ANSI/TIA-607-A, Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
5. ANSI/TIA-758-A, Customer-Owned Outside Plant Telecommunications Infrastructure Standard
6. ANSI/TIA- 1179 Healthcare Facility Telecommunications Infrastructure Standard
7. National Electrical Code (NEC), based upon year approval by local codes or AHJ
8. Building Industry Consulting Services International (BICSI) Telecommunications Distribution Methods Manual (TDMM), current edition
9. Local, county, state and federal regulations and codes in effect as of date of purchase
10. Equipment of foreign manufacture must meet U.S. codes and standards. It shall be indicated in the proposal the components that may be of foreign manufacture, if any, and the country of origin.

1.04 COMMUNICATIONS ROOMS

A. Communications rooms must be dedicated to designated equipment and services only:

1. Space shall not be used for storage of equipment not related to designated equipment and services.
2. Hazardous or corrosive materials shall not be stored in the space.
3. Piping, ductwork and distribution of power, not related to designated equipment and services shall not pass through or be located within the space.
4. With the exception of fire sprinklers, all water pipes shall be routed around communications rooms.

B. Each communication room shall be equipped with fire detection, fire-extinguishing system and prevention devices. Connect detection devices to base building fire alarm system. A minimum of one (1) smoke detector shall be installed in each communications room.

C. The A/E shall ensure that foreign piping such as water pipes, steam pipes, soil pipes, sanitary drains, storm drains, A/C ducts, and other unrelated systems utilized for or containing liquids, or gases are not installed or pass through telecommunication rooms. Sprinkler piping shall not pass through the telecommunications space to serve other areas. Sprinkler piping serving only telecommunications spaces shall not be considered foreign to the telecommunications installation.

D. Walls shall be covered with .75 inch x 4 foot x 8 foot AC-grade plywood backboard from 12 inches AFF (smooth side to interior of room mounted vertically), capable of supporting mounted hardware and equipment. Plywood shall be affixed to the studs in the walls with screws that penetrate the studs a minimum of 1 inch, are spaced not greater than 18 inches apart in each stud, and with screws one inch from the top and bottom of plywood. Plywood shall be sealed against the wall and painted on all exposed sides with two coats of flat white non-reflective paint. Fire-treatment verification stamps on plywood shall be left unpainted to be readable.

E. Communications room walls shall extend from floor slab to ceiling deck, with a minimum height of 8 feet - 6 inches, and with no drop ceilings installed.

F. Cable tray or ladder rack should be used to distribute cables between rooms through finished wall penetrations.

G. To reduce static, floors should not have carpet, but be sealed concrete to prevent concrete dust from forming.

H. Communications rooms shall have only one lockable entrance door, 36 inches wide and 80 inches in height, that opens towards the outside of the room, and does not open into another room.

1. Doors shall be provided with a lockset for the appropriate technology key with pinned hinges and anti-pry guards.

2. Doors should have no windows or door seals.

3. Communications rooms should have no exterior identifying markings.

4. Contractor shall download the Owner furnished Typical Communications Equipment Room Layout drawing (AutoCad), make modifications to indicate actual Project installation requirements and submit in accordance with Project Specification Section 27 00 00. An electronic version is available at the Internet address: http://www2.mdanderson.org/depts/cpm/standards/supp.html .

I. Mechanical:

1. Install monitoring sensors with dedicated environmental controls operating 24 hours a day, 365 days a year in the communications rooms.

2. Provide ventilation in the communications rooms to dissipate heat generated by active devices.

3. Temperature and Humidity requirements:

a. Maintain communication rooms at an average of 60°F to 70°F, with a relative non-condensing humidity of 30% to 50%.

b. The temperature range should be maintained within ± 9°

J. Plumbing:

1. If fire suppression is used, install wire cages on sprinkler heads to prevent accidental operation.

2. Do not place sprinkler heads over equipment or cabling. In the event of a leak this will protect the equipment and cabling.

3. Drainage troughs are also recommended for leakage protection.

K. Electrical:

1. One manufacturer's product is recommended for each type of installation. Mixing of different manufacturer products for one item in not acceptable.

2. No electrical feeders/branch circuits shall be placed in or run through any communications room except as required to service those rooms.

3. The Contractor shall:

a. Install a slot (a UL-approved fire-rated assembly) to accommodate cable runway entry from corridor and a fire-retardant system (bricks, boards, mechanical, etc). The formed slot shall have no burrs or sharp edges. This opening in the wall will be used to pass data and voice cabling from the corridor cable tray into the communications room.

b. Provide uniform illumination of at least 50 foot-candles (fc) 3 feet AFF for communications rooms located a minimum of 8 feet-6 inches AFF.

1) Light fixtures in communications rooms are to be positioned for maximum lighting. Do not install over cable tray, ladder rack, or 19" standing racks.

2) Provide enough power receptacles to support equipment and service. Coordinate power requirements of active equipment with electrical designer.

L. Relay Racks:

1. 19-inch by 84-inch relay racks are to be used for mounting and termination of inter-building and intra-building fiber optic/ copper cables and components.

a. The racks shall have adequate horizontal and vertical cable management for the 8P8C patch panels and switches.

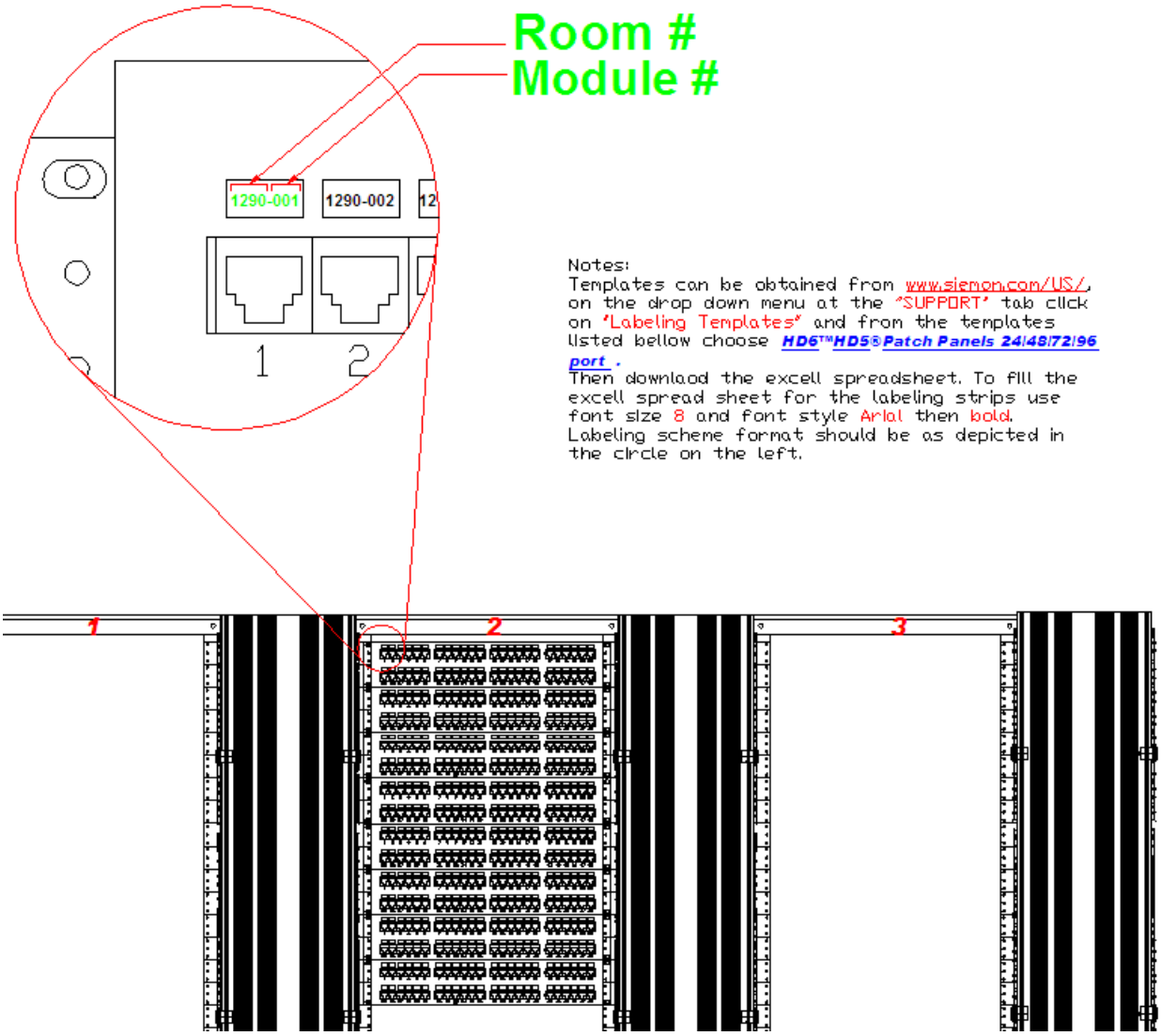
b. Racks with active electronics shall have rack mounted power strips.

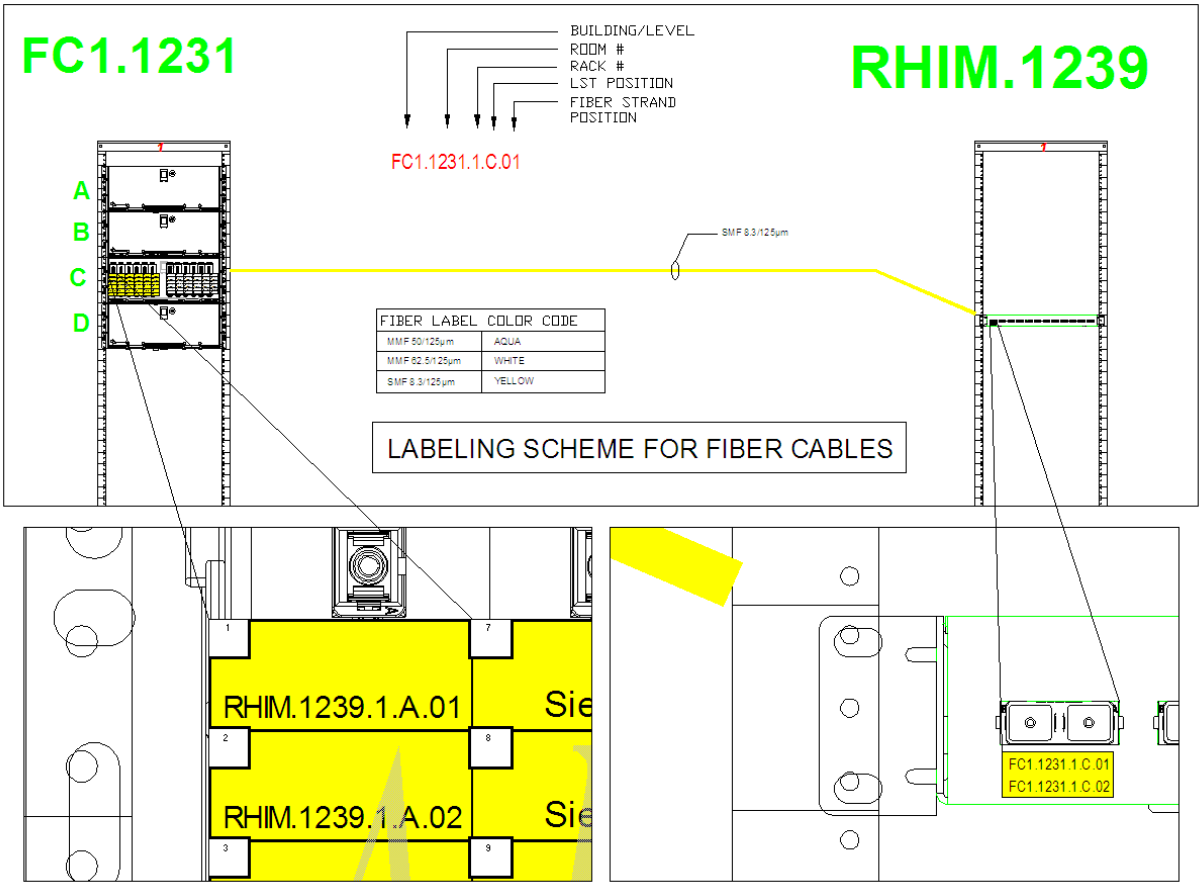
c. Contractor shall download the Owner furnished Typical Communications Relay Rack Configuration drawings (AutoCad), make modifications to indicate actual Project installation requirements and submit in accordance with Project Specification Section 27 00 00. An electronic version is available at the Internet address: http://www2.mdanderson.org/depts/cpm/standards/supp.html .

M. Labeling

1. Refer to the following illustrations for all labeling racks, patch panels, etc.

LABELING SCHEME FOR COPPER CABLES ON PATCH PANELS





1.05 SUBMITTALS

A. Refer to section 27 00 00

1.06 QUALITY ASSURANCE

A. Refer to section 27 00 00

B. Product Standards:

1. Equipment and materials shall be standard products of a manufacturer regularly engaged in the manufacture of telecommunications cabling products and shall be the manufacturer's latest standard design in satisfactory use for at least one year prior to bid opening.

2. Items of the same classification shall be identical. This requirement includes equipment, modules, assemblies, parts, and components.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Refer to section 27 00 00

B. Coordinate layout and installation of equipment with owner's communications and LAN equipment and service suppliers. Coordinate service entrance arrangement with local exchange carrier.

1.08 PROJECT/SITE CONDITIONS

A. Refer to section 27 00 00

1.09 WARRANTY

A. Refer to section 27 00 00

B. At the start of the project, contractor shall register the project with the manufacturer to help insure and facilitate manufacturer's warranty process.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. 19" Floor-Mounted Equipment Racks with 6" channel and Support Components

1. Chatsworth
2. B-Line
3. Owner approved alternate

B. Horizontal Runway and Support Components

1. Chatsworth
2. B-Line
3. Owner approved alternate

C. Horizontal Rack-Mount Cable Management

1. B-LINE
2. CPI (Chatsworth)
3. Owner approved alternate

D. Vertical Rack-Mount Cable Management

1. B-LINE
2. CPI (Chatsworth)
3. Owner approved alternate

E. Equipment Cabinet, Floor-Mounted

1. B-LINE
2. CPI (Chatsworth)

3. Owner approved alternate

F. Equipment Cabinet, Wall-Mounted

1. B-LINE

2. CPI (Chatsworth)

3. Owner approved alternate

G. Raised Floor Rack Support

1. Chatsworth

2. B-Line

3. Owner approved alternate

H. Labeling

1. Refer to section 27 00 00

I. Firestopping

1. Refer to section 27 00 00

2. Refer to Division 07

2.02 ACCESSORIES

A. Rack-mounted Uninterruptible Power Supply (UPS)

1. The UPS shall have an output capacity sufficient to support all equipment housed in the relay rack plus growth.

2. The UPS interface port shall have an RS-232 communications port and a 10 Base-T Ethernet port for LAN management.

3. The control panel shall have a LED status display for load and battery bar graphs in addition to replace battery and overload indicators.

a. Rack-mounted surge suppression shall be vertically mounted and made for this orientation.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Refer to Section 27 00 00

3.02 PREPARATION

A. Refer to section 27 00 00

B. Meet jointly with telecommunications and LAN equipment suppliers, local exchange carrier representatives, and Owner to exchange information and agree on details of equipment arrangements and installation interfaces.

C. Adjust arrangements and locations of equipment with distribution frames, cross-connects, and patch panels of cabling systems of other communications, electronic safety and security, and related systems that share space in the equipment room.

D. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.

3.03 INSTALLATION

A. Refer to section 27 00 00

3.04 FIELD QUALITY CONTROL

A. Refer to section 27 00 00

3.05 CLEANING

A. Refer to section 27 00 00

3.06 ACCEPTANCE

A. Refer to section 27 00 00

END OF SECTION 27 11 00

SECTION 27 15 00 – COMMUNICATIONS HORIZONTAL CABLING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them, including but not limited to the following:

1. Division 07 - Penetration Firestopping
2. Section 27 00 00 - Communications
3. Section 27 05 26 - Grounding and Bonding for Communications Systems
4. Section 27 05 28 - Pathways for Communications Systems
5. Section 27 05 43 - Underground Ducts and Raceways for Communications Systems
6. Section 27 05 53 - Identification for Low-Voltage Cables
7. Section 27 11 00 - Communications Equipment Room Fittings
8. Section 27 13 00 - Communications Backbone Cabling

1.02 SUMMARY

A. Section Includes:

1. This section includes the horizontal cabling portion of a structured cabling system (SCS) including:

a. Optical fiber

b. Copper and coaxial cabling

c. Termination and patch cables

B. Provide all horizontal cabling, terminating hardware, adapters, and cross-connecting hardware necessary to interconnect all system equipment including equipment located in communications rooms.

1.03 REFERENCES

A. The publications listed below form a part of this specification. The publications are referred to in the text by basic designation only.

B. Specific reference in specifications to codes, rules, regulations, standards, manufacturer's instructions, or requirements of regulatory agencies shall mean the latest printed edition of each in effect at the date of contract unless the document is shown dated.

C. Conflicts:

1. Refer to section 27 00 00

D. Codes and Standards:

1. ANSI/TIA-568-C Commercial Building Telecommunications Wiring Standard

2. ANSI/TIA-569-B Commercial Building Standard for Telecommunications Pathways and Spaces

3. ANSI/TIA-606-A Administration Standard for Commercial Telecommunications Infrastructure

4. ANSI/TIA-607-A Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications

5. ANSI/TIA-758-A Customer-Owned Outside Plant Telecommunications Infrastructure Standard

6. ANSI/TIA-1179 Healthcare Facility Telecommunications Infrastructure Standard

7. National Electrical Code (NEC), based upon year approval by local codes or AHJ

8. Building Industry Consulting Services International (BICSI) Telecommunications Distribution Methods Manual (TDMM), current edition

9. Local, county, state and federal regulations and codes in effect as of date of purchase

10. Equipment of foreign manufacture must meet U.S. codes and standards. It shall be indicated in the proposal the components that may be of foreign manufacture, if any, and the country of origin.

1.04 SUBMITTALS

A. Refer to sections 27 00 00 and 27 13 00

1.05 QUALITY ASSURANCE

A. Refer to section 27 00 00

1.06 DELIVERY, STORAGE, AND HANDLING

A. Refer to sections 27 00 00 and 27 13 00

B. Storage temperature range: -40°F to 149°F (-40°C to 65°C)

1.07 PROJECT/SITE CONDITIONS

A. Refer to section 27 00 00

1.08 WARRANTY

A. Refer to section 27 00 00

1.09 MAINTENANCE AND SUPPORT

A. Refer to section 27 13 00

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Horizontal Category 6A UTP Cable Plenum-rated

1. Siemon

2. Approved alternate

B. Horizontal Category 6 UTP Cable Plenum-rated

1. Siemon

2. Approved alternate

C. Horizontal Category 5e UTP Cable Plenum-rated

1. Siemon

2. Approved alternate

D. Information outlet components

1. Siemon Category 6A Jack -10GMX-02, White, angled.

2. Siemon Blank – Part Number MX-BL-02. White

3. Approved alternate

E. 24-Port and 48-Port Patch Panels

1. Siemon

2. Approved alternate

F. Wall and Rack Mount 110 Termination Blocks

1. Siemon

2. Approved alternate

G. Faceplate for wall-mount telephones

1. Siemon

2. Approved alternate

H. Fiber Horizontal Cable Plenum-rated

1. Siemon

2. Approved alternate

I. Fiber Connectors, (LC)

1. Siemon

2. Owner- approved alternate

J. Fiber Termination Shelves and Cabinets (Rack-Mountable)

1. Siemon

2. Owner- approved alternate

K. Fiber Distribution Cabinet (Wall –Mounted)

1. Siemon

2. Approved alternate

L. Fiber adapter panels (6-port)

1. Siemon

2. Approved alternate

M. Patch Cords, Copper:

1. Siemon

2. All Patch Cords Furnished / Installed by Owner

3. Approved alternate

N. Fiber Duplex Patch Cables (Type SM and MM)

1. Siemon

2. All Patch Cords Furnished / Installed by Owner

3. Approved alternate

O. Labeling

1. Refer to section 27 00 00

P. Fire stopping

1. Refer to section 27 00 00

Q. Horizontal Series 6 Quad-Shield Coaxial Cable Plenum-Rated

1. Commscope

R. Series 6 Quad-Shield Coaxial Patch Cable

1. Commscope

S. F-Type Connector

1. Compression

2. F-Fitting Barrel Insert

T. Horizontal .500 Hardline Unjacketed Coaxial Cable (provide proper ceiling rated cabling)

1. Commscope

U. .500 Hardline Connector

1. Amphenol three piece pin type connector

V. Tap

1. Pico Macom TMP-S Series

2. Three-way (hardline) splitter Pico Macom TMP-S Series

2.02 ACCESSORIES

A. The Contractor shall:

1. Mount one laminated full-size hard copy in color of an as-built floor plan designating workstation locations, pathways, and communications room locations. Confirm hard copy size with Owner. As-built floor plan shall be scalable, and shall have an identified standard scale.

2. Install the laminated drawings within a protective Plexiglas encasement on the wall of the servicing communications rooms. To ease accessibility the Plexiglas encasement shall be in either flip-down format or file folder format.

2.03 HORIZONTAL CABLING

A. Recognized cabling for providing the signal medium from the work area to the communications room shall include the following:

1. Four-pair Category 6 UTP cable

2. Four-pair Category 6A UTP cable

3. 50 µm multi-mode optical fiber

B. Optical Fiber Requirements – Refer to Section 27 13 00 Communications Backbone Cabling for additional general requirements:

1. Multi-mode fibers shall have dual wavelength capability; transmitting at 850 and 1300 nm ranges.

2. Laser optimized 50 µm ± 2.5 µm core

3. 125 µm ± 1 µm cladding diameter

4. Maximum Fiber Loss: 3.5 dB/km at 850 nm and 1.0 dB/km at 1300 nm

5. Minimum Bandwidth: 200 MHz at 850 nm and 500 MHz at 1300 nm

6. Single mode shall not be used for horizontal cabling.

C. Category 6 UTP Cable Requirements: High performance Category 6 UTP shall adhere to the following:

1. 23/24 AWG solid bare copper

2. Cable jacket shall comply with NEC Article 800 for use as a plenum cable and shall be UL and c (UL) Listed Type CMP (communications multipurpose plenum).

3. Cable shall terminate on an eight-pin modular jack at each outlet. All horizontal cabling shall meet or exceed the ANSI/EIA/TIA-568-C.2 Commercial Building Telecommunications Cabling Standard, Part 2: Balanced Twisted Pair Cabling Components.

4. Cables shall be marked as UL verified with a minimum of Category 6 rating.

5. The cable shall support Voice, Analog Base band Video/Audio, Fax, Modem, Switched-56, T-1, ISDN, RS-232, RS-422, RS-485, 10BASE-T Ethernet, Token Ring, 100Mbps TP-PMD, 100BASE-T Ethernet, 155 Mbps ATM, AES/EBU Digital Audio, 270 Mbps Digital Video, 622 Mbps 64-CAP ATM and emerging high-bandwidth applications, including 1 Gbps Ethernet, gigabit ATM, as well as all 77 channels (550 MHz) of analog broadband video

6. The maximum horizontal cable length for Category 6 copper cable from the termination of the cable in the communications room to the outlet is 295 feet.

7. Cable shall meet or exceed the following electrical characteristics:

8. Cable shall be specified to 250 MHz and shall meet the manufacturer's guaranteed electrical performance and physical specifications as follows:

D. Category 6A UTP Cable Requirements: High performance Category 6A UTP shall adhere to the following:

1. 23/24 AWG solid bare copper

2. Cable jacket shall comply with NEC Article 800 for use as a plenum cable and shall be UL and c (UL) Listed Type CMP (communications multipurpose plenum).

3. Cable shall terminate on an eight-pin modular jack at each outlet. All horizontal cabling shall meet or exceed the ANSI/TIA-568-C.2 Commercial Building Telecommunications Cabling Standard, Part 2: Balanced Twisted Pair Cabling Components.

4. Cables shall be marked as UL verified with a minimum of Category 6A rating.

5. The cable shall support Voice, Analog Base band Video/Audio, Fax, Modem, Switched-56, T-1, ISDN, RS-232, RS-422, RS-485, 10BASE-T Ethernet, Token Ring, 100Mbps TP-PMD, 100BASE-T Ethernet, 155 Mbps ATM, AES/EBU Digital Audio, 270 Mbps Digital Video, 622 Mbps 64-CAP ATM and emerging high-bandwidth applications, including 1 Gbps Ethernet, gigabit ATM, as well as all 77 channels (550 MHz) of analog broadband video

6. The maximum horizontal cable length for Category 6A copper cable from the termination of the cable in the communications room to the outlet is 295 feet.

7. Cable shall meet or exceed the following electrical characteristics:

8. Cable shall be specified to 500 MHz and shall meet the manufacturer's guaranteed electrical performance and physical specifications.

E. Cabling Method:

1. The Contractor shall:

   a. Provide cabling in accessible spaces, cable tray, (surface and/or enclosed raceway), conduits, and/or J-Hook cable support system. Within consoles, racks, cabinets, desks, and counters, in accessible ceilings spaces and in gypsum board partitions where open cable method may be used. Use UL or ETL listed plenum rated cable in all spaces.

   b. Conceal raceway and cabling except in unfinished spaces as is practical.

   c. Utilize conduits/cable tray as indicated on the drawings.

   d. Route data and voice cables separately in a neat and orderly fashion. No cable ties or wraps shall be used to secure the cables in the runway outside of the communications rooms. Hook and loop fasteners shall be used for any final cable securing needed. Fasteners shall be rated for the area they are used in, (Plenum as required).

   e. Examine pathway elements intended for cable.

   f. Check raceways and other elements for compliance with space allocations, installation tolerances, debris, hazards to cable installation, and other conditions affecting installation. Proceed with installation only after unsatisfactory conditions have been corrected.

F. Application of Media:

1. Horizontal cabling

   a. The Contractor shall:

      1) Install cable using techniques, practices, and methods that are consistent with specified data cabling and the installed components and that ensure specified performance levels of completed and linked signal paths, end to end.

      2) Install cables in continuous lengths from communications outlet to specified patch panels for data and termination blocks for voice.

      3) Terminate horizontal voice cables into termination blocks without damaging twisted pairs or jacket.

      4) Terminate horizontal data cables onto 8P8C modular patch panels without damaging twisted pairs or jacket.

      5) Pull cables in smooth and regular motions using methods that prevent cable kinking.

      6) If necessary use approved cable pulling lubricant.

7) Keep all items protected before and after installation with dust and moisture proof barrier materials/envelopes. If wiring is terminated on patch panels, data, voice jacks prior to painting, carpet installation, and general finish clean up, these jacks shall be placed in a protective envelope to ensure dust, debris, moisture, and other foreign material do not settle onto jacks' contacts. Envelope will be removed on final trim out after other trades have completed their finish work. It shall be the Contractor's responsibility to ensure the integrity of these protective measures throughout the life/installation of the project.

8) Do not bind cables tightly together with tie or other wraps. Wraps shall slip loosely around cables. Use Velcro wraps instead of cables ties for all bundling in the communications rooms.

9) Pull cables simultaneously if more than one is being installed in the same raceway/pathway.

10) Use pulling means; including fish tape, cable, rope, and basket weave wire/cable grips that will not damage media or raceway.

11) Install open cabling parallel and perpendicular to surfaces or structural members following surface contours where possible.

12) Do not bend cable greater than a bend radius of 1.00 inch.

b. Cable bundles brought into the communications rooms shall be routed and dressed in such a manner that prior to termination the cables are not subject to damage and misuse such as installers walking on the bundles that are lying on the floor. Cable pulling force shall not exceed 25 pounds of pulling tension or cable manufacturer's recommended pulling tensions.

c. When exiting runway and/or conduit via a means to ensure support of the cable, shall thereafter be supported with approved materials, and space supporting hardware to maintain performance characteristics, or as listed below.

G. Separation of Wires and Cabling Installation Practices:

1. The Contractor shall:

a. Comply with NEC / TIA rules for separating unshielded copper communication and data-processing equipment cables from potential EMI sources, including electrical power lines and equipment.

b. Maintain a minimum spacing of 18 inches from electrical feeders and/or branch circuit wiring.

c. Maintain a minimum spacing of 12 inches from auxiliary systems cabling.

d. Maintain a 1-inch separation where UTP cables must pass perpendicularly to electrical, plumbing, or other wiring, conduit, or piping systems. Use non-conduit bushings, if necessary to maintain separation, which allow for the addition of a reasonable number of cables in the future.

e. Maintain communications pathways away from electrical apparatus such as motor driven equipment and transformers, minimum separation distance of 10-feet is recommended.

f. Provide all necessary installation materials, hardware, tools and equipment to perform insulation displacement type terminations at all data outlets, patch panels, and voice termination materials.

g. Dress and terminate horizontal cables in consistent consecutive order.

h. Arrange cables on patch panels and voice termination hardware in ascending order of room numbers and outlet numbers within rooms.

i. Provide a 3-foot 6-inch service loop for horizontal cables at I/O's. Locate service loop above or below I/O were vertical cable run transitions to horizontal run.

j. Maintain twists in cable pairs to within .5-inch of termination.

k. Group all specialty cables such as the pay phone cables, elevator line, etc which do not have their own termination hardware, in one group, clearly labeled as to cable number and function, in the last positions on the horizontal cabling blocks in each communications room.

l. Limit cable-bending radius for fiber optic cable to 20 times the cable diameter during installation, and 15 times the cable diameter after installation. Follow manufacturer's requirements for copper cable bending radius.

m. Do not leave cables on the floor unprotected or cable bundles hanging from the ceilings. Coil them up in a temporary manner and protect them from damage.

n. Start numbering at the left of the main door to the room and continue in a clockwise direction around the room.

o. The cables within the room will be terminated starting with the cables located to the left of the main door to the room and continue around the room in a clockwise direction.

2. Fiber Optic Cable Installation

a. Fiber optic cable shall be installed in inner duct from near end termination point to far end termination point. Only UL-approved plenum-rated inner duct shall be installed in all plenum areas. Metallic conduit may be used in lieu of inner duct in plenum-rated ceilings if it is bonded and grounded correctly.

b. Only technicians-trained and certified by the product manufacturer shall perform terminations. Terminations shall be made in a controlled environment. Cables may be assembled off -site, although testing must be completed with the cable in its final installed condition. Test optical fiber on the reel for distance and continuity verification before installation.

c. At each location where fiber cable is exposed to human intrusion, it shall be marked with warning tags. These tags shall be yellow or orange in color, and shall contain the warning "CAUTION FIBER OPTIC CABLE". The text shall be permanent, black, block characters, and at least .1875-inch high. A warning tag shall be permanently affixed to each exposed cable or bundle of cables, at intervals of not less than 5 feet. Any section of exposed cable that is less than 5 feet in length shall have at least one warning tag affixed to it.

H. Coaxial Cable Requirements:

1. RG-11 shall be considered if distances are long; designer shall evaluate distance, bandwidth and frequency of operation.

2. Shall consist of a #20 AWG solid-copper center conductor with 95% copper braided shield. The cable shall be UL and (UL) Listed for Fire Safety and ISO 9001 Certified.

3. Characteristic Impedance shall be 75 Ohms at 50 MHz

2.04 TERMINATION HARDWARE

A. Station Hardware

1. Flush mount jacks shall be mounted in a faceplate with back box.

2. Outlets shall not be mounted on temporary, movable, or removable surfaces, doors, or access hatches without prior Owner approval.

3. 8P8C Jack Pin Assignments - Pin connections for voice and data information outlets and patch panels shall match T-568B termination standard under the EIA/TIA 568- A code.

4. Pin assignments at all voice and data panels or connecting blocks shall match pin assignments at the information outlets.

5. Color designation for UTP / F/UTP inserts:

a. Data, Voice, Access Control, Fire Alarm > White (Wall mount and modular furniture)

b. PICIS > Green

c. Command Center > Purple

d. Physiological Monitoring > Blue

e. Anesthesiologist > Yellow

f. Refrigerator Monitoring > Red

B. Optical Fiber Interconnect Units, Distribution Shelves, and Adapter panels

1. Modular in design and used in fiber optic interconnection and cross-connection.

2. 19-inch rack-mountable

3. Owner approved industry-standard connectors.

C. Optical Fiber Outlets:

1. Modular in design

2. Duplex Type LC fiber optic coupling/adapter

D. Copper patch panels:

1. Copper patch panels shall be rated to match installed cable plant.

2. Horizontal copper cables shall be terminated in eight position/eight conductor (8P8C) modular patch panels with no distinction between voice and data.

3. The termination block on the patch panel shall support the appropriate applications, including 100 Base-T, 52/155 Mbps ATM, and 1000 BASE-T Gigabit Ethernet, and facilitate cross connection and inter connection using modular patch cords.

4. All Modular jack panels shall be wired to T-568B unless requested otherwise by Owner.

5. The wiring block shall accommodate #23 AWG cable conductors.

6. All modular cross connect panels shall be UL-listed.

E. Work area outlets:

1. 8P8C non-keyed modular outlets for applications up to one Gbps and ANSI/TIA/EIA-568-C compliant for the specified transmission requirements.

2. Part of the UL LAN Certification and Follow-up Program.

3. Universal eight-position jack pin/pair assignments.

4. White in color for data outlets and blue in color for voice outlets.

F. Outlet Faceplates:

1. Match electrical outlets in color and material type.

2. Four-position with blanks inserted in unused ports.

2.05 PATCH CABLES

A. Multi-mode Optical Fiber

1. All Patch Cables are Furnished and Installed by the Owner

B. Copper

1. All Patch Cables are Furnished and Installed by the Owner.

2.06 IDENTIFICATION (LABELING) SYSTEM

A. Refer to sections 27 00 00 and 27 13 00.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Refer to Section 27 00 00

B. Verify the following before proceeding:

1. Conduits, cable trays and pull boxes are properly installed following section 270528.

2. Plywood backboards in communications rooms are properly installed in accordance with section 27 11 00.

3. Grounding system is properly installed and tested following section 27 05 26.

4. All high-pair count copper cables are routed properly and attached.

5. All optical fiber links are terminated and tested.

6. All backbone cabling service loops are installed and protected.

7. Liquid-carrying pipes are not installed in or above voice and data system communications rooms. Do not proceed with installation in affected areas until removed.

3.02 PREPARATION

A. Refer to section 27 00 00

3.03 INSTALLATION

A. Refer to section 27 00 00

B. All installation shall be done in conformance with ANSI/TIA/EIA-568-C standards, BICSI methods, industry standards and manufacturer's installation guidelines. The Contractor shall ensure that the maximum pulling tensions of the specified distribution cables are not exceeded and cable bends maintain the proper radius during the placement of the facilities. Failure to follow the appropriate guidelines shall require the Contractor to provide in a timely fashion the additional material and labor necessary to properly rectify the situation. This shall also apply to any and all damages sustained to the cables by the Contractor during the implementation.

C. The Contractor shall

1. Provide shall provide a 3-foot service loop above the access ceiling or cable trays unless specified otherwise. All service loops shall be a minimum of 18 inches in diameter and be accessible for maintenance.

2. Coordinate loop placement and orientation with the technology consultant. This allows for future changes or expansion without installing new cables.

D. Cabling between communications rooms and workstation locations shall be made as individual “home runs”. No intermediate punch down blocks or splices may be installed or utilized between the communications rooms and the information outlets at the workstation location.

E. All cable must be handled with care during installation so as not to change performance specifications. Factory twists of each individual pair must be maintained up to the connection points at both ends of the cable. There shall never be more than .5 inches of unsheathed Category 5e or 6 UTP cable at either the wiring closet or the workstation termination locations.

F. All cabling and associated hardware shall be placed so as to make efficient use of available space. All cabling and associated hardware shall be placed so as not to impair equipment's efficient use of their full capacity.

G. Exposed Cable

1. All station cabling shall be installed inside walls or ceiling spaces whenever possible.

2. Exposed station cable will only be run where indicated on the drawings and will only be allowed when no other options exist. Owner must approve all exceptions.

H. Wireless Access Point Cable Requirements

1. The Contractor shall:

a. Install one (1) Category 5E ORANGE CMP cable from dedicated wireless patch panel(s) in telecommunications room terminated with a modular plug on the WAP location (wired to T568B).

b. All WAP locations and cables shall be accessible by use of a 6' ladder.

I. Special Circuits

1. The Contractor shall coordinate with the Owner on the cable termination plan for special circuits (cables to wireless access point locations, IP security cameras, emergency analog telephone lines (elevators, fire alarms, etc.), service provider special circuits, security circuits, etc.).

a. Install one (1) Category 5E BLUE CMP cable from dedicated IP video surveillance patch panel(s) in telecommunications room terminated with a 8P8C modular plug on the camera location (wired to T568B).

b. WAP's (wireless access point) and IP security cameras shall be terminated with a 8P8C modular plug at the device end.

c. Location and termination field description

1) Room location

2) Rack-mount or wall mount

3) Termination field type

a) Specific patch panel ports versus a separate dedicated patch panel

b) 110-type or M66 blocks

d. Unique identifiers

1) Segregation and position on equipment rack

2) Port color-coding

3) Unique labeling

2. The Contractor shall provide a copy of the finalized plan in writing to the Owner's representative for review and authorization to proceed.

J. All cabling placed above drop ceilings must be supported by cable tray, saddle bags or conduit. The Contractor shall permanently affix cable supports to the building structure or substrates and provide attachment hardware and anchors designed for the structure to which attached and are suitably sized to sustain the weight of the cables to be supported. Attaching cable to pipes or other mechanical items is not permitted. Communication cables shall be routed so as to provide a minimum of 18 inches spacing whenever possible from light fixtures, sources of heat and EMI sources. Cabling shall not be attached to ceiling grid wires. Multiple cables are to be dressed every 5 feet to 7 feet. Maximum cable sag between cable hooks is 3"-6". Plastic/nylon tie-wraps are not allowed to permanently secure cables inside the Telecommunications Rooms. (See Section 270529 Hangers and Supports for Communications Systems).

K. In the Telecommunications Room (TR), cables shall be combed and dressed with Velcro ties in a manner as to prevent twists, “braiding” and crossed cables in the cable bundle from the telecommunication room entrance to the termination point at the rear of the patch panel. Behind the patch panel, the cable bundle shall be attached to the rear cable support bar, and shall drop out each cable in a neat, cascading manner to prevent crossed and/or interwoven cables to each patch panel port termination point.

L. Identification - The Contractor shall:

1. Label cable terminations on designation strips.

2. Label all cable at each terminating point.

3. Label each port of the work area outlet.

4. Cable identification numbers shall not be duplicated.

5. Labeling convention to be coordinated with Owner.

6. Label data patch panels and voice blocks in the communications rooms to match those on the corresponding voice and data outlets. The font shall be at least .125-inch in height.

7. Where a wireless access point is installed above an acoustical ceiling, label the ceiling grid frame below the access point, displaying the data port number and, if applicable, the access point identification number. Coordinate with the Owner for all access point identification information.

8. All labels shall correspond to as-built drawings and to final test reports.

9. Coordinate with Owner for specifications on labeling of all hardware, cabling, and related equipment prior to any testing.

10. Label each distribution rack, block and other terminating equipment unit and field within that unit within 4 inches from the block or patch panel termination. Keep labels in a neat and orderly lineup.

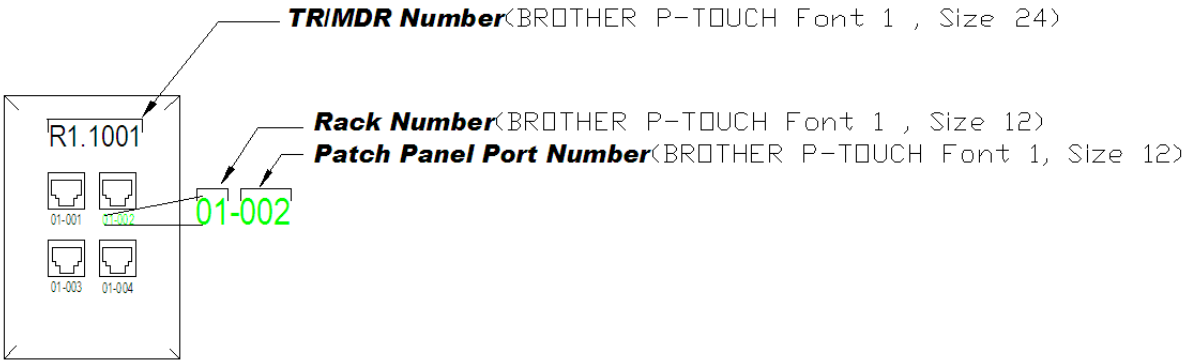
11. Label each connector and each discrete unit of cable-terminating and connecting hardware within connector fields, in wiring closets and equipment rooms. Where similar jacks and plugs are used for both communication and data-processing equipment, use a different color for jacks and plugs of each service.

12. Post the cable schedule in a prominent location in each wiring closet and equipment room. List incoming and outgoing cables and their designations, origins, and destinations.

13. Provide electronic copy of final comprehensive schedules for project in software and format selected by Owner.

14. Refer to the following drawing for faceplate labeling:

FACE PLATE LABELING



M. Documentation:

1. All cable inventory data documentation shall be submitted in format coordinated with and approved by Owner so that data can be incorporated into existing databases.

2. Documentation shall include cable identification number, source and destination, type of cable, length of cable and number of pairs or fibers.

3. Complete cross connect documentation is required. It shall include detailed documentation of each pair of all copper backbone cable and strand of fiber.

3.04 FIELD QUALITY CONTROL

A. Refer to section 27 00 00

3.05 POST-INSTALLATION TESTING OF CATEGORY 5E CABLING

A. Contractor shall test each Cat 5E Cable prior to acceptance.

B. Contractor shall supply all of the required test equipment used to conduct acceptance tests.

C. Contractor shall submit acceptance documentation as defined below. No cabling installation is considered complete until test results have been completed, submitted and approved.

D. Standards Compliance and Test Requirements:

1. Copper Cabling shall meet ANSI/TIA-568-C.2 Horizontal cabling requirements.

2. Optical fiber shall meet ANSI/TIA-568-C.0 Optical Fiber Transmission/Test Requirements, and Annex E: Optical Fiber Field Test Guidelines

E. Cable Test Documentation:

1. Cable test documentation shall be submitted in hard copy and electronic formats. If proprietary software is used, disk or CD shall contain any necessary software application required to view test results. If the results are delivered in a standard format like Excel, Access, CSV files, etc., software to read these files is not required. Electronic reports shall be accompanied by a Certificate signed by an authorized representative of the Contractor warranting the truth and accuracy of the electronic report. Certificate shall reference traceable circuit numbers that match the electronic record.

2. Each test record shall contain the cable ID as follows: “MEDIA TYPE – SOURCE ROOM – DESTINATION ROOM – STRAND/PAIR #”, e.g. MM-MC-HC23-001.

3. Copper: Test reports shall include the following information for each cabling element:

   a. Wire map results that indicate that 100% of the cabling has been tested for shorts, opens, miss-wires, splits, polarity reversals, transpositions, presence of AC voltage and end-to-end connectivity.

   b. Length, propagation delay, and delay skew relative to the relevant limit. Any individual test that fails the relevant performance specification shall be marked as a FAIL.

   c. For Category 5E cabling: Attenuation, NEXT, PSNEXT, Return Loss, ELFEXT, and PSELFEXT data that indicate the worst case result, the frequency at which it occurs, the limit at that point, and the margin. These tests shall be performed in a swept frequency manner from 1 MHz to highest relevant frequency, using a swept frequency interval that is consistent with TIA and ISO requirements. Information shall be provided for all pairs or pair combinations and in both directions when required by the appropriate standards. Any individual test that fails the relevant performance specification shall be marked as a FAIL. Test shall also include mutual capacitance and characteristic impedance

   d. Cable manufacturer, cable model number/type, and NVP

   e. Tester manufacturer, model, serial number, hardware version, and software version.

   f. Cable ID and project name

   g. Auto-test specification used

   h. Overall pass/fail indication

   i. Date of test

F. Cable Test Equipment:

1. Test equipment used under this contract shall be from manufacturers that have a minimum of 5 years experience in producing field test equipment. Manufacturers shall be ISO 9001 certified.

   a. Copper: Fluke DTX Cable Analyzer or submitted and Owner-approved equivalent.

   b. Fiber Optic: Fluke DTX Cable Analyzer or submitted and Owner-approved equivalent.

2. Test equipment for Category 6 UTP shall be UL-verified to meet Level III accuracy as specified in ANSI/TIA-568-C. The cable installers shall have a copy of this reference in their possession and be familiar with the contents.

3. Test equipment for multimode fiber cabling shall meet the requirements of ANSI/TIA-526-14-A. The light source shall meet the launch requirements of ANSI/TIA-455-50B, Method A. The cable installers shall have a copy of these references in their possession and be familiar with the contents

4. Test equipment for single mode fiber cabling shall meet the requirements of ANSI/TIA-526-7-1998: Optical Power Loss Measurements of Installed Single Mode Fiber Cable Plant-OFSTP-7.

5. The test instrument shall be within the calibration period recommended by the manufacturer.

6. Test instruments shall have the latest software and firmware installed.

7. All test tools of a given type shall be from the same manufacturer, and have compatible electronic results output.

8. Test adapter cables shall be approved by the manufacturer of the test equipment. Adapters from other sources are not acceptable.

9. All test tools of a given type shall be from the same manufacturer, and have compatible electronic results output.

10. Test adapter cables must be replaced after 1000 tests to ensure accuracy.

11. Test equipment must have a dynamic range of at least 100 dB to minimize measurement uncertainty.

12. Test equipment must be capable of storing full frequency sweep data for all tests and printing color graphical reports for all swept measurements.

13. Test equipment must include S-Band time domain diagnostics for NEXT and return loss (TDNXT and TDRL) for accurate and efficient troubleshooting.

14. Test equipment must be capable of running individual NEXT, return loss, etc measurements in addition to auto tests. Individual tests increase productivity when diagnosing faults.

15. Test equipment must include S-Band time domain diagnostics for NEXT and return loss (TDNXT and TDRL) for accurate and efficient troubleshooting.

16. Test equipment must be capable of running individual NEXT, return loss, etc measurements in addition to auto tests. Individual tests increase productivity when diagnosing faults.

17. Test equipment must include a library of cable types, sorted by major manufacturer.

18. Test equipment must store at least 1000 Category 5e auto tests in internal memory.

19. Test equipment must be able to internally group auto tests and cables in project folders for good records management.

20. Test equipment must include DSP technology for support of advanced measurements.

21. Test equipment must make swept frequency measurements in compliance with TIA standards.

22. The measurement reference plane of the test equipment shall start immediately at the output of the test equipment interface connector. There shall not be a time domain dead zone of any distance that excludes any part of the link from the measurement.

3.06 POST-INSTALLATION TESTING FOR CATEGORY 6 CABLE

A. Contractor shall test each Category 6 cable and each fiber strand of every optical fiber cable prior to acceptance.

B. Contractor shall supply all of the required test equipment used to conduct acceptance tests.

C. Contractor shall submit acceptance documentation as defined below. No cabling installation is considered complete until test results have been completed, submitted and approved.

D. Standards Compliance and Test Requirements:

1. Category 6 Copper Backbone Cabling shall meet ANSI/TIA-568-C.2 Category 6 Horizontal cabling requirements.

2. Optical fiber shall meet ANSI/TIA-568-C.3 Optical Fiber Cabling Components Standard requirements.

E. Cable Test Documentation:

1. Cable test documentation shall be submitted in hard copy and electronic formats. If proprietary software is used, disk or CD shall contain any necessary software application required to view test results. If the results are delivered in a standard format like Excel, Access, CSV files, etc., software to read these files is not required. Electronic reports shall be accompanied by a Certificate signed by an authorized representative of the Contractor warranting the truth and accuracy of the electronic report. Certificate shall reference traceable circuit numbers that match the electronic record.

2. Each test record shall contain the cable ID as follows: “MEDIA TYPE – SOURCE ROOM – DESTINATION ROOM – STRAND/PAIR #”, e.g. MM-MC-HC23-001.

3. Copper: Test reports shall include the following information for each cabling element:

a. Wire map results that indicate that 100% of the cabling has been tested for shorts, opens, miss-wires, splits, polarity reversals, transpositions, presence of AC voltage and end-to-end connectivity.

b. Length, propagation delay, and delay skew relative to the relevant limit. Any individual test that fails the relevant performance specification shall be marked as a FAIL.

c. For Category 6 cabling: Attenuation, NEXT, PSNEXT, Return Loss, ELFEXT, and PSELFEXT data that indicate the worst case result, the frequency at which it occurs, the limit at that point, and the margin. These tests shall be performed in a swept frequency manner from 1 MHz to highest relevant frequency, using a swept frequency interval that is consistent with TIA and ISO requirements. Information shall be provided for all pairs or pair combinations and in both directions when required by the appropriate standards. Any individual test that fails the relevant performance specification shall be marked as a FAIL. Test shall also include mutual capacitance and characteristic impedance

d. Cable manufacturer, cable model number/type, and NVP

e. Tester manufacturer, model, serial number, hardware version, and software version.

f. Cable ID and project name

g. Auto-test specification used

h. Overall pass/fail indication

i. Date of test

j. Name of Technician Performing Testing

F. Cable Test Equipment:

1. Test equipment used under this contract shall be from manufacturers that have a minimum of 5 years experience in producing field test equipment. Manufacturers shall be ISO 9001 certified.

   a. Copper: Fluke DTX Cable Analyzer or submitted and Owner-approved equivalent.

   b. Fiber Optic: Fluke DTX Cable Analyzer or submitted and Owner-approved equivalent.

2. Test equipment for Category 6 UTP shall be UL-verified to meet Level III accuracy as specified in ANSI/TIA/EIA-568-C. The cable installers shall have a copy of this reference in their possession and be familiar with the contents.

3. Test equipment for multimode fiber cabling shall meet the requirements of ANSI/TIA/EIA-526-14-A. The light source shall meet the launch requirements of ANSI/EIA/TIA-455-50B, Method A. The cable installers shall have a copy of these references in their possession and be familiar with the contents

4. Test equipment for single mode fiber cabling shall meet the requirements of ANSI/TIA/EIA-526-7-1998: Optical Power Loss Measurements of Installed Single Mode Fiber Cable Plant-OFSTP-7.

5. The test instrument shall be within the calibration period recommended by the manufacturer.

6. Test instruments shall have the latest software and firmware installed.

7. All test tools of a given type shall be from the same manufacturer, and have compatible electronic results output.

8. Test adapter cables shall be approved by the manufacturer of the test equipment. Adapters from other sources are not acceptable.

9. All test tools of a given type shall be from the same manufacturer, and have compatible electronic results output.

10. Test adapter cables must be replaced after 1000 tests to ensure accuracy.

11. Test equipment must have a dynamic range of at least 100 dB to minimize measurement uncertainty.

12. Test equipment must be capable of storing full frequency sweep data for all tests and printing color graphical reports for all swept measurements.

13. Test equipment must include S-Band time domain diagnostics for NEXT and return loss (TDNXT and TDRL) for accurate and efficient troubleshooting.

14. Test equipment must be capable of running individual NEXT, return loss, etc measurements in addition to auto tests. Individual tests increase productivity when diagnosing faults.

15. Test equipment must include S-Band time domain diagnostics for NEXT and return loss (TDNXT and TDRL) for accurate and efficient troubleshooting.

16. Test equipment must be capable of running individual NEXT, return loss, etc measurements in addition to auto tests. Individual tests increase productivity when diagnosing faults.

17. Test equipment must include a library of cable types, sorted by major manufacturer.

18. Test equipment must store at least 1000 Category 6 auto tests in internal memory.

19. Test equipment must be able to internally group auto tests and cables in project folders for good records management.

20. Test equipment must include DSP technology for support of advanced measurements.

21. Test equipment must make swept frequency measurements in compliance with TIA standards.

22. The measurement reference plane of the test equipment shall start immediately at the output of the test equipment interface connector. There shall not be a time domain dead zone of any distance that excludes any part of the link from the measurement.

3.07 POST-INSTALLATION TESTING FOR CATEGORY 6A CABLE

A. Contractor shall test each Category 6A cable and each fiber strand of every optical fiber cable prior to acceptance.

B. Contractor shall supply all of the required test equipment used to conduct acceptance tests.

C. Contractor shall submit acceptance documentation as defined below. No cabling installation is considered complete until test results have been completed, submitted and approved.

D. Standards Compliance and Test Requirements:

1. Category 6A Copper Backbone Cabling shall meet ANSI/TIA/EIA-568-C. Category 6A Horizontal cabling requirements.

2. Optical fiber shall meet ANSI/TIA/EIA-568-C.3 Optical Fiber Cabling Components Standard requirements.

E. Cable Test Documentation:

1. Cable test documentation shall be submitted in hard copy and electronic formats. If proprietary software is used, disk or CD shall contain any necessary software application required to view test results. If the results are delivered in a standard format like Excel, Access, CSV files, etc., software to read these files is not required. Electronic reports shall be accompanied by a Certificate signed by an authorized representative of the Contractor warranting the truth and accuracy of the electronic report. Certificate shall reference traceable circuit numbers that match the electronic record.

2. Each test record shall contain the cable ID as follows: “MEDIA TYPE – SOURCE ROOM – DESTINATION ROOM – STRAND/PAIR #”, e.g. MM-MC-HC23-001.

3. Copper: Test reports shall include the following information for each cabling element:

a. Wire map results that indicate that 100% of the cabling has been tested for shorts, opens, miss-wires, splits, polarity reversals, transpositions, presence of AC voltage and end-to-end connectivity.

b. Length, propagation delay, and delay skew relative to the relevant limit. Any individual test that fails the relevant performance specification shall be marked as a FAIL.

c. For Category 6A cabling: Attenuation, NEXT, PSNEXT, Return Loss, ELFEXT, and PSELFEXT data that indicate the worst case result, the frequency at which it occurs, the limit at that point, and the margin. These tests shall be performed in a swept frequency manner from 1 MHz to highest relevant frequency, using a swept frequency interval that is consistent with TIA and ISO requirements. Information shall be provided for all pairs or pair combinations and in both directions when required by the appropriate standards. Any individual test that fails the relevant performance specification shall be marked as a FAIL. Test shall also include mutual capacitance and characteristic impedance

d. Cable manufacturer, cable model number/type, and NVP

e. Tester manufacturer, model, serial number, hardware version, and software version.

f. Cable ID and project name

g. Auto-test specification used

h. Overall pass/fail indication

i. Date of test

F. Cable Test Equipment:

1. Test equipment used under this contract shall be from manufacturers that have a minimum of 5 years experience in producing field test equipment. Manufacturers shall be ISO 9001 certified.

    a. Copper: Fluke DTX Cable Analyzer or submitted and Owner-approved equivalent.

    b. Fiber Optic: Fluke DTX Cable Analyzer or submitted and Owner-approved equivalent.

2. Test equipment for Category 6A UTP shall be UL-verified to meet Level IV accuracy as specified in ANSI/TIA/EIA-568-C.2. The cable installers shall have a copy of this reference in their possession and be familiar with the contents.

3. Test equipment for multimode fiber cabling shall meet the requirements of ANSI/TIA/EIA-526-14-A. The light source shall meet the launch requirements of ANSI/EIA/TIA-455-50B, Method A. The cable installers shall have a copy of these references in their possession and be familiar with the contents

4. Test equipment for single mode fiber cabling shall meet the requirements of ANSI/TIA/EIA-526-7-1998: Optical Power Loss Measurements of Installed Single Mode Fiber Cable Plant-OFSTP-7.

5. The test instrument shall be within the calibration period recommended by the manufacturer.

6. Test instruments shall have the latest software and firmware installed.

7. All test tools of a given type shall be from the same manufacturer, and have compatible electronic results output.

8. Test adapter cables shall be approved by the manufacturer of the test equipment. Adapters from other sources are not acceptable.

9. All test tools of a given type shall be from the same manufacturer, and have compatible electronic results output.

10. Test adapter cables must be replaced after 1000 tests to ensure accuracy.

11. Test equipment must have a dynamic range of at least 100 dB to minimize measurement uncertainty.

12. Test equipment must be capable of storing full frequency sweep data for all tests and printing color graphical reports for all swept measurements.

13. Test equipment must include S-Band time domain diagnostics for NEXT and return loss (TDNXT and TDRL) for accurate and efficient troubleshooting.

14. Test equipment must be capable of running individual NEXT, return loss, etc measurements in addition to auto tests. Individual tests increase productivity when diagnosing faults.

15. Test equipment must include S-Band time domain diagnostics for NEXT and return loss (TDNXT and TDRL) for accurate and efficient troubleshooting.

16. Test equipment must be capable of running individual NEXT, return loss, etc measurements in addition to auto tests. Individual tests increase productivity when diagnosing faults.

17. Test equipment must include a library of cable types, sorted by major manufacturer.

18. Test equipment must store at least 1000 Category 6A auto tests in internal memory.

19. Test equipment must be able to internally group auto tests and cables in project folders for good records management.

20. Test equipment must include DSP technology for support of advanced measurements.

21. Test equipment must make swept frequency measurements in compliance with TIA standards.

22. The measurement reference plane of the test equipment shall start immediately at the output of the test equipment interface connector. There shall not be a time domain dead zone of any distance that excludes any part of the link from the measurement.

3.08 POST-INSTALLATION TESTING FOR OPTICAL FIBER: TESTING SHALL BE PERFORMED ON ALL FIBERS IN THE COMPLETED END-TO-END SYSTEM.

a. Refer to section 27 13 00

b. Power Meter and Source Loss Reports: Testing shall consist of a bi-directional, dual wave length end to end test. The system loss measurements shall be provided at 850 and 1300 nanometers for multi-mode fibers and 1310 and 1550 for single mode fibers.

c. Optical Time Domain Reflectometer (OTDR) Reports: Testing shall consist of a bi-directional end to end OTDR trace performed per TIA/EIA 455-61. The system loss measurements shall be provided at 850 and 1300 nanometers for multi-mode fibers and 1310 and 1550 for single mode fibers.

d. The acceptable link attenuation for a multimode horizontal optical fiber cabling system is based on the maximum distance of 295 feet.

e. The horizontal link may be tested using a fixed upper limit for attenuation of 2.0 dB. This value is based on the loss of two connector pairs, one pair at the telecommunications outlet/connector and one pair at the horizontal cross-connect, plus 295 feet of optical fiber cable.

f. A horizontal link in a network with a consolidation point may be tested using a fixed upper limit for attenuation of 2.75 dB.

3.09 CLEANING

A. Refer to section 27 00 00

3.10 ACCEPTANCE

A. Once all work has been completed, test documentation has been submitted and approved, and the Owner is satisfied that all work has been completed in accordance with contract documents, the Owner will notify Contractor in writing of formal acceptance of the system.

B. Contractor's RCDD shall warrant in writing that 100% of the installation meets the requirements specified herein.

C. Acceptance shall be subject to completion of all work, successful post-installation testing which yields 100% PASS rating, and submittal and approval of full documentation as described above. Tests with the "* PASS" (asterisk) will not be acceptable. These circuits must be repaired to meet "PASS".

END OF SECTION 27 15 00

SECTION 27 40 16 - AUDIO-VIDEO SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SECTION INCLUDES

A. Furnishing, installing, testing and documenting audio-visual systems for multi-use and conference rooms.

B. Audio-Visual Systems shall consist of multiple systems with various configurations per the AV Room Type Device Schedules and the design specifications and drawings.

C. These systems include some or all of the following:

1. Wall mounted, ceiling mounted and ceiling hung speaker systems.

2. Mounting of flat screen video displays and projectors.

3. Audio input/output panels, microphones, wireless microphone systems, mixers, switchers, audio processors and amplifiers.

4. Video input/output panels, PTZ cameras, DVD players, switchers and scalers.

5. Video conferencing codec's, microphones, cameras, mounts and cables.

6. Programmable audio-visual remote and automated control system and associated support devices for controlling: audio and videos systems, etc.

7. Floor, wall and desktop connection hubs for audio, video, broadband, LAN, remote control signaling, computer and power connections.

8. Termination, connector and pull junction boxes.

9. Flat screen video display mounting systems.

10. Projector mounting

11. Wiring and connectors.

1.03 OVERVIEW

A. The work detailed by these specifications and drawings has been specified to meet certain requirements for performance. Some information, such as exact equipment models, layout, wire routing, additional conduit and power requirements, etc. has been omitted. It shall be the responsibility of the Contractor to translate these specifications and drawings into a complete design package containing all necessary elements for a complete turnkey installation including all material, labor, warranties, shipping and permits.

B. Gen ral elements of the work shall consists of but not limited to:

1. e Procure all permits and license required to complete this installation.

2. Attend pre-construction/pre-submittal meeting with Owner and Consultant to review design package for the Audio-Video Systems.

3. Prepare schedule of work.

4. Submittal preparation and processing prior to ordering equipment.

5. Attend submittal review meeting.

6. Provide materials necessary to complete the Audio-Video Systems.

7. Perform camera pre-installation sign-off walk through with Owner and Consultant.

8. Installation of cameras and camera cabling

9. Provide all required software and licenses to the Owner.

10. Contractor shall provide continuous on-site supervision of the installation technicians. On-site supervision shall include: daily supervision of the work, updating work site progress drawings to reflect changes and installations details, preparing weekly progress reports and attendance at site coordination meetings as directed by the Owner and Consultant.

11. The Contractor shall provide all miscellaneous hardware including cable management devices, termination cabinets, wire and cable labeling materials, fasteners, hangers and brackets as required.

12. The contractor shall provide all materials, equipment, labor and all other incidental material, tools, appliances and transportation as required for a complete and functional video system (VS) as described herein and supplementary drawings.

13. Coordinate receipt of Owner furnished equipment.

14. Perform installation according to contract documents and manufacturers recommendations.

15. Protect new facilities finishes and equipment.

16. Maintain construction materials and refuse within the area of work.

17. Clean the work area at the end of each day.

18. Provide system software and programming and other materials necessary for the Audio-Video Systems to function by standard industry practices.

19. Program Audio-Video Systems and load with user define text and specified operations per design specifications and drawings.

20. Perform initial testing, programming and adjustments with written reports.

21. Make final adjustments, calibrations and programming modifications as directed by the Owner and Consultant.

22. Demonstrate all systems for final acceptance.

23. Preparation of O&M manuals and as-built documents for Owner's use.

24. Providing training for Owner's staff, facility personnel and technical staff.

25. Providing warranty service for a period of one year from acceptance date.

26. Provide extended system support.

1.04 DEFINITIONS

A. AVS: Audio-Visual System.

B. OFOI: Owner Furnished Owner Installed.

C. CONTRACTOR: Contractor or subcontractor providing and installing the Audio-Visual System.

D. PROVIDE: Furnish, install, commission, test and warrant.

E. WORK: Action required furnishing, installing, commissioning, testing and warranting the Audio-Visual Systems.

F. COMPONENT: Any individual item of equipment or material which is an element of the Audio-Visual Infrastructure System.

G. ZONE – Separate parallel signal path with independent processing and alternate program capabilities.

H. AGC: Automatic gain control.

I. CCD: Charge-coupled device.

J. CTS: Certified Technology Specialist.

K. MPEG: Moving picture experts group.

L. NTSC: National Television System Committee.

M. UPS: Uninterruptible power supply.

N. PoE: Power over Ethernet

O. GC: General Contractor

1.05 PERFORMANCE REQUIREMENTS

A. These specialized AVS systems are designed to efficiently support the Owner's various facilities and activity areas in a manner, which can be proficiently managed by the staff. Work shall include the complete turnkey installation and commissioning of these systems per the following specifications and drawings.

1.06 SUBMITTALS

A. Product Data:

1. List all system components including manufacturer and model number.

2. Manufacturer's literature sheets for all materials and equipment, including warranty information, recommended preventative maintenance and spare part inventory recommendations. Literature containing more than one device shall be clearly marked to delineate item(s) included in the Work.

3. Clearly indicate color or special finishes.

4. Correlate products with 27 00 00 Specification and use in Project.

5. Contractor's on-site CTS supervisor shall review, approve and sign off all submittal documents.

B. Pricing Submission: Contractor shall submit a complete pricing sheet that includes an itemized listing of all equipment, materials and labor required for the installation of the system as specified herein. The listing shall be organized by room and shall contain: item description, item model number, quantity, unit cost and extended labor, material and installation cost required to provide a complete and functional system.

C. Programming:

1. Provide and coordinate with the Owner all possible control functionalities based on project drawing and specifications.

D. Shop Drawings:

1. Contractor's on-site CTS supervisor shall review, approve and sign off all shop drawings, coordination drawings As Built Drawings documents.

2. Reproducing Contract Documents for shop drawing is not acceptable.

3. Shop drawings to include the following:

a. Drawing legend sheet describing all symbols used on the drawings.
b. Floor plans with all devices and wiring raceway depicted.
c. Wire runs with tags for type, gauge, quantities and cable identifiers.
d. System riser diagram indicating all field devices, riser paths and room designations.
e. Block diagram for each system showing all equipment and signal pathways.
f. Point schedules defining interconnection of all inputs and outputs for all equipment including data connections and other systems with cable identifiers.
g. Elevations of equipment racks and teaching consoles.
h. Fabrication shop drawings for all custom components.
i. Diagrams for power, signal, control wiring and grounding.
j. Include plans, elevations, sections, details, and attachments to other work.

E. Coordination Drawings: Reflected ceiling plans, drawn to scale, with ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings are shown and coordinated, using input from installers of the items involved. Provide similar elevation drawings for wall-mounted items.

F. Samples: Provide as requested for colors and texture coordination.

G. Partial submittals shall not be acceptable without prior approval by Owner.

H. No portion of the work shall commence or equipment ordered until the Owner has approved the submittals.

I. The Contractor shall not be relieved from any contract-required responsibility by the Owner's approval of submittals.

J. Nothing in the specification shall relieve Contractor of system package design responsibility, including, but not limited to, all equipment furnished under this Contract. The Contractor is, in all cases, solely responsible for the performance of the delivered AVS, and for furnishing complete system documentation for each and every part of the system.

K. Extended AVS Support.

1. Provide pricing for AVS hardware and software support including necessary reconfiguration and data base changes for years 2 through 5.

L. Resubmitting.

1. Make corrections or changes in Submittals as required by the Consultant's stamped instructions and attached comments and resubmit.

2. Identify changes on resubmittals by clouding. Only indicated changes will be reviewed when resubmitted.

3. Added drawings shall be clearly identified.

4. Contractor shall be responsible for project delays caused by rejected submittals.

5. Consultant shall be compensated for additional services for submittals rejected more than twice. The amount of such compensation shall be incorporated by change order and withheld from the Contractor's Application for Payment.

1.07 QUALITY ASSURANCE

A. Installer Qualifications:

1. The Contractor performing the installation shall have a minimum of 5 years experience in the installation of AVS systems of similar size and scope.

2. An Infocomm CTS shall supervise and approve all on-site work as a recognized member of the Contractor's installation team. All installation team members must demonstrate knowledge and compliance with all Infocomm, TIA, UL, and NEC methods, standards and codes. Submit resumes of the entire team and completed training courses and certifications.

3. All members of the installation team must be certified by the Manufacturer as having completed the necessary training to complete their part of the installation.

4. Owner's representative may make such investigations as deemed necessary to determine that the Contractor is responsive, responsible and qualified in the area of work contemplated by the Contract. In this regard, the Contractor shall furnish to the Owner such information as requested for this purpose. Information and data may include (but not necessarily be limited to): Date of organization and/or incorporation and number of years engaged in this business under present firm's names; list of major equipment owned by the company; list of principal personnel who will be involved in the execution of this contract with the experience and qualifications of each person.

5. Contractor shall have local in-house engineering and project management capability consistent with the requirements of this project. The Contractor shall provide a project manager that shall be the same individual throughout the project and shall be the person responsible for system programming, preparation of Operation and Maintenance Manuals, Training, Programs, Schedules and Test Protocols, documentation of system testing, maintenance of record drawings and coordination and scheduling of all labor.

6. Contractor shall be or have direct relations through their subcontractors, an authorized manufacturer’s representative for all products they furnish or install.

7. Contractor shall have a local organization capable of providing maintenance and service for the specified system. Facility shall be no more than 100 miles from Owner's site.

8. Contractor shall be capable of providing emergency service on a 24-hour, 7 days a week basis.

B. Conflicts:

1. In the event of any conflicts between documents referenced herein and the contents of this specification, the Contractor shall notify in writing to Consultant of any such occurrences before the purchasing of any equipment, materials and/or installation. The Consultant will notify the Contractor of any actions required to resolve these conflicts. Such actions may include but are not limited to: design changes, equipment, materials and/or installation changes. In any event, Contractor shall not supersede specifications and standards from the latest NFPA and NEC publications.

C. The Contractor shall provide all materials, equipment and installation in compliance with the latest applicable standards from ANSI, ASTM, FCC, IEEE, NCTA, NEC, NEMA, NFPA, REA, TIA/EIA, and UL including but not limited to:

1. American National Standards Institute (ANSI).

2. ANSI T1.404 (DS3) and CATV Applications.

3. American Society for Testing And Materials (ASTM).

4. American with Disabilities Act (ADA).

5. EIA/TIA-569 Standard, Commercial Building Standard for Telecommunications Pathways and Spaces.

6. EIA/TIA-607 Commercial Building Grounding and Bonding Requirements for Telecommunications.

7. National Cable Television Association (NCTA).

8. NCTA-02 NCTA Recommended Practices for Measurements on Cable Television Systems.

9. National Electrical Code (NEC) (Latest revision and pertinent addendums).

    a. Article 250, Grounding.
    b. Article 300, Part A. Wiring Method.
    c. Article 310, Conductors for General Wiring.
    d. Article 800, Communication Systems.

10. National Fire Protection Association (NFPA) Publications (Latest revisions and pertinent addendums).

11. Underwriters Laboratories (UL).

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. NECA 1 Good Workmanship in Electrical Contracting.

1.08 PROJECT CONDITIONS

A. Environmental Limitations: System components shall be equipped and rated for the environments where installed.

B. Environmental Conditions.

1. Capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:

    a. Interior, Controlled Environment: System components installed in conditioned interior environments shall be rated for continuous operation in ambient conditions of 36 to 122 deg F (2 to 50 deg C) dry bulb and 20 to 90 percent relative humidity, non-condensing.
    b. Interior, Uncontrolled Environment: System components installed in non-conditioned interior environments shall be rated for continuous operation in ambient conditions of 0 to 122 deg F (minus 18 to plus 50 deg C) dry bulb and 20 to 90 percent relative humidity, non-condensing.
    c. Exterior Environment: System components installed in locations exposed to weather shall be rated for continuous operation in ambient conditions of minus 30 to plus 122 deg F (minus 34 to plus 50 deg C)] dry bulb and 20 to 90 percent relative humidity, condensing. Rate for continuous operation when exposed to rain as specified in NEMA 250, winds up to 85 mph (137 km/h) and snow cover up to 24 inches (610 mm) thick.

1.09 PROJECT COORDINATION AND PLAN

A. Contractor shall submit a project plan detailing the steps and associated timeframe to meet the General Contractor's schedule requirements. Project plan should include benchmarks for items such as regular project meetings, equipment order and delivery, installations, configuration and calibrations, testing and burn-in, training, substantial completion notification, testing and final acceptance.

B. Contractor assumes total responsibility for coordinating with building trades or other parties as may be identified by the General Contractor.

C. Coordinate size and location of conduit systems, back boxes, and provisions for electrical power to equipment of this Section.

D. The Contractor must obtain written permission from the General Contractor prior to routing and/or installing cable, equipment or service through the facility.

E. Contractor shall prepare the installation schedule to coordinate sequencing, dependencies and priorities of the system installation including work by other trades.

1.10 COMMISSIONING

A. Commissioning of systems specified in this section is part of the construction process. Documentation and testing of these systems, as well as training of the Owner's operation and maintenance personnel, is required in cooperation with the Owner's Representative and the Commissioning Agent. Project Closeout is dependent on successful completion of all commissioning procedures, documentation, and issue closure.

B. Training of the Owner's operation and maintenance personnel is required in cooperation with the Owner's Representative. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems. The instruction shall be scheduled in coordination with the Owner's Representative after submission and approval of formal training plans.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Audio Extractor

1. Extron HAE-100 (HAE)

B. Audio Mixer

1. Biamp Nexia CS (DSP)

C. Amplifier

1. Extron MPA 401 (AMP)

D. Audio Summing Amplifier

1. Extron ASA 304 (ASA)

E. CableCubby

1. Extron Cable Cubby 300S with US AC Module (CC)

F. Control System

1. AMX Netlinx NI-700 (CONT1)
2. AMX Netlinx NI-3100 (CONT2)
3. AMX Netlinx NI-4100 (CONT3)

G. Control Panel

1. AMX NXD-500i (CP1)
    a. Include required POE and power supply
2. AMX NXD-700Vi (CP2)
    a. Include required POE and power supply

H. Data Switch

1. Cisco Catalyst 2940 SI 8-Port (DSW1)
2. Cisco Catalyst 2960 SI 24-Port (DSW2)

I. Device Plate

1. Custom Panelcrafters 6-Gang Device Plate (FP1, FP, FP3)

J. Distribution Amplifier

1. Extron P/2 DA2xi (DA)

K. Document Camera

1. Provided by owner (DOC)
    a. Provide VGA patch cord to document camera

L. Equipment Rack

1. Middle Atlantic SRSR Series Sliding Rail System (CR1, CR2 & CR3)
    a. Provide blanks panels at all empty rack units
    b. Provide universal rack shelf kits for non-rack mountable devices & provide false plate at open slots

M. Floor Box

1. FSR FL-600P with 6” depth and hinge cover (FB)

a. Verify edge height and finish with Architect

b. Provided by Electrical Contractor

c. AV Contractor to provide 6-gang AV custom faceplate

N. Flat Screen Display (FSD1)

1. Display shall be furnished and installed by Owner

a. Chief PNRIW Series In-Wall Swing Arm Mount shall be furnished and installed by Owner

b. Provide HDMI & VGA/audio cabling from local poke-thru device to display

c. Provide and terminate AV plates at poke-thru and display mounting box

O. Flat Screen Display In-Wall Mounting Box

1. PAC501 Series In-Wall Swing Arm Accessory

a. Furnished and installed by AV Contractor

b. General Contractor shall provide blocking and bracing to support 200 lbs

c. Provide one (1) mounting box for each display shown on AV floor plans and identified as device FSD1

P. Flat Screen Display (FSD2)

1. Display & mount shall be furnished and installed by Owner

a. Provide HDMI & VGA/audio cabling from local AV modular furniture faceplate to display

b. Provide HDMI & VGA/audio connectors and modular furniture faceplate

Q. Lectern

1. DWI 300 Compact Lectern (LECT)

a. Prior to purchase, coordinate finish with Architect

b. Provide visual presentation drawer

c. Provide front and rear rackrails

d. Provide keyboard drawer

e. Provide device cut-outs: Extron CableCubby, AMX touch panel, LittleLite & gooseneck microphone

f. Provide LittleLite gooseneck lamp assembly

g. Provide Extron HDMI, VGA/Aud, & USB patch cables at Extron CableCubby

h. Provide Extron VGA patchcord to document camera

R. Microphone

1. AKG CGN-321E with H500 shock mount & windscreen (MIC)

S. Poke-Thru

1. Wiremold 8AT Recessed 8” Evolution Series & cover (PT)

a. Provided by Electrical

b. Coordinate finish with Architect

c. AV Contractor shall provide HDMI and VGA/audio architectural plates

T. Power

1. AMX PSN2.8

2. Furman P-8 Pro Series 2 (PWR)

U. Projector

1. Panasonic PT-FW300V & lens (PROJ)

a. Provide (1) spare lamp for each projector

V. Projector Mount

1. Da-lite CM-SCP Unistrut Suspended Ceiling Plate, UPM-1 mount and 1.5” pole

a. Coordinate color with Architect

b. Provide (1) per projector (PROJ)

W. Projection Screen

1. Da-Lite

a. Tensioned Advantage Deluxe Electrol (SCRN)

b. Size: 52” x 92”

c. Da-Mat projection surface

d. Include integrated low voltage control SCB-100 serial board for interface to control system and 3-button low voltage wall switch. Coordinate color and type of low voltage wall switch with Architect.

e. Provide unistrut and all-thread for proper mounting installation. All mounting must support a minimum of 5 time total weight mounting.

f. Provide a minimum of 12” of blackdrop and adequate amount to allow for the limits of each screen so that bottom of projected image is 48” above finished floor.

X. Pull-Box

1. 24” X 24” X 12” screw cover pull box (PBOX)

a. Provided by Electrical Contract

Y. Speaker

1. JBL 26CT (S)

a. Tap at 7.5 Watts each

Z. Switcher

1. Extron SW2 HDMI (SWIT1)
2. Extron SW4 VGA Ars (SWIT2)
3. Extron Crosspoint Ultra 84 HVA (SWIT3)
4. Extron DXP 84 HDMI (SWIT4)

AA. Rack Panel

1. Extron AAP 301 (RP) to include:

a. Include Extron Architectural Adapter Plates as shown on drawing details

BB. Tuner

1. Contemporary Research 232-ATSC+ HDTV (TUN) with RU rack kit

CC. UTP Transmitter

1. Extron HDMI 201 Tx (TX1)
2. Extron HDMI 201 A D Tx (TX2)

DD. UTP Receiver

1. Extron HDMI 201 Rx (RX)

EE. Wireless keyboard bundle

1. Wireless Computing RF-410

FF. Wireless Microphone System

1. RevoLabs Executive HD 4 (WMIC)

    a. 4-Channel microphone receiver

    b. 1x4 charger base

    c. Coordinate frequency sources in the area and with manufacturer's recommendations

2.02 A/V CONNECTION PLATES

A. Provide types, sizes and configuration per drawings and schedules with the following minimum features:

1. Finish shall be anodized aluminum

2. Engraved legends

3. Solder, pass thru and connectors as required

4. All connectors on wall plates shall be recessed

5. No pigtails are allowed

6. Use Panelcrafters or equivalent

2.03 CONNECTORS

A. No pigtails are allowed.

B. All AV connectors shall be Nuetrik or equivalent

1. Audio (microphone level): 3-conductor XLR AES/EBU compliant

    a. Use Neutrik RF shielded connectors for microphones at lecterns and tables.

2. Audio (line level): ¼" TRS phone jack with insolated bushings. No RCA

3. Audio (PC line level): 3.5mm TRS

4. Control Panels: XLR type with pro

5. Video: HD-SDI compliant to 3 GHZ ADC or Kings. BNC dual crimp.

6. RGBHV: 75 ohm BCP-C dual crimp BNC

7. VGA: DE-15HD, isolated from panel and with hex nuts

8. Data 8P8C (RJ-45): Re: Section 27 15 00 – Communications Horizontal Cabling

2.04 CABLES

A. All AV is to be provided by AV Contractor.

B. All AV cables will be plenum rated per NEC.

C. Provide types and quantities per drawings and schedules.

D. Interconnect Wiring:

1. Insulation shall be rated for a minimum of 300 volts.

2. Wire types and minimum sizes:

a. Analog Audio: Cable – West Penn 25291 or equal
b. Digital Audio: Belden 1801B or equal
c. Analog Composite Video: West Penn 25806 or Belden 89120
d. RGBHV Cable: Belden 1283S5, West Penn 258195 or Liberty RGB5C-PLN
e. Control Cable: West Penn 25350
f. Loudspeaker Cable: West Penn 25226B & 25227B
g. CAT 6A Cable: Re: Section 27 15 00 – Horizontal Communications Cabling

E. Minimum acceptable AVS systems wiring performance standards shall be as follows:

1. Speaker cable - Per ANSI WC57 standard test.

2. CAT6A - Per ANSI/TIA/EIA-568-8.1 standard test. Re: Div 27 15 00

3. Fiber optic cable - Per ANSI/TIA/EIA-568-B standard test.

4. RS 232 - Per ANSI/ WC66 standard test.

5. Line level shielded audio cable - Per ANSI WC66 standard test.

6. Microphone level shielded audio cable - Per ANSI WC66 standard test.

7. Video coax cable - Per ANSI/TIA/EIA–TSB-67standard test.

8. Multi-conductor control cable - Per ANSI WC57 standard test.

2.05 PATCH CABLE

1. Provide Extron AV patch cables for all AV interconnection plates

2. Provide Data CAT6A patch cables. Re: Section 27 15 00 – Horizontal Cabling

2.06 CONTROL SYSTEM PROGRAMMING

A. For all AMX controlled equipment, Contractor shall provide basic AMX control system programming to test for proper operation upon receipt of the equipment.

a. Connect AMX controlled equipment to an AMX controller and provide a level of control system programming that demonstrates that proper communication between the two devices.

b. When the equipment is installed at the project site in its final configuration, the Contract shall furnish a level of control system programming to demonstrate that equipment is wired and communicating appropriately. This task shall be performed prior to Tekvox providing and loading their final programming code.

B. Final programming of the AMX AV Control Systems shall be furnished by TekVox Inc through a contract with MDACC.

C. Contractor shall assist TekVox with loading and testing of the control system program(s) until projector is accepted by the owner.

2.07 AUDIO SYSTEM DSP PROGRAMMING

A. Final programming of the DSP Audio Processors shall be furnished by TekVox Inc through a contract with MDACC.

B. Contractor shall assist TekVox with loading and testing of the DSP program(s) until projector is accepted by the owner.

C. When the equipment is installed at the project site in its final configuration, the Contract shall furnish a level of control system programming to demonstrate that the DSP is wired and communicating appropriately. This task shall be performed prior to Tekvox providing and loading their final programming code.

PART 3 - EXECUTION

3.01 CONSTRUCTION MEETINGS

A. The Consultant and/or Owner will hold regular construction meetings to review the installation schedule. It is mandatory that the Contractor's project manager attend each meeting.

3.02 SITE INSPECTION

A. Continuously verify that the site conditions are in agreement with the Contract Documents and the AVS design. Notify Owner's representative immediately of conditions that affect the performance of the installed system.

B. Coordinate any required work that is not specified in the Contract Documents.

3.03 COORDINATION

A. Adequate conduit and back boxes are provided for the specified system installation.
B. Adequate power has been provided for the specified system installation.
C. Verify mounting location of all devices with Owner prior to installation.

3.04 GENERAL

A. The Contractor shall be responsible for providing all wire and cable as required for

complete and operational system.

B. All cables must be continuous runs from device location to the final point of termination. No mid run cable splices will be allowed.

C. Make connections and splices with solderless devices that are mechanically and electrically secure in accordance with manufacturer's recommendations.

D. The cable installation techniques shall be such that the mechanical and communications characteristics of the cables are not degraded at the time of installation. Any special environmental requirements for equipment shall be specified.

E. Wiring Method: Install cables in raceways except in accessible indoor ceiling spaces, in hollow gypsum-board partitions, and as otherwise indicated. Conceal raceways and wiring except in unfinished spaces.

F. Distribution of the cabling will be accomplished through cable trays, J-hooks, cable runways, conduit raceways, ducts, core holes, extended columns, false half columns and plenums. Horizontal cable segments will be placed in cable trays and when they leave cable trays will be supported by distribution rings. Where cables converge at equipment room locations, they will be supported by cable runways and distribution rings. All cable placements shall be based on the enclosed drawings.

G. The Contractor shall not place wiring in the same conduit or raceway with wire for electrical power distribution.

H. Connectors to all devices in system shall be protected against moisture. Approval of the method shall not relieve the Contractor of full responsibility for proper application and workmanship of the materials in the manner specifically approved. All connector threads shall be treated with an approved silicone lubricant.

I. The Contractor shall be responsible for providing approved grounds for all AVS system equipment per the manufactures recommendations. The Contractor shall also be responsible for ensuring ground continuity by properly bonding all appropriate cabling, closures, cabinets, service boxes, and framework. All ground connections shall consist of minimum 12 AWG copper wires and shall be supplied from an approved building ground and bonded to the main electrical ground. Contractor must notify the Owner prior to making any changes in submitted system design and/or installation.

J. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

K. Splices, Taps, and Terminations: For power and control wiring, use numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

L. Grounding: Provide independent-signal circuit grounding per practices published by the manufacturer.

3.05 IDENTIFICATION, LABELING AND DOCUMENTATION

A. The Contractor shall label all termination devices, panels, enclosures and equipment rooms. The Contractor will mark each unit with engraved lamicoid labels permanently fixed on front and back of the unit, denoting its equipment identification as labeled on drawings. Font shall be Helvetica with 1/8” (minimum) engraved white letter. Labels shall not impair the equipment or present a hazard to maintenance personnel.

B. Place wire identification numbers 1/8” on each end of all conductors and or connectors by using sleeve type heat shrinkable markers. Install markers to be legible from left to right or top to bottom. Wire numbers shall be computer printed (Brady TLS2200 with Permasleeve cable marking labels or equivalent). Hand written labels are not

acceptable.

C. Mark all spare conductors.

D. Contractor to maintain a progress set of design documents on the Project site. These documents shall be updated daily to reflect the current condition of the work and available for review by the Consultant and Owner when requested.

E. If changes occur prior to acceptance testing altering the documentation previously furnished. The Contractor shall formally update and reissue the relevant documentation to the Consultant and Owner.

F. Consultant and Owner will review all documentation for accuracy and completeness and may reject substandard submittals.

G. The Contractor shall establish and maintain complete system documentation, including documentation procedures, operational information, configuration information and drawings. Documentation shall include the following:

1. Floor plan drawings indicating device locations, unique system point numbers with device legends indicating manufacturers and model numbers for each device.

2. The unique system point number of a device shall identify either through the software or hardwire connection, the specific device or group of devices associated with the unique point number in the system.

3. Floor plan drawings indicating conduit and wire routing and junction box locations.

4. Wire routing shall include cable identification and terminal strip numbers.

5. Mounting details for all equipment and hardware.

6. Functional block diagrams for each system.

7. Wiring details showing rack elevations, equipment wiring and terminations and inter-rack wiring.

3.06 FIELD QUALITY CONTROL

A. Inspection: Verify that units and controls are properly installed, connected, and labeled, and that interconnecting wires and terminals are identified.

B. Pre-testing: Align and adjust system and pretest components, wiring, and functions to verify that they comply with specified requirements.

C. Test Schedule: Schedule tests after pre-testing has been successfully completed and system has been in normal functional operation for at least 14 days. Provide a minimum of 10 days' notice of test schedule.

D. Operational Tests: Perform operational system tests to verify that system complies with Specifications. Include all modes of system operation. Test equipment for proper operation in all functional modes.

E. Remove and replace malfunctioning items and retest as specified above.

F. Record test results for each piece of equipment.

G. Re-test: Correct deficiencies identified by tests and observations and retest until specified requirements are met.

3.07 ADJUSTING

A. Speaker Systems

B. Equalize speaker systems flat from 80 Hz to 2 KHz with a 2dB per octave roll-off thereafter. Program a high pass filter at 60Hz with 12dB per octave roll off and a low pass filter 15 KHz with 12 dB per octave roll off.

C. Use a minimum of three measurement locations in the system's intended coverage area to calibrate the system response.

D. Verify system gain and amplifier levels.

E. Verify speaker polarity

F. Adjust appropriate speaker delays.

G. Set and adjust limiters.

H. Contractor shall provide for calibration of the system:

1. Sound analyzer (SmartLive, TEF SoundLab, Meyer's SIM or equivalent) with trained operator for adjusting and verifying delay timing, cabinet aim and equalization.

2. Suitable calibrated microphone.

I. The Contractor shall coordinate this testing and calibration. It is anticipated that this work will take 1 hour per classroom. It will be necessary to have a quiet room during these times.

J. Contractor to record all measurements, settings and adjustment for inclusion in the O&M manuals.

K. Adjust limit switches on electric operated projection screens.

L. Adjust back focus on all video cameras.

M. Occupancy Adjustments: When requested within 12 months following the of date of Substantial Completion, provide on-site assistance in adjusting systems to suit actual occupied conditions and to optimize performance of the installed equipment. Tasks shall include, but are not limited to, the following:

1. Check cable connections.

2. Check proper operation of equipment.

3. Adjust all presets; consult Owner's personnel.

4. Recommend changes to the AVS to improve Owner' utilization of the system.

5. Provide a written report of adjustments and recommendations.

3.07 TRAINING

A. AVS training shall be provided for the operator/user and technical staff. Operator/user training shall minimally consist of 8 ea. 1-hour sessions. Technical operation and maintenance training session shall minimally consist of 8 ea. 1-hour session. Training sessions to be coordinated with the Owner and scheduled throughout the 1-year warranty period.

B. A complete operation and maintenance manuals and preliminary as-built drawings shall be delivered to the Owner one week prior to the training sessions.

C. Operator/user training shall minimally consist of:

D. Provide custom system specific printed reference material for each trainee that documents and explains in layman's terms:

1. System block diagram.

2. Normal day-to-day operation.

3. Operator selectable features.

4. Provide a hands-on training with Q & A session.

E. Provide and review a custom, system specific, quick reference guide for the inexperienced operator.

F. Technical Operations and Maintenance training shall consist of:

1. The technical explanation shall be sufficiently thorough that: staff personnel shall be able to make any programming changes required, analyze malfunctions and make equipment substitutions or bypasses necessary to maintain system operation except for the malfunctioning equipment or circuits.
2. Provide printed reference material for each trainee that documents and explains in technical terms:
   a. System block diagram with technical features.
   b. Technical operation, adjustments and programming.
   c. System features and programming.
   d. Review of as-built drawings.
   e. Provide a hands-on training with Q & A session.

3.08 WARRANTY

A. The Contractor shall warrant the system for parts and labor for one (1) year. Warranty commences at the time of substantial project completion and acceptance by Owner. Nothing shall be construed to limit this obligation to a shorter period.

B. Warranty service shall be rendered on-site by request of Owner to repair or replace any defective materials, equipment and workmanship without cost to the Owner, unless the Owner has previously given the Contractor a written acceptance of such condition.

C. The Owner shall give prompt notice of the defect(s) either verbally or in writing to Contractor.

D. Perform preventative maintenance during the warranty period, which includes:

1. Cleaning and inspection of all devices every 6 months.

2. Clean and vacuum console and rack equipment every 6 months.

3. Service technician performing service / warranty work shall check-in and out with Owner for each visit.

4. Provide a written report to Owner documenting any work performed during the warranty period within 24 hours of such event. Report shall detail work performed, equipment repaired or replaced, etc.

5. Provide loner equipment that is equivalent to the malfunction equipment for any equipment not field repairable.

6. The Owner reserves the right to expand or add to the system during the warranty period using firm(s) other than the Contractor for such expansion without affecting the Contractor's responsibilities, provided the expansion is performed by an authorized dealer for the affected equipment.

7. Contractor shall maintain all equipment software, hardware and firmware to the most recent version available at the time of acceptance and during the warranty period. Contractor shall furnish a log of all software and firmware versions unitized in the system.

3.07 REPAIR OR REPLACEMENT SERVICE

1. Repair or replacement service during the warranty period shall be performed 7 days a week, 24 hours a day and with a 4 hour response time.

2. Emergency repair or replacement service during the warranty period shall be performed 7 days a week, 24 hours a day and with a 1 hour response time.

3. If the Contractor cannot restore system operation during the warranty period within 2 business days of the system failure, the Owner reserves the right to require the Contractor to provide on-site manufacturer's service technicians at no additional cost.

4. During warranty period, limit equipment repair to two (2) times. If any device requires repair for a third time, contractor shall replace the equipment at no additional cost to the Owner.

3.08 SUBSTANTIAL COMPLETION

A. Work must meet the following requirements to qualify for the Owner's consideration of Substantial Completion:

1. All AVS devices shall be fully installed, powered, online and fully operational.

2. All sub-system interfaces must be complete and operational.

3. All training complete.

4. Owner may utilize the system for its designed intent.

B. Contractor will provide a list of remaining work items and approximate completion date.

C. Contractor will certify in writing that all remaining work is minor in nature and will be completed in less than 30 days.

3.09 TESTING REQUIREMENTS

A. The Contractor shall perform sample tests in the presence of the Consultant and Owner. Performing the testing procedures specified herein assures that the communication cabling and system electronics meets the performance characteristics specified.

B. All testing shall comply with EIA/TIA Standards and that of the equipment manufacturers. If testing indicates that the performance characteristics are not met, the test shall be failed test and any other test that may be affected by the modification and/or repair shall be rerun and verified.

C. Test equipment will be provided by the Contractor to test and to certify the 100% operational condition of all materials and equipment.

D. The Contractor shall prepare and submit all test procedures and data forms for the pre-installation, post installation and subsystem test to Owner. The test procedures shall have Owner approval before the tests.

3.10 SYSTEM CHECK OUT AND VERIFICATION

A. Verify continuity of cabling between field devices and controllers.

B. Commission all devices from field to front end.

C. Contractor supplied "As Built" Drawings shall show conduit routing.

D. Review all as-built documentation and Operation and Maintenance manuals with Owner. Revise and reissue as required.

E. Provide as-built documentation in hard copy, PDF and AutoCAD formats.

F. Demonstrate proper sequences of operation for all devices.

3.11 FINAL ACCEPTANCE OF SYSTEMS

A. Each area of construction completed and submitted as complete shall meet the following criteria under testing:
   1. System must meet all specifications as described in these instructions.
   2. Operational prints, manuals, signal logs, an as built prints must be furnished.
   3. Visual testing and signal verification will be conducted at random locations to determine that equipment performs satisfactorily.

B. Specifications set forth for construction of the system have been devised in order to insure system compatibility and performance. Compliance to these specifications will be determined during periodic observances of construction. Repeated failure to comply with the specification will be considered before the initial acceptance phase of the plant

commences.

C. Within ten days receipt of the final acceptance notice, the Owner's representatives shall schedule and perform the final inspection. When the work is found acceptable under the contract documents and the contract is fully performed, declare the project complete.

3.12 PRICING FORMS

A. In addition to all other required bid forms, Contractor shall prepare and present to Owner and Owner's representative pricing based on the requirements of 27 40 16.

B. Pricing shall include the list of equipment and labor in tabular form including; part number, item description, unit price, number of units, extended price and totals. The pricing shall breakdown the material and labor in the categories.

C. Contractor shall provide Service Agreement pricing levels for terms of 1, 2 and 3 years. Breakout service pricing levels by response times of within 2 hours, 24 hours or more than 24 hours.

END OF SECTION 27 40 16

SECTION 28 00 00 – ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.01 PROJECT SUMMARY/OVERVIEW

A. This document covers the general requirements for work to be performed to provide electronic security and surveillance at the M.D. Anderson Cancer Center 1MC Tenant Build-out Phase 3 project.

B. The contents of this document are critical to the security of the MDACC-1MC and are considered confidential. This information shall not be disclosed to anyone other than authorized personnel.

C. The security systems shall consist of the following integrated subsystems as specified herein:

1. Electronics Access Control and Intrusion Detection
2. Electronic Surveillance
3. Electronic Racks, Cabinets and Enclosures
4. Wire and Cable

D. Provide all work as detailed in the Contract Drawings as a turn-key installation including all material, labor, programming, as-built documentation, warranties, taxes, freight and permits. (unless otherwise noted including, but not limited to, networking equipment) Only items and requirements specifically stated to be provided under another section shall not be a requirement for this section of the work.

E. Related Sections include:

1. Section 087100 Door Hardware
2. Section 142000 Elevators
3. Section 260000 Electrical
4. Section 270000 Communications
5. Section 270528 Pathways for Communications Systems
6. Section 271100 Communications Equipment Room Fittings
7. Section 271300 Communications Backbone Cabling
8. Section 281000 Electronic Access Control and Intrusion Detection
9. Section 282000 Electronic Surveillance
10. Section 283100 Fire Alarm and Smoke Detection

1.02 GENERAL REQUIREMENTS

A. Upon completion of commissioning testing and Owner acceptance, 4b Technology Group bears no liability or responsibility for the continued proper operation of the installed systems.

B. The items described herein shall not be modified or submitted without consent of 4b Technology Group and/or the owner.

C. Electronic security systems integrator (security subcontractor) manager/supervisor shall attend meetings arranged by the Contractor, Architect, Owner (including project meeting as scheduled by UTPD), and by any party affected by the work of this Section 280000.

D. If the manufacturer of security devices or connecting hardware has supplied post manufacture performance data, copies of such are to be kept for inclusion in the documentation and made available to the Owner upon request.

E. All materials are to be new unused and of the latest series of model number, unless otherwise indicated by the Owner or security system designer.

F. The Owner has indicated that their preferred manufacturer for the Access Control and Intrusion Detection is Software House Ccure 8000 on this project to insure compatibility and interoperability with existing installed systems (no deviations allowed}.

G. The Owner has indicated that their preferred manufacturer for the IP Video Management System (VMS) is Pelco Endura on this project (no deviations allowed).

1. All electronic surveillance integrators on-site must be Endura Certified.
2. On-site Pelco Professional Services shall be used for a minimum of 5 days.

H. All security contractor personnel must be manufacturer certified and capable of an installation that falls under the manufacturer's guidelines necessary to obtain a manufacturer warranty. The integrator shall provide all components/materials essential for a complete and functional security access and surveillance system.

I. Security contractor shall issue a two (2) year warranty on installation and workmanship from system acceptance established by the University of Texas Police Department at Houston.

J. These Specifications and Drawings are intended for bidding purposes only. No part shall be copied or used for any purpose other than bidding on this project. This package shall be contractual upon bid award.

K. Drawings and Specifications are to be used in conjunction with one another and to supplement one another. In general Specifications determine the nature and quality of the materials and tests, and drawings establish the quantities, details and give characteristics of performance that should be adhered to in the installation of the security system components. If there is an apparent conflict between the drawings and specifications, or within the specifications themselves. the items with greater quantity or quality shall be estimated and installed. Clarification with the Owner/Designer about these items shall be made prior to purchase and installation. Questions regarding the Specification or system requirements should be directed in writing to 4b Technology Group or the Owner.

L. The security integrator shall adhere to Div. 1 general requirements and written security Specifications and Drawings within this construction package and shall be responsible for complying with all local. state and federal laws or regulations applicable to the work being performed, even though said law, rule or regulation is not identified herein

M. The security integrator shall arrange and pay for any inspections required by the public agencies having jurisdiction in the area.

N. The security integrator shall procure and maintain for the duration of this agreement, insurance against claims for injuries to persons or damages to property which may arise from, or conjunction with, the performance of the work hereunder by the security contractor, his agents, representatives, or employees. The security contractor shall pay the cost of such insurance.

O. The security integrator will respect and protect the privacy and confidentiality of the Owner, his employees, processes, products, and intellectual property to the extent necessary, consistent with the legal responsibilities of the State of Texas and the Owner.

P. If required the security subcontractor shall sign a non-disclosure agreement and abide by its requirements to keep confidential all information concerning bid documents and this Project.

Q. Furnish submittals and manuals in accordance with Div. 1.

R. Furnish a detailed material list complete with suppliers (distributors) list of components and distributors name, address, and phone number.

S. Refer to Specifications issued by Architect, Division 1, for Project and cost payments.

1.03 REFERENCES

A. The publications listed below form a part of this Specification. The publications are referred to in the text by basic designation only.

B. Specific reference in Specifications to codes, rules, regulations, standards, manufacturer's instructions, or requirements of regulatory agencies shall mean the latest printed edition of each in effect at the date of contract unless the document is shown dated.

C. Where conflicts exist between referenced requirements, comply with the more stringent requirement. For conflicts between referenced requirements and contract documents comply with the one that is more stringent.

1. Federal, State, and Local codes, regulations and ordinances
2. NFPA 101: Life Safety Code
3. NFPA 730: Guide for Premises Security
4. NFPA 731: Standard for the Installation of Electronic Premises Security
5. National Electric Code (NEG), latest edition.
6. Building Codes (UBC) (IBC), latest editions.
7. Occupational Health and Safety Act (OSHA).
8. Americans with Disabilities Act (ADA).
9. Local Governing Authorities Having Jurisdiction.
10. Underwriters Laboratory (UL) Applicable Standards for Safety and Security
11. Institute of electrical and Electronics Engineers (IEEE) Applicable Standards
12. Electronic Institute of America (EIA) Applicable Standards
13. Telecommunications Industry Association (TIA) Applicable Standards
14. BICSI Electronic Safety and Security Design Reference Manual (ESSDRM).
15. MDACC Design Guidelines for Security Systems
    a. http://www2.mdanderson.org/depts/cpm/standards/specs.html#div28)

D. Related Documents.

1. Drawings, general provisions of contract, uniform general conditions, supplementary general conditions, architectural plans & specifications, requirements of Division 1, electrical, mechanical specifications and plans and security plans.

1.04 DESCRIPTION OF SYSTEM WORK

A. Furnish and install all materials, tools, equipment, and services for all electronic security/surveillance devices to provide functioning systems in accordance with performance requirements specified and any modifications resulting from reviewed shop and filed coordinated drawings.

1. Electronic Access Control: This system replaces the typical mechanical key controlled door lock with a door locking system that uses an access card as the access credential. The system includes an electric door-locking mechanisms, card reader located adjacent the door, door status sensor, door prop alarm and a request to exit device. Typical system configuration is card or schedule controlled entry with free exiting.
2. Intrusion Detection System: This system monitors areas for unauthorized entrance or intruder. This system can consist of motion sensors, door status sensors, glass break sensors and one or more control keypads. The keypad is used to arm/disarm system through the use of a Software House LCD reader and accomplished by badging and authorized credential.
3. Duress Button: These buttons, also known as panic buttons, are installed in locations where potential personal safety or security threats exist. Depressing the button sends a silent priority alarm signal to University of Texas at Houston Police Department (UTPD) with location and specific alarm information. The panic button is usually located in the knee space underneath a desk or service counter.
4. Police Help Call Station: The typical system is a distinct box or pole with a call button, "Police Emergency" signage and a blue locator lamp. Depressing the call button puts the individual in direct voice contact with UTPD along with specific location information and provides an alarm signal into the access control system. These can be interior or exterior installations. Typical installations are parking lots or remote areas where personal safety is a concern.
5. Surveillance: This system is used to provide VMS of security sensitive areas and target items.

B. Drawings are representative and show general arrangement of systems and equipment, except when dimensioned or detailed. For exact locations refer to dimensioned architectural drawings.

1. Field measurements take precedence over dimensioned drawings.
2. Field verify locations and arrangement of all systems and equipment.
3. Coordinate all work with other trades and Contractor.

C. Electronics systems work as specified in this Section and Sections 280500, 281000 282000 includes.

1. Project kick-off/pre-submittal meeting with the Architect, Designer, and Contractor to review security design package. Additional participants shall include Division 8, 14 and Division 26 subcontractors.
2. Preparation of pre-installation submittals, including point-to-point wiring information for security equipment to interface to work by others prior to start of any installation work. Include lock permit requests in submittals for review.
3. Furnishing and installation of all security devices, components and accessories.
4. Furnishing and coordination on installation of special back boxes for security equipment and field devices as required.

5. Equipment Racks and Cabinets shall to be furnished and installed by the Security contractor. Coordinate location size and positioning of racks and cabinets with telecommunication contractor.
6. Furnishing, installation and termination of all copper wiring and cabling including any special purpose wire and cable for electronic security systems. Coordinate all network and fiber optic cable interface provided by telecommunications subcontractor.
7. Coordinate raceway and power distribution systems power provided by Division 26.
8. Provide and install 12/24 VAC/DC input power to all field devices as required.
9. Coordination with other trades and Owner required to facilitate the installation of the security equipment. Coordination shall include Division 8 (doors), Division 26 (power, raceways, and fire alarms), Division 14 (elevator controls), Division 27 (telecommunications network interface).
10. Wiring and termination of electrified door hardware by security subcontractor shall be concurrent with the installation of these electrified components by the door hardware subcontractor.
11. Programming of all security control equipment and prior coordination with the Owner's security and telecommunications personnel. Refer to MDACC specification 28 05 00 for programming particulars and details.
12. Preparation of "As-Built" documentation.
13. Testing and adjustment of completed work.
14. Warranty service for completed work.

1.05 SUBMITTALS

A. See requirements of Division 1.

B. No submittals will be reviewed until security system integrator qualifications are approved; including, but not limited to SoftwareHouse Ccure and Pelco Endura certifications.

C. Pre-fabrication submittals for electronic security shall be complete and submitted at the same time. No partial electronic security systems submittals will be accepted for review. Allow 2 weeks for consultant review of submittals.

D. Submittal Product Data shall include:

1. Equipment schedules listing all system components, manufacturer, model number and quantities of each.
2. General functional description of each system.
3. Floor plans necessary to identify specific device locations, cable routes and quantities, cable types, riser locations, and references to installation details and diagrams.
4. Riser diagram showing routes between floors or other areas that are not easily identified on the floor plans.
5. Complete manufacturer's technical data including manufacturer warranty information, descriptive literature, illustrations, and installation instructions for all components included within this project indicating compliance with applicable referenced standards, size, dimensions, model number, electrical characteristics, support requirements, connection requirements and all applicable information verifying that submitted components comply with Contract Documents.
6. Security one line diagrams showing all input and output points of the system.
7. All cable and wiring types for each device type used.
8. Power supply points listing with devices and maximum loads to prevent overloading.

9. Certification that lock wiring and access control systems requirements have been coordinated with electrified door hardware, fire alarm systems, automatic door controls, and overhead door controls specified in other sections and other packages.

E. Security Design Drawings to be supplied by 4b Technology Group or the Architect for security subcontractor to prepare Master "As-Built" drawings.

F. As-Built drawings shall be in current AutoCAD format, same version as used by the Architect. Dimensions and scale of the drawing sheets submitted shall match the size of the drawing used for the contract documents, and shall include the following.

1. Utilize normally recognized drafting procedures that match AutoCAD standards, Architect, and Designer guidelines and methodology.
2. The As-Built drawings shall incorporate all changes made to the building identified in, but not limited to, Addenda, contemplated change notices, Site Instructions or deviations resulting from site conditions.
3. Dimensioned plan and elevation views of all security components.
4. Transformer and amplifier locations identified.
5. Cable routing paths of security cables to identified infrastructure pathways.
6. All rack and cabinet locations and labeling thereof.
7. One-line diagrams of equipment/device interconnecting cabling of the security systems.
8. Standard or typical installation details of installations unique to Owner's requirements.
9. Submit one soft and one hard copy with project deliverables within 30 days of project completion.

G. LAN/WAN Network Devices:

1. All LAN/WAN Networked Devices shall require an additional submittal to identify the Medium Access Control (MAC) address (Layer 2) of each provided device, the location to be installed and the port configuration needed for communication. The expected turnaround time for this data to be provided to the contractor is 3 weeks.

H. FPT Documentation

1. All FPT Documentation shall require an additional submittal to ensure the accuracy of the detailed devices to be tested and their programming of the electronic security system (s}. The expected turna round time for this date to be provided back to the contractor is 3 weeks. Programming will not be allowed on the electronic access control system until the submittal of the FPT documents has been approved.

I. Post Installation Meetings:

1. At the time of substantial completion the contractor shall call and arrange for a post installation meeting to present and review all submittal documents to include but not be limited to As-Built Drawings, Test reports, Warranty paperwork, etc. Attendees shall be Client staff, 4b Technology Group, GC, and others that the GC deems appropriate.
1. At this meeting the contractor shall present and explain all documentation, asking for feedback on its completeness. Any discrepancies or deviations noted by and agreed to by participants shall be remedied by the contractor and resubmitted within one week of the meeting.

J. Security integrator shall provide three (3) copies of the O&M Manual at the conclusion of the project which will include, but not be limited to the following requirements:

1. Ring binder with project title and contractor's name on cover and spine including:
   a. Sequence of operations, design philosophy, and specific functions
   b. System block diagram
   c. List of system associated mechanical locking keys with key codes and tamper resistant hardware types.
   d. Equipment list, including a brief description, model, and the total number of each item used in the project.
   e. Manufacturer warranty information specifically indicating the manufacturer agreement to repair or replace components that fail in materials or
   f. Camera schedule including: number, location, camera model/manufacturer, view, lens, power source, multiplexer/input, settings entered on site, etc.
   g. Manufacturers' data sheet and O&M manual for associated equipment.
   h. Maintenance Data: Servicing requirements, inspection data, preventative maintenance schedule, exploded assembly views, replacement part numbers and availability, location and contact numbers of service depot.
   i. Loose leaf pocket containing as-built drawings for each floor plan layout and rack and wall elevation layouts. Each drawing shall show: cable type and identifier, actual cable routing pathway, device number (camera, etc.), and device input/output number.
   j. Final test data (measured video levels, day & night camera snapshots in JPEG format and other significant operating parameters).

1.06 QUALITY ASSURANCE

A. Electronic security systems integrator (security subcontractor) shall meet the following minimum requirements.

1. All work specified herein shall be the responsibility of a single electronic security systems integration contractor. Bidders shall document a minimum of five years' experience in the fabrication, assembly and installation of system of similar complexity as specified herein. The documentation shall include the names, locations and points of contact for at least three installations of the type and complexity specified herein. The bidders shall provide a brief overview of each system detailing what Access Control/Intrusion Detection system and Surveillance system that was used; the amount of equipment installed, and certifies that the system has been in operation for a minimum of 24 months.
2. The Contractor (security integrator) shall have a service facility and organization with staffing capable of providing comprehensive maintenance and service to the specified systems within 4 hours after being called, 24 hours per day and 7 days a week.
3. The Contractor (security integrator) shall provide in-house engineering and project management capabilities consistent with the requirements of the work. The Contractor shall have a project manager and field supervisor in place which oversees the entire project till completion of the project. The assigned project manager will be responsible for coordination, scheduling, manpower, functional performance testing (FPT) etc. of the project. The Contractor's field supervisor shall be present during the full duration of the project to oversee field installations and to coordinate with other trades to ensure progress on the project.

4. The Contractor (security integrator) shall provide factory certified technicians to work on any Software House iSTAR or Pelco Endura component installed on this project. In addition, the individual(s) who will be programming on the CCURE 800 must be certified by Software House as a factory certified technician. All technicians who will be working on the site must be licensed through the State of Texas as a Security Installer.
5. The contractor (security integrator) must maintain an operating facility in the local area (50 mile radius) of the Project location to provide service to the Owner for the warranty period. At the Owners request for service, the security integrators shall dispatch a service technician to the location (normally with four hours) to affect the required repairs or adjustments. If necessary repair cannot be made at the time of the service call the integrator shall provide “loner” devices to restore the system to proper operation.
   a. The contractor shall maintain a spare parts inventory necessary to resolve component failures of the system.
6. A BICSI RCDD shall approve all on-site work as a recognized member of the Contractor's installation team. All installation team members must demonstrate knowledge and compliance with all BICSI, TIA/EIA, UL, and NEC methods, standards and codes.

B. Security integrators desiring approval must comply with Division 1 requirements.

C. Security integrator must be cognizant of site conditions, verify locations of new and existing equipment, and determine exact requirements for connection and interface.

1.07 DELIVERY, STORAGE AND HANDLING

A. Equipment and components shall be delivered properly protected and undamaged with original containers, packaging, and labels intact.

B. Store, handle, and protect all related materials and equipment in accordance with Manufacturer's recommendations.

C. Provide additional protection during handling as necessary to prevent breaking, scraping, marring, or otherwise damaging products or surrounding areas.

D. Equipment and components shall be protected from the weather, humidity, temperature variations, dirt, dust, or other contaminants. Equipment damaged prior to system acceptance shall be replaced at no cost to the owner.

E. Protect all equipment and components that are to be installed from theft, vandalism, or use by unauthorized persons.

1.08 PROJECT/SITE CONDITIONS

A. Security contractor is responsible for conducting a site survey prior to the commencement of work to determine locations of all existing security devices and verify the proposed locations of the new components to be installed.

B. Security contractor will coordinate all work through the Contractor and schedule work to cause as little interference or interruption of existing services as possible.

C. Security contractor will arrange and pay for all necessary permits, licenses, and inspections. Security contractor shall prepare all information necessary to obtain a permit for Electronics Locking Mechanisms in compliance with the Owner requirements.

D. Verify with Division 26 installer all conduit and special back box requirements in a timely manner

1.09 WARRANTY

A. See requirements in Division 1 Specifications.

B. The Security Integrator shall warrant all completed work, including all materials and labor, to be free from defects in design, workmanship, and/or materials for a period of two (2) years from final acceptance date.

1. System acceptance is defined as the completion of all functional performance testing and the resolution of all punch list items.

C. Warranty Service

1. In the event that defects in the materials and/or workmanship are identified during the warranty period, the contractor shall provide all labor and materials to correct the deficiency.
2. All service work shall be performed by factory certified technicians.
3. All warranty service shall include the replacement of all parts and or components as required to restore normal system operation. If parts or components need to be repaired, a loaner will be supplied and installed until the part or component can be repaired and reinstalled.
4. Immediately following a warranty service request, the Contractor shall provide written documentation to The University of Texas Police Department (UTPD) which details the service work completed, cause of trouble, and any outstanding work required to restore a complete and normal system.

D. Repair and/or Replacement Service shall be performed within two schedules dependent on criticality:

1. Schedule One - 7 days a week 24 hours a day
2. Schedule Two - 8am to 5pm on business days

E. Schedule One shall apply to major system components:

1. iSTAR Controllers
2. Building Perimeter Doors (ground level or pedestrian bridge)
3. Code Blue emergency communication devices failures
4. Endura cameras and components

F. Schedule Two shall apply for all other components and devices not included in Schedule One.

G. All repairs shall be completed within 48 hours upon site arrival. If the failure exceeds 48 hours, UTPD reserves the right to require the contractor to provide on-site manufacturer support at no additional cost to UTPD.

H. The University of Texas Police Department reserves the right to expand or add to the system during the warranty period using an installer/integrator other than the Contractor for such expansion without affecting the contractor's responsibilities, provided that the installer/integrator used is an authorized dealer for the equipment or system being expanded.

I. Extended warranties on equipment components offered by the manufacturer shall be passed through to the Owner. Warranty provisions shall be fully transferable only at the direction of the Owner, in the event that ownership of the installed security systems is transferred.

1.10 EXTRA MATERIALS

A. The Contractor will maintain a spare parts inventory to resolve any critical component failure the day of the incident. Critical components shall include:

1. iSTAR Controllers - ACMs and GCMs
2. Card Readers
3. Motion Detectors
4. Door Position Switches
5. Cameras
6. Endura Components
7. Power Distribution Unit Components (any and all components)

B. Provide for delivery and use of loaner equipment by the manufacturer within 48 hours of failure while failed parts are repaired. After the return of the repaired equipment, UTPD will retain the loaned equipment for a period of not less than 30 days for video retrieval.

1.11 SYSTEM STARTUP

A. After all systems have been tested, accepted and turned up for operation, the Security Contractor shall provide “User Training” to client personnel.

1. The Ccure 8000 training shall cover all newly installed components, devices and systems. The training period shall be at least sixteen (16) hours for up to four (4) people of the clients choosing.
2. The Endura training shall cover all newly installed components, devices and systems.
3. The integrator shall provide for two people, of MDA Anderson’s choosing, to be trained and certified on the Endura system at Pelco's Training facilities in Clovis, CA including ALL travel expenses.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturers are shown in individual specification sections.

B. Equipment manufacturers and model numbers indicated in individual specification sections are identified as minimum equipment requirements.

C. All substitutions shall meet or exceed these minimum requirements and must be approved by the Owner/Architect prior to purchase.

D. All manufacturers' equipment shall be available through a nationally recognized supplier network.

2.02 EQUIPMENT

A. Provide security fasteners on all equipment, device plates, etc. within public areas.

1. Allen head with center pin, hardened steel.
2. Provide four (4) fastener tools to Owner.

B. Equipment installed in exterior applications shall be fitted with fasteners and exposed surfaces of stainless steel or other corrosion resistant material.

C. All materials and equipment used must be new and unused, prime quality products.

D. All equipment connected to AC circuits shall be protected from power surges. Equipment protection shall meet requirements of ANSI C62.41. Fuses shall not be used for surge protection.

E. All equipment or components installed on the exterior of a building where the equipment is subject to adverse weather/elements shall be enclosed in weatherproof enclosures.

F. Enclosures and boxes to be NEMA 3R hot dipped galvanized steel, weatherproof cast iron, or NEMA 4X stainless steel.

G. All mounting and support hardware shall be hot dipped galvanized or stainless steel.

2.03 WIRE AND CABLE

A. Minimum Specifications

1. All wire and cable shall be Underwriter's Laboratories (UL) approved for its intended application, shall meet all national, state and local code requirements for its application, and shall meet or exceed manufacturers' recommendations for the components connected.
2. Provide Plenum-rated cable as required by code.
3. All wire and cable shall meet individual system or subsystem manufacturer specifications. All cabling shall be in accordance with the PDS standards set in place by MD Anderson.
4. Wire and cable shall comply with the applicable requirements of the National Electrical Code (NEC), latest edition, in regards to cable construction and usage.
5. Insulation shall be rated for a minimum of 300 volts

B. All conductors and cable shall meet individual security system manufacturer specifications.

1. Provide shielded conductors and cable as required by the manufacturer or as required to provide for interference-free signals.
2. Color coding shall be accomplished by using solidly colored insulation. Grounding conductors, where insulated, shall be colored solid green or identified with green color as required by NEC.

C. Increase conductor sizes on cables as required to be consistent with circuit current ratings, length of wire runs, and manufacturers' recommendations

1. Alarm device field wiring shall be in accordance with the equipment manufacturer's specifications.
2. Low voltage power circuits shall use conductors as required by the equipment manufacturer's specifications.
3. Plenum rated cable shall be used as required by code.

D. Follow requirements as outlined in Sections on Structured Cabling Systems for all telecommunications interface cables.

1. Intra-building data communications circuits shall incorporate category 5e, 6, or 6a UTP cable.

E. Patch Cables:

1. Provide pre-manufactured patch cables (cable, connectors, boots, etc.) as required to connect security systems to voice and data communication outlets.
2. Patch cables shall be certified for their specific use to meet or exceed applicable industry specifications (e.g. EIA/TIA, ETL, UL, CSA, etc.)
3. Provide cable lengths as necessary to neatly route cables through cable management systems and other cable organization systems.
4. Provide connectors as required for proper termination. Provide boots for connectors where applicable to prevent snagging.

F. The minimum conductor sizes are for distances as per the manufacturer's specifications from security device to security panel. The contractor shall size the conductor accordingly for longer runs. Minimum Conductor and Cable Types and Sizes.

1. Low Voltage Power Cable
   a. 18AWG, twisted, stranded, insulated, and jacketed
2. Card Reader Cable
   a. 20 AWG, stranded, individually shielded twisted pairs, insulated and jacketed
3. Alarm Point Monitoring Cable
   a. 20 AWG, twisted, stranded, insulated, and jacketed
4. Control Point Cable (Non-power)
   a. 20 AWG, twisted, stranded, insulated, and jacketed
5. Control Point Cable (Low Voltage Power)
   a. 18 AWG, twisted, stranded, insulated, and jacketed
6. Composite Cable
   a. All Composite cable shall meet all of the above requirements. There shall not be a drain that is over the entire composite cable bundle, it shall be limited to the reader cable only.

G. Coaxial Cable

1. RG-59/U with a minimum center conductor of 20AWG solid, bare copper and overall bare copper braided shield shall be used for cable runs less than 750 feet.
2. RG-6/U with a minimum center conductor of 18AWG solid, bare copper and overall bare copper braided shield shall be used for cable runs more than 750 feet.
3. Coaxial cables with copper coated steel center conductors will not be acceptable.
4. Provide 20 feet of additional cable for each camera mounted in accessible ceilings to provide for flexibility in camera placement.

5. All Coaxial Cable runs shall have a service loop of 20 feet to compensate for any final field modification. The cable shall be bundled and wrapped neatly in the above ceiling.
6. All Coaxial Cable shall never be subjected to a bend less than a 6 inch radius.
7. Coaxial Cable connectors shall consist of three piece crimp connectors.

PART 3 - PRODUCTS

3.01 CONTRACTOR ACCESS

A. Access to SMS is limited to UTPD approved system nodes. Contractors shall perform all programming from UTPD Technical Services workroom unless otherwise approved by UTPD Project Management.

B. Access to SMS server is prohibited

C. Access to UTPD HUB rooms requires prior notification and approval from UTPD project management. Access requires contractor with Pelco and Integral Manufacturer Certification to be present at all times. No access will be granted outside normal working hours of UTPD Technical Services Component.

3.02 INSTALLATION

A. All personnel working on this project shall be experienced, highly skilled installers with a minimum of three (3) years' work on similar type projects.

B. Changes in location of any work require the written approval of UTPD prior to initiation.

1. Changes in indicated sizes shall not be made without the written approval of UTPD.

C. Install all equipment in accordance with manufacturer's recommendations.

D. All systems shall be designed and installed to provide 24 hour a day, 7 days a week operation.

E. Provide all necessary anchoring devices and supports.

1. Use structural supports suitable for equipment, or as indicated.
2. Check loading and dimensions of equipment with shop drawings.
3. Do not cut or weld to, building structural members.

F. General wiring installation

1. Run wire with conduit, exposed above accessible ceilings, below accessible floors, in floor cable trays and in riser rooms.
2. Utilize cable trays whenever possible.
3. All cabling shall be installed per Owner's requirements.
4. All wire ways shall be per construction documents. If the construction documents do not detail a wire way, it is the responsibility of the security contractor to provide their own wire way.
5. Provide plenum cable when ran thru Plenum areas.
6. Provide code compliant fire proofing techniques for all penetrations of fire rated partitions and slabs.
7. Fasten cables throughout cable paths securely to building structure every 10 feet at minimum.

8. Cable runs shall be continuous from device location to the final point of termination.
9. Provide grommets and strain relief material where necessary to avoid abrasion of wire and excess tension on wire and cable.

G. Component Connections

1. The following components must be labeled utilizing an approved labeling device with the above mentioned device naming standards:
   a. Card Readers - Both in the field and in the panel where it terminates. Field Labeling shall be affixed to the bottom, if not applicable on the inside edge, of each device.
   b. Cameras - Both in the field and where it terminates. Field Labeling shall be affixed to the camera above the ceiling, if not applicable the top edge of housing.
   c. All other previously listed security devices shall be labeled on the cable where it terminates to the device and where the cable terminates to the security controller or power supply.
2. Prepare wire ends for attachment to components in accordance with manufacturer recommendations.
3. Wire nuts shall not be an acceptable means of connecting wire and cable. All connections shall be made by crimp connection only.
4. Connections shall be labeled with the above mentioned device naming standards.
5. Controller Connections
6. Contractor shall not connect any iSTAR controller to the system outside of UTPD Technical Services Component's normal business hours. All initial system activations shall be performed and tested prior to implementation on the production environment.

H. Provide labeling suitable to Owner for all major equipment components. Coordinate with Owner on numbering scheme to match existing. Major equipment components are comprised of:

1. All security equipment racks, cabinets, and enclosures including access control and power supply cabinets/enclosures.
2. Video monitors, CCTV system matrix units, video distribution/line amplifiers, digital video recorders, and quad units.

I. Label all cables and wiring using waterproof, self-adhesive computer printed labels. Label both ends of each cable. At multi conductor cable terminations label each conductor.

J. Permanently label bulkhead connectors on all coaxial and fiber patch panels to indicate the cable/fiber strand, application, and origination point.

K. Provide a complete cable identification plan/list with project completion submittal.

L. Coordinate extension and connection to commercial, emergency/UPS power circuits provided by Division 26. Make power connections in accordance with Division 26.

M. All installation of security systems shall be complete at least thirty calendar days prior to occupancy

3.03 ADJUSTING

A. Ensure that all provisions and requirements of this specification are met. Verify through inspections, demonstrations and tests

B. Perform required tests to demonstrate workmanship, operation, and performance.

1. Conduct tests with Architect/Owner and if required, inspectors of agencies having jurisdiction present.
2. Arrange test dates in advance and give all parties a minimum of 48 hours' notice.

C. Repair or replace equipment or systems found defective or inoperative and re-test until 100% satisfactory results are obtained.

D. Verification inspections will be made of all equipment components and installations for proper functioning of locking hardware and lock controls, mounting/placement of sensors, and cameras, etc. to guarantee requirements of the Specifications are complied with. The Owner's quality control representative shall have the opportunity to witness all inspections, or to conduct installation inspections of his own.

3.04 SYSTEM ACCEPTANCE

A. Functional Performance Testing (FPT) requires that an authorized representative of the University of Texas at Houston Police Department review all security technology components to assure they are properly installed, functional, and integrated into UTPD's existing security technology infrastructure.

B. Functional Performance testing shall begin when the following conditions exist:

1. All perimeter doors as defined above in Schedule A are 100%
2. All Cameras and equipment are 100%
3. All critical and high priority devices are 100%
4. All other doors are 90%

C. All FPT documentation shall utilize UTPD's Functional Performance Testing Documentation.

1. See UTPD FPT Documents
2. The Contractor shall provide two weeks advance notification to UTPD for scheduling of the Initial FPT.
3. The Contractor shall provide four copies of recorded drawings and four copies of completed FPT Documents before the FPT process is to start.
4. The Contractor shall provide in ACAD an electronic version of the recorded documents before the FPT process is to start.

D. The Contractor shall provide the Project Manager, Field Supervisor and a CCURE Certified Technician during the FPT process for adequate support during the testing process.

1. The Contractor shall staff the CCURE Monitoring Station to acknowledge alarms during the testing.
2. The Contractor shall accompany UTPD in the field to assist in the functional demonstration of security devices.
3. The Contractor shall supply four radios, two for the CCURE Monitoring Stations and two for the field, to allow for efficient communication between the FPT personnel.

E. The Contractor shall complete the punch-list developed and distributed by UTPD.

1. The Contractor shall produce documentation to demonstrate the punch-list has been completed and the installation is at Final Completion.

F. Once system acceptance has been established by UTPD, that date will be the beginning of the warranty period.

G. UTPD reserves the right to suspend and/or terminate testing at any time when the system fails to perform as specified.

H. In the event that the Contractor, Architect, or UTPD are required to witness a retest at a later date because the subcontractor is not properly prepared to conduct the acceptance tests or because the systems being tested have failed such tests, which shall be solely determined by UTPD, the cost of witnessing additional tests shall be borne exclusively by the security subcontractor. Costs are to be based on time and materials at the established rates of the Architect or UTPD.

END OF SECTION 28 00 00

SECTION 28 10 00 – ELECTRONIC ACCESS CONTROL AND INTRUSTION DETECTION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 SUMMARY

A. Provide all work as detailed in the Contract Drawings as a turn-key installation including all material, labor, programming, as-built documentation, warranties, taxes, freight and permits. Only items and requirements specifically stated to be provided under another section shall not be a requirement for this section of the work.

B. The end product by which the security contractor is to produce shall be a complete, operational and functional access control system.

C. Systems and Equipment

1. Provide the following systems and equipment:

a. Battery backup lock power supplies with fire alarm interface

b. Interface to electrified door hardware

c. Infrastructure for card access control doors

d. Access control printers

e. Access Control Management System (ACMS)

f. System sensors, initiating devices, connectors and equipment enclosures

g. Wire and Cable

D. Coordination

1. Coordinate all installation of the access control system with the following related systems:

a. Video Surveillance

b. Door Hardware

c. Fire Alarm

d. Elevator

e. Electrical

f. Telecom

1.03 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the Contract Documents.

1.04 QUALITY ASSURANCE

A. Contractor Qualifications

1. All work specified herein shall be the responsibility of a single electronic security systems integration contractor. Bidders shall document a minimum of five years experience in the fabrication, assembly and installation of system of similar complexity as specified herein. The documentation shall include the names, locations and points of contact for at least three installations of the type and complexity specified herein. The bidders shall provide a brief overview of each system detailing what access control system was used; the amount of equipment installed; and certify that the system has been in operation for a minimum of 24 months.

2. The contractor shall have a service facility and organization with staffing capable of providing comprehensive maintenance and service to the specified systems within 4 hours after being called, 24 hours per day and 7 days a week.

3. The Contractor shall provide in-house engineering and project management capabilities consistent with the requirements of the work. The Contractor shall have a project manager and field supervisor in place which oversees the entire project till completion of the project. The assigned project manager will be responsible for coordination, scheduling, manpower, functional performance testing (FPT) etc. of the project. The Contractor's field supervisor shall be present during the full duration of the project to oversee field installations and to coordinate with other trades to ensure progress on the project.

4. The Contractor shall provide factory certified technicians to work on any Software House Istar installed on this project. In addition, the individual(s) who will be programming on the CCURE 800 must be certified by Software House as a factory certified technician. All technicians who will be working on the site must be licensed through the State of Texas as a Security Installer.

5. The Contractor must be familiar with local codes and contract conditions pertaining to this project.

B. Product Standards

1. All materials installed on this or any other project must be new and the latest specification and version from the manufacturer.

2. All products installed shall be what is depicted in these specifications with no exceptions.

1.05 SUBMITTALS

A. General:

1. All submitted data shall be specific to this project and identified as such. Generic submittal data will not be accepted.

2. Submit transformer and amplifier locations for review.

B. Product Data:

1. Manufacturers descriptive literature, illustrations and installation instructions for all components included within this project indicating compliance with applicable referenced standards, size, dimensions, model number, electrical characteristics, support requirements, connection requirements and all applicable information verifying that submitted components comply with Contract Documents.

C. Record Documents:

1. Identify transformer and amplifier locations on the record drawings.

2. Manufacturer's warranty form in which manufacturer agrees to repair or replace components that fail in materials or workmanship within specified warranty period.

D. Operation and Maintenance Data:

1. Operation Data: Include manufacturer’s installation and operating instructions.

2. Maintenance Data: Servicing requirements, inspection data, preventative maintenance schedule, exploded assembly views, replacement part numbers and availability, location and contact numbers of service depot.

E. LAN/WAN Network Devices:

1. All LAN/WAN Networked Devices shall require an additional submittal to identify the MAC Address of the Contractor provided device, the location to be installed and the port configuration needed for communication. The expected turnaround time for this data to be provided back to the contractor is 3 weeks.

F. FPT Documentation

1. All FPT Documentation shall require an additional submittal to ensure the accuracy of the detailed devices to be tested and their programming in the ACMS. The expected turnaround time for this date to be provided back to the contractor is 3 weeks.

1.06 DELIVERY, STORAGE AND HANDLING

A. Equipment and components shall arrive on-Site properly protected and undamaged with containers, packaging and labels intact.

B. Store, handle and protect materials and equipment in accordance with Manufacturer's recommendations.

C. Provide additional protection during handling as necessary to prevent breaking scraping, marring, or otherwise damaging products or surrounding areas.

D. Protect all equipment and components that are to be installed within this project from theft, vandalism, and exposure to rain, freezing temperatures and direct sunlight.

E. Protect installed equipment and components from damage and prevent use by unauthorized persons.

1.07 EXTRA MATERIALS

A. Spare Parts

1. The Contractor will maintain a spare parts inventory to resolve any critical component failure the day of the incident. Critical components shall be:

a. Istars – ACMs and GCMs

b. Card Readers

c. Motion Detectors

d. Door Position Switches

1.08 WARRANTY

A. Warranty

1. The Contractor shall warranty the completed work for a period of two years, from the date of system acceptance, to be free of defect in design, workmanship or material.

2. System acceptance is defined as the completion of all functional performance testing and the resolution of all punch list items.

B. Warranty Service

1. In the event that defects in the materials and/or workmanship are identified during the warranty period, the contractor shall provide all labor and materials to correct the deficiency.

2. All service work shall be performed by factory certified technicians.

3. All warranty service shall include the replacement of all parts and or components as required to restore normal system operation. If parts or components need to be repaired, a loaner will be supplied and installed until the part or component can be repaired and reinstalled.

4. Immediately following a warranty service request, the Contractor shall provide written documentation to The University of Texas Police Department (UTPD) which details the service work completed, cause of trouble and any outstanding work required to restore a complete and normal system.

C. Repair and/or Replacement Service

1. Service shall be completed within two schedules dependent on criticality:

a. Schedule One – 7 days a week 24 hours a day

b. Schedule Two – 8am to 5pm on business days

D. Schedule One shall apply to major system components:

1. Istars

2. DVRs

3. Building Perimeter Doors (ground level or pedestrian bridge)

4. Code Blue emergency communication devices failures

E. Schedule Two shall apply for all other components and devices not included in Schedule One.

F. All Repairs shall be completed within 48 hours from site arrival. If the failure exceeds 48 hours, UTPD reserves the right to require the contractor to provide on-site manufacturer support at no additional cost to UTPD.

G. The University of Texas Police Department reserves the right to expand or add to the system during the warranty period using firms other than the Contractor for such expansion without affecting the contractor's responsibilities, provided that the firms used are authorized dealers for the equipment or system being expanded.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.02 ACESS CONTROL MANAGEMENT SYSTEM (ACMS)

A. System Description

1. The existing ACMS consists of a CCURE 8000 platform with the majority of the system consisting of Istar security controllers.

2. The current location for the ACMS Server is in the Cancer Prevention Building data center and is monitored by several functional components of UTPD.

3. All Istars shall communicate via the existing Ethernet infrastructure. All Istars shall have network connectivity within 10 feet, provided by others. The Contractor shall provide all jumper cables to connect to wall jacks.

B. Acceptable Manufacturer

1. Software House Istars with 16 card reader capacity, NO EXCEPTION.

2.03 ACCESS CONTROL

A. Doors controlled by card readers

1. Card Reader and remote control of access points including doors, sliding doors, elevators and hall calls.

2. Control point outputs for lock power and device control activated by a card reader or ACMS.

3. Card Reader Controlled Doors

4. Provide Card Readers

B. Door Switch Monitors

1. Provide one normally closed magnetic door position switch for each leaf of card reader controlled doors to monitor door status. These inputs shall be wired with supervision.

C. Request-to-exit (REX)

1. Provide REX motion sensors for Maglock Doors only.

2. Wire the REX motion sensor to the Door REX Input. This input shall be wired for supervision. The configuration on this motion shall be non-resettable and activate for only two seconds.

3. Doors equipped with electrified locksets shall have integrated REX switches. This hardware is provided by others. This hardware should be installed by the security contractor to ensure proper installation and to prevent the damage of the REX switch.

4. Doors equipped with electrified crashbars shall have integrated REX switches. This switch shall be supplied and installed by the security contractor. The crashbar shall be installed and supplied by others.

D. Card Reader Controlled Sliding Doors

1. Provide Card Reader.

2. Provide Door Position Switch

3. Interface the Card Reader Control Point to the Sliding Glass Door to activate and deactivate locking solenoid and to enable and disable the outside motion detector.

4. The egress motion detector shall always unlock and open the sliding door and send a signal to the ACMS to shunt the notification of an intrusion alarm.

E. Card Reader Controlled Elevators

1. Provide Card Reader.

2. The ACMS shall provide for card reader control of Elevator Floor select buttons.

3. When the card reader is in Card Access mode a properly programmed card is to be presented and the SMS shall enable the floor select buttons and the user shall be able to select the appropriate floor select button for access.

4. The contractor shall provide a relay for every floor in every cab. For example, if there are 8 floors and 8 cabs, 64 relays will be supplied by the contractor.

5. The ACMS shall allow button selection for 5 seconds per valid card read.

6. When the card reader is in free access the floor select buttons shall operate normally.

F. Card Reader Controlled Elevator Hall Call Buttons

1. Provide Card Reader.

2. Provide Card Reader adjacent to hall call station. When the card reader is in Card Access mode a properly programmed card is to be presented and the SMS shall enable the hall call button and the user shall be able to select the button for access.

3. The contractor shall provide a relay for every button being controlled at the hall call station.

4. The ACMS shall allow button selection for 5 seconds per valid card read.

5. When the card reader is in free access the hall call buttons shall operate normally.

2.04 SMS PROGRAMMING

A. The CCURE 8000 manages all card access, burglar and panic alarms, TDLs, pull stations, door contacts; and can receive integrated video surveillance feeds with all points. In order for monitoring and repair personnel to maximize the system, it is required that devices are programmed with consistency for easier user interface and identification.

B. Programming Istars

1. All devices shall be flashed to concur with current ACMS firmware version

2. Device naming standards

3. Building in which Istar is installed

4. Room number in which Istar is installed

5. If more than one Istar in a room, then name them “#1”, “#2”, etc.

a. Example: ACB. 1.111 #1 or ACB 1.111 #2

C. Programming Istar Clusters

1. All clusters shall only contain a single Istar device (Master)

2. Cluster naming standards

3. Building in which the controller is installed

4. If there is more than one, then name them “#1”, “#2”, etc.

5. Then add the word “Cluster”

a. Example: ACB 1.1111 Cluster or ACB 1.1111 #2 Cluster

D. Programming Alarm Points – The Alarm Point should be left in default programming for clear identification of where the device is terminated.

E. Programming Readers – The Reader should be left in default programming for clear identification of where the device is terminated.

F. Programming Outputs – The Output should be left in default programming for clear identification of where the device is terminated.

G. Doors will be programmed to include the Building Acronym and Room Number followed by a brief description of the area.

1. If doors is located in corridor or other common area the nearest Room Number shall be utilized

a. Example: ACB 1.111 Histotechnology Lab

2. Events to be programmed for each door will be Force Open, Held Open, and Communication Failure.

3. The text to be written in the Configure/Event window under “Display this line when activated” category should correspond specifically with the title of the event.

a. Example: If the event is titled Force Open, then the displayed line should contain the above door programming followed by DOOR FORCED OPEN

H. The same holds true for Held Open and Comm Fail events. The category “Display this line when activated” should contain the above door programming “DOOR HELD OPEN” and “COMM FAIL” respectively.

I. In all the above noted events, the category “Display this line when deactivated” should contain the above door programming followed by “NORMAL”.

J. Alarm Point Programmed Events will be programmed using the Building Acronym, Room Number, brief description of the area and the Device Name.

1. The following type devices are used throughout campus:

a. Panic (for all Duress Buttons)

b. Burglar (for all Intrusion Zones)

c. Police Pull Stations (for UTPD Blue Pulls)

d. TDL (for Time Delayed Locks)

e. Door Open (for all Door Contacts not associated to Readers)

f. Motion Detectors

g. Communication Phones

h. Emergency Phone Station

i. AED (AED Defibrillators)

j. Fire Notifiers

k. ITI Alarms

2. The text to be written in the Configure/Event window under “Display this line when activated” category should correspond specifically with the title of the device.

a. Example: If the device is titled “Panic”, then the category “Display this line when activated” should contain the above device programming followed by “PANIC IS IN ALARM”.

b. The same holds true for all the other devices respectively. The category “Display this line when activated” should contain the above device programming followed by “IS IN ALARM”.

c. In all the above noted devices, the category “Display this line when deactivated” should contain the above device programming followed by “IS NORMAL”.

3. The event priority shall be programmed as follows:

a. Critical

1) Blue Pull Stations

2) Panic Buttons

3) Emergency Phone Stations

4) Fire Alarms

5) Sensitive Areas defined as:

a) Irradiator Areas

b) Cashier Areas

c) Pharmaceutical Areas

b. High

1) Exterior Doors

2) TDLS

3) Intrusion Zones

4) HUB and other Telecommunication Areas

c. Medium

1) Other Doors

2) Communication Failure

3) Tamper Alarms

4) AED Defibrillators

d. Low

1) None

K. Groups will be built for ease of testing (Monitoring Privileges) and other uses later. All devices programmed that correlate to the below noted groups will be placed in those groups. Groups to be built include:

1. Input (Note: All inputs will be placed in an ALL INPUTS GROUP)

2. Output

3. Event

4. Elevator

5. Reader

6. Floor

L. If the project is a new building, then the groups will be named by the Building and Device Group. For example:

1. “ACB Input Group”

2. “BSRB Elevator Group”

3. “Faculty Center Reader Group”

M. If the project is a smaller build out or renovation, then the groups will be named by the Building, the new area being renovated, and the Device Group. For example:

1. “ACB Mammography Output Group”

2. “PPB Dispatch Reader Group”

3. “SCRB Cafeteria Event Group”

2.05 EQUIPMENT REQUIREMENTS

A. Istars

1. Shall be a 16 Card Reader panel with 64mb Ram.

2. Shall have 20% room for expansion (readers, inputs and outputs).

3. Shall have all alarmed inputs supervised.

4. If doors are wired Wiegand, with no Reader Modules (RM4s or the like) then a Software House I-8 board will be installed at the panel for all alarm point monitoring. All Door Contacts will be programmed for inputs 1-8 and all REXs will be programmed on inputs 9-16 on the ACM.

B. Tamper Switches

1. Provide Normally Closed plunger type tamper switches to monitor the status of Istars, PDUs and APSs.

C. Card Readers (NO EXCEPTIONS)

1. Proximity Reader

a. HID RP40

2. Proximity Mullion Mounted

a. HID RP15

3. Proximity Elevator Mounted

a. HID RP40

4. Proximity Hall Call Mounted

a. HID RP40

5. Intrusion Zone Reader

a. Software House RM2L-PH

6. Card Readers shall be of proximity technology and shall read encoded data from access cards and transmit the data to the Istars.

7. LED Configuration

a. Wire and program card reader LEDs to indicate the conditions and functions as follows:

b. RED LED in the normal locked state

c. GREEN LED upon a valid card read and the door is the unlocked mode

d. Flashing RED LED upon an invalid card read, forced door and held open door alarm conditions

e. Card Reader LEDs shall operate identically throughout the project.

D. Electric Locking Mechanisms

1. all interfacing of all electrically controlled devices

2. Electrified locksets and pass thru hinges shall be installed by the security contractor to ensure proper installation and to prevent damage of the integrated REX switch.

a. Locksets, hinges, crashbars and power supplies for crashbars are supplied by others.

3. Delayed Egress Locking Devices (DELD)

a. This hardware will be provided by others

b. All DELDs will be monitored for:

1) Door position switches

2) Alarm activation

c. Will require remote reset thru a control point from the Istar via ACMS.

d. Will require interface thru Fire Alarm System. The relay is to be provided by others, the interface to be completed by the security contractor.

E. Request-to-exit (REX) Motion Sensor

1. Detection Technology: Passive Infrared

2. Detection Pattern: Coverage of door opening

3. Output Contact: Normally open contact that closes on activation (activation for 2 seconds)

4. Power Requirements: 24V DC

5. Mounting: Surface mount to wall, ceiling or door mullion
6. Acceptable Manufacturer:
   a. Bosch/Detection Systems Inc. (DS150i) (NO EXCEPTIONS)

F. Door Position Switches
1. Normally Closed door position switches.
2. Acceptable Manufacturer:
   a. Sentrol 1078 (NO EXCEPTIONS)

G. Overhead Door Position Switches (ODPS)
1. Configuration: DPDT
2. Construction: Heavy Duty
3. Mount: Floor
4. Provide armor cable from ODPS to junction box.
5. Acceptable Manufacturer:
   a. Sentrol 2507 (NO EXCEPTIONS)

H. Duress Pull Stations
1. RSG/AAMES - Security Model RMS-6T-UT (NO EXCEPTIONS)
2. Device to be wired normally closed.

I. Personnel Duress Alarm
1. United Security Products - Model HUB2SA (NO EXCEPTIONS)
2. Device to be wired normally closed.
3. Devices to be mounted under desks, verify locations with owner.

J. Direct Dial Telephone Units
1. Provide Direct Dial Telephone Units.
2. Provide Direct Dial Telephone Units with 2 Form C Relays for alarm signaling to ACMS.
3. One relay is to be programmed for activation of device (future alarm call up capability).
4. One relay is to be programmed for door release.
5. The door release shall be wired to the Istar and an event programmed to perform the door unlock for remote entry.
6. The numbers to be dialed will be given per location installation.

7. The Contractor shall mount all Direct Dial Telephone Units such that they are flush mounted when applicable.

8. Acceptable Manufacturer:

   a. Select Engineering Systems, Inc. model SAT3R (NO EXCEPTIONS)

K. Power Supplies

1. Provide power supplies for all ACMS equipment.

2. The power supply for the Istar shall have a minimum 4 hour backup and shall not be shared with any other security device.

3. Acceptable Manufacturers - Software House APS AS0063-00 (NO EXCEPTIONS)

4. Provide power for all electric locking mechanisms except Delayed Egress Locking Devices and Electric Latch Retraction Devices.

5. All PDUs controlling security devices, other than readers shall be 24 Volts DC.

6. Fail Secure Locks shall operate normally upon fire alarm activation and during power failure conditions.

7. Fail Safe Locks shall unlock under the following conditions:

   a. Building Fire Alarm

   b. Loss of Istar Power

   c. Failure of the Power Supply

8. Provide Power Distribution boards with independent fused outputs and relays for all locking hardware. Power distribution boards for fail safe locks shall include a fire override relay. Interface the relay with the fire alarm system such that a dry contact from the fire alarm system shall remove power to all fail safe devices during a fire alarm condition.

9. Provide Power supplies with independent fused outputs for all other security devices ie. Local Alarm Panels, Motions, There shall be no bussing of any device requiring power.

10. Acceptable Manufacturers

    a. BASE Electronics

    b. Alarm-Saf

    c. Or UTPD approved equivalent

L. Elevator PDUs

1. Provide Elevator PDU.

2. Provide a relayed interface board to be the demarcation between the elevator signal wires and the security system relay boards (R8 or ACM outputs).

3. All wiring shall be completed such that in the event of a power failure, the elevators will operate normally.

4. Acceptable Manufacturers - Base Electronics (NO EXCEPTIONS)

5. Provide a key override switch on the Elevator PDU.

   a. Key Switch will disengage the security system so that the elevator can operate independently.

   b. When the Key Switch is used it will send a signal to the ACMS for acknowledgement of Elevator Bypass.

   c. Contractor shall supply one Key Switch for each elevator.

   d. The Key Switch shall accept a Best 7pin Core.

   e. Acceptable manufacturers - Designed Security Inc. Model ES450-K3 (NO EXCEPTIONS)

PART 3 - EXECUTION

3.01 PROJECT MEETINGS

A. Contractor shall be required to attend Project Meetings as scheduled by UTPD. The Contractor representative shall be the Security Project Manager, NO EXCEPTIONS.

3.02 CONTRACTOR ACCESS

A. Access to ACMS is limited to UTPD approved system nodes. Contractors shall perform all programming from UTPD Technical Services workroom unless otherwise approved by UTPD Project Management.

B. Access to ACMS server is prohibited

C. Access to UTPD HUB rooms requires prior notification and approval from UTPD project management. Access requires contractor with Manufacturer Certification to be present at all times. No access will be granted outside normal working hours of UTPD Technical Services Component.

3.03 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. All installation shall be in accordance with manufacturer's specifications and published recommendations.

C. Wiring

   1. Run wire with conduit, exposed above accessible ceilings, below accessible floors, in floor cable trays and in riser rooms.

   2. Utilize cable trays whenever possible.

   3. All cabling shall be installed per Owner's requirements.

   4. All wireways shall be per construction documents. If the construction documents do not detail a wireway, it is the responsibility of the security contractor to provide their own wireway.

5. Provide plenum cable when ran thru Plenum areas.

6. Provide code compliant fire proofing techniques for all penetrations of fire rated partitions and slabs.

7. Fasten cables throughout cable paths securely to building structure every 10 feet at minimum.

8. Cable runs shall be continuous from device location to the final point of termination.

9. Provide grommets and strain relief material where necessary to avoid abrasion of wire and excess tension on wire and cable.

10. Component Connections

    a. The following components must be labeled utilizing an approved labeling device with the above mentioned device naming standards:

    b. Card Readers – Both in the field and in the panel where it terminates. Field Labeling shall be affixed to the bottom, if not applicable on the inside edge, of each device.

    c. All other previously listed security devices shall be labeled on the cable where it terminates to the device and where the cable terminates to the security controller or power supply.

    d. Prepare wire ends for attachment to components in accordance with manufacturer recommendations.

    e. Wire nuts shall not be an acceptable means of connecting wire and cable. All connections shall be made by crimp connection only.

    f. Connections shall be labeled with the above mentioned device naming standards.

    g. Controller Connections

    h. Contractor shall not connect any Istar controller to the SMS outside of UTPD Technical Services Component's normal business hours. All initial system activations shall be performed and tested prior to implementation on the production environment.

3.04 SYSTEM ACCEPTANCE

A. Functional Performance Testing (FPT) requires that an authorized representative of the University of Texas at Houston Police Department review all security technology components to assure they are properly installed, functional, and integrated into UTPD's existing security technology infrastructure.

B. Functional Performance testing shall begin when the following conditions exist:

    1. All perimeter doors as defined above in Schedule A are 100%

    2. All critical and high priority devices are 100%

    3. All other doors are 90%

C. All FPT documentation shall utilize UTPD's Functional Performance Testing Documentation.

    1. See UTPD FPT Documents

2. The Contractor shall provide two weeks advance notification to UTPD for scheduling of the Initial FPT.

3. The Contractor shall provide four copies of recorded drawings and four copies of completed FPT Documents before the FPT process is to start.

4. The Contractor shall provide in AutoCAD an electronic version of the recorded documents before the FPT process is to start.

D. The Contractor shall provide the Project Manager, Field Supervisor and a CCURE Certified Technician during the FPT process for adequate support during the testing process.

1. The Contractor shall staff the CCURE Monitoring Station to acknowledge alarms during the testing.

2. The Contractor shall accompany UTPD in the field to assist in the functional demonstration of security devices.

3. The Contractor shall supply four radios, two for the CCURE Monitoring Stations and two for the field, to allow for efficient communication between the FPT personnel.

E. Punchlist is developed and distributed by UTPD

1. The Contractor shall produce documentation to demonstrate the punchlist has been completed and the installation is at Final Completion.

F. Once the system is accepted, the devices are then placed in the view of Police Communication Center for monitoring and dispatch. Once system acceptance has been established by UTPD, that date will be the beginning of the warranty period.

G. UTPD reserves the right to suspend and/or terminate testing at any time when the system fails to perform as specified.

END OF SECTION 28 05 00

SECTION 28 20 00 – ELECTRONIC SURVEILLANCE

PART 1 GENERAL

1.01 SUMMARY/OVERVIEW

A. This section provides specifications for the installation of the IP based Video Surveillance System (VSS) in the M.D. Anderson Cancer Center 1MC Build-Out Phase 3 project.

B. Related Sections include:

1. Section 142000 Elevators
2. Section 260000 Electrical
3. Section 270000 Communications
4. Section 271100 Pathways for Communications Systems
5. Section 271100 Communication Equipment Room Fittings
6. Section 271300 Communications Backbone Cabling
7. Section 280000 Electronic Security
8. Section 280500 Racks Cabinets and Enclosures
9. Section 281000 Electronic Access Control and Intrusion Detection

1.02 REFERENCES

A. See Section 280000 Electronic Security.

B. NTSC Color System Standards.

1.03 SYSTEM DESCRIPTION

A. Pelco Endura Surveillance System

1. The added Endura storage will be located in UTPD HUB room in 1MC4.2371.
2. All networking equipment shall be provided by MDACC IT department.
3. Video from all 1MC cameras transmitted on owner supplied network to the UTPD Hub Room.

B. The security contractor shall furnish and install the system within the MDACC-CRB complex, consisting of camera assemblies, network video servers, wiring & cabling not provided by telecom contractor. The network video servers shall be on emergency/UPS power.

C. The VMS software shall be loaded on MDACC provided and security integrator provided workstations to enable viewing of cameras or playback of recorded data via the owner's LAN/WAN.

D. Camera assemblies include camera, lens, housing, and mount. Scope of work shall be complete from point of origin to point of termination in the MDF/IDF room.

E. Coordinate all work that must be performed in the MDF/IDF room with the General Contractor, Telecommunications subcontractor, and Electrical subcontractor.

F. Surveillance images to be retained for at least 30 days for all cameras added in the system. The security integrator shall coordinate with the owner to verify if specific camera images require more or less retention time.

G. Testing of the system includes checkout of installed equipment back to the follow Security rooms to confirm proper operation of camera assemblies:

1. 1MC UTPD HUB Room
2. UTPD Police Communications Center (Physical Plant Building)
3. Backup Communications Center (Pickens Academic Tower)
4. Monitoring Services (1MC)
5. Pressler Garage Parking Services Office
6. Other remote monitoring workstations including, but not limited to:
   a. Offices for Neil Hart
   b. Offices for Diane Confer
   c. Offices for Dan Goolsby (located in 1MC)

H. Security integrator shall provide all necessary test equipment to fully demonstrate proper performance of field devices. Copies of test results shall be included in the project completion submittals given to UTPD including a copy of final video images once the camera system is accepted to serve as a quality and coverage baseline for subsequent viewing.

1.04 SUBMITTALS

A. Follow provisions of Section 280000 for additional requirements.

B. Project Data: Description of system operation indicating the purpose and capability of each device/component of the system with a functional diagram indicating all interfaces to other systems.

C. IP: Video Quality test reports shall be provided for all cameras to confirm an optimum high definition video signal.

D. Shop drawings shall reflect all requirements associated with Owner provided or existing equipment and materials that will be used as part of this system.

1. All cameras shown on the floor plan sheets shall be clearly numbered. Coordinate numbering scheme with UTPD.
2. Camera schedule including: number, location, camera model/manufacturer, view, lens, power source, multiplexer/input, settings entered on site, etc.

E. Product Data: Manufacturer's technical data sheets and specifications.

1.05 QUALITY ASSURANCE

A. Follow provisions of Section 280000.

1.06 DELIVERY, STORAGE AND HANDLING

A. See Section 280000.

1.07 PROJECT/SITE CONDITIONS

A. See Section 280000

1.08 WARRANTY

A. See Section 280000

PART 2 - PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Pelco Endura System

1. Endura NSM5200 Digital Recorders (quantity as required)

B. Lockable HUB room Cabinets

1. CPI N-Series TeraFrame
2. Cooper B-Line
3. Owner Approved Equivalent

C. IP Camera Dome Fixed Interior Cameras

1. Camera
   a. Pelco Sarix IDE10DN-O
2. Lens
   a. 13M2.8-12

D. Transaction' 1.3MP set to .5MP IP Camera Dome Fixed Interior Cameras

1. Camera
   a. Pelco Sarix IDE10DN-O
2. Lens
   a. 13M2.8-12

E. 'High Resolution' 2.1MP set to 1.3MP IP Camera Dome Fixed Interior Cameras

1. Camera
   a. Pelco Sarix IDE20DN-O
2. Lens
   a. 13M2.8-12

F. 'Identity' 4CIF IP Camera Dome Fixed Interior Cameras (For Wide Dynamic Range Locations Only)

1. Camera
   a. Pelco IP110-DWV9

G. Wire and Cable (Cat 5E cable by Division 27)

1. UTPD Approved Equivalent

H. Uninterruptible Power Supply (UPS)

1. APC Smart UPS
2. Minute-Man II
3. Owner Approved Equivalent.

PART 3 - PART 3 EXECUTION

3.01 EQUIPMENT REQUIREMENTS

A. Video Management System (VMS)

1. The VMS shall capture video images of the IP cameras and record data to the Endura storage devices in the UTPD HUB room.
2. The VMS shall provide for 10 second pre-alarm and 30 second post-alarm motion recording.
3. The Contractor shall program all camera inputs for video motion.
4. Minimum Specifications:
   a. Recording Rate:
      1) 'Identity' 4CIF cameras 15 images per second.
      2) 'Transaction' .5 MP cameras 20 images per second
      3) 'High Resolution' 1.3 MP cameras 15 images per second
   b. Image Quality:
      1) 4CIF cameras 640X480
      2) .SMP cameras 800X600
      3) 1.3 MP cameras 1280 x 1024
   c. Compression: H.264
   d. Storage Capacity: 30 Days plus 30 days of Endura Storage based on 50% motion recording.
   e. Mount: Cabinet Mounted

B. Camera requirements:

1. Provide backlight compensation for interior cameras with views that include exterior glass.
2. Provide Pelco IP110-DWV9 cameras with wide dynamic CCDs where extreme light levels changes may occur. Field Verify these locations prior to installation.
3. Field verify the exact camera location, position and mounting with the architect, UTPD and owner prior to installation.
4. Field verify and confirm camera views with UTPD and the owner prior to final installation and adjust camera positions and lens requirements as required.
5. Minimum Specifications:
6. Lens:
   a. All lenses to be vari-focal
   b. All cameras and lenses to be color
   c. All lenses to be auto iris

C. Camera Housings and Mounts

1. Wiring to all cameras shall pass from the back-box through the mount and into the housing. Exposed wiring of any kind shall not be acceptable.
2. All camera domes shall be smoked.

3.02 INSTALLATION

A. Refer to provisions of Section 280000

B. All devices and components shall be compatible.

C. Make all necessary adjustments to camera lenses to obtain clear, crisp images and desired field of view to the Owners satisfaction. Substitute camera lenses as necessary to obtain required field of view at no additional cost.

1. Adjust all cameras to specified resolution for area of install
2. Provide and install PoE mid-span devices as required to produce high definition images with no blurring/streaking or noticeable lag video line amplifiers as required to compensate for long cable runs and insure 1Vp/p video signals at all equipment inputs.

D. Video Integration with UTPD Security and Video Systems:

1. The security contractor is to integrate the VMS and the CCURE 8000 via ASCII text stream so that the alarmed events in CCURE automatically present themselves in the video monitoring application.
2. The security contractor is to integrate the VMS and the access control so that all new cameras on the UTPD camera system can be viewed through the VMS monitoring application.

E. Coordinate with Owner for all system programming requirements. Camera titles shall be consistent for all system components. Obtain a printout of all programming prior to system check out and final acceptance inspection. Provide a cross reference between specified camera numbers and programmed camera numbers.

F. Programming Standards

1. The cameras programmed in the VMS shall include the Building Acronym, Room Number, a brief description of the area and the port number on the PoE Switch.
   a. Example: 1MC 2.1946 Drug Storage
2. All VMS shall be programmed using the CCURE 800 CCTV Actions to call up cameras in the video monitoring application previously defined.
   a. CCURE CCTV Video actions shall be programmed for all Critical and High priority events for devices contained in a camera's field of view.

G. Install the initial system, setup parameters, and program all system components as necessary for proper operation. Submit all programming on electronic media to the Owner.

H. Install all Point-to-Point wiring with appropriate terminal connections for every wire and component termination so that all connections are mechanically and electrically secure.

I. Install field wiring in continuous lengths, without splices.

J. Verify upon job completion that all wiring and terminations are clearly labeled using the UTPD Video Programming standards to identify the wire and terminal.

END OF SECTION 28 23 00