

Project Manual

for

The University of Texas MD Anderson Cancer Center
Houston, Texas

TB Exhaust Thimble Relocation (Vet Med)

MD ANDERSON PROJECT: 18-0015

PROJECT DELIVERY METHOD: Job Order Contract

Issued for Bid Construction – June 22, 2018

OWNER'S REPRESENTATIVE

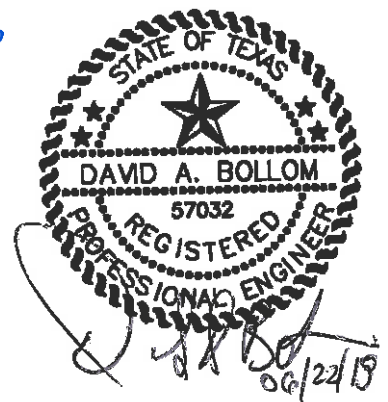
Michael Trest
Facilities Planning Design & Construction
University of Texas MD Anderson Cancer Center
6900 Fannin, Suite 10.1078
Houston, TX 77030
Phone: 713-563-3546

PROJECT ARCHITECT

Ronald T. Wedemeyer
Facilities Planning Design & Construction
University of Texas MD Anderson Cancer Center
6900 Fannin, Suite 8.1010
Houston, TX 77030

PROJECT MECHANICAL ENGINEER

David A. Bollom, P.E.
Facilities Planning Design & Construction
University of Texas MD Anderson Cancer Center
6900 Fannin, Suite 9.1028
Houston, TX 77030



PROJECT MANUAL TABLE OF CONTENTS

A – PROCUREMENT AND CONTRACTING REQUIREMENTS GROUP

DIVISION 00	PROCUREMENT AND CONTRACTING REQUIREMENTS	
	2013 Uniform General Conditions for University of Texas System Building Construction Contracts	Issued by Owner under separate cover for Contractor Procurement
00 25 00	Owners Special Conditions	Issued by Owner under separate cover for Contractor Procurement
00 25 00 A	Attachment “A” - Minimum Wage Rate Determination	Issued by Owner under separate cover for Contractor Procurement
00 25 00 B	Attachment “B” - Facilities Planned Utility Outages Policy	Issued by Owner under separate cover for Contractor Procurement
00 25 00 C	Attachment “C” - Project Sign Layout	Issued by Owner under separate cover for Contractor Procurement
00 25 00 D	Attachment “D” - Bastrop Visitation and Tour Policy Statement and Medical Documentation Requirements	Issued by Owner under separate cover for Contractor Procurement
00 73 16	Project Insurance (OCIP)	Issued by Owner under separate cover for Contractor Procurement

B - SPECIFICATIONS GROUP

DIVISION 01	GENERAL REQUIREMENTS	
01 31 00	Project Administration	Issued by Owner under separate cover for Contractor Procurement
01 32 00	Project Planning and Scheduling	Issued by Owner under separate cover for Contractor Procurement
01 35 16	Alteration Project Procedures	Issued by Owner under separate cover for Contractor Procurement
01 35 23	Project Safety (OCIP)	Issued by Owner under separate cover for Contractor Procurement
01 35 25	Owner Safety Requirements	Issued by Owner under separate cover for Contractor Procurement
01 35 25 A	Attachment “A” - Maintaining Indoor Air Quality During Construction And Maintenance Activities Policy	Issued by Owner under separate cover for Contractor Procurement

DIVISION 01	GENERAL REQUIREMENTS	
01 45 00	Project Quality Control	Issued by Owner under separate cover for Contractor Procurement
01 57 23	Temporary Storm Water Pollution Control	Issued by Owner under separate cover for Contractor Procurement
01 57 25	Dust Control Plan	Issued by Owner under separate cover for Contractor Procurement
01 77 00	Project Closeout Procedures	Issued by Owner under separate cover for Contractor Procurement
01 79 00	Demonstration and Training	Issued by Owner under separate cover for Contractor Procurement
01 89 23	Site HVAC Utilities Performance Requirements	Issued by Owner under separate cover for Contractor Procurement
01 91 00	General Commissioning Requirements	Issued by Owner under separate cover for Contractor Procurement

DIVISION 02	EXISTING CONDITIONS	REVISION
02 41 19	Selective Demolition	

DIVISION 09	FINISHES	REVISION
09 22 16	Non-Structural Metal Framing	
09 29 00	Gypsum Drywall	
09 91 00	Painting	

DIVISION 20	COMMON FIRE SUPPRESSION, PLUMBING AND HVAC REQUIREMENTS	REVISION
20 01 00	Basic Fire Suppression, Plumbing and HVAC Requirements	
20 05 29	Supports and Sleeves	

DIVISION 23	HEATING, VENTILATING, AND AIR CONDITIONING	REVISION
23 05 90	Contractor Coordination with Testing, Adjusting and Balancing	
23 05 93	System Testing, Adjusting and Balancing	
23 31 00	Ductwork	

END OF SECTION 00 01 10

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 become the Contractor's property and shall be removed from the Site with further disposition of the Contractor'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 brick and stone structures by sledging the masonry into removal sizes. Portions of such structures below the permanent ground-line, which will not in any manner interfere with the proposed construction, may be left in place, but removal shall be carried at least two feet below the permanent ground-line and neatly squared off.
- 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 09 22 16 – NON-STRUCTURAL METAL FRAMING

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.

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, or structurally equivalent), unless otherwise indicated.
 2. Thickness: 0.0179 inch (25 gauge, or structurally equivalent) where indicated.
 3. Thickness: 0.0329 inch (20 gauge, or structurally equivalent) where indicated.
 4. Thickness: As indicated.
 5. Depth: 3-5/8 inches, unless otherwise indicated.
 6. Depth: 6 inches where indicated.
 7. Depth: 4 inches where indicated.
 8. Depth: 2-1/2 inches where indicated.
 9. Depth: 1-5/8 inches where indicated.
 10. 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.

4. Thickness: 0.0179 inch (25 gauge) where indicated.
 5. Thickness: 0.0270 inch (22 gauge) where indicated.
 6. Thickness: As 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

1. Steel Stud Systems to Receive Metal Lath: Comply with requirements of ML/SFA 920, "Guide" "Specifications for Metal Lathing and Furring" applicable to each installation condition and type of metal stud system indicated.

- 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. At non-load bearing partitions constructed to underside of floor or roof deck, provide for ½ inch of deflection at studs. Attach studs to slotted track, or hold studs down from top of deep leg track and do not attach to track.
 - c. 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.
- F. For exterior soffits provide cross bracing and additional framing indicated or required to resist wind uplift.

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 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.
 - 1. Extend vertical jamb studs through suspended ceilings and attach to underside of floor or roof structure above.
- 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 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 agencies acceptable to authorities having jurisdiction.
- B. Perform gypsum board Work in accordance with recommendations of ASTM C 754 and 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 manufacturer's technical literature for each product and system indicated.
 2. 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.
- B. Shop Drawings:
1. Show details of fabrication and installation, including plans, elevations, sections, details of components and attachments to other work. Include scaled and dimensioned drawings showing control and expansion joints in walls and ceilings.
- C. Record Documents:
1. Provide record approved product data and shop drawings.
- 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 non-adhesive 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 from 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. Grid Suspension Systems:
 - a. Armstrong World Industries.
 - b. Chicago Metallic Corp.
 - c. USG Corporation.
 - 2. Gypsum Board and Related Products:
 - a. Georgia Pacific Corp.
 - b. Gold Bond Building Products Div., National Gypsum Co.
 - c. Temple-Inland.
 - d. USG Corporation.

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 653/A 653M, 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.
- H. Grid Suspension System: ASTM C 645, manufacturer's standard grid suspension system composed of main beams and cross furring members which interlock to form a modular supporting network.
1. Non Fire Rated Direct Hung Suspended Drywall Furring System: Heavy-duty, double web steel main and cross runners with 1-3/8 inch wide capped flange face for screw attachment, and channel type wall track at perimeter; Chicago Metallic "640 Furring System".

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 1396/C 1396M, "Regular" for vertical surfaces, "Sag-Resistant" for ceilings, and as follows:
1. Type: Type X where required for fire-resistant rated assemblies.
 2. Type: Foil backed where indicated.
 3. Edges: Tapered.
 4. Thickness: 5/8 inch, unless otherwise indicated.
 5. Subject to compliance with requirements, products which may be incorporated in the Work where "Regular" gypsum wallboard is indicated include:
 - a. "GP Gypsum Board"; Georgia Pacific Corp.
 - b. "Regular Gypsum Board"; Gold Bond Building Products Div., National Gypsum Co.
 - c. "SHEETROCK Brand Gypsum Panels"; USG Corporation.
 6. Subject to compliance with requirements, products which may be incorporated in the Work where "Type X" gypsum wallboard is indicated include:
 - a. "Firestop Type C"; Georgia Pacific Corp.
 - b. "Fire Shield G"; Gold Bond Building Products Div., National Gypsum Co.
 - c. "SHEETROCK Brand FIRECODE 'C' Gypsum Panels"; USG Corporation.

2.05 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, Corp.
- C. Metal Cornerbead and Edge Trim for Exterior Ceilings: Comply with ASTM C 1047, formed from rolled zinc.

2.06 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.

2.07 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 Sealants."
- 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. USG Corporation "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 Company.
- L. Security Mesh: $\frac{3}{4}$ inch x 16 gage, flatten.

2.08 TEXTURE FINISH MATERIALS

- A. Primer: Of type recommended by manufacturer of texture finish.
- B. Polystyrene Aggregated Finish for Ceilings: Manufacturer's standard proprietary product formulated with polystyrene aggregates for spray application, with surface burning characteristics of 25 per ASTM E 84, and in texture indicated.
- C. Products: Subject to compliance with requirements, provide one of the following products:
 - 1. "IMPERIAL QT SPRAY Medium Texture Finish"; USG Corporation.
 - 2. "IMPERIAL QT SPRAY Coarse Texture Finish"; USG Corporation.
 - 3. "Perfect Spray Medium"; Gold Bond Building Products Div., National Gypsum Co.
 - 4. "Perfect Spray Medium"; Gold Bond Building Products Div., National Gypsum Co.

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.
- F. Grid Suspension System: Attach perimeter wall track or angle where grid suspension system meets vertical surfaces. Mechanically join main beam and cross furring members to each other and butt cut to fit into wall track.
- 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.
- P. Seal penetrations and holes in Rated smoke walls to comply with requirements specified in Division 08 Section "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. Single Layer Fastening Methods: Apply gypsum boards to supports as follows:
 - 1. Fasten with screws.
 - 2. Fasten to steel framing with adhesive and supplementary screws.
- C. 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 plastic edge trim where indicated on wall panels at juncture with ceilings.

- F. 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.
- G. Install H molding in exterior gypsum drywall construction where control joints are indicated.

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. Pre-fill open joints and rounded or beveled edges, if any, using setting type joint compound.
- C. Apply joint tape at joints between gypsum boards, except where trim accessories are indicated.
- D. 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,
- E. 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.
- F. 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 than 12 inches above ceiling line, additional labeling shall be provided on the non-rated partition 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 APPLICATION OF TEXTURE FINISH

- A. Surface Preparation and Primer: Prepare and prime drywall and other surfaces in strict accordance with texture finish manufacturer's instructions. Apply primer to all surfaces to achieve texture finish.
- B. Finish Application: Mix and apply finish to drywall and other surfaces indicated to receive finish in strict accordance with manufacturer's instructions to produce a uniform texture matching Architect's sample without starved spots or other evidence of thin application, and free of application patterns.
- C. Remove any texture droppings or overspray from door frames, windows and other adjoining construction.

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 91 00 – PAINTING

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.

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 the 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.
- B. "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 and 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. Subject to compliance with above requirements, "Bio Zapp Paint Odor Eliminator" by Bio Zapp Laboratories, (941/922-9199) 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) Concrete: Provide two 4-inch-square samples for each color and finish.

- 2) Concrete Masonry: Provide two 4 by 8-inch samples of masonry, with mortar joint in the center, for each finish and color.
- 3) Painted Wood: Provide two 12 by 12-inch samples of each color and material on hardboard.
- 4) Stained or Natural Wood: Provide two 4 by 8-inch samples of natural and stained wood finish on actual wood surfaces.
- 5) 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.
- 6) Drywall: Provide two 12 by 12-inch samples of each color and finish.

B. Product Data:

1. Submit manufacturer's catalog cuts and descriptive information on each product used. Include preparation requirements and application instructions.

C. Record Documents: Provide record approved samples and product data.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to the job 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 deg 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 MANUFACTURERS

PPG Industries, Inc.
www.ppg.com

One PPG Place
Pittsburgh, PA 15272

Benjamin Moore Paints
www.benjaminmoore.com

101 Paragon Drive
Montvale, NJ 07645

Glidden Professional
www.gliddenprofessional.com

15885 West Sprague Road, Strongsville,
OH 44136

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 INTERIOR PAINTING SCHEDULE

- A. Gypsum Drywall; 2 finish coats over primer:
 - 1. Primer 1A:
 - a. PPG: Pure Performance Interior Latex Primer 9-900.
 - b. Benjamin Moore: N372 Eco Spec WB interior latex primer.
 - c. Glidden Professional: LM 9116 Lifemaster 0 VOC Primer.

2. Finish Coat 1A:
 - a. PPG: Pure Performance Interior Latex Eggshell 9-300.
 - b. Benjamin Moore: N374 Eco Spec WB Eggshell Finish.
 - c. Glidden Professional: LM 9300 Lifemaster 0 VOC Interior Eggshell.
3. Primer 1B:
 - a. PPG: Speedhide Zero Interior Latex Primer 6-4900.
 - b. Benjamin Moore: Fresh Start Primer 023 All Purpose 100% Acrylic Latex.
 - c. Glidden Professional: Lifemaster LM 9116 0 VOC Primer.
4. Finish Coat 1B:
 - a. PPG: Speedhide Zero Interior Latex Eggshell 6-4310.
 - b. Benjamin Moore: N538 Ultra Spec 500 Zero VOC Eggshell Finish.
 - c. Glidden Professional: Ultra-Hide No VOC Interior Eggshell Paint 1411 Series.

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 non-galvanized 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 of mechanical, electrical, and plumbing items is limited to exposed natural gas piping, exposed fire sprinkler piping, and roof top exhaust fan hoods. Items in mechanical and electrical rooms shall not be field painted unless otherwise scheduled on Drawings.
- 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. Finish interior of wall and base cabinets and similar field- finished casework to match exterior.
 9. Finish exterior doors on tops, bottoms, and side edges same as exterior faces.
 10. Sand lightly between each succeeding enamel or varnish coat.
 11. 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. Block Fillers: Apply block fillers to concrete masonry block at a rate to ensure complete coverage with pores filled.

1. Prime Coats: Before application of finish coats, apply a prime coat of material as recommended by the manufacturer to material that is required to be painted or finished and has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to assure a finish coat with no burn through or other defects due to insufficient sealing.
- H. Stipple Enamel Finish: Roll and redistribute paint to an even and fine texture. Leave no evidence of rolling such as laps, irregularity in texture, skid marks, or other surface imperfections.
- I. 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.
- J. Transparent (Clear) Finishes: Use multiple coats to produce a glass-smooth surface film of even luster. Provide a finish free of laps, cloudiness, color irregularity, runs, brush marks, orange peel, nail holes, or other surface imperfections.
 1. Provide satin finish for final coats.
- K. 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 weathering.
 - h. Dry opacity.
 - i. Accelerated yellowness.
 - j. Recoating.

- k. Skinning.
- l. Color retention.
- m. 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 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 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 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. 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 $\frac{3}{4}$ -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.

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.

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. 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.
- D. 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 and 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.

END OF SECTION 20 01 00

SECTION 20 05 29 – SUPPORTS AND SLEEVES

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.

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. Nail drive anchors, 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. 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.
- D. 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.
- E. 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. 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.
 6. Piping supported from the floor shall utilize corrosion resistant metal channels or brackets that are anchored to the floor slab.
 7. All water piping shall be isolated from building components to prevent the transmission of sound.
 8. 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.
- F. systems shall be Factory Mutual and Underwriters' Laboratories, Inc. listed and labeled.

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. 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.

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 $\frac{1}{2}$ 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. 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.
- X. 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..
- Y. 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.

END OF SECTION 20 05 29

**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 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. 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 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.

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. 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.
 - k. , design and actual.

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 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.

END OF SECTION 23 05 93

SECTION 23 31 00 – DUCTWORK

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.

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. AWS D1.1 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.

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.

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⁾
Exhaust Systems:		
General Lab Exhaust Air Device to Horizontal Distribution	316L Stainless Steel	Medium Pressure

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.

2.04 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

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. 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. All visible welds in ductwork between biosafety cabinets, canopy hoods and fume hoods and the ceiling shall be ground and polished.
- G. Project inspector shall be notified to inspect all field fabricated offsets before cover-up or external insulation is applied.
- H. Support flexible ducts as per SMACNA standards to prevent sags, kinks and to have 90 degree turns.
- I. 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 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