PROJECT MANUAL

July 22, 2020

Contract Documents

For the project titled:

TENNESSEE COLLEGE OF APPLIED TECHNOLOGY MEMPHIS

TCAT Memphis
New Building & Renovations

660 Mosby Avenue
Memphis, Tennessee 38105
TBR SBC No. 166/000-04-2013Y3

OWNER
STATE OF TENNESSEE
TENNESSEE BOARD OF REGENTS

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TCAT MEMPHIS
New Building & Renovations

SBC Project No: 166/000-04-2013Y3

OWNER
STATE OF TENNESSEE
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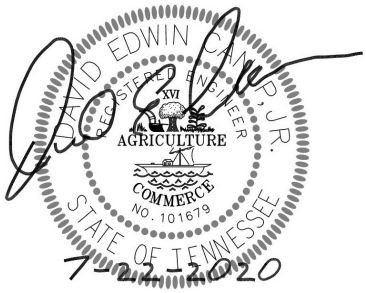
ARCHITECT
braganza design/ GROUP
2029 Peabody Ave., Memphis, TN 38104
Tel (901) 458-7600

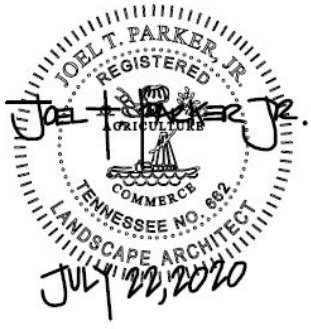
CONSULTING ENGINEERS:

Civil/ Structural
Burr & Cole Consulting Engineers, Inc
3485 Poplar Ave., Memphis, TN 38111

Mechanical
Barham Cain Mynatt, Inc.
1015 Cordova Station Rd., Cordova, TN 38018



Electrical
Canup Engineers, Inc.
7953 Stage Hills Blvd., Suite 107, Memphis, TN 38133



Landscape
KWA - Kersey/Wike Associates, P.C.
5050 Poplar Avenue Suite 1503, Memphis, TN 38157

SECTION 00 01 10
TABLE OF CONTENTS

DIVISION 0 - BIDDING AND CONTRACT REQUIREMENTS

Section 00 00 01 – Title Page
00 01 10 – Table of Contents
00 01 15 – List of Drawings
00 11 16 – Invitation to Bid
00 21 13 – Instruction to Bidders
00 25 13 – Pre-Bid Meetings
00 30 00 – Information to available to Bidders
00 31 32 – Geotechnical Information Available to Bidders
00 41 13 – Bid Form
00 45 21 – Drug-Free Workplace Affidavit
00 47 13 – Construction Bid Envelope
00 52 13 - Agreement
00 61 13 – Contract Bond
00 61 43 – Three Year Roof Bond
00 72 03 – General Conditions of the Contract (April 2019)

DIVISION 1 - GENERAL REQUIREMENTS

Section 01 11 00 – Summary of Work
01 22 13 – Unit Prices
01 22 15 – List of Unit Prices
01 23 00 – Alternates
01 25 13 – Product Substitution Procedures
01 25 33 – Product Substitution Request Form
01 26 00 – Contract Modification Procedures
01 26 20 – Weather Delays
01 26 25 – Weather Delay Report
01 26 40 – Form for Amendment, Change Order, or Directive
01 26 54 – Form for Price Summary
01 26 55 – Form for Price of Work
01 26 56 – Form for Price of Time
01 29 54 – Retainage Escrow Initiation
01 29 73 – Schedule of Values
01 29 76 – Progress Payment Procedures
01 31 19 – Project Meetings
01 31 90 – Administrative Logs
01 31 93 – Visitor Log
01 32 00 – Construction Progress Documentation

01 33 00 – Submittal Procedures
01 40 00 – Quality Requirements
01 41 15 – Basic Regulatory Requirements
01 45 29 – Testing Laboratory Services
01 50 00 – Temporary Facilities and Controls
01 57 23 – Temporary Storm Water Pollution Control
01 60 00 – Product Requirements
01 73 29 – Cutting and Patching
01 74 19 – Construction Waste Management and Disposal
01 77 70 – Closeout Procedures
01 78 01 – Closeout Submittals
01 78 25 – Data Binder Receipt
01 78 88 – Report of Subcontractors and Suppliers
01 79 21 – Demonstration and Training
01 79 25 – Demonstration and Training Verification
01 81 14 - High Performance Building Requirements (HPBr)
01 91 13 – Commissioning
01 91 23 – Performance Testing Identification Form
01 91 26 – Performance Testing Procedures Form
01 91 29 – Functional Performance Test Certificate

DIVISION 2 – SITE WORK
Section 02 40 00 – Existing Conditions and Demolitions

DIVISION 3 – CONCRETE
Section 03 30 00 – Cast-In-Place Concrete

DIVISION 4 - MASONRY
Section 04 05 10 – Mortar and Masonry Grout
04 05 23 – Masonry Accessories
04 20 00 – Unit Masonry
04 21 00 – Brick Masonry Veneer

DIVISION 5 – METALS
Section 05 12 00 – Structural Steel Framing
05 21 00 – Steel Joists
05 31 00 – Steel Deck
05 40 00 – Cold Formed Metal Framing
05 50 00 – Metal Fabrications
05 58 00 – Expansion Control

DIVISION 6 – WOOD, PLASTICS AND COMPOSITES

Section 06 10 53 – Miscellaneous Rough Carpentry
06 16 00 – Sheathing
06 40 23 – Interior Architectural Woodwork

DIVISION 7 - THERMAL AND MOISTURE PROTECTION

Section 07 14 16 – Cold Fluid-Applied Waterproofing
07 21 00 – Thermal Insulation
07 28 00 – Fluid-Applied Membrane Weather Barriers
07 42 13 – Metal Composite Wall Panels
07 50 36 – Total Roofing System Warranty
07 53 23 – Ethylene-Propylene-Diene-Monomer (EPDM) Roofing
07 62 00 – Sheet Metal Flashing and Trim
07 65 00 – Flexible Flashing
07 71 00 – Roof Specialties
07 72 00 – Roof Accessories
07 84 00 – Penetration Firestopping
07 84 43 – Joint Firestopping
07 92 00 – Joint Sealants

DIVISION 8 – OPENINGS

Section 08 11 13 – Hollow Metal Doors and Frames
08 31 13 – Access Doors and Frames
08 33 23 – Overhead Coiling Doors
08 41 13 – Aluminum Storefront and Entrances
08 71 11 – Door Hardware
08 80 00 – Glazing

DIVISION 9 – FINISHES

Section 09 22 16 – Non-Structural Metal Framing
09 29 00 – Gypsum Board
09 30 00 – Tiling
09 51 23 – Acoustical Panel Ceilings
09 61 00 – Concrete Floor Finish
09 65 13 – Resilient Base and Accessories
09 65 19 – Resilient Tile Flooring
09 68 13 – Tile Carpeting
09 91 23 – Painting

DIVISION 10 – SPECIALTIES

Section 10 14 00 – Interior Signage
10 21 13 - Toilet Compartments
10 28 00 – Toilet and Bath Accessories
10 44 13 – Fire Extinguisher Cabinets

10 44 16 – Fire Extinguishers
10 50 20 – Canopies

DIVISION 11 – EQUIPMENT

Section Not Used

DIVISION 12 – FURNISHINGS

Section 12 24 13 – Roller Window Shades

DIVISION 13 – SPECIAL CONSTRUCTION

Section Not Used

DIVISION 14 - CONVEYING SYSTEMS

Section Not Used

DIVISION 21 – FIRE SUPPRESSION

Section 21 05 00 – Common Work Results for Fire Suppression
21 05 48 – Vibration and Seismic Controls for Fire Suppression
21 10 00 – Water Based Fire Protection Sprinkler System

DIVISION 22 – PLUMBING

Section 22 05 00 – Common Work Results for Plumbing
22 05 29 – Hangers and Supports for Plumbing Piping Equipment
22 07 00 – Plumbing Insulation
22 11 16 – Domestic Water Piping
22 11 19 – Domestic Water Piping Specialties
22 13 16 – Sanitary Waste and Vent Piping
22 13 19 – Sanitary Waste Piping Specialties
22 15 13 – General Services Compressed Air Piping
22 34 00 – Fuel-Fired Domestic Water Heater
22 40 00 – Plumbing Fixtures

DIVISION 23 – HEATING, VENTILATING, AND CONDITIONING

Section 23 05 00 – Common Work Results for HVAC
23 05 10 – Indoor Air Quality Management Plan
23 05 13 – Common Motor Requirements for HVAC
23 05 29 – Hangers and Supports for HVAC Equipment
23 05 48 – Seismic and Wind Loading Restraints for HVAC
23 05 93 – Testing, Adjusting and Balancing for HVAC
23 07 00 – HVAC Insulation
23 08 00 – Commissioning of HVAC
23 08 13 – Sensor Point Calibration Check Sheet
23 09 00 – DDC Building Automation System
23 11 23 – Natural Gas Piping
23 31 13 – Metal Ducts
23 33 00 – Air Duct Accessories

23 37 13 – Diffusers, Registers and Grilles
23 73 33 – Fuel Fired Heating Equipment
23 74 13 – Packaged Rooftop Air Conditioning Units

DIVISION 26 – ELECTRICAL

Section 26 00 00 – Basic Electrical Requirements
26 05 19 – Low Voltage Electrical Power Conductors and Cables
26 05 26 – Grounding and Bonding for Electrical Systems
26 05 29 – Hangers and Supports for Electrical Systems
26 05 33 – Raceways and Boxes for Electrical Systems
26 05 48.16 – Seismic Controls for Electrical Systems
26 05 53 – Identification for Electrical Systems
26 08 00 – Commissioning of Electrical
26 08 06 – Panelboard Check Sheet
26 08 13 – Power Circuit Check Sheet
26 08 50 – Lighting Check Sheet
26 22 13 – Low Voltage Distribution Transformers
26 24 16 – Panelboards
26 27 26 – Wiring Devices
26 28 13 – Fuses
26 28 16 – Enclosed Switches and Circuit Breakers
26 51 19 – LED Interior Lighting
26 52 19 – Emergency and Exit Lighting
26 56 13 – Lighting Poles and Standards
26 56 19 – LED Exterior Lighting

DIVISION 27 – COMMUNICATIONS

Section Not Used

DIVISION 28 – ELECTRONIC SAFETY AND SECURITY

Section 28 05 13 – Conductors and Cables for Electronic Safety and Security
28 46 21.11 – Addressable Fire-Alarm Systems

DIVISION 31 – EARTHWORK

Section 31 00 00 – Earthwork
31 10 00 – Site Clearing
31 31 16 – Termite Control
31 32 00 – Soil Cement Base
31 57 13 – Erosion and Sediment Control

DIVISION 32– EXTERIOR IMPROVEMENTS

Section 32 12 16 – Asphaltic Concrete Paving
32 13 13 – Concrete Paving & Curbs
32 16 13 – Drainage Appurtenances
32 31 13 – Chain Link Fencing

DIVISION 33 – UTILITIES
Section 33 10 00 – Water Distribution
33 30 00 – Sanitary Sewer System
33 40 00 – Storm Drainage System

END OF CONTENTS

SECTION 00 01 15
LIST OF DRAWINGS

Sheet Number	Sheet Name	First Issue Date	Current Revision Number	Current Revision Date
01 General				
A0.0	COVER SHEET	10.18.19	6	07.22.20
A0.1	ABBREVIATIONS, LEGENDS & GENERAL INFORMATION	10.18.19	5	07.22.20
02 Life Safety				
LS1.0	BUILDING CODE ANALYSIS	10.18.19	6	07.22.20
LS1.1	OVERALL LIFE SAFETY PLAN	10.18.19	6	07.22.20
LS1.2	U.L. ASSEMBLY DETAILS	10.18.19	6	07.22.20
03 Civil				
C1.1	TOPOGRAPHIC SURVEY 1 of 4	10.18.19	2	07.22.20
C1.2	TOPOGRAPHIC SURVEY 2 of 4	10.18.19	2	07.22.20
C1.3	TOPOGRAPHIC SURVEY 3 of 4	10.18.19	2	07.22.20
C1.4	TOPOGRAPHIC SURVEY 4 of 4	10.18.19	2	07.22.20
C1.5	DEMOLITION PLAN	10.18.19	4	07.22.20
C1.6	DEMOLITION PLAN	10.18.19	4	07.22.20
C2.1	CIVIL SITE PLAN	10.18.19	5	07.22.20
C2.2	CIVIL SITE PLAN	10.18.19	3	01.24.20
C3.1	GRADING & DRAINAGE PLAN	10.18.19	5	07.22.20
C3.2	GRADING & DRAINAGE PLAN	10.18.19	4	07.22.20
C3.3	RETAINING WALL PLANS	10.18.19	4	07.22.20
C3.4	EROSION CONTROL PLAN PHASE 1	10.18.19	4	07.22.20
C3.5	EROSION CONTROL PLAN PHASE 2	10.18.19	4	07.22.20
C3.6	EROSION CONTROL DETAILS	10.18.19	4	07.22.20
C4.1	SANITARY SEWER SITE PLAN	10.18.19	4	07.22.20
C4.2	DOMESTIC & FIRE WATER PLAN	10.18.19	5	07.22.20
C4.3	DOMESTIC & FIRE WATER DETAILS	10.18.19	4	07.22.20
C5.1	CIVIL DETAILS	10.18.19	4	07.22.20
C5.2	CIVIL DETAILS	10.18.19	4	07.22.20
C5.3	CIVIL DETAILS	10.18.19	2	07.22.20
C5.4	CIVIL DETAILS	10.18.19	2	07.22.20

04 Arch. Site				
AS1.1	ARCHITECTURAL SITE PLAN	10.18.19	5	07.22.20
AS1.2	ENLARGED SITE PLANS	10.18.19	5	07.22.20
AS1.3	ENLARGED SITE PLANS	10.18.19	5	07.22.20
05 Landscaping				
L1.0	PLANTING NOTES	10.18.19	4	07.22.20
L1.1	PLANTING PLAN	10.18.19	4	07.22.20
06 Architectural				
A2.1	OVERALL FLOOR PLAN	10.18.19	6	07.22.20
A2.2	EQUIPMENT PLAN	10.18.19	6	07.22.20
A2.3	OVERALL REFLECTED CEILING PLAN	10.18.19	6	07.22.20
A2.4	OVERALL ROOF PLAN	10.18.19	4	07.22.20
A3.1	EXTERIOR ELEVATIONS	10.18.19	5	07.22.20
A3.2	EXTERIOR ELEVATIONS	10.18.19	4	07.22.20
A4.1	BUILDING SECTIONS	10.18.19	4	07.22.20
A4.2	BUILDING SECTIONS	10.18.19	4	07.22.20
A4.3	WALL SECTIONS	10.18.19	4	07.22.20
A4.4	WALL SECTIONS	10.18.19	6	07.22.20
A4.5	WALL SECTIONS	10.18.19	5	07.22.20
A4.6	WALL SECTIONS	10.18.19	4	07.22.20
A4.7	SECTIONS & DETAILS	10.18.19	4	07.22.20
A4.8	SECTIONS & DETAILS	10.18.19	5	07.22.20
A4.9	SECTIONS & DETAILS	10.18.19	3	07.22.20
A4.10	SECTIONS & DETAILS	10.18.19	3	07.22.20
A4.11	ROOF DETAILS	10.18.19	4	07.22.20
A5.1	DOOR & WINDOW SCHEDULE	10.18.19	6	07.22.20
A6.1	FINISH FLOOR PLAN	10.18.19	4	07.22.20
A6.2	ENLARGED RESTROOM PLANS, ELEVATIONS & ACCESSIBILITY DETAILS	10.18.19	3	07.22.20
A6.3	INTERIOR ELEVATIONS	10.18.19	3	07.22.20
A6.4	INTERIOR ELEVATIONS	10.18.19	3	07.22.20
A6.5	FINISH SCHEDULE & DETAILS	10.18.19	3	07.22.20

A7.1A	OVERALL FLOOR PLAN	10.18.19	2	07.22.20
A7.2A	ENLARGED COSMETOLOGY FLOOR PLANS	10.18.19	2	07.22.20
A7.3A	ENLARGED COSMETOLOGY FLOOR PLANS REFLECTE CEILING PLANS	10.18.19	2	07.22.20
A7.4A	ENLARGED BARBERING FLOOR PLANS	10.18.19	2	07.22.20
A7.5A	ENLARGED BARBERING REFLECTED CEILING PLANS	10.18.19	2	07.22.20
A7.6A	COSMETOLOGY INTERIOR ELEVATIONS	10.18.19	2	07.22.20
A7.7A	BARBERING INTERIOR ELEVATIONS	10.18.19	2	07.22.20
A7.8A	ENLARGED COSMETOLOGY AND BARBERING FINISH PLANS	10.18.19	2	07.22.20
07 Structural				
S0.1	GENERAL NOTES	10.18.19	4	07.22.20
S0.2	STATEMENT OF SPECIAL INSPECTIONS AND SPECIAL INSPECTION SCHEDULE	10.18.19	4	07.22.20
S2.1	FOUNDATION PLAN	10.18.19	6	07.22.20
S2.2	ROOF FRAMING PLAN	10.18.19	6	07.22.20
S3.1	BRACE FRAME ELEVATIONS	10.18.19	4	07.22.20
S3.2	BRACE FRAME ELEVATIONS	10.18.19	4	07.22.20
S3.3	FRAMING ELEVATIONS	10.18.19	2	07.22.20
S3.4	STEEL BRACED FRAME DETAILS	10.18.19	4	07.22.20
S3.5	STEEL BRACED FRAME DETAILS	10.18.19	4	07.22.20
S4.1	SECTIONS	10.18.19	4	07.22.20
S4.2	SECTIONS	10.18.19	4	07.22.20
S4.3	SECTIONS AND DETAILS	10.18.19	2	07.22.20
S5.1	TYPICAL DETAILS AND SCHEDULES	10.18.19	4	07.22.20
S5.2	TYPICAL DETAILS AND SCHEDULES	10.18.19	4	07.22.20
S5.3	TYPICAL DETAILS AND SCHEDULES	10.18.19	4	07.22.20
S5.4	COLUMN SCHEDULE	10.18.19	4	07.22.20
08 Plumbing				
FP1.1	FIRST FLOOR PLAN - FIRE PROTECTION	06.10.20	6	07.22.20
FP2.1	FIRE PROTECTION DETAILS	06.10.20	5	07.22.20
P1.1	FIRST FLOOR PLAN - PLUMBING	06.10.20	7	07.22.20
P1.2	PARTIAL FLOOR PLANS - PLUMBING	06.10.20	6	07.22.20
P1.3	ENLARGED COSMETOLOGY FLOOR PLANS - PLUMBING	10.18.19	2	07.22.20
P2.1	PLUMBING DETAILS	06.10.20	5	07.22.20
P2.2	PLUMBING DETAILS	06.10.20	4	07.22.20

P3.1	PLUMBING RISER DIAGRAMS	06.10.20	4	07.22.20
09 Mechanical				
M1.0	SITE PLAN - NATURAL GAS	10.18.19	5	07.22.20
M1.1	OVERALL FLOOR PLAN - HVAC	10.18.19	6	07.22.20
M1.2	ROOF PLAN - HVAC	10.18.19	6	07.22.20
M1.3	PARTIAL ENLARGED FLOOR PLAN - HVAC	10.18.19	6	07.22.20
M1.4	PARTIAL ENLARGED PLAN AT WELDING AREA - HVAC	10.18.19	6	07.22.20
M2.1	HVAC SCHEDULES	10.18.19	6	07.22.20
M3.1	HVAC DETAILS	10.18.19	6	07.22.20
M4.1	HVAC SECTIONS	10.18.19	6	07.22.20
10 Electrical				
E0.1	ELECTRICAL LEGEND & NOTES	10.18.19	5	07.22.20
E0.2	SCHEDULES & RISER DIAGRAM	10.18.19	4	07.22.20
E0.3	UL DETAILS	10.18.19	5	07.22.20
E1.0	SITE PLAN - NEW	10.18.19	6	07.22.20
E2.0	LIGHTING PLAN	10.18.19	6	07.22.20
E3.0	POWER & SYSTEMS PLAN	10.18.19	6	07.22.20
E3.1	COMMUNICATION & SECURITY PLAN	10.18.19	3	07.22.20
E4.0	ROOF PLAN	10.18.19	5	07.22.20
E5.0	PANEL SCHEDULES	10.18.19	4	07.22.20
E5.1	PANEL SCHEDULES (CONT.)	10.18.19	5	07.22.20
E6.0A	ENLARGED BARBERING FLOOR PLANS	10.18.19	2	07.22.20
E6.0B	ENLARGED COSMETOLOGY FLOOR PLANS	10.18.19	2	07.22.20

END OF LIST

00 11 16 – INVITATION TO BID

PROJECT:

TCAT Memphis - New Building & Renovations

SBC Number 166/000-04-2013Y3

Tennessee College of Applied Technology

Memphis/ Shelby County

INVITATION:

The State of Tennessee is inviting General Contractor bids for the Work of this project. Examine documents at the Designer's office or Plan Rooms on or after July 29, 2020.

Bidding Documents in PDF format may be obtained at no cost from the following source.

Upon written request, Designer will email link to download documents.

Entities obtaining Bidding Documents become Bidders of Record for notifications. Bidders of Record may purchase hard copies of Bidding Documents from the same source (nonrefundable).

Bidders shall be licensed and qualified per state law. Five percent (5%) Bid Security is required in the form of a Bid Bond or check (certified or cashier's) made payable to State of Tennessee. Non-discrimination policy applies.

BIDS RECEIVED AT:

braganza design

2029 Peabody Avenue

Memphis, TN 38104

Until 2:00 P.M., Central Standard Time, local time

On Wednesday, August 26, 2020

Bids will be received and time-stamped at the Designer's office on or before the Bid Date. The Bid opening will occur via a video conference meeting. Date, time and video meeting access information will be issued via Addendum.

PRE-BID CONFERENCE AT:

Tennessee College of Applied Technology

550 Alabama Avenue

Memphis, TN 38105

At To Be Determined, local time

On To Be Determined

Attendees are required to sign into campus required registry. Attendance at Pre-Bid Conference requires mandatory social distancing along with face mask or covering. No exceptions. Site tours will be held immediately after the Pre-Bid Conference.

Tours will be limited to groups of (10) attendees at one time. It is anticipated to have two tours taking approximately one-hour each. Attendees are required to sign-up for tours upon entering the Pre-Bid Conference.

PLAN ROOMS:

Memphis Reprographics - Memphis, TN

Memphis Builder's Exchange - Memphis, TN

West Tennessee Plan Room - Jackson, TN

Builder's Exchange of Tennessee - Nashville, TN

iSqFT - isqft.com

DESIGNER:

braganza design/ GROUP

2029 Peabody Avenue, Second Floor

Memphis, TN 38104.

Phone: 901.458.7600

Contact: Chris Norton, AIA

END OF SECTION

00 21 13 – INSTRUCTIONS TO BIDDERS

PART 1 - GENERAL

1.01 BIDDING DOCUMENTS

A. Bidding Documents may be obtained by Bidders and Subcontractors as described in the Invitation to Bid.

B. Bidders of Record will be issued subsequent addenda.

1.02 EXAMINATION

A. Bidders shall carefully examine site and documents to obtain first-hand knowledge of existing conditions and Work proposed.

B. Contractor will not be given extra payment for conditions which can be determined by examining site and documents.

1.03 QUESTIONS

A. Bidders shall submit questions about bidding documents to Designer in writing. Replies will be issued to Bidders of Record by addenda and will become part of Contract Documents. Designer and Owner will not make oral clarifications.

B. Questions shall be received by Designer at least six calendar days before bid opening date.

C. Normal practice is that no addenda affecting pricing will be issued less than three calendar days before bid opening date.

1.04 SUBSTITUTIONS

A. Substitution requests before receipt of bids shall be prepared in accordance with 01 25 13 Product Substitution Procedures.

B. Substitution requests before receipt of bids shall be received ten calendar days before date set to receive bids. However, regardless of the date received, consideration of substitution requests is not an obligation of the Designer or Owner and the Designer will determine if sufficient time is available for evaluation of the request.

C. Acceptable substitutions will be identified in addenda.

D. Bidders submitting bids in reliance upon a substitution when the substitution has not been approved prior to bidding do so at their own risk.

1.05 LICENSING AND QUALIFICATIONS

A. Bidders shall be familiar with the Contractors Licensing Act of 1976, as currently amended (codified in Tennessee Code Annotated (TCA) § 62-6-101, et seq.). A contract will not be awarded to a bidder whose bid is in conflict with State licensing law.

B. Bidders with five or more employees are required by TCA § 50-9-113 to submit a completed Section 00 45 21 Drug-Free Workplace Affidavit with their bid that attests they have a complying drug-free workplace program.

C. In compliance with TCA § 50-9-114 bidders are advised that the Owner does not operate a certified drug-free workplace program that serves for compliance with TCA § 50-9-113.

D. Bids submitted shall not include a contractor or subcontractor disqualified from participating in State Building Commission projects. The State Architect maintains a list of those that are disqualified.

E. The bidder and its subcontractors shall not knowingly utilize the services of an illegal immigrant in the performance of the Work, and shall not knowingly utilize the services of any subcontractor, sub-subcontractor, or consultant who utilizes the services of an illegal immigrant in the performance of the Work.

F. In compliance with the Iran Divestment Act bids submitted shall not include a contractor or subcontractor on the list created pursuant to TCA § 12-12-106.

1.06 BID FORM

A. Make bids on an unaltered Bid Form. Submit one Bid Form. Failure to completely fill out Bid Form may cause bid to be rejected.

B. To indicate availability of an Add Alternate at no additional charge, write "No Charge" in the space. Additional stipulations or qualifications on Bid Form may cause bid to be rejected.

C. Bid Form shall be signed by person or persons legally authorized to bind Bidder to contract.

1.07 BID SECURITY

A. Bid Security is required in the amount of five percent (5%) of total amount of bid, including alternates, in the form of a Bid Bond or check (certified or cashier's) made payable to State of Tennessee.

B. Bid Bonds shall be issued by Surety company licensed to do business in Tennessee by Tennessee Department of Commerce and Insurance, and shall have certified and current Power-of-Attorney for Attorney-in-Fact attached.

C. Owner may retain Bid Security of bidders to whom award is being considered until either (a) Contract has been executed, or (b) specified time has elapsed so that bid is not binding, or (c) bid has been rejected. If Bidder refuses to enter into Contract or fails to furnish all required attachments properly executed, the amount of Bid Security shall be forfeited to Owner as liquidated damages, not as penalty.

1.08 BID SUBMITTAL

A. Submit Bid Form, with required attachments, enclosed and sealed in a 9 inch by 12 inch Bid Envelope with Bid Envelope cover information as provided in Section 00 47 13 attached to the Bid Envelope. Bidder shall fill in blank spaces on face of Envelope except the blank space provided for Designer's approval.

B. If any work, regardless of dollar value, is required for any or of the subcontract trades listed on the Bid Envelope form, list subcontractor(s) that will perform that work. If Bidder will perform that work with Bidder's own forces, fill in Bidder's name as subcontractor. If no work is required in a category, write "None Required" in space provided for subcontractor(s). If acceptance of Alternate or combination of Alternates changes subcontractor, indicate change on Bid Envelope.

C. Provide State contractor license number, expiration date, and applicable classifications for Bidder and listed subcontractors, as applicable by State licensing law.

D. Bidders are solely responsible for ensuring that bids are received by the time and at the place identified for receipt of bids. The bid opening time shall be established by the timepiece of the Owner's representative. Bids received late will be returned unopened.

E. A bid sent by mail or courier shall be enclosed in an envelope clearly marked "Bid Envelope Enclosed".

1.09 MODIFICATION AND WITHDRAWAL PRIOR TO CLOSE OF BIDDING

A. Modification: Bids, once submitted, may be modified before the scheduled opening time only upon receipt of a written modification signed by a person legally authorized to bind Bidder to contract. Modification to a bid may be made as an "Add" or "Deduct" only. Modification to bid may be written on the Bid Envelope with the signature of an authorized representative of the Bidder also written on the Bid Envelope. Modification shall indicate only the amount of change, clearly identified as an "Add" or "Deduct", and not indicate either the prior or resulting bid amount.

B. Withdrawal: Bids, once submitted, may be withdrawn before the scheduled opening time only upon receipt of a written withdrawal request signed by a person legally authorized to bind Bidder to contract.

1.10 POST-BID WITHDRAWAL OF BID FROM CONSIDERATION DUE TO MISTAKE

A request to withdraw a bid due to a mistake shall follow the Policy and Procedure of the State Building Commission. In addition to the requirements therein, such requests shall be delivered in writing to the Owner not later than twenty-four hours after the time fixed for receipt and opening of bids.

1.11 CONSIDERATION OF BIDS

A. To be considered, bids shall be made in accordance with these Instructions to Bidders. Failure to comply with these requirements may cause bid to be rejected.

B. The Owner reserves right to: reject Unit Prices proposed in a bid without invalidating other portions of bid; reject a bid which does not provide all required Unit Prices; waive informalities; and, reject any or all bids.

C. It is Owner's intent to award contract based upon lowest evaluated responsive bid submitted by responsible Bidder for Base Bid plus Alternates (if any) taken in order up to, but not to exceed the Bid Target. If the Base Bid of all bidders exceeds the established Bid Target, the low Bidder is determined by the lowest Base Bid submitted by a responsible Bidder irrespective of any Alternates (if any) bid. When Alternates are included in bidding, Bid Target will be announced at bid opening prior to opening bids. Alternates may be accepted or rejected at Owner's discretion, provided that final combination of Base Bid and accepted Alternates does not change low Bidder as established by above method.

D. In the event of tie bids, preference will be given to in-State bidder over out-of-State bidder; and, if a tie still exists, successful Bidder will be determined by chance, e.g. a coin toss.

1.12 POST-BID INFORMATION

Each Bidder shall be prepared, if requested by Owner or Designer, to present, within ten days of the request, evidence of experience, qualifications, and financial ability to carry out the terms of the contract.

1.13 BONDS

A. If the initial Contract Sum as awarded exceeds $100,000, the successful Bidder shall provide Contract Bond in an amount of 100 percent of Contract Sum and in accordance with the requirements and form exhibited as Section 00 61 13.

B. The successful Bidder shall furnish, if applicable, a Three Year Roof Bond in an amount stipulated on the Bid Form and in accordance with the requirements and the form exhibited as Section 00 61 43.

1.14 EXECUTION OF THE CONTRACT

A. If a Bidder is presented the written Agreement form for signing, then that Bidder shall deliver to the Owner, within ten calendar days after presentation, the required number of counterparts of the signed Agreement Form, Contract Bond, Roof Bond (if required), and certificates of insurance, ACH Credits Form, and W-9 federal tax form.

B. Failure of the Bidder to return the Agreement as stipulated above shall entitle the Owner to require forfeiture of Bid Security and to proceed with award to the next lowest responsive Bidder.

1.15 AWARD OF THE CONTRACT

Presentation of Agreement form by Owner to Bidder for signature does not constitute award of Contract. Contract shall not be considered awarded until Bidder has received a fully executed Agreement.

1.16 DIVERSITY PARTICIPATION

A. It is the express desire of the Owner and the State Building Commission to include an emphasis on diversity in its contractual relationships with contractors for the construction, demolition or renovation of State projects under jurisdiction of the Commission. The Commission acknowledges that firms who demonstrate and embrace diversity within their programs and policies are assisting the State in achieving its goals in building a more reflective marketplace of the community within this State.

B. It is a requirement of all successful Bidders or proposers on projects under the jurisdiction of the State Building Commission that they report to the State the names and amounts of contracts entered into with diversity-owned businesses on their contract with the State in order for the State to collect data on such participation.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION

SECTION 00 25 13
PRE-BID MEETING

PART 1 - GENERAL

1.01 SCHEDULING AND ATTENDANCE

A. The Designer, in cooperation with the Owner and Campus, will schedule and administer a Pre-Bid Meeting prior to the Bid Date for prospective bidders.

B. Representatives of the Owner, Designer and Campus will attend.

C. Attendance is not mandatory as a prerequisite to submit a bid for this project but is strongly encouraged.

D. Interested contractors, subcontractors and suppliers will be allowed to visit the campus during the scheduled pre-bid meeting only. Additional site visits may not be available to interested Contractor or Subcontractors, depending on the Campus's Schedule.

E. Refer to Section 00 11 16 – Invitation to Bid for the date of Pre-Bid Conference. Any changes will be issued via an Addendum.

1.02 ADDITIONAL SITE INVESTIGATIONS

A. Access to the Site:
   1. The Contractor shall contact the Designer in writing to schedule a site visit for investigations beyond the Summary of Work reviewed at the Pre-Bid Conference.
      a. Provide minimum (3) days written notice to Designer to schedule the investigation.
      b. Provide details of the intended investigation.

B. PROTECTION AND/OR REPLACEMENT OF CONTIGUOUS ITEMS
   1. Contractor shall repair and/ or replace all contiguous items and other items which are disturbed, broken, removed or otherwise damaged during the site investigation.
   2. Existing construction damaged during the investigation shall be replaced with materials, methods and design of the original construction.

PART 2 - MATERIALS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

00 30 00 – INFORMATION AVAILABLE TO BIDDERS

PART 1 - GENERAL

1.01 PURPOSE

This section identifies information that was gathered solely for the use of the Designer, is not a Bidding Document, but is available for review by Bidders. Bidders have the entire responsibility for their interpretation and use of this information and shall not rely on the information for preparation of a bid.

1.02 INFORMATION AVAILABLE

SUB-SURFACE INVESTIGATION AND REPORT

A. A sub-surface investigation has been performed at the project site

B. The Owner is not responsible for variations in the sub-surface conditions. Bidders shall decide for themselves the character of the material to be encountered.

C. The report of the findings of this investigation is on file in the Designer's office, and may be reviewed there by any prospective Bidder of Record. Bidders should call ahead to schedule an appointment. A copy will be provided to any Bidder of Record upon request.

1.02 ACCESS TO INFORMATION

Upon written request, Designer will email link to download documents.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION

00 31 32 – GEOTECHNICAL INFORMATION AVAILABLE TO BIDDERS

PART 1 - GENERAL

1.01 PURPOSE

This section identifies information that was gathered solely for the use of the Designer, is not a Bidding Document, but is available for review by Bidders. Bidders have the entire responsibility for their interpretation and use of this information and shall not rely on the information for preparation of a bid.

1.02 SUB-SURFACE INVESTIGATION AND REPORT

A. A sub-surface investigation has been performed at the project site

B. The Owner is not responsible for variations in the sub-surface conditions. Bidders shall decide for themselves the character of the material to be encountered.

C. The report of the findings of this investigation is on file in the Designer's office, and may be reviewed there by any prospective Bidder of Record. Bidders should call ahead to schedule an appointment. A copy will be provided to any Bidder of Record upon request.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION

00 41 13 – BID FORM

TO: State of Tennessee **FROM BIDDER**: _____

FOR:

Project Title: TCAT Memphis - New Building and Renovations

Project SBC No.: 166/000-04-2013Y3

A. The Bidder hereby acknowledges, attests, certifies, warrants, and assures that:

1. Bidder has received, read and understands the Bidding Documents and this bid is made in accordance therewith.
2. Bidder has visited the site and become familiar with the local conditions under which the Work is to be performed and has correlated all observations with the requirements of the Bidding Documents.
3. Documents identified as “Information Available to Bidders” are prepared solely for the Designer's use in design of this Work and have not been relied upon in the preparation of this bid. The use and interpretation of such information for any purpose is entirely the responsibility of the using party.
4. Bidder shall not utilize the services of a contractor or subcontractor disqualified from participating in State Building Commission projects.
5. Bidder shall not knowingly utilize the services of an illegal immigrant in the performance of this Contract and shall not knowingly utilize the services of any subcontractor or consultant who will utilize the services of an illegal immigrant in the performance of this Contract.
6. In compliance with the Iran Divestment Act the Bidder is not on the list created pursuant to Tennessee Code Annotated (TCA) § 12-12-106 and shall not utilize any subcontractor on that list.
7. Bid Security, in the amount of five percent (5%) of the total amount of bid, including Alternates, is attached hereto.
8. A Drug-Free Workplace Affidavit, in the form of Section 00 45 21, is attached hereto.
9. Failure to complete this Bid Form, provide required attachments, or comply otherwise with instructions to Bidders, may be cause for rejection of bid.
10. The person who signs this bid on behalf of the Bidder is legally empowered to bind the Bidder to a Contract.
11. The following statement is (mark the one that is applicable) [ ] True [ ] False:

    The Bidder and/or any of the Bidder's employees, agents, independent contractors and/or proposed Subcontractors have been convicted of, pled guilty to, or pled nolo contendere to any contract crime involving a public contract.

12. Bidder has received the following addenda:

    Addendum No. _____ dated _____. Addendum No. _____ dated _____.

    Addendum No. _____ dated _____. Addendum No. _____ dated _____.

PAGE 2 FROM BIDDER: _____

B. The Bidder agrees to:

1. Honor this bid for 45 days following the date of the scheduled opening of bids.
2. Enter into and execute a contract, if presented on the basis of this bid, and to furnish certificates(s) of insurance, bond(s), and other documents related to the contract as required, including, if the initial Contract Sum as awarded exceeds $100,000, the Contract Bond.
3. Accomplish the Work in accordance with the Contract Documents.
4. Furnish Three Year Roof Bond in the form of Section 00 61 43 in the amount of: Three Hundred and Twenty-Five Thousand Dollars and No cents. $325,000.00.
5. Achieve Substantial Completion of the Work in accordance with the number of calendar days Contract Time set forth, allotted from and including the date stipulated in the Notice to Proceed; and, accept the conditions for Liquidated Damages in the amount set forth per calendar day.

Phase	Commencement	Contract Time	Liquidated Damages
ALL	Notice to Proceed for All Work	365 Days	$500 Per Day
	Not Applicable	Days	$ Per Day
	Not Applicable	Days	$ Per Day
	Not Applicable	Days	$ Per Day

C. BASE BID: The Bidder agrees to complete the Work of the Base Bid for this project for the lump sum of the following amount (In both words and figures. Figures prevail. Words clarify at Owner's discretion.):

_____ and _____/100ths Dollars

$_____

D. ALTERNATES: The Bidder agrees to include Work of the following Alternate(s), as specified in Section 01 23 00 Alternates, for the additional lump sum(s) of the following amount(s) (In both words and figures. Figures prevail. Words clarify at Owner's discretion.):

ALTERNATE No.1: Interior and Exterior Signage.

_____ and _____/100ths Dollars

$_____

ALTERNATE No. 2: Outdoor Welding Storage Enclosure.

_____ and _____/100ths Dollars

$_____

ALTERNATE No. 3: Not Applicable

_____ and _____/100ths Dollars

$_____

ALTERNATE No. 4: Not Applicable

_____ and _____/100ths Dollars

$_____

E. UNIT PRICES: The Bidder agrees to include work in the Base Bid and Alternates as specified for the Quantity Allowance of Unit Price Items and propose, subject to Owner acceptance, the following Unit Prices for inclusion in the Agreement as specified in Section 01 22 13 Unit Prices:

Item No.	Unit Price per Unit	Unit	Name, Work Included
1		CY	Undercutting Unsuitable Material: Undercutting of unsuitable material under the proposed building, roadways, and paved areas beneath subgrade and dispose offsite. Includes Offsite Soil Backfill: Offsite approved backfill material (including transportation) under building, roadways, and paved areas where undercutting of unsuitable material occurred. Compute in Cubic Yards.

F. BID SUBMITTAL:

This bid is submitted by:

Authorized Signature: _____ Date: _____

Printed Name, Title: _____

On behalf of:

Bidder Name: _____

Bidder's Address: _____

_____

_____

Bidder's Phone: _____

Bidder's Fax: _____

Bidder's Email: _____

END OF SECTION

00 45 21 – DRUG-FREE WORKPLACE AFFIDAVIT

STATE OF _____

COUNTY OF _____

The undersigned, principal officer of _____, the Contractor, an employer of five or more employees contracting with _____, the Owner, to provide construction services, hereby states under oath as follows:

1. The undersigned is a principal officer of the Contractor and is duly authorized to execute this Affidavit on behalf of the Contractor.

2. The Contractor submits this Affidavit pursuant to Tennessee Code Annotated (TCA) § 50-9-113, which requires each employer with five or more employees receiving pay who contracts with the state to provide construction services to submit an affidavit stating that such employer has a drug-free workplace program that complies with TCA Title 50, Chapter 9.

3. The Company is in compliance with TCA § 50-9-113.

Further affiant saith not.

_____

Principal Officer

STATE OF _____

COUNTY OF _____

Before me personally appeared _____, with whom I am personally acquainted (or proved to me on the basis of satisfactory evidence), and who acknowledged that such person executed the foregoing affidavit for the purposes therein contained.

Witness my hand and seal at office this _____ day of _____, 20____.

_____

Notary Public

My commission expires:_____

END OF AFFIDAVIT

00 47 13 – CONSTRUCTION BID ENVELOPE

Bid to the State of Tennessee for Project:

Project Title: _____

SBC Number: _____

Institution: _____

City/County: _____

Project Designer: _____

Any blank spaces may cause bid to be unacceptable and rejected.
Provide state contractor license number, expiration date, and classification for Bidder and listed subcontractors as applicable.
Provide all names as used for licensing.

Bidder Identification:
Bidder: _____

Address: _____

Tennessee Contractor License Information: ☐ Or check here if Bidder is unlicensed.

License Number _____
License Classification Applicable to Project _____

License Expiration Date _____ Dollar Limit: $_____.

Subcontractors to be used on this Project (or Bidder if Bidder is to perform the work):

- If any work, regardless of dollar value, is required for trades below, list subcontractor(s) that will perform that work, or, if Bidder will perform work in that category with Bidder's own forces, fill in Bidder's name as subcontractor.
- If no work is required in a subcontractor category, write "None Required".
- If the monetary amount of a subcontractor's work is such that no license is require, write "N/A" in the license number column, but still write name.

	Name	License Number	Expires	Classification
Electrical				
Geothermal				
HVAC				
Masonry				
Plumbing				
Roofing				

This Bid Envelope approved for public opening _____

Signature of Designer or its representative

Agreement

Between Owner and Contractor

Where the Basis of Payment is a

Stipulated Sum.

AGREEMENT

made as of the <<Number, e.g. "2nd">> day of <<Month>>

in the year of <<Year number in words>>.

BETWEEN THE OWNER:

State of Tennessee, via the Contracting Agency:

<<State Procurement Agency>>

<<Street or P.O. Box>>

<<City, State, Zip Code>>

AND THE CONTRACTOR:

<<Contractor Name>>

<<Street or P.O. Box>>

<<City, State, Zip Code>>

ACH Address: <<Street or P.O. Box>>

<<City, State, Zip Code>>

THE PROJECT:

<<SBC Number>>

<<Campus or Institution Name>>

<<Project Title Designated by Owner>>

THE DESIGNER:

<<Designer Name>>

<<Street or P.O. Box>>

<<City, State, Zip Code>>

THE OWNER AND THE CONTRACTOR AGREE AS SET FORTH BELOW.

ARTICLE 1 – THE WORK AND THE CONTRACT DOCUMENTS

1.1 The Contractor shall perform all the Work required by the Contract Documents for the Project identified on page one.

1.2 The Contract Documents are identified in the Conditions of the Contract (General, Supplementary, and other Conditions). These form the Contract and constitute the entire agreement between the Owner and the Contractor, and are as fully a part of the Contract as if attached to this Agreement or repeated herein. An enumeration of the Contract Documents appears in paragraph 1.4.

1.3 Terms used in this Agreement which are defined in the Conditions of the Contract shall have the meanings designated in those Conditions.

1.4 The Contract Documents, except for Modifications issued after execution of this Agreement, are enumerated as follows:

1. This Agreement.

<<Continued list of Contract Documents including applicable drawings, project manual, and addenda>>

ARTICLE 2 – TIME OF COMMENCEMENT AND SUBSTANTIAL COMPLETION

2.1 The Work to be performed under this Contract shall be commenced on the date stipulated in the Notice to Proceed; and, subject to authorized adjustments, Substantial Completion shall be achieved in

<<Number of calendar days from and including the date stipulated in the Notice to Proceed>>

2.2 Liquidated Damages, as set forth in the Conditions of the Contract, are

<<Dollar amount per calendar day>>

ARTICLE 3 – CONTRACT SUM

3.1 The Owner shall pay the Contractor in current funds for the performance of the Work, subject to Modifications as provided in the Contract Documents, the Contract Sum of

<<Contract Sum in words>>

($<<Contract Sum in numbers>>)

3.2 The Contract Sum is determined as follows:

<<Listing of base bid and any alternates and total>>

3.3 The following Unit Prices will be used as specified:

<<Listing or statement of none established at initial award>>

This instrument may be executed in one or more counterparts. It shall be fully executed when each party whose signature is required has signed at least one counterpart, even though no one counterpart contains the signatures of all the parties to this instrument. Electronic, scanned or facsimile signatures shall have the same force and effect as original signatures.

This Agreement entered into as of the day and year first written above as witnessed:

BY CONTRACTOR: <<Contractor Name>>

Signature: _____

Name: _____

Title: _____

AND BY OWNER: State of Tennessee,

<<State Procurement Agency>>

By: _____

Head of Higher Education Institution
<<Name>>
<<Title>>

Approved: _____

Head of Financial Office
<<Name>>
<<Title>>

Approved: _____

Head of Legal Office
<<Name>>
<<Title>>

Approved: _____

Head of State Procurement Agency
<<Name>>
<<Title>>

Approved: _____

State Architect

END OF AGREEMENT FORM for the Project titled:

<<SBC Number>>

<<Campus or Institution Name>>

<<Project Title Designated by Owner>>

00 61 13 – CONTRACT BOND

Bond No. <<Number>>

TENNESSEE STATE BUILDING COMMISSION STANDARD FORM

Know all men by these presents: that we

<<Name>>

(hereinafter called the "Principal") and

<<Name>>

(hereinafter called the "Surety") do hereby acknowledge ourselves indebted and securely bound and held unto

State of Tennessee

<<State Procurement Agency>>

<<Address Line 1>>

<<Address Line 2>>

(hereinafter called the "Owner"), and in the penal sum of

<<Amount>>

good and lawful money of the United States of America, for the use and benefit of those entitled thereto, for the payment of which, well and truly to be made, we bind ourselves, our heirs, our administrators, executors, successors, and assigns, jointly and severally, firmly by these presents.

But the condition of the foregoing obligation or bond is this:

Whereas, the Owner has engaged the principal for the sum of

<<Amount>>

to complete the Work of the project titled: **<<Title>>**

SBC No. **<<Number>>**

as more fully appears in a written agreement or contract bearing the date of **<<Date>>**

a copy of which said agreement or contract is by reference hereby made a part thereof, as fully and to the same extent as if copied in length herein, and it is the desire of the Owner that the Principal shall assure all undertakings under said agreement or contract and shall assure and protect all laborers and furnishers of material on said Work both as provided by Tennessee Code Annotated Sections 4-15-102 (f)(2) and 12-4-201 through 12-4-206, and any and all amendments thereto, and shall assure the prompt payment of claims as provided by Tennessee Code Annotated Sections 12-4-207 through 12-4-208, and any and all amendments thereto. The Principal shall also comply with provisions of Tennessee Code Annotated Sections 12-4-401 through 12-4-415, and any and all amendments thereto, pertaining to the payment of the prevailing wage rate.

Now, therefore, if the Principal shall fully and faithfully perform all undertakings and obligations under the contract hereinbefore referred to and shall fully indemnify and hold harmless the Owner from all costs and damage whatsoever which it may suffer by reason of any failure on the part of the Principal to do so, and shall fully reimburse and repay the Owner any and all outlay and expense which it may incur in making good any such default, and shall fully pay for all of the labor, material and work used by the Principal and any immediate or remote sub-contractor or furnisher of material under him in the performance of said contract, in lawful money of the United States, as the same shall become due, then this obligation or bond shall be null and void, otherwise to remain in full force and effect.

And for value received, it is therefore stipulated and agreed that no change, extension of time, alteration or addition to the terms of the contract or to the Work to be performed thereunder or to the specifications accompanying the same shall in any wise affect the obligation under this bond, and notice is hereby waived of any such change, extension of time, alteration or addition to the terms of the contract or to the Work or to the specifications.

In witness whereof the Principal has hereunto affixed its signature and Surety has hereunto caused to be affixed its corporate signature and seal, by its duly authorized officers, on this <<Day number>> day of <<Month>>, 20<<Year number>>.

Executed in <<Number>> counterparts.

Witness:

<<Name of Principal>>
(Name of Principal)

(Authorized Signature)

<<Name of Signatory>>
(Name of Signatory)

<<Title of Signatory>>
(Title of signatory)

<<Name of Surety>>
(Name of Surety)

(Signature of Attorney-in-fact)

<<Name of Attorney-in-fact>>
(Name of Attorney-in fact)

<<License Number>>
(Tennessee license number of Agent or Attorney-in-fact)

(Countersignature of Agent if not same as Attorney-in-fact)

Surety Company issuing bond shall be licensed to transact business in State of Tennessee by Tennessee Department of Commerce and Insurance. Bonds shall have certified and current Power-of-Attorney for the Surety's Attorney-in-Fact attached. Attorney-in-Fact who executes bond on behalf of Surety shall be licensed by the State of Tennessee, and shall affix license number to bond; or, countersignature by a licensed agent of the State of Tennessee, and the agent's license number, shall be affixed to the bond in addition to the signature of the Attorney-in-Fact.

END OF SECTION

00 61 43 – THREE YEAR ROOF BOND

Bond No. <<Number>>

TENNESSEE STATE BUILDING COMMISSION STANDARD FORM

GENERAL INFORMATION:

Principal: **<<Name>>**

Surety Name: **<<Name>>**

Surety Address: <<Address Line 1>>

<<Address Line 2>>

Building Owner: State of Tennessee

Tennessee Board of Regents

1 Bridgestone Park

Nashville, TN 37214

Project Title: **TCAT Memphis Phase II Renovations**

SBC No.: **166/00004-2013Y3**

Project Contract Date: **<<Date>>**

KNOW ALL MEN BY THESE PRESENTS:

That we, the Principal and the Surety, are held and firmly bound unto the Building Owner in the amount of

$325,000.00

for the payment thereof in good and lawful money of the United States of America the Principal and the Surety bind themselves, their heirs, executors, administrators, successors, and assigns, jointly and severally, firmly by these presents.

Whereas, Principal has, by written agreement referenced above, entered into a contract (hereinafter referred to as "the Contract" and hereby referenced herein) with the Owner for the construction of the Project identified above.

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION is such that if the Principal shall fully indemnify the Owner for all loss that the Owner may suffer by reason of any defective material and/or workmanship in the materials furnished for and the installation of the above referenced Project roofing system which become apparent during the period of three (3) years from the date of Substantial Completion of the above referenced Project roofing system, then this obligation shall be null and void; otherwise it shall remain in full force and effect.

Surety hereby agrees that no change, extension of time, alteration or addition to the terms of the contract or to the Work to be performed thereunder or to the specifications accompanying the same shall in any way affect the obligations under this bond, and notice is hereby waived of any such change, extension of time, alteration or addition to the terms of the contract or to the Work or to the specifications.

IN WITNESS WHEREOF the Principal has hereunto affixed its signature and Surety has hereunto caused to be affixed its corporate signature and seal, by its duly authorized officers, on this <<Day number>> day of <<Month>>, 20<<Number>>.

Executed in <<Number>> counterparts.

Witness:

<<Name of Principal>> (Name of Principal)	<<Name of Surety>> (Name of Surety)
_____ (Authorized Signature)	_____ (Signature of Attorney-in-fact)
<<Name of Signatory>> (Name of Signatory)	<<Name of Attorney-in-fact>> (Name of Attorney-in fact)
<<Title of Signatory>> (Title of signatory)	<<License number>> (Tennessee license number of Agent or Attorney-in-fact)
	_____ (Countersignature of resident Agent if not same as Attorney-in-fact)

Surety Company issuing bond shall be licensed to transact business in State of Tennessee by Tennessee Department of Commerce and Insurance. Bonds shall have certified and current Power-of-Attorney for the Surety's Attorney-in-Fact attached. Attorney-in-fact who executes bond on behalf of Surety shall be licensed by and a resident of State of Tennessee, and shall affix license number to bond; or, countersignature by a licensed agent who is a resident of State of Tennessee, and the agent's license number, shall be affixed to the bond in addition to the signature of the Attorney-in-Fact.

END OF SECTION

SECTION 01 11 00
SUMMARY OF WORK

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following:
   1. Work covered by the Contract Documents.
   2. Type of Contract.
   3. Owner-furnished products.
   4. Owner's occupancy requirements.

B. Related Sections include the following:
   1. Division 1 Section "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

1.03 WORK COVERED BY CONTRACT DOCUMENTS

A. Project Identification: Tennessee College of Applied Technology – Memphis Campus
   1. Project Location: 660 Mosby Avenue, Memphis, TN 38105 & 550 Alabama Avenue
   2. Project Number: TBR SBC No. 166/000-04-2013Y3

B. Owner: Tennessee Board of Regents (TBR), 1 Bridgestone Park, Third Floor, Nashville, TN 37214.
   1. Owner's Representative: **Robert Bryant, AIA**

C. Designer/ Architect: braganza design/ GROUP, 2029 Peabody Ave., Memphis, TN 38104-3700.
   1. Designer's Representative: **Chris Norton, AIA**

D. The Work consists of the following:
   1. Architectural:
      a. New construction for a 1-story, approx. 20,368 SF building on an existing campus for Tennessee College of Applied Technology – Memphis. Building constructed of brick veneer on metal stud walls and structural steel.
      b. This higher education vocational training facility has programs focused on professional certifications in Automotive and Diesel Technology and Welding. The vocational and training laboratories are incidental uses for the training education. No paint shops, hazardous material (i.e. gasoline) will be stored on campus.

c. Maintenance renovations in the existing administration and education building.

2. Civil:
   a. Site grading & drainage.
   b. Underground utilities.
   c. Retaining walls.
   d. New parking lot.

3. Structural:
   a. Foundation and slab-on-grade design, including concrete walls, wall footing, column concrete piers and footings. Steel column base plates and anchor rods.
   b. Roof framing design, including roof deck, steel beams, steel joists and steel columns.
   c. Seismic-Force-Resisting-System including steel braces, steel bracing columns with base plates and anchor rods, grade beams and footings.
   d. Masonry wall design including slab-on-grade, concrete walls and footings.

4. Fire Protection
   a. The fire protection system shall be a wet type system that provides full coverage of the new building. Auto repair, welding, service, and storage areas shall have ordinary hazard group two coverage. All other areas shall have light hazard coverage. A 6" underground main shall supply a wet riser with a double check detector assembly, sprinkler alarm valve, and flow switch. All tamper switches and flow switches shall be connected to a fire alarm system. A 4" underground fire department connection shall be provided with a remote siamese connection. The sprinkler heads shall be a combination of upright and concealed, flat plate type. The wet sprinkler system shall meet all requirements of NFPA 13.

5. Plumbing
   a. The plumbing system shall meet all requirements of the 2015 International Plumbing Code and local amendments.
   b. The sanitary waste and vent system shall collect all waste discharge from plumbing fixtures and pipe to a public sanitary sewer. Floor drains from the auto repair garage shall be collected and piped into an oil interceptor before discharging to the sanitary sewer. All condensate piping shall be connected to the sanitary system by means of an air gap at a mop sink or connecting to the house side of a floor drain p-trap. Dual outlet roof drains with primary and secondary connections shall be piped for storm drainage from the roof. Secondary drains shall spill to the building exterior, and primary drains shall be piped to the public storm drainage system.
   c. A 2-1/2" domestic cold water supply from the public utility water main shall be installed and routed to a parallel reduced pressure backflow preventer assembly in the building. The domestic cold water shall supply all plumbing fixtures and hose bibbs. A 100 gallon, 199,000 Btu/hr gas water heater shall provide domestic hot water for plumbing fixtures. The water heater shall have an aquastat and circulating pump and shall meet the requirements of IECC 2015. Emergency drench showers shall be provided tepid water through a thermostatic mixing valve supplied with domestic hot and cold water.

   d. Compressed air shall be provided to the auto repair garages and welding lab. The air compressor shall be located outside the building and provided by the owner. The

compressed air piping shall be installed high within the structural roof joists and looped to each area that is served. Compressed air drops shall have service valves and blow down outlets and connect to hose reels. Exact location and mounting heights of hose reels shall be coordinated with the owner prior to beginning construction. Shut-off valves shall be installed to isolate each loop.

6. Mechanical:
   a. System of new roof mounted constant volume packaged rooftop units (gas heat/electric cooling) and associated ductwork and air distribution devices to serve the new building. The building has been divided into four (4) heating & cooling zones with a total of five (5) packaged rooftop units. Ventilation air for each system to be provided per the ASHRAE requirements or as needed for exhaust air make-up – whichever is greater. Carbon Monoxide exhaust capture systems are provided for the Automotive Technology Lab and The Diesel Lab. The Welding Lab is heated and ventilated only. A ductless split system is to be provided in the MDF room for dedicated temperature control.

   b. Natural gas shall be extended from the existing campus gas meter center to the new building. Gas piping in the new building shall be seismically braced.

   c. Controls for the new building shall be an extension of the Trane Building Automation System (BAS) being installed as a part of the Phase One work at this campus. System must be fully integrated and coordinated with mechanical equipment DDC controllers furnished and installed in the equipment manufacturer's factory as specified in those sections. The intent of the BAS is to integrate all new mechanical equipment into one system for global monitoring, control, and alarming associated with the building.

   d. Systems shall be tested and balanced by an independent, certified Test & Balance Contractor at the completion of the installation. All systems are to be tested and training is to be provided to the owner on the equipment and controls at substantial completion.

   e. The project includes an Indoor Air Quality Management Plan. The contractor shall be responsible for providing and maintaining very high air quality for the duration of construction and upon Substantial Completion when the project is turned over to the owner

7. Electrical:
   a. The building is served by a new 480Y/277V electrical service. Each lab space will have a dedicated 480Y/277V panel and 208Y/120V panel serving only the lab space. All additional building loads will be served by a set of panels dedicated to building loads.

   b. The building will have a new fire alarm system installed. Fire alarm system shall provide audible and visual notifications for alarm as well as monitor building sprinkler system.

   c. A new lighting control system will be installed. Lighting control system will communicate via wireless technology to allow lighting within classroom and lab spaces to be raised/lowered to occupant's preference. Lighting will also have the capability to be controlled via time of day control and integration into building automation system. New

site lighting will be provided around the exterior of the building as well as in the new student parking area.

E. The Sequence of Work consists of the following:
   1. New Parking Lot: Construct new parking lot at the corner of Alabama Avenue and Mosby Avenue. Work must be complete prior to beginning work around new building to allow migration of student/ public parking.
   2. New Building: Site work and construction of new building will occur after New Parking Lot is useable.
   3. Administration Building Renovation: Renovation work to the Cosmetology and Barbering programs can be performed any time during project time during campus approved work hours. Coordinate construction schedule with campus prior to beginning work.

1.04 UTILITY USE

A. Available utilities, such as water and power, may be used by the Contractor subject to restrictions as follows:
   1. The Owner will have the right to direct tap points and identify panels and other services that the Contractor may use.
   2. The Contractor will be responsible for installation, maintenance, and removal of temporary services.
   3. The Owner will have the right to restrict use in time of emergency or for the repeated abuse by the Contractor.

1.05 TYPE OF CONTRACT

A. Project will be constructed under a single prime contract.

1.06 OWNER-FURNISHED AND INSTALLED PRODUCTS

A. Owner will furnish and install products indicated. The Work includes providing support systems to receive Owner's equipment.
   1. Contractor is responsible for protecting Owner-furnished items from damage when items are at the Project site.
   2. If Owner-furnished items are damaged as a result of Contractor's operations, Contractor shall repair or replace them.
   3. Owner will install and otherwise incorporate Owner-furnished items into the Work.

B. Owner-Furnished Products Include:
   1. Lab equipment.
   2. Bridge Crane
   3. Vehicle lifts.
   4. Furniture.
   5. Toilet Accessories.

PART 2 - **PRODUCTS (Not Used)**

PART 3 - **EXECUTION (Not Used)**

END OF SECTION

01 22 13 – UNIT PRICES

PART 1 - GENERAL

1.01 SUMMARY

A. Unit prices are subject to determination at the time of a Modification if the solicited unit price was not accepted and not listed in the Agreement.

B. Unit prices may be established by appropriate Modification.

C. Unit price items are listed in Section 01 22 15 with related sections for each.

D. If no base quantity is stipulated, or if the base quantity is zero, then the unit price is invalid.

E. Unit prices include all direct and indirect costs, except overhead and profit, associated with the unit price item, and are treated as direct prices to the Owner by the Contractor, regardless of whether the work of the unit price item is being performed by a subcontractor or a sub-subcontractor.

F. Each unit price multiplied by its base quantity constitutes an allowance included in the Contract Sum.

1.02 ADMINISTRATION

A. Use the related item number on all unit price documentation.

B. Represent the allowance for each unit price item as a distinct line item in the Schedule of Values.

C. Keep a daily log of actual quantities of specified work units encountered, consumed, or expended. When submitting an application for payment which includes payment for unit price items, provide Designer a copy or report of the log which is acceptable to Designer. Actual quantities and the Contractor's log are subject to verification by Designer.

D. Adjustment of costs

1. Continuously monitor the consumption of each base quantity and the associated use of the allowance and the anticipated use to complete the Work. Do not exceed an allowance.

2. If a base quantity and the associated allowance are at risk of being exceeded, request a Modification to increase them in a timely manner to avoid delay in the Work.

3. If all of the Work of an allowance is complete and there is unexpended Allowance remaining, request a modification to decrease the allowance to equal the amount that has been used.

E. If adjustments exceed, or are expected to exceed, a cumulative twenty five percent (25%) of the initial base quantity, either party to the Contract may initiate renegotiation for a new unit price. Such a new unit price shall be made a part of the Contract by appropriate Modification.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION

01 22 15 – LIST OF UNIT PRICES

PART 1 - GENERAL

1.01 LIST OF UNIT PRICES

Item No.	Related Sections	Base Quantity	Unit	Unit Price Per Unit	Work Included
1	31 00 00	750	CY	S	Undercutting Unsuitable Material: Undercutting of unsuitable material under the proposed building, roadways, and paved areas beneath subgrade and dispose offsite. Includes Offsite Soil Backfill: Offsite approved backfill material (including transportation) under building, roadways, and paved areas where undercutting of unsuitable material occurred. Compute in Cubic Yards.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION

01 23 00 – ALTERNATES

PART 1 - GENERAL

1.01 REQUIREMENTS

A. Section includes identification of each Alternate by number, and describes the basic changes to be incorporated into the Work if a particular Alternate is made a part of the work by specific provisions in the Agreement between the Owner and the Contractor.

B. Related sections are referenced in the definition of each Alternate.

C. Coordination of related work and modifications to surrounding work as required to properly integrate each Alternate, and to provide the complete construction required by the Contract Documents, is the responsibility of the Contractor.

1.02 DESCRIPTION OF ALTERNATES

Alternate #1 - Interior & Exterior Signage - Includes:

Interiors signs: Types 1 through 6.

Exterior signs:

6'-0" Tall., 3/8" THK. CNC CUT STL. PLATE w/ POWDER-COATED FINISH "TCAT" logo. Include structural design to support sign. Include power.

Alternate 2 - Welding Storage EnclosureInterior and Exterior signage package. Includes:

Brick and block enclosur e

Metal roof

Structure

(6) pipe bollards

Chain-link fence around (3) compartments

Chain-link fence around Scrap Metal

Concnrete pad around Scrap Metal Storage

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION

01 25 13 PRODUCT SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.01 SUBSTITUTIONS:

A. Contractor assumes all risks associated with premature ordering and installation of substitute products.

B. The specifically named manufacturers, products, and systems, and descriptive characteristics used in the Contract Documents normally serve only to establish a level of quality and a performance standard. Unless a specific restriction is placed upon an item in the specifications, Contractor may submit proposals for substitutions. The Owner reserves the right to disallow substitutions.

C. Delays caused by tardiness of Contractor in preparing and forwarding submittals do not constitute an acceptable basis for consideration of substitute products. Delays due to factors which were in effect prior to project bidding do not constitute an acceptable basis for consideration of substitute products.

D. Decisions heretofore made concerning the equivalence or equality of materials, supplies and equipment furnished for or incorporated in other projects, completed or under construction for the Owner shall not be considered as precedents or criteria and shall have no bearing or influence on the question of equivalent, equal or comparable materials, supplies and equipment for the Work.

1.02 SUBSTITUTION REQUEST FORM:

A. Requests for substitutions shall be submitted to Designer on the form exhibited as Section 01 25 33, or in a similar format which provides the same or more information.

B. When making requests for substitutions, Contractor assumes the following responsibilities:

1. To have investigated the proposed substitute product and determined it is equal or superior in all respects to that specified;

2. To provide the same warranty for substitute that Contractor would for that specified;

3. To provide complete cost data, and waive all claims for additional costs related to substitution which subsequently become apparent; and

4. To coordinate installation of the accepted substitute, making such changes as may be required for Work to be complete in all respects.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION

01 25 33 – PRODUCT SUBSTITUTION REQUEST FORM

To: braganza design	Project: TCAT Memphis Phase II Renovations
Attention: Chris Norton, AIA	SBC Number: 166/000-04-2013Y3
Specified Item Name and Manufacturer: <<Item name and manufacturer>>	Proposed Substitute Item Name and Manufacturer: <<Item name and manufacturer>>

1. The following are attached (mark all that apply):
   - ☐ Complete Description ☐ Catalog
   - ☐ Laboratory Tests ☐ Specifications Data
2. This substitution will have the following effects on dimensions, gauges, weights, etc.:
   <<Comments>>
3. This substitution will have the following effects on wiring, piping, ductwork, etc.:
   <<Comments>>
4. This substitution will have the following effects on other trades:
   <<Comments>>
5. This substitution will have the following effect on construction schedules:
   <<Comments>>
6. The proposed substitute(s) differs from the specified product(s) in quality and performance as follows:
   <<Comments>>
7. Manufacturer guarantees for the substitute(s) and the specified product(s) are (check one):
   ☐ The Same ☐ Different (if different, explain below)
   <<Comments>>

8. Information on the availability of maintenance services and replacement materials for proposed substitute(s) is provided on an attached sheet.

   ☐ Attached ☐ Not Applicable

9. Names, addresses, and phone numbers of fabricators and suppliers for proposed substitute(s) are provided on an attached sheet.

   ☐ Attached ☐ Not Applicable

10. If the proposed substitution is accepted, it will result in:

    ☐ No Cost Impact

    ☐ A Cost Decrease of $<<Amount>>

    ☐ A Cost Increase of $<<Amount>> As Shown on Attached Itemization

11. License fees or royalties are pending on the proposed substitute.

    ☐ No ☐ Yes (if yes, explain below)

    <<Comments>>

12. The undersigned shall pay for additional studies, investigations, submittals, redesign, and analysis by the Designer necessitated by this substitution request.

Substitutions must be requested in accordance with applicable Contract requirements. After bidding, substitutions are to be submitted only by Contractor. Substitute products should not be ordered or installed without written acceptance.

Submitted By:

Signature:	Date: <<Date>>
Printed Name: <<Name>>	Firm Name: <<Name>>

13. Designer Review and Comments:

    ☐ Accepted ☐ Rejected

    ☐ Accepted as Noted ☐ Rejected (received too late)

    ☐ Rejected (submitted incomplete)

    <<Comments>>

Signature:	Date:
Printed Name:	Firm Name:

14. Owner Review:

Signature:	Date:

END OF SECTION

01 26 00 – CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.01 SUPPORTING DOCUMENTATION FOR PROPOSALS OR CLAIMS

A. Propose related changes to Work, Contract Sum, and Contract Time, in writing together. Propose unrelated changes separately. Attach and reference pertinent documents related to the change.

B. For a change in the Work, specifically describe proposed change, or briefly describe the proposed change with specific reference to a completely descriptive attachment, such as a request for proposal from the Designer.

C. For a change in Contract Sum, state briefly the reason for change, state the amount, and provide itemization of values on the following forms or similar forms providing the same information:

1. Section 01 26 54 Form for Price Summary, listing the itemizations of Work by subcontractors and the Contractor that together apply to an entire related change in work.

2. Section 01 26 55 Form for Price of Work, detailing the quantities, units, costs, and extensions for materials, equipment, and labor, subtotaled, plus overhead, and profit related to a specific proposed change in the Work.

3. Section 01 26 56 Form for Price of Time, if applicable, deriving an average cost per day.

D. For a change in Contract Time:

1. Fully describe the extent of and reasons for the change and effect of the change on the construction schedule, and attach a revised construction schedule. Take into account weekends, holidays, and the specified standard baseline for weather delays during the period of the requested extension.

2. For a change based on weather-related delay refer to Section 01 26 20.

1.02 SIGNATURES FOR CHANGE ORDER

Form shall be similar in format and content to Section 01 26 40 and signed by authorized representatives of the Owner, Designer, and Contractor according to the following procedure:

1. Designer prepares and submits supporting documents to Owner.

2. Owner produces and signs three (3) counterparts of form. Owner scans and transmits an informational copy to its construction representative, Designer, and Contractor.

3. Owner's construction representative brings owner's three original, signed counterparts to next progress meeting, unless urgency and opportunity make for a more timely execution.

4. Designer and Contractor both sign all three (3) counterparts at progress meeting. Each retains a counterpart, and the Owner's construction representative retains the third for the Owner.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION

01 26 20 – WEATHER DELAYS

PART 1 - GENERAL

1.01 EXTENSION OF CONTRACT TIME

If a Claim is made for an extension of time based upon weather delays in accordance with the General Conditions an extension may be granted only for the number of weather delay days in excess of the number of days listed for the applicable month on the standard baseline.

1.02 STANDARD BASELINE FOR ADVERSE WEATHER

A. The standard baseline is defined as the number of calendar days for each month during which construction activity exposed to weather conditions is expected to be prevented and suspended by cause of adverse weather. Suspension of construction activity for the number of days each month as listed in the standard baseline is included in the Work and is not eligible for extension of Contract Time.

B. The Owner has established a standard baseline for the State of Tennessee as follows:

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
12	11	8	7	7	6	7	5	4	5	6	11

1.03 ADVERSE WEATHER AND WEATHER DELAY DAYS

A. Adverse weather is defined as the occurrence of one or more of the following conditions within a 24 hour day that prevents construction activity exposed to weather conditions or access to the site:

1. Precipitation (rain, snow, or ice) in excess of one-tenth inch liquid measure.
2. Temperatures that do not rise above the minimum required for the day's construction activity, if such temperature requirement is specified or accepted as standard industry practice.
3. Sustained wind speed in excess of the maximum for the day's construction activity, if such sustained wind speed maximum is specified or accepted as standard industry practice.
4. Dry out days under the following conditions:
    a. more precipitation days occur than listed in the standard baseline;
    b. there is a hindrance to site access or sitework and Contractor has taken all reasonable accommodations to avoid such hindrance; and,
    c. no more than one dry out day is allocated for each additional day of precipitation more than the standard baseline that total one inch or more, liquid measure, unless specifically recommended by the Designer.

B. A weather delay day may be counted if adverse weather prevents work on the project for 50% or more of the contractor's scheduled work day and critical path construction activities were included in the day's schedule, including a weekend day or holiday if Contractor has scheduled construction activities that day.

1.04 DOCUMENTATION AND SUBMITTALS

A. Weather Delay Report:

1. Use a copy of Section 01 26 25 as a weather delay report, indicating for each calendar month the days on which construction activity affecting the critical path of the Work was prevented by weather conditions.
2. In the column for the cause, indicate measurement of precipitation, temperature, wind, or other influencing factors.
3. Describe the construction activity that was scheduled, on the critical path, and delayed.
4. At the end of the month, add up the number of days delay, subtract the baseline number given in this Section, and show the resulting claimable days in excess of baseline.
5. Submit a copy of the completed report with the next application for payment. Reports submitted with applications for payment do not constitute a claim or preliminary claim for extension of time.

B. Claim for a time extension based on weather delay(s):

1. Submit a copy of all reports completed since the last month for which a time extension was previously claimed, or the commencement of Work if no previous claim, through the last month for which delay is being claimed. Claims for time extension based upon weather delays are unjustified if a submitted report does not corroborate the claim or if no report was submitted when it was required with an application for payment.
2. Submit daily jobsite work logs showing which and to what extent critical path construction activities have been affected by weather on a monthly basis.
3. Submit actual weather data to support claim for time extension obtained from nearest NOAA weather station or other independently verified source approved by Designer at beginning of project.
4. Organize claim documentation to facilitate evaluation on a basis of calendar month periods and the standard baseline.
5. Submit in accordance with the requirements of the Contract Documents.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION

01 26 25 – WEATHER DELAY REPORT

SBC Project Number and Project Name:		Month and Year Reported Below:
Date	Weather condition causing delay	Work scheduled on critical path for this day that was delayed.
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
21		
22		
23		
24		
25		
26		
27		
28		
29		
30		
31		
	Total number of days this month with delay due to weather	
	Baseline number from Section 01 26 20	
	Total – Baseline = claimable days	

END OF SECTION

01 26 40 – FORM FOR AMENDMENT, CHANGE ORDER, OR DIRECTIVE

[ ] Amendment	PROJECT:
[ ] Change Order	Project Number:
[ ] Construction Change Directive	Modification Number:
Original Contract Date:	Date This Change Initiated:

The following changes in the Contract are hereby directed:

Item	Reference	Work	Contract Sum	Contract Time

The original Contract Sum	$
Net Change previously authorized	$
The Contract Sum prior to this Modification	$
This modification (*increases* / *does not change* / d*ecreases*) the Contract Sum	$
The new Contract Sum, including this modification	$
This Modification (*increases* / *does not change* / *decreases*) the Contract Time	
The new Contract Time, including this Modification	
The last day of the Contract Time, including this Modification	

CONTRACTOR	DESIGNER	OWNER
Signed	Signed	Signed
Name & Date	Name & Date	Name & Date
For	For	For

Changes over 10% cumulatively or exceeding $500,000.00, STATE ARCHITECT:

Signed	Name	Date

01 26 54 - FORM FOR PRICE SUMMARY

SBC Project Number:	Project Name:

Name of General Contractor:

Proposal Number:	Date Itemized:	Page of pages

Work by Subcontractors	Name of Subcontractor	Costs and Allowances

Subtotal:			0.00
General Contractor mark-up on Subtotal:		% =	0.00
Subtotal for General Contractor for work by subcontractors:			0.00

Work by General Contractor	

Subtotal (including Subcontractors and the General Contractor):			0.00
Bond Premium:		% =	0.00
Total:			0.00

Cells with red underline (if viewed in color) are for you to fill in. Others are protected.

Rounding off is permitted if rounding up for decreases and rounding down for increases. Math functions in Excel show rounded to nearest penny, but carry exact value for calculations. Let embedded math do its work.

This spreadsheet is available on the Owner's Designers' Manual website.

01 26 55 - FORM FOR PRICE OF WORK

SBC Project Number:	Project Name:

Work itemized below provided by:

Proposal Number:	Date Itemized:	Page	of	pages

Description	Material				Equipment				Labor			
	Quantity	Unit	Cost	Extension	Quantity	Unit	Cost	Extension	Quantity	Unit	Cost	Extension
				0.00				0.00				0.00
				0.00				0.00				0.00
				0.00				0.00				0.00
				0.00				0.00				0.00
				0.00				0.00				0.00
				0.00				0.00				0.00
				0.00				0.00				0.00
				0.00				0.00				0.00
				0.00				0.00				0.00
				0.00				0.00				0.00
				0.00				0.00				0.00
				0.00				0.00				0.00
				0.00				0.00				0.00
				0.00				0.00				0.00
				0.00				0.00				0.00
				0.00				0.00				0.00
				0.00				0.00				0.00
				0.00				0.00				0.00
				0.00				0.00				0.00
				0.00				0.00				0.00
				0.00				0.00				0.00
				0.00				0.00				0.00

Materials	Subtotal	0.00	Equipment			Labor	Subtotal	0.00
	% Sales Tax =	0.00					% Burden =	0.00
	Cost:	0.00		Cost:	0.00		Cost:	0.00

Cells with red underline (if viewed in color) are for you to fill in. Other cells are protected. Rounding off is permitted if rounding up for decreases and rounding down for increases. Math functions in Excel show rounded to nearest penny, but carry exact value for calculations.

Let embedded math in "extension" columns do its work.

This spreadsheet is available on the Owner's Designers' Manual website.

Subtotal of Costs of Materials + Equipment + Labor = $	0.00
10% Overhead allowed on costs = $	0.00
Subtotal of Costs + Overhead = $	0.00
5% Profit allowed on Costs + Overhead = $	0.00
Total for this change = $	0.00

01 26 56 - FORM FOR PRICE OF TIME

SBC Project Number:	Project Name:

Work itemized below provided by:

Proposal Number:	Date Itemized:	Page	of	pages

Description	Period Cost	Period (Year, Month, Week, Day)	Cost Per Day
Superintendent Salary			
Superintendent Vehicle			
General Use Vehicles			
Field Office			
Field Office Equipment			
Computer			
Fax Machine			
Copier			
Typewriter			
Calculator			
Field Office Utilities			
Electricity			
Natural Gas			
Water Service			
Drinking Water			
Telephone Service			
On-Site Storage			
Shed			
Trailer			
Safety Program			
Cleaning			
Site Toilet(s)			

Cells with red underline (if viewed in color) are for you to fill in. Other cells are protected. Math functions show rounded to penny, but carry exact value for calculations. Let embedded math do its work. Use "Year", "Month", "Week", or "Day" for period. This spreadsheet is available on the Owner's Designers' Manual website.

Subtotal of Costs:	
10% for Overhead:	
Subtotal with Overhead:	
5% for Profit:	
Total per day:	

01 29 54 – RETAINAGE ESCROW INITIATION

PART 1 - GENERAL

1.01 BASIC REQUIREMENTS

A. Reference Tennessee Code Annotated (TCA) § 66-34-104.

B. In accordance with State law retainage shall be deposited into an interest-bearing escrow account if the original Contract Sum is $500,000 or greater.

C. Failure to have the escrow account operational by the time of the Contractor's second application for payment will result in delay of payment or inability of the Owner to make payment. Any such delay or inability to pay will not be grounds for relief under the prompt payment statutes.

1.01 BANKING INSTITUTION REQUIREMENTS

The banking institution handling the retainage escrow account must be in an appropriate custodial care agreement with the State Treasurer. If not already in such an agreement, a banking institution can request such an agreement from the State Treasurer, subject to meeting eligibility requirements of TCA §12-4-108(c).

1.03 PROCESS

A. Shortly after award of contract, the Tennessee Department of Finance and Administration (F&A) will send the Contractor information for starting the account. This information typically includes the following:

1. Procedural guide

2. Forms including the basic application provided herein as Form A.

3. List of banks that currently have agreements with the State to host retainage escrow accounts.

B. The instructions from F&A will include a name and phone number to call for help if the Contractor needs help completing Form A or if the Contractor plans to use a lending institution that does not have a current agreement with the State for hosting retainage escrow.

C. Immediately upon award of a contract with a Contract Sum of $500,000 or greater, complete the Form A shown in this section, arrange for the completed Form A to be executed by the escrow bank, and instruct the bank to submit the original wet-signature Form A to the following address.

Retainage Escrow Coordinator
Tennessee Department of Finance and Administration
Office of Business and Finance
Suite 2000 William R. Snodgrass Tennessee Tower
312 Rosa L. Parks Avenue
Nashville TN 37243-0294

FORM A

APPLICATION FOR THE SUBSTITUTION OF SECURITIES FOR ALL AMOUNTS RETAINED ON STATE BUILDING COMMISSION CONSTRUCTION CONTRACTS

Date: _____

RE: Contract Number: _____
Project No.: _____
Location: _____
_____

Dear State Building Commission:

Pursuant to the provisions of Tennessee Code Annotated, Sections 12-4-108,

Contractor's name and address as appearing on construction Contract:	

hereby requests that whenever payment for which certain amounts are retained by the State Building Commission as determined by the subject construction contract, the amount so retained be substituted for approved securities, as designated by the Tennessee State Treasurer.

The undersigned Contractor hereby appoints _____
(Name of Banking Institution)

located at _____ to be its
(Complete Address of Banking Institution)

agent and attorney-in-fact to receive all amounts retained by the State Building Commission under the provisions of the subject construction Contract and to purchase Retainage Securities of the following type: _____
(Description & Account Number)

The appointed Banking Institution, as indicated by the acceptance signature shown below, agrees to enter or has already entered into a Trust Agreement with the Tennessee State Treasurer to act as custodian and servicing agent of Retainage Securities and to perform all assigned duties and responsibilities with respect thereto as set forth in the Trust Agreement, which is herein incorporated by reference.

Very truly yours,

_____ _____
(Signature of Authorized Representative of Contractor) *(Title)*

ACCEPTED:

_____ _____
(Signature of Authorized Officer of Banking Institution) *(Title)*

CONTACT PERSON (BANK) _____
PLEASE PRINT

PHONE NUMBER _____

END OF SECTION

01 29 73 – SCHEDULE OF VALUES

PART 1 - GENERAL

1.01 FORM AND APPROVAL

A. The form for the Schedule of Values shall be AIA Document G703 Continuation Sheet.

B. If objected to by the Designer or the Owner revise and resubmit the Schedule of Values to the Designer's and Owner's satisfaction prior to submitting an Application for Payment.

1.02 LEVEL OF DETAIL

A. Provide a breakdown of the Contract Sum in sufficient detail to facilitate ongoing evaluation of Applications for Payment and progress measurement and reports.

B. Round off line items to the nearest whole dollar with the total equal to the Contract Sum.

1.03 ALLOCATION OF VALUES

A. Phases:

1. If Phases are stipulated with distinct commencement, duration, or completion requirements, divide the allocation to correspond to the Phases.

2. Within each Phase subdivide the allocations as described below and subtotal.

B. Sitework:

Provide line items for sitework including categories for site utilities, roads and parking, and appurtenances according to general type and physical separation.

C. Each involved building or major structure:

1. Categorize items by major trades or units of work corresponding to the divisions and sections of the specifications.

2. Further subdivide as desired but maintain a distinct and identifiable correspondence to this allocation.

D. If allowances are stipulated in the Work, provide a line item in the Schedule of Values for each allowance, including quantity allowances associated with Unit Prices. If the project has phases associate the allowance with the relevant phase.

E. If the Contract is a CM/GC contract based on a Guaranteed Maximum Price (GMP) with estimated trades identified as a part of the GMP, provide a distinct line item for each estimated trade.

F. Prior to receipt of written approval of a Change Order, do not show in any respect a Change Order intended to modify the Contract sum, regardless of the Change Order's status prior to being fully execute. After a Change Order which modifies the Contract Sum is approved and fully executed by the Owner show the Change Order as follows.

1. Provide a single line item for each fully executed Change Order with identification by Change Order number.

2. Maintain these line items through the balance of the project.

G. For the final statement of accounting incorporate Change Orders that modify the Contract Sum into the appropriate allocations.

END OF SECTION

01 29 76 – PROGRESS PAYMENT PROCEDURES

PART 1 – GENERAL

1.01 SUBMITTAL:

A. In each Application for Payment provide the document indicated in the following table according to its context.

Counterpart or Copy	Progress Payment	Reducing Retainage Upon Subst. Completion	Final Payment	Document	§ 1.03 Subsection
counterpart	YES	YES	YES	G702 Application	A
copy	YES	YES	YES	G703 Continuation	B
copy	no	no	YES	Final Accounting	C
copy	YES	YES	YES	Contingency & Reserve Logs (if CM/GC)	D
copy	if any	if any	no	Off-Site Stored Materials documents	E
counterpart	no	no	YES	Affidavit of Payment	F
counterpart	no	YES	YES	Consent of Surety with Power of Attorney	G
copy	no	no	YES	Insurance Certificate	H
copy	no	no	YES	Statement of Continuing Insurability	I
copy	no	if any	if any	U&O Permit	J
copy	no	YES	YES	Data Binder Receipt(s)	K
copy	no	no	YES	Roof Warranty or Warranties	L
copy	no	no	YES	Report of Subcontractors and Suppliers	M
copy	YES	if any	no	Visitor Log	N
copy	YES	if any	no	Weather Delay Report	O

B. Provide application documents assembled in order listed above on 8½" x 11" pages, except 11" x 17" pages can be used for Progress Schedules and Submittal Logs if folded to fit an 8½" x 11" size. Orient all pages as shown below. Provide application sets bound with a single clip (no staple) affixed to the upper left of the G702 first page (according to its orientation ◤).

C. Counterpart documents shall be original instruments with wet signatures and embossed or wet-stamped seals, in each set of application documents.

D. Provide a draft submission, including attachments, as a PDF attached to an email, to Designer and to the Owner's construction representative three days prior to actual submittal.

E. Provide actual submission of five sets of the application documents to the Designer at progress meeting, substantial completion inspection meeting, or final inspection meeting. If submitted outside of these meetings, provide conveyance of application to Designer, from Designer to Owner's construction representative, and from Owner's construction representative to Owner's central office.

1.02 INCLUSIONS AND CALCULATIONS:

A. Accurately represent all values with two decimal places, calculated to the penny.

B. Stored Materials: Materials suitably stored on-site but not yet incorporated into the Work can be included; and, those suitably stored off-site can be included if documented in accordance with later provisions of this section.

C. On CM/GC contracts, the total completed and stored to date for estimated trades can only be included once bids have been taken, subcontracts awarded, and the actual price reconciled to the Reserve Log.

D. Calculation of retainage and amounts withheld:

1. Credit for completed work and stored materials, and deductions for incomplete work, comprise the Total Completed and Stored to Date. The Total Completed and Stored to Date shall not include the value of punch list items that remain incomplete after Substantial Completion.

2. Retainage is calculated as a percentage of Total Completed and Stored to Date: 5% prior to Substantial Completion; 2% after Substantial Completion; then, none at final payment. In the continuation sheets, showing retainage at individual line items is not required and is discouraged, as it promotes rounding errors. Retainage should only be shown at phase sub-totals, if phases exist, and when retainage rates vary between phases.

3. Other amounts withheld (i.e., potential liquidated damages or in response to subcontractor claims of non-payment) can be added to the continuation sheet and deducted from the Total Completed and Stored to Date, or can be deducted from the resulting current payment due after retainage and prior payments are accounted.

E. If a billing period would cross a State fiscal year (ending June 30, starting July 1), provide separate pay requests for the portion of work performed in each fiscal year.

1.03 FORMS, FORMAT, AND CONTENT:

A. G702 Application: Use AIA Document G702 Application and Certificate for Payment

1. For project identification, include the Owner's project number featured prominently, institution name, and work name, which is normally the project title shown in the Agreement.

2. Provide a unique, sequential application number.

3. Include the Contractor's address exactly as provided in the ACH Form.

4. Show the county where the Work is located, normally where AIA captions "Contract for".

B. G703 Continuation: Use AIA Document G703 Continuation Sheet itemized with the line items and values of the schedule of values accepted by Designer, and values and percentages for each line item. If there are phases, include a sub-total for each phase as well as a grand total.

C. Final Accounting: Allocate final Contract Sum as if Modifications had been fully incorporated in Contract Sum at award of Contract, and shall follow the same format as the schedule of values.

D. GMP Contingency Log and Reserve Log, only if a CM/GC contract.

E. Off-Site Stored Materials: If any, provide the following.

1. Statement identifying where materials are stored, and assuring that materials are tagged to identify them for use in the project.

2. Bill(s) of sale for materials claimed that list(s) all items.

3. Certificate of insurance covering materials claimed, recognizing Owner's right to make claims.

F. Affidavit of Payment of Debts and Claims: Provide counterpart using AIA Document G706, when requesting final payment for the Work or reduction of retainage to zero for any portion of the Work.

G. Consent of Surety:

1. If seeking reduction in retainage prior to final payment for the entire Work, or final payment on only a portion of the Work, provide counterpart using AIA Document G707A Consent of Surety to Reduction in Retainage, or a similarly formed letter.

2. If seeking final payment, provide counterpart using AIA Document G707 Consent of Surety Company to Final Payment, or a similarly formed letter.

3. If Contractor has listed exceptions in the affidavit of payment, Surety's consent shall acknowledge such exceptions.

4. If Contract is not bonded, consent of surety is not required, and Owner will instead advertise a public notice of settlement, and wait 30 days for responses, before accepting the application.

5. Provide counterpart of power of attorney with consent of surety.

H. Insurance Certificate: If seeking final payment, provide certificate of insurance for products and completed operations as required by the General Conditions of the Contract for Construction.

I. Statement of continuing insurability: If seeking final payment, a letter written to the effect required by the General Conditions of the Contract.

J. Use & Occupancy Permit (some jurisdictions have a different name): Provide copy with first application following substantial completion.

K. Data Binder Receipt:

1. With first application following substantial completion, provide copy of document identifying to whom Contractor delivered the operating and maintenance data binders.

2. With application for final payment, provide copy of document identifying to whom Contractor delivered project data binders

L. Roof Warranty or Warranties, if any required, on the Owner's section 07 50 36 standard form.

M. Report of Subcontractors and Suppliers, on the standard form.

N. Visitor Log for the period covered by application. After substantial completion, provide log(s) for periods prior to substantial completion that have not been provided in a prior application.

O. Weather Delay Report for all calendar months completed, up to the date of substantial completion, and not previously submitted.

1.04 CERTIFICATION

A. Designer, if in disagreement with the amounts claimed in an application, may either return application to Contractor for revision and resubmittal, or revise application by hand to indicate corrections Designer considers appropriate.

B. Designer, finding an application complete and correct, will certify the application and return one of the sets to Contractor to indicate the action taken.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION

01 31 19 – PROJECT MEETINGS

PART 1 - GENERAL

1.01 SCHEDULING AND ATTENDANCE

A. The Designer, in cooperation with the Owner and the Contractor, will schedule and administer a pre-construction meeting, periodic progress meetings, and any required special meetings.

B. Representatives of the Owner and the Designer will attend.

C. Attending representatives of the Contractor, subcontractors, and suppliers shall be qualified and authorized to act on behalf of the entity each represents.

D. The Contractor representative shall be authorized to sign Change Orders.

1.02 PRE-CONSTRUCTION MEETING

A. A pre-construction meeting will be scheduled upon the award of the contract prior to the issuance of the Notice to Proceed.

B. The Contractor shall arrange for the following participants in the pre-construction meeting:

1. The Contractor's superintendent and management representative having authority to sign change orders.
2. Major subcontractors' representatives
3. Major suppliers' representatives
4. Others as desired

1.03 PROGRESS MEETINGS

A. Progress meetings are held to provide a regular and frequent opportunity for the following purposes.

1. Conduct a general review of the progress of the Work aimed at identifying and mitigating impediments to timely completion.
2. Provide an opportunity for the Contractor to submit Applications for Payment along with appropriate attachments and other submittals.
3. Designer and Contractor sign Change Orders in accordance with § 01 26 00.

B. Progress meetings will be scheduled and conducted at the project site when deemed advisable by the Designer until the Work is complete, typically twice monthly.

C. The Contractor shall arrange for the following participants in progress meetings:

1. The Contractor's superintendent and management representative having authority to sign change orders.
2. Subcontractors' representatives, as befits the agenda
3. Suppliers' representatives, as befits the agenda
4. Others, as appropriate.

D. Proceedings of these meetings will be recorded and the Contractor will be furnished copies for its use and for distribution to subcontractors, material suppliers and vendors.

1.04 SPECIAL MEETINGS

The Contractor and its subcontractors and suppliers shall attend special meetings as deemed necessary and requested by the Designer.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION

01 31 90 – ADMINISTRATIVE LOGS

PART 1 - GENERAL

1.01 SUBMITTALS LOG

A. If any shop drawings, product data, or sample submittals are required by the Contract Documents, maintain a submittals log to record the status of submittals made to the Designer.

B. Process:

1. Submit three (3) copies with each Application for Payment.
2. Clearly identify the Project.
3. Record activities with respect to shop drawings, product data, samples, and such other submittals which are required by the Contract Documents.
4. Indicate for each submittal made to date:
    a. Title or name, and type of submittal.
    b. Date submitted to the Designer.
    c. Date returned by the Designer.
    d. General nature of the Designer's response.

1.02 VISITOR LOG

A. Maintain visitor log in the field office (or with the project superintendent when no field office is required) to record visits by all persons not a part of the Contractor's forces, materials suppliers, or subcontractors' forces, until substantial completion of the entire Work.

B. Process:

1. Submit a copy with each counterpart of each application for payment, covering the period since the last log(s) submitted.
2. Clearly identify the Project.
3. Use the form of specification Section 01 31 93, and indicate:
    a. Visitor name and affiliation.
    b. Date and time of visit.
    c. Length of time on site.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION

01 31 93 – VISITOR LOG

Please print information below if you represent the Owner, institution, Designer or a consultant, a testing agency engaged by the Owner or Designer, a regulatory authority, or yourself as a private individual. Please estimate how long you will be on site, rather than logging out when you leave.

Persons who are employed by the Contractor, a subcontractor, a sub-subcontractor, a supplier, or a testing agency engaged by any of these, are NOT VISITORS, and should not log in on this Log.

Name	Representing	Arrival Date and Time	How Long On Site	Phone No. While On Site

01 32 00 – CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 – GENERAL

1.01 IDENTIFICATION

A. Identify clearly the Project, SBC Number, and date of issuance or revision on each submitted schedule.

1.02 CONSTRUCTION SCHEDULE FORMAT

A. Use a bar chart or critical path schedule format or other method approved by the Designer. A critical path schedule is recommended to enable meeting requirements for documentation for time extension requests.

B. Utilize a construction scheduling software for development and updates.

C. Outline the orderly progress of the Work as planned from the Notice to Proceed through Substantial Completion on the contractually required date.

D. Categorize the Work by major work area and distinct trade or team. If phases are specified also categorize by phase.

E. Divide work activities into one month or less duration.

F. Provide an identifiable relationship to the schedule of values.

G. Identify projected monthly progress, points of 50% completion and Substantial Completion, and other major milestones.

H. If included in the Work, commissioning and storm water pollution protection plan activities shall be major milestones.

I. If planting that is seasonally sensitive is included in the Work, show such distinctly in a seasonally appropriate time.

J. Transmit the schedule in PDF format when requested by the Owner or Designer.

1.03 INITIAL CONSTRUCTION SCHEDULE

Submit within 21 days of award of the Contract and no later than the date of submission of the first Application for Payment.

1.04 UPDATED CONSTRUCTION SCHEDULE

A. Submit a copy attached to each counterpart of Applications for Payment.

B. Format in a manner similar to the initial progress schedule and as follows:

1. Indicate the initial construction schedule for the Work.

2. Identify the actual progress through the period covered by the current Application for Payment.

3. Indicate the planned progress through Substantial Completion including extensions of time made by Modification.

4. If actual progress falls behind previous projections, indicate the recovery plan so that the Work will be completed on time.

1.05 SUBMITTALS SCHEDULE

A. Submit in writing with the initial construction schedule.

B. The submittals schedule may be incorporated into the construction schedule if clearly identified.

C. Identify submittals to be made.

D. Show date for submission and date by which Designer should respond, allowing sufficient time for review. Designer may require revision of the submittals schedule if times allotted for review are insufficient.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION

SECTION 01 33 00
SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.
   1. Contractor's construction schedule (See General Conditions, Paragraph 3.10, Submission of Progress Schedule).
   2. Submittal schedule.
   3. Shop Drawings.
   4. Product Data.
   5. Samples.

B. Administrative Submittals: Refer to other Division 1 Sections and other Contract Documents for requirements for administrative submittals. Such submittals include, but are not limited to, the following:
   1. Permits.
   2. Applications for Payment.
   3. Performance and payment bonds.
   4. Insurance certificates.
   5. List of subcontractors.

C. Progress Reports:
   1. Daily Reports: Progress reports shall be kept on a daily basis to cover each facet of the work. These reports shall be kept on file at the field office and shall be made available for review upon request of the Architect or his representative.
   2. Monthly Reports: Submit with the monthly Application for Payment, in which the progress is reported on each rea of work being undertaken.

D. Related Sections include the following:
   1. Section 01 29 76 - "Progress Payment Procedures" for submitting Applications for Payment and the Schedule of Values.
   2. Division 1 Section "Project Management and Coordination" for submitting and distributing meeting and conference minutes and for submitting Coordination Drawings.
   3. Section 01 32 00 - "Construction Progress Documentation" for submitting schedules and reports, including the Submittals Schedule and Contractor's Construction Schedule.
   4. Section 01 40 00 - "Quality Requirements" for submitting test and inspection reports.
   5. Section 01 77 00 - "Closeout Procedures" for submitting warranties.
   6. Section 01 78 01 - "Closeout Submittals" for submitting Record Drawings, Record

Specifications, and Record Product Data.
7. Division 01 78 01 Section "Project Data Binders" for submitting operation and maintenance manuals.
8. Divisions 2 through 33 Sections for specific requirements for submittals in those Sections.

1.03 DEFINITIONS

A. Action Submittals: Written and graphic information that requires Architect's responsive action.

1.04 SUBMITTAL PROCEDURES

A. General: Architect, upon written request from Contractor, may provide electronic copies of CAD floor plans for the development of shop drawings. BIM Models will not be provided.
   1. Contractor will sign written release guaranteeing the CAD files will be used solely for this project.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
   1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
   2. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
      a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

C. Submittals Schedule: Comply with requirements in Section 01 31 10 "Administrative Requirements" for submittals and time requirements for scheduled performance of related construction activities.

D. Processing Time: Allow enough time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
   1. Initial Review: Allow 10 working days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
   2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
   3. Resubmittal Review: Allow 10 working days for review of each resubmittal.

E. Identification: Place a permanent label or title block on each submittal for identification.
   1. Indicate name of firm or entity that prepared each submittal on label or title block.
   2. Provide a space approximately 6 by 4 inches on label or beside title block to record Contractor's review and approval markings and action taken by Architect.
   3. Include the following information on label for processing and recording action taken:
      a. Contractor's name.

b. Subcontractor's name.
c. Project name.
d. Date.
e. Name and address of subcontractor/supplier/manufacturer.
f. Number and title of appropriate Specification Section.
g. Contract Drawing sheet/detail number for reference, as appropriate.
h. Location(s) where product is to be installed, as appropriate.
i. Other necessary identification.

F. Deviations: Highlight, encircle, or otherwise specifically identify deviations from the Contract Documents on submittals.

G. Additional Copies: Unless additional copies are required for final submittal, and unless Architect observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.

H. Transmittal: Package each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Architect will return submittals, without review, received from sources other than Contractor.
1. Transmittal Form: Provide locations on form for the following information:
a. Project name.
b. Date.
c. Destination (To:).
d. Source (From:).
e. Names of subcontractor/manufacturer/supplier.
f. Specification Section number and title.
g. Remarks.
h. Signature of transmitter.
2. Record relevant information, requests for data, revisions other than those requested by Architect on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations.

I. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
1. Note date and content of previous submittal.
2. Note date and content of revision in label or title block and clearly indicate extent of revision.
3. Resubmit submittals until they are marked "Reviewed by Architect...".

J. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

K. Use for Construction: Use only final submittals with mark indicating " Reviewed by Architect...".

1.05 ACTION SUBMITTALS

A. General: Prepare and submit Action Submittals required by individual Specification Sections.

B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
   1. If information must be specially prepared for submittal because standard printed data are not suitable for use, submit as Shop Drawings, not as Product Data.
   2. Mark each copy of each submittal to show which products and options are applicable.
   3. Include the following information, as applicable:
      a. Manufacturer's written recommendations, product specifications, and installation instructions.
      b. Standard color charts.
      c. Notation of coordination requirements.
   4. Submit Product Data before or concurrent with Samples.
   5. Number of Copies: Submit electronically when possible. If hard copy, three copies of Product Data, unless otherwise indicated. Architect will return two copies. Mark up and retain one returned copy as a Project Record Document.

C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
   1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
      a. Identification of products.
      b. Dimensions.
      c. Notation of dimensions established by field measurement.
      d. Relationship to adjoining construction clearly indicated.
      e. Notation of coordination requirements.
      f. Fabrication and installation drawings.
      g. Roughing-in and setting diagrams.
      h. Wiring diagrams showing field-installed wiring, including power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.
      i. Compliance with specified standards.
      j. Seal and signature of professional engineer if specified.
   2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches but no larger than 30 by 42 inches. Electronic submissions preferred.
   3. Number of Copies, if hard copy: Submit three opaque copies of each submittal, unless copies are required for operation and maintenance manuals. Architect/Consultant will each retain one copy; remainder will be returned. Mark up and retain one returned copy as a Project Record Drawing.

D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.
   1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.

2. Identification: Attach label on unexposed side of Samples that includes the following:
   a. Generic description of Sample.
   b. Product name and name of manufacturer.
   c. Sample source.
   d. Number and title of appropriate Specification Section.
3. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
   a. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
4. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
   a. Number of Samples: Submit two sets of Samples. Architect will retain one Sample set; remainder will be returned.
5. Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
6. If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit several units that show approximate limits of variations.

E. Application for Payment: Comply with requirements specified in Section 01 29 76 "Progress Payment Procedures."

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 CONTRACTOR'S REVIEW

A. Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.

B. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.02 ARCHITECT'S ACTION

A. General: Architect will not review submittals that do not bear Contractor's approval stamp and

will return them without action.

B. Action Submittals: Architect will review each submittal, make marks to indicate corrections or modifications required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action taken.

C. Partial submittals are not acceptable, will be considered nonresponsive, and will be returned without review.

D. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

3.03 ARCHITECT'S ACTION

A. Action Stamp: The Architect will stamp each submittal with a uniform, self-explanatory action stamp. The stamp of the Architect on returned Shop Drawings and samples shall be interpreted as follows:
   1. Reviewed/ No Exceptions Noted: Conforms to design concept of the project.
   2. Reviewed as Noted/ No Exceptions Taken Revised As Noted: Items noted for correction must not be fabricated or furnished without correction as noted.
   3. If the above comments are offered Fabrication/ Installation may be undertaken.
   4. Not Approved: Items submitted are rejected.
   5. Revise and Resubmit or Rejected: The item is rejected as not in accordance with the contract requirement, or for other justified cause. The submission shall be corrected and resubmitted. No item is to be fabricated or furnished under this stamp.
   6. If the above comments are offered Fabrication and/ or Installation may not be undertaken.
   7. List of Subcontractors: Submit list of subcontractors as required by Instruction to Bidders.

END OF SECTION

SECTION 01 40 00
QUALITY REQUIREMENTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section includes administrative and procedural requirements for quality assurance and quality control.

B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
   1. Specific quality assurance and control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
   2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
   3. Requirements for Contractor to provide quality-assurance and -control services required by Architect, Owner, Construction Manager, or authorities having jurisdiction are not limited by provisions of this Section.

1.03 DEFINITIONS

A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Architect or Construction Manager.

C. Mockups: Full size physical assemblies that are constructed on-site. Mockups are constructed to verify selections made under sample submittals; to demonstrate aesthetic effects and, where indicated, qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified

installation tolerances. Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.

1. Integrated Exterior Mockups: Mockups of the exterior envelope erected separately from the building but on the project site, consisting of multiple products, assemblies and subassemblies.

D. Preconstruction Testing: Tests and inspections performed specifically for the Project before products and materials are incorporated into the Work to verify performance or compliance with specified criteria.

E. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.

F. Source Quality-Control Testing: Tests and inspections that are performed at the source, i.e., plant, mill, factory, or shop.

G. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

I. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.

1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade or trades.

J. Experienced: When used with an entity or individual, "experienced" means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.04 CONFLICTING REQUIREMENTS

A. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Architect for a decision before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply

with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.05 INFORMATIONAL SUBMITTALS

A. Contractor's Quality-Control Manager Qualifications: For supervisory personnel.

B. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility sent to authorities having jurisdiction before starting work on the following systems.
   1. Seismic-force resisting system, designated seismic system, or component listed in the designated seismic system quality assurance plan prepared by the Architect.
   2. Main wind-force resisting system or a wind-resisting component listed in the wind-force-resisting system quality assurance plan prepared by the Architect.

C. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

D. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
   1. Specification Section number and title.
   2. Entity responsible for performing tests and inspections.
   3. Description of test and inspection.
   4. Identification of applicable standards.
   5. Identification of test and inspection methods.
   6. Number of tests and inspections required.
   7. Time schedule or time span for tests and inspections.

1.06 CONTRACTOR'S QUALITY-CONTROL PLAN

A. Quality-Control Plan, General: Submit quality-control plan within 10 days of Notice to Proceed, and not less than five days prior to preconstruction conference. Submit in format acceptable to Architect. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities. Coordinate with Contractor's construction schedule.

B. Quality-Control Personnel Qualifications: Engage qualified full-time personnel trained and experienced in managing and executing quality-assurance and quality-control procedures similar in nature and extent to those required for Project.
   1. Project quality-control manager may also serve as Project superintendent.

.

C. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.

D. Testing and Inspection: Include in quality-control plan a comprehensive schedule of Work requiring testing or inspection, including the following:
   1. Contractor-performed tests and inspections including subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections.
   2. Special inspections required by authorities having jurisdiction and indicated on the "Statement of Special Inspections."
   3. Owner-performed tests and inspections indicated in the Contract Documents, including tests and inspections indicated to be performed by the Commissioning Authority.
   4. Owner-performed Special Inspections indicated in the Contract Documents, including Special Inspections will be contracted separately from Contractor for Construction and performed by the Special Inspector contracted to the Owner.

E. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring work into compliance with standards of workmanship established by Contract requirements and approved mockups.

F. Monitoring and Documentation: Maintain testing and inspection reports including log of approved and rejected results. Include work Architect has indicated as nonconforming or

defective. Indicate corrective actions taken to bring nonconforming work into compliance with requirements. Comply with requirements of authorities having jurisdiction.

1.07 REPORTS AND DOCUMENTS

A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:
   1. Date of issue.
   2. Project title and number.
   3. Name, address, and telephone number of testing agency.
   4. Dates and locations of samples and tests or inspections.
   5. Names of individuals making tests and inspections.
   6. Description of the Work and test and inspection method.
   7. Identification of product and Specification Section.
   8. Complete test or inspection data.
   9. Test and inspection results and an interpretation of test results.
   10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
   11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
   12. Name and signature of laboratory inspector.
   13. Recommendations on retesting and reinspecting.

B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:
   1. Name, address, and telephone number of technical representative making report.
   2. Statement on condition of substrates and their acceptability for installation of product.
   3. Statement that products at Project site comply with requirements.
   4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
   5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
   6. Statement whether conditions, products, and installation will affect warranty.
   7. Other required items indicated in individual Specification Sections.

C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:
   1. Name, address, and telephone number of factory-authorized service representative making report.
   2. Statement that equipment complies with requirements.
   3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
   4. Statement whether conditions, products, and installation will affect warranty.
   5. Other required items indicated in individual Specification Sections.

D. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.08 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

B. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

D. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

F. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar to those indicated for this Project in material, design, and extent.

H. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.
   1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.

I. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 329; and with additional qualifications specified in individual Sections; and where required by authorities having jurisdiction, that is acceptable to authorities.
   1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
   2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.

J. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

K. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of

manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

L. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
   1. Build mockups in location and of size indicated or, if not indicated, as directed by Architect or Construction Manager.
   2. Notify Architect and Construction Manager days in advance of dates and times when mockups will be constructed.
   3. Employ supervisory personnel who will oversee mockup construction. Employ workers that will be employed during the construction at the Project.
   4. Demonstrate the proposed range of aesthetic effects and workmanship.
   5. Obtain Architect's and Construction Manager's approval of mockups before starting work, fabrication, or construction.
      a. Allow seven days for initial review and each re-review of each mockup.
   6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
   8. Demolish and remove mockups when directed, unless otherwise indicated.

1.09 QUALITY CONTROL

A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
   1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
   3. Payment and Contract for Special Inspection services will be made by Owner and provided as a consultant to the Architect.
   4. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.

B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities required to verify that the Work complies with requirements, whether specified or not.
   1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
   3. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
      a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
   4. Notify Architect at least 72 hours in advance of time when Work that requires testing or inspecting will be performed.
   5. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.

6. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
7. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

C. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Division 01 Section "Submittal Procedures."

D. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions,

verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.

F. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.

H. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
   1. Notify Architect, Construction Manager, and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
   2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
   3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
   4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
   5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
   6. Do not perform any duties of Contractor.

I. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
   1. Access to the Work.
   2. Incidental labor and facilities necessary to facilitate tests and inspections.
   3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
   4. Facilities for storage and field curing of test samples.
   6. Delivery of samples to testing agencies.
   7. Preliminary design mix proposed for use for material mixes that require control by testing agency.
   8. Security and protection for samples and for testing and inspecting equipment at Project site.

J. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
   1. Schedule times for tests, inspections, obtaining samples, and similar activities.

1.010 SPECIAL TESTS AND INSPECTIONS

A. Statement of Special Inspections is an IBC requirement that may be enforced by local jurisdiction; see Evaluations. Contractor will provide authority having jurisdiction with special inspection reports.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.01 TEST AND INSPECTION LOG

A. Prepare a record of tests and inspections. Include the following:
   1. Date test or inspection was conducted.
   2. Description of the Work tested or inspected.
   3. Date test or inspection results were transmitted to Architect.
   4. Identification of testing agency or special inspector conducting test or inspection.

B. Maintain log at Project site. Post changes and modifications as they occur. Provide access to test and inspection log for Architect's and Construction Manager's reference during normal working hours.

3.02 REPAIR AND PROTECTION

A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
   1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Division 01 Section "Execution."

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION

01 45 29 – TESTING LABORATORY SERVICES

PART 1 - GENERAL

1.01 TESTING REQUIRED BY SECTIONS 1704 AND 1705 OF THE INTERNATIONAL BUILDING CODE

For the types of work listed under Sections 1704 and 1705 of the International Building Code, the Owner and Designer shall make arrangements for the employment and payment of services of approved agencies to perform inspections and tests.

1.02 TESTING OTHER THAN THAT REQUIRED BY SECTIONS 1704 AND 1705 OF THE INTERNATIONAL BUILDING CODE

A. For the types of work not listed under Sections 1704 and 1705 of the International Building Code the Contractor shall employ and pay for the services of an independent testing laboratory, approved by the Designer, to perform specified services and testing. Employment of laboratory does not relieve Contractor's obligations to perform the Work.

B. Coordinate and pay for inspections and testing required by law, ordinance, rules, regulations, orders, or approvals of public authorities as required by the Contract Documents. Furnish copies of products test reports as required.

C. Furnish incidental labor and facilities to facilitate inspections and tests and for storage and curing of test samples.

D. Notify the lab sufficiently before operations to allow for laboratory personnel assignment and tests scheduling.

E. Make arrangements with lab and pay for additional samples and tests required for Contractor's convenience.

F. Contractor employed testing laboratory qualifications.

1. Meet basic requirements of ASTM E329-18 Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection.

2. Be authorized to operate in the State of Tennessee.

G. Contractor employed testing laboratory duties and limitations of authority:

1. Perform specified inspections, sampling, materials testing and methods of construction testing and promptly submit an electronic copy of the written report of each test and inspection to the Designer.

2. Laboratory is not authorized to release, revoke, alter or enlarge on requirements of the Contract Documents, approve or accept portions of the Work, or perform duties of the Contractor.

END OF SECTION

01 50 00 – TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

Provide structurally sound and neat temporary facilities and controls as necessary for the Work. Remove promptly as each is no longer required.

1.02 TEMPORARY OFFICE

Provide a temporary field office sized as necessary to support the Work. Adequate space and facilities shall be provided in the field office for convenient use and storage of contract drawings and specifications, approved shop drawings and field records. A telephone will be required.

1.03 TEMPORARY SHEDS

Provide watertight and secure storage sheds as necessary to hold materials to be protected while stored on the site.

1.04 TEMPORARY TOILET FACILITIES

Provide adequate temporary toilet and hand washing facilities for the use of all workers, conforming to all applicable laws, ordinances and regulations. Maintain these facilities in sanitary condition and remove upon completion of work.

1.05 TEMPORARY ENCLOSURES

A. Provide temporary weather tight enclosures or coverings for exterior openings in the building when required to permit the use of temporary heat or to protect the finished work from damage by the elements, and when necessary for security.

B. Provide temporary dust-tight partitions of plywood construction between the interior of new and existing buildings when work has progressed to the point where a new building is to be connected to an existing building, and in other locations as required by renovation work.

1.06 PROTECTION AND USE OF SITE

A. Maintain any existing site fencing. Provide and maintain all other fencing, planking, bridges, bracing, shoring, sheet piling, lights, barricades, warning signs and guards as necessary for the protection of persons, streets, sidewalks, landscaping, bridges, piers, buildings and property, both on and off the site, from construction related damage.

B. The Contractor shall confine site operations to areas designated for its use on the Drawings. The Contractor shall not interfere with the operations of surrounding buildings and shall not unreasonably clutter the site with materials or equipment.

C. Should any damage occur, Contractor shall restore such to its original condition in a manner acceptable to the Designer.

D. Take adequate precautions against fire. Keep flammable material at an absolute minimum, ensure that such material is properly handled and stored. Except as otherwise provided herein, do not permit fires to be built or open salamanders to be used in any part of the work.

E. The Contractor shall be responsible for maintaining site access and paying all highway fees.

F. The Contractor shall be responsible for repair of any damage resulting from the performance of the Work to lawns, pavement, sidewalks, curbs, streets, public utilities, and other public property. Repairs shall restore to the conditions existing prior to performance of the Work.

1.07 WATER AND SNOW CONTROL

A. Keep the site and the project free of accumulation of water and supply, maintain and operate all necessary pumping and bailing equipment.

B. Remove snow and ice as necessary for the protection and prosecution of the work, and protect the work against weather damage.

1.08 TEMPORARY HEATING

A. Provide heat, fuel and services as necessary to protect all work and materials against injury from dampness and cold until final acceptance of all work and material in the contract. The Contractor shall provide heat as follows:

1. At all times during the placing, setting and curing of concrete, provide sufficient heat to ensure the heating of the space involved to not less than 50 degrees F unless otherwise approved.

2. For a period of ten days and until final acceptance of the Work or until full occupancy, provide sufficient heat to maintain a temperature of not less than 60 degrees F.

B. Provide temporary heat by approved heating apparatus that will not endanger or damage work in place. Do not use unvented open flame heaters to heat or dry out freshly-placed concrete or plaster.

C. In remodeled areas where the existing heating system remains intact and functioning, replace all disposable filters, clean all permanent filters and clean any duct systems from accumulation of dust and dirt.

1.09 MAINTENANCE OF TRAFFIC AND CIRCULATION

Maintain circulation of traffic, both pedestrian and vehicular, and access to all parts of the site by fire-fighting apparatus during construction.

1.10 VERMIN CONTROL

During construction, the Contractor shall keep the building and the area of the construction free of food scraps and similar organic matter that would attract vermin, and it shall take measures necessary to prevent infestation of the building. If, at the time of final inspection or within six months after occupancy, the building is found to be infested by rodents or other vermin, the Contractor shall bear the expense of extermination.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION

01 57 23 – TEMPORARY STORMWATER POLLUTION CONTROL

PART 1 – GENERAL

1.01 JURISDICTION

This project is under the jurisdiction of the Tennessee Department of Environment and Conservation (TDEC) and a Stormwater Pollution Prevention Plan (SWPPP) has been filed. TDEC has provided a Construction General Permit (CGP) Notice of Coverage (CGP-NOC or just NOC). Under a NOC, the Owner is primary permittee, and the Contractor is considered a secondary permittee and may be referred to as a Construction Site Operator, by virtue of having day-to-day operational control of those activities at a project which are necessary to ensure compliance with a SWPPP for the site or other permit conditions.

1.02 RELATED SECTIONS

A. Copies of the NOC and SWPPP are normally included in the specifications but formatted without a specification section number. They may follow this Section or may be added by addendum or modification, and are to be considered a part of this Section. A copy of each, not bound into larger volumes of the Contract Documents, may be obtained from the Designer for ease of carrying out the requirements below.

B. Other technical aspects of the SWPPP are described in the Contract Documents where appropriate.

1.03 BASIC COORDINATION AND MONITORING

A. NOC: Post a copy of the NOC in a prominent, public location, such as a general notices board where building permit, employment regulations, and prevailing wage rates are posted. Protect the NOC from weather without obstructing its visibility. Repair or replace the NOC if it becomes damaged or missing.

B. SWPPP:

1. Maintain a copy of the SWPPP on site at all times. If a construction office/trailer is on site, keep the SWPPP documents inside it in a designated location. If there is no office/trailer, construct a SWPPP box and store the SWPPP documents therein. If the site is inactive, or does not have an on-site location adequate to store and protect the SWPPP, post a notice alongside the NOC telling where the SWPPP is stored, with a contact name and phone number. If the SWPPP is located off-site, provide reasonable local access to it during normal working hours.

2. Make updated plans and inspection reports available upon request to the operator of the local MS4, inspectors, and local agencies approving EPSC plans, grading plans, or stormwater management plans.

C. Rainfall Monitoring:

1. Maintain a rain gage on site, or determine a reliable local reference resource for rainfall monitoring. A resource off of the immediate campus where the project is located is not adequately local for normal daily readings. On days when Contractor's forces are not on site, if an on-campus local resource is unavailable, a rainfall reading can be obtained from a reliable nearby resource.

2. Take 24-hour rainfall depth measurement readings at a consistent time of day each day. When a rain event occurs, record the approximate beginning and ending time. Record the daily readings on 01 26 25 Weather Delay Report, even if Work is not delayed.

3. Keep a copy of rainfall records with the SWPPP.

D. EPSC Field Plans: A set of Erosion Prevention and Sediment Control (EPSC) plans shall be designated “field plans” and used to show modifications and updates and the date of each change, which can be hand-written on the sheets. Maintain these field plans nearby the overall project record documents.

E. Site Assessment: As soon as SWPPP Site Assessment features are in place, notify the Designer that the Work is ready for the SWPPP Site Assessment.

F. Twice Weekly Inspections:

1. Conduct inspections of the storm water control measures twice-weekly and at least 72 hours apart. Where sites or portion(s) of sites have been temporarily stabilized, or runoff is unlikely due to extreme drought, or winter conditions such as freezing or snow or ice covering, written notification may be submitted to the local environmental field office that inspections are being curtailed; and, if not objected to by that office, then such inspection may be conducted only once per month until construction activity resumes or thaw or precipitation results in runoff. Inspection requirements do not apply after Work has achieved final stabilization.

2. The person making the inspections must have active certification, having completed the TDEC “Fundamentals of Erosion Prevention and Sediment Control Level 1” course.

3. A “Construction Stormwater Inspection Certification (Twice-Weekly Inspections)” form must be filled out by the inspector for each inspection. Keep copies of completed forms with the SWPPP. Blanks of this form can be found in the Tennessee Erosion and Sediment Control Handbook issued by the Tennessee Department of Environment and Conservation.

G. Final Stabilization: Submit statement of final stabilization to the Designer when permanent site work is in place and temporary stormwater control measures have been removed, typically when requesting substantial completion inspection, at the substantial completion inspection, or when requesting final inspection. Final stabilization is defined as 70% density of a permanent groundcover over all previously disturbed area(s).

H. Record Documents: In addition to keeping the Project Record Documents complete with as-built conditions, at Final Stabilization assemble all twice-weekly inspection reports and site audit reports, and include these in the Project Data Binders.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION

STORM WATER POLLUTION PREVENTION PLAN FOR TENNESSEE COLLEGE OF APPLIED TECHNOLOGY 660 MOSBY AVENUE MEMPHIS, TENNESSEE 38105

OWNER:

STATE OF TENNESSEE/ TENNESSEE BOARD OF REGENTS SBC # 166/000-04-2013Y3

PREPARED BY:

JOEL T. JOHNSON, P.E., EPSC Level II
BURR & COLE CONSULTING ENGINEERS, INC.
3485 POPLAR AVE., SUITE 200
MEMPHIS, TN 38111

March 3, 2020

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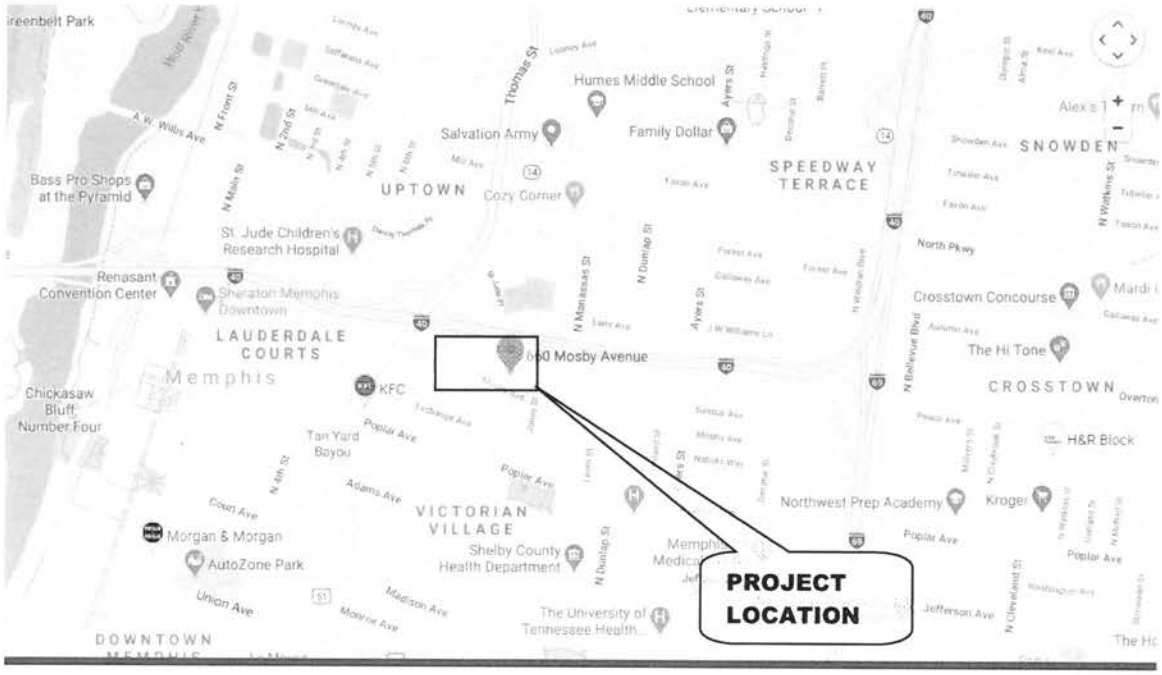
March 3, 2020

SWPPP
TCAT Memphis Phase II
Memphis, Tennessee

TABLE OF CONTENTS

1. SITE MAP
2. CONSTRUCTION SITE STORM WATER CONTROL PLAN
3. CONSTRUCTION MANAGEMENT TECHNIQUES
4. REPORTING AND RECORD KEEPING REQUIREMENTS
5. SEQUENCE OF ACTIVITIES
6. DISCHARGES INTO IMPAIRED TENNESSEE WATERS
7. SPILLS AND NON-STORM WATER CONTINGENCIES
8. RUNOFF CALCULATIONS
9. OWNER AND CONTRACTOR CERTIFICATIONS
10. PLANS
11. USGS 7.5 MINUTE QUAD MAP EXCERPT
12. NOTICE OF INTENT (NOI)
13. T.D.E.C. CONSTRUCTION STORM WATER INSPECTION REPORT
14. T.D.E.C. NOTICE OF TERMINATION (NOT)

1. SITE MAP



2. CONSTRUCTION SITE STORM WATER CONTROL PLAN

A. It is the intent of this site-specific plan to minimize the erosion of soil and the discharge of other pollutants into waters of the State of Tennessee. This plan will be kept on site and made available to the Division of Water Pollution Control inspector upon request. N.O.C. will be posted at the job site trailer. Contacts: Mr. Roland Rayner, President, TCAT Memphis (901) 543-6100.

1. The activity for this project includes **Area A**: construction of an educational facility for Tennessee College of Applied Technology and **Area B**: clearing and grubbing a vacant property for a parking lot. The project will be located at 660 Mosby Avenue in the City of Memphis. There will be only one general contractor involved in the construction. The one general contractor will be responsible for installing and maintaining the erosion control measures and the SWPPP. The project will begin in the summer of 2020 and be complete in fall of 2021. Area A building will be built over an existing parking lot. Area B parking lot will be built on a previously developed vacant lot. During the building construction, the existing conditions will remain undisturbed as much as possible to limit the amount of disturbance. The building site will be stripped of asphalt in the footprint initially. The building site will be filled with off-site fill material to bring the site up to grade. The fill will be approximately 1'-4' over a portion of the construction area. Each of these activities will be covered by the Erosion Control Plans.

2. The approximate disturbed area is in two separate areas:

Area A: Building/Parking/Grading	2.16 acres
Area B: Parking lot	1.6 acres

From pre-development to post-development, the percentage of impervious area will decrease.

	Pre-Runoff Coefficient	Post-Runoff Coefficient
Area A	CN=97	CN=95
Area B	CN=88	CN=85

3. Common off-site borrow soil will be brought onto the site for building pad fill. The offsite borrow pit will be determined by the general contractor. The contractor shall verify the borrow area be maintained according to TDEC requirements.

4. Erosion Control Plans have been submitted which shows approximate slopes, the drainage patterns, locations of drainage structures, erosion control structures, erosion control construction notes, and erosion control details.

5. The project is located in City of Memphis; the on-site drainage will flow through storm water structures to the Mississippi River.

B. If the plan is reviewed by the Division, the Director or authorized representative may notify the dischargers that the plan does not meet minimum requirements. The dischargers will have 48 hours, unless the Director provides additional time, after such notification to make changes to sediment and erosion controls to prevent the discharge of sediment from the site and seven (7) days to make necessary changes to the plan.

C. Construction management techniques for this site are described in Section 3 of this plan.

D. During construction, all newly cut and/or fill areas lacking adequate vegetation will be seeded, fertilized, mulched, and/or sodded as required to effectively prevent soil erosion per TDEC regulations. Refer to the Erosion Control Plans for additional details and instructions.

E. It is the responsibility of the Owner and the General Contractor to implement and maintain the site storm water control (Erosion Control Plans) plan during all phases of construction until completion, approval and acceptance of new work by the Owner and all applicable governing agencies having jurisdiction over the work.

3. CONSTRUCTION MANAGEMENT TECHNIQUES

A. General:

1. The removal of the existing topsoil will be held to the minimum necessary for grading and equipment operation.

2. Construction must be sequenced to minimize the exposure time of cleared surface area.

3. Construction must be staged or phased for the project. Areas of one phase must be stabilized before another phase can be initiated. Stabilization will be accomplished by temporarily or permanently protecting the disturbed soil surface from rainfall impacts and runoff.

4. Erosion and sediment control measures must be in place and functional before grading operations begin and must be constructed and maintained throughout the construction period. Temporary measures may be removed at the beginning of the workday but must be replaced at the end of the workday.

5. Schedule of Inspections

    a. Inspections described in paragraphs b, c and d below, shall be performed at least twice every calendar week. Inspections shall be performed at least 72 hours apart. Where sites or portions(s) of construction sites have been temporarily stabilized, or runoff is unlikely due to winter conditions (e.g., site covered with snow or ice) or due to extreme drought, such inspection only has to be conducted once per month until thawing or precipitation results in runoff or construction activity resumes. Inspection requirements do not apply to definable areas that have been finally stabilized. Written notification of the intent to change the inspection frequency and the justification for such request must be submitted to the local Environmental Field Office. Should the division discover that monthly inspections of the site are not appropriate due to insufficient stabilization measures or otherwise, twice weekly inspections shall resume. The division may inspect the site to confirm or deny the notification to conduct monthly inspections.
    b. Qualified personnel, EPSC Level 1certified above (provided by the permittee or cooperatively by multiple permittees) shall inspect disturbed areas of the construction site that have not been finally stabilized, areas used for storage of materials that are exposed to precipitations, structural control measures, locations where vehicles enter or exit the site, and each outfall.
    c. Disturbed areas and areas used for storage of materials that are exposed to precipitation shall be inspected for evidence of, or the potential for, pollutants entering the site's drainage system. Erosion prevention and sediment control measures shall be observed to ensure that they are operating correctly.
    d. Outfall points (where discharges leave the site and/or enter waters of the state) shall be inspected to determine whether erosion prevention and sediment control measures are effective in preventing significant impacts to receiving waters. Where discharge locations are inaccessible, nearby downstream locations shall be inspected. Locations where vehicles enter

or exit the site shall be inspected for evidence of offsite sediment tracking. The outfall point is on site and is noted on the Erosion Control Plans.

e. Based on the results of the inspection, any inadequate control measures or control measures in disrepair shall be replaced or modified, or repaired as necessary, before the next rain event, but in no case more than 7 days after the need is identified.

f. Based on the results of the inspection, the site description identified in the SWPPP and pollution prevention measures identified in the SWPPP shall be revised as appropriate, but in no case later than 7 days following the inspection. Such modifications shall provide for timely implementation of any changes to the SWPPP, but in no case later than 14 days following the inspection.

g. All inspections shall be documented on the Construction Stormwater Inspection Certification form provided in this SWPPP for all construction sites. An alternative inspection form may be used as long as the form contents and the inspection certification language are, at minimum, equivalent to the division's form and the permittee has obtained a written approval from the division to use the alternative form. Inspection documentation will be maintained on site and made available to the division upon request. Inspection reports must be submitted to the division within 10 days of request. If the division requests the Construction Stormwater Inspection Certification form to be submitted, the submitted form must contain the printed name and signature of the trained certified inspector and the person who meets the signatory requirements of the NOI.

h. Trained certified inspectors shall complete inspection documentation to the best of their ability. Falsifying inspection records or other documentation or failure to complete inspection documentation shall result in a violation of this permit and any other applicable acts or rules.

B. Vegetative Controls:

1. Pre-construction vegetative ground cover will not be destroyed, removed or disturbed more than ten (10) calendar days prior to grading or earth moving operations.

2. To the extent feasible, appropriate cover will be applied within seven (7) calendar days on areas that will remain unfinished for more than fourteen (14) calendar days. Examples of cover are grass, sod, straw, mulch, fabric mats, etc.

3. Permanent soil stabilization with perennial vegetation will be applied as soon as practicable after final grading.

C. Structural Controls:

1. There is very limited surface water flowing toward the construction area. This water is being re-directed around the construction site by existing curbs on adjacent streets.

2. Erosion and sediment control measures will be designed according to the size and slope disturbed or drainage areas to detain runoff. Erosion and sediment controls shall be designed to control the rainfall and runoff from a 5-year, 24-hour storm, as a minimum. Permittees shall maintain a rain gauge at the site.

D. Discharge Quality:

1. There will be no distinctly visible floating scum, trash, debris, oil or other matter contained in the storm water discharge.

2. The storm water discharge must not cause an objectionable color contrast or odor in the receiving stream or existing storm drainage system(s).

3. The storm water discharge must not contain materials in concentrations sufficient to be hazardous or otherwise detrimental to humans, livestock, wildlife, plant life, or fish and aquatic life in the receiving stream or existing storm drainage system(s).

4. REPORTING AND RECORD KEEPING REQUIREMENTS

A. The permittee will maintain records of checks and repairs on site.

B. Records and information resulting from the monitoring activities required by this rule will be retained for a minimum of three (3) years or longer if requested by the Division of Water Pollution Control.

C. Knowingly making any false statement on any report required by this rule may result in the imposition of criminal penalties as provided for in Section 309 of the Federal Water Pollution Control Act and in Section 69-3-115 of the Tennessee Water Quality Control Act.

D. Posting information at the construction site

1. The permittee shall post a notice near the main entrance of the construction site accessible to the public with the following information:

   a. A copy of the NOC with the NPDES permit tracking number for the construction project;
   b. Name, company name, E-mail address (if available), telephone number and address of the project site owner/operator or a local contact person;
   c. A brief description of the project; and
   d. The location of the SWPPP.

The notice must be maintained in a legible condition. If posting this information near a main entrance is infeasible due to safety concerns, or not accessible to the public, the notice shall be posted in a local public building. This permit does not provide the public with any right to trespass on a construction site for any reason, including inspection of a site. This permit does not require that permittees allow members of the public access to a construction site.

2. The permittee shall also retain following items/information in an appropriate location on-site:

   a. A rain gauge;
   b. A copy of twice weekly inspection reports;
   c. A documentation of quality assurance site assessments, if applicable; and
   d. A copy of the site inspector's Fundaments of Erosion Prevention and Sediment Control Level 1 Certification.

5. SEQUENCING OF ACTIVITIES

A. Temporary sediment barriers will be installed down slope of the disturbed area and moved further down slope as the ground-disturbing activity is extended. All erosion prevention and sediment control best management practices identified in this SWPPP will be installed as recommended in the Tennessee Erosion and Sediment Control Handbook.

B. **Area A: Building:** Land-disturbing activity at the building footprint will begin with the designation of the construction entrance/exit on Mosby Road. The construction activity will access the site via the Mosby Road. The existing asphalt paving will be used to access the site. A truck wash will be installed for the use of any vehicles leaving the site. The truck wash will recycle the wash water and will be self-contained so that no water can escape to the street or toward the public drainage system. The activities will begin with the removal of asphalt paving in the footprint of the building. Once the asphalt has been removed the site will be filled to accomplish design grades.

C. **Area B: Parking Lot:** Land-disturbing activity at the parking lot will begin with the designation of the construction entrance/exit on Alabama Street. The construction activity will access the site via the Alabama Street. The contractor will construct a limestone entrance/exit on Alabama Street. A truck wash will be installed for the use of any vehicles leaving the site. The truck wash will recycle the wash water and will be self-contained so that no water can escape to the street or toward the public drainage system. The activities will begin with the clearing of the site. Once the top soil has been removed the site will be graded to accomplish design grades.

D. Construction of silt fences will be completed, and they will be functional prior to clearing. The silt fences will slow down the storm water and drop out larger soil particles. The silt fences will allow easy clean out of any built-up sediment deposits. There are no sediment basins anticipated for this project.

E. Sequencing of activities will include:

1. Construction Exit
2. Erosion Control measures as identified on ECP Phase 1
3. Remove asphalt pavement
4. Fill/Grade site
5. Install underground utilities to include storm drainage
6. Construct the parking lot
7. Construct the building
8. Stabilize disturbed areas created by utilities, with seeding and mulching
9. Erosion Control measures as identified on ECP Phase 2
10. Near completion of project final grade site and install sod and landscaping

F. Sodding or other stabilization measure as identified per the Erosion Control Plans will occur after final grade is achieved and before any further disturbance of the site.

G. Storm drain inlet protection will be installed in accordance with TDEC Handbook.

H. Sediment will be removed from sediment traps, silt fences, and other sediment controls before the design capacity of the structure has been reduced by 50%. The sediment will be removed with a back-hoe and loaded onto a truck; the sediment will remain on-site and used for fill. Litter, construction debris, and construction chemicals exposed to storm water will be picked up prior to anticipated storm events (e.g., forecasted by local weather reports), or otherwise prevented from becoming a pollutant source for storm water discharges (e.g., screening, outfalls, daily pick-up, etc.). After use, silt fences will be removed or otherwise prevented from becoming a pollutant source for storm water discharges. Temporary measures may be removed at the beginning of the workday, but will be replaced at the end of the workday.

I. Stabilization will be accomplished as soon as practicable after attainment of final grade and no later than seven days after attaining final grade. Where earth-disturbing activity has temporarily ceased, temporary stabilization will be applied within seven days if the activity will not resume within 15 days. The dates when major grading activities occur, the dates when construction activities temporarily or permanently cease on a portion of the site, and the dates when stabilization measures are initiated will be recorded and maintained on the site. Stabilization methods are outlined in the Erosion Control Plans (attached) and will include sod.

6. DISCHARGES INTO IMPAIRED (UNAVAILABLE PARAMETERS) TENNESSEE WATERS

A. Additional SWPPP/BMP Requirements for discharges into impaired TN Waters

Discharges that would add loadings of a pollutant that is identified as causing or contributing to an impairment of a water body on the list of impaired waters, are not authorized by this permit. To be eligible to obtain and maintain coverage under this permit, the operator must satisfy, at a minimum, the following additional requirements for discharges into waters impaired by siltation (or discharges upstream of such waters and because of the proximity to the impaired segment and the nature of the discharge is likely to contribute pollutants of concern in amounts measurable in the impaired segment that may affect the impaired waters).

1. This SWPPP certifies that erosion prevention and sediment controls used at the site are designed to control storm runoff generated by a 5-year, 24-hour storm event as a minimum, either from total rainfall in the designated period or the equivalent intensity as specified on the following website http://hdsc.nws.noaa.gov/hdsc/pfds/orb/tn_pfds.html. When clay and other fine particle soils are found on sites, additional physical or chemical treatment of storm water runoff may be used.
2. This SWPPP has been prepared by a person who, at a minimum, has completed the department's Level II Design Principles for Erosion Prevention and Sediment Control for Construction Sites course.
3. The permittee shall perform inspections at least twice every calendar week. Inspections shall be performed at least 72 hours apart.
4. The permittee must certify on the form provided in this SWPPP whether or not all planned and designed erosion prevention and sediment controls are installed and in working order. The form must contain the printed name and signature of the inspector and the certification must be executed by a person who is a duly authorized representative of the signatory on the NOI. The record of inspections must be kept at the construction site with a copy of the SWPPP.
5. In the event the division finds that a discharger is complying with the SWPPP, but contributing to the impairment of a receiving system, then the discharger will be notified by the director in writing that the discharge is no longer eligible for coverage under the general permit. The permittee may update the SWPPP and implement the necessary changes designed to eliminate further impairment of the receiving system. If the permittee does not implement the SWPPP changes within 7 days of receipt of notification, the permittee will be notified in writing that continued discharges must be covered by an individual permit. To obtain the individual permit, the operator must file an individual permit application (EPA Forms 1 and 2F). The project must be stabilized immediately until the SWPPP is updated and the individual permit is issued. Only discharges from earth disturbing activities necessary for stabilization are authorized to continue until the individual permit is issued.
6. The site is presently an agricultural operation in a suburban city. The building site is presently an agricultural field. The maximum outfall will be 6.4 acres during construction routed through a sediment basin. A temporary sediment basin is required.

7. The director may require revisions to the SWPPP necessary to prevent a negative impact to legally protected state or federally listed aquatic fauna, their habitat, or the receiving waters.

7. SPILLS AND NON-STORM WATER CONTINGENCIES

A. Any spillage will be removed immediately. Contaminated soils will be placed on heavy plastic and covered or placed into approved containers to prevent contact with storm water. All fuel tanks will be in the containment area. Oils, other vehicle fluids, paints, and solvents will be stored in the construction trailer. Any spill in excess of two gallons will be reported to a representative of State of Tennessee.

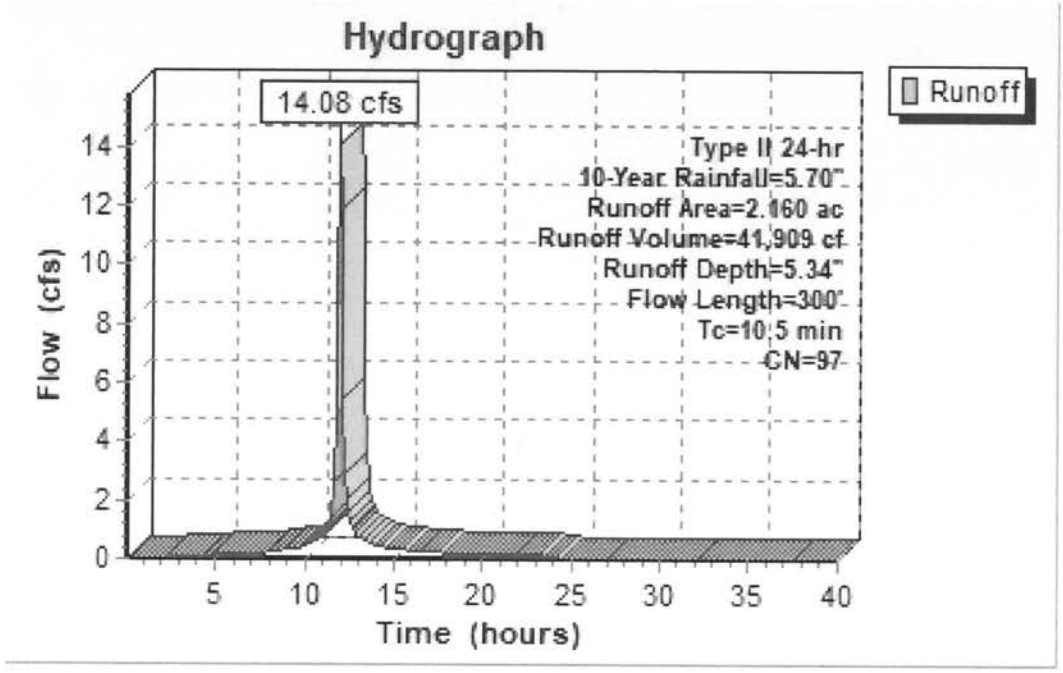
B. **If a release containing a hazardous substance in an amount equal to or in excess of a reporting quantity established under either r40 CFR 117 or 40 CFR 302 occurs during a 24-hour period, the contractor will immediately notify the permittee who shall then do the following: notify the National Response Center (NRC) (800-424-8802) and the Tennessee Emergency Management Agency (TEMA) (emergencies: 800-262-3300; non-emergencies: 800-262-3400); as well as the local Environmental Assistance Center.** Also, State of Tennessee will prepare a revision of this document to identify measures to prevent the reoccurrence of such releases.

C. Concrete trucks will wash out at the designated area. Each contractor is responsible to provide litter control for trash generated by his crew. Paint cans, oil cans, used oil, and filters will be contained and disposed of by the contractor by taking them to any County Hazardous Waste Disposal Center.

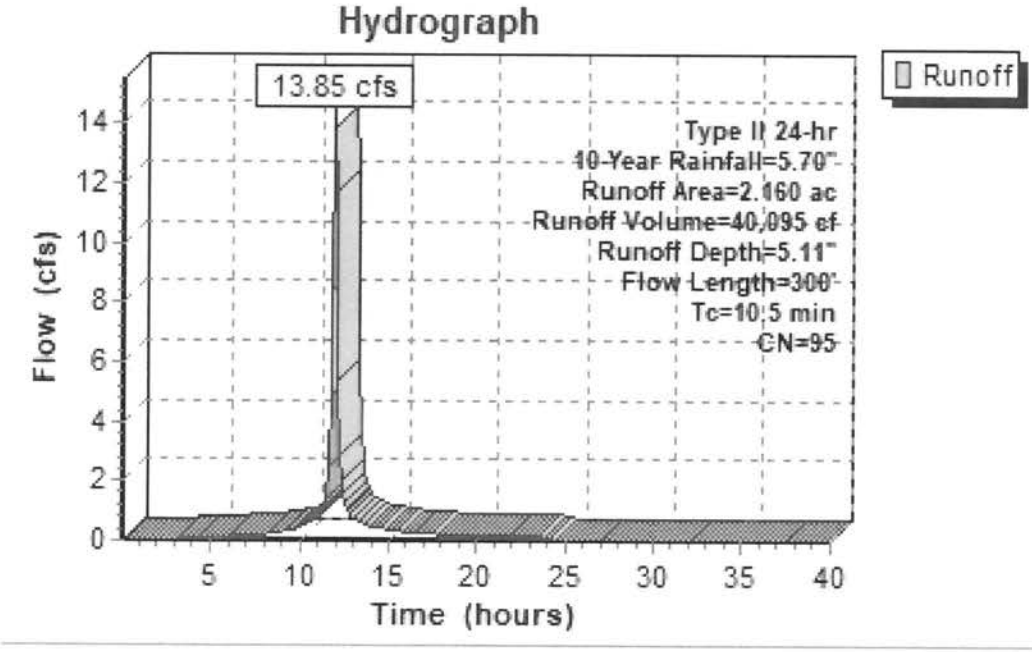
8. RUNOFF CALCULATIONS

A. In both **Area A** and **Area B**, the construction of the TCAT Memphis facility will decrease the rate of runoff from the site. The SCS TR-20 Type II Method 24 hr. 10 year storm, rainfall=5.7" was used to determine the storm water runoff. The charts below show the pre and post development runoff of each area.

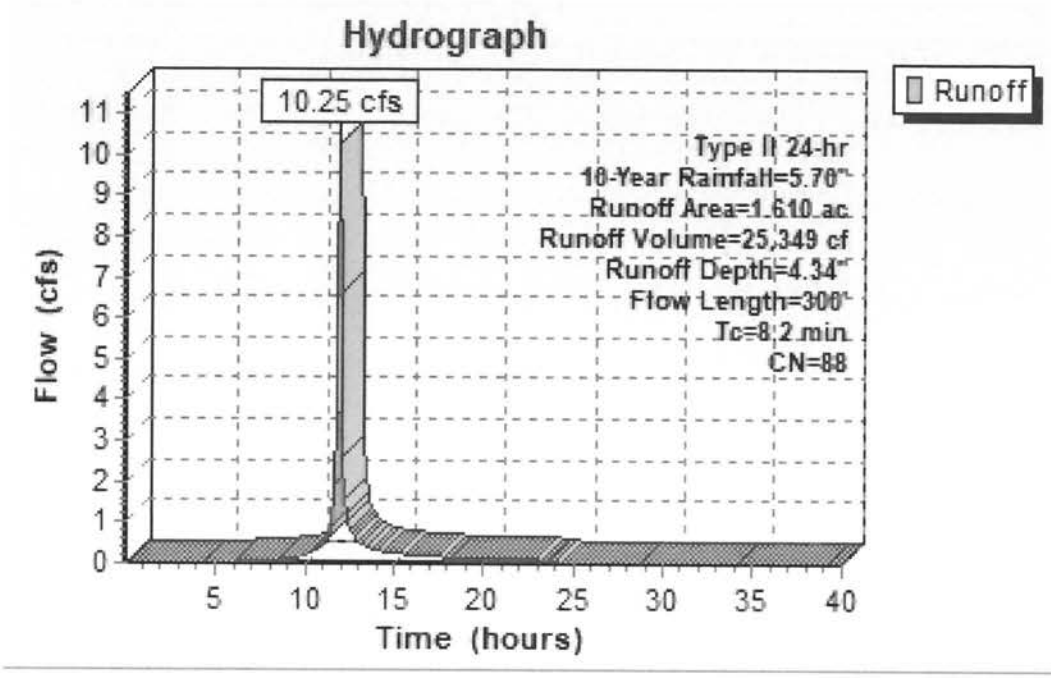
AREA A PREDEVELOPMENT RUNOFF



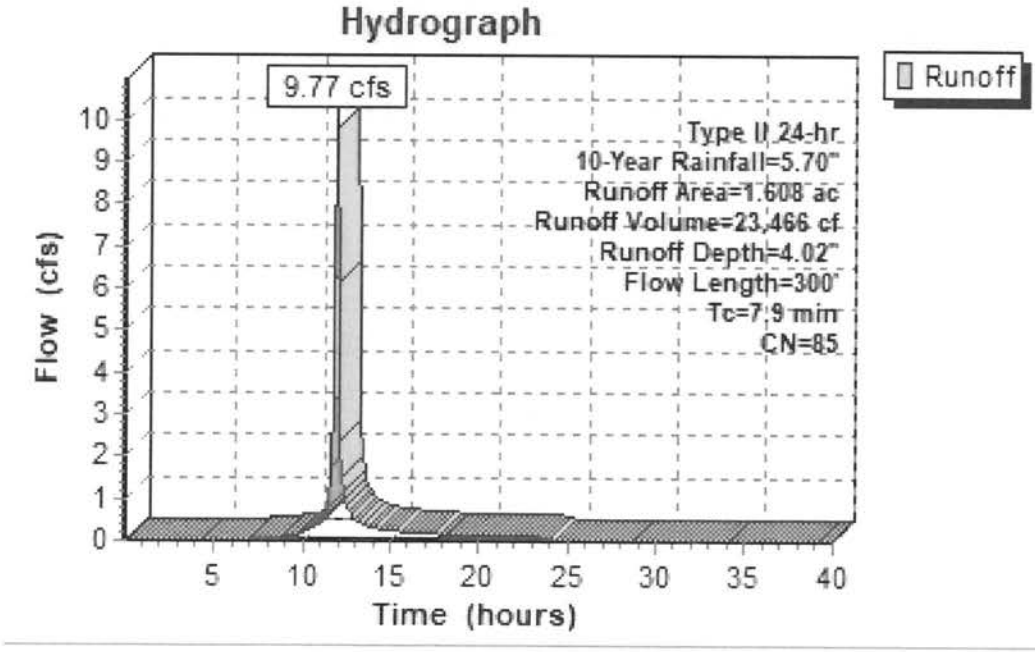
AREA A POST DEVELOPMENT RUNOFF



AREA B PREDEVELOPMENT RUNOFF



AREA B POST DEVELOPMENT RUNOFF



9. OWNER AND CONTRACTOR CERTIFICATIONS

A. I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is to the best of my knowledge and belief, true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment of knowing violations.

TCAT Memphis, President 5/28/2020

Owner/Developer – Title Date

Roland Rayner

Printed Name

B. I certify under penalty of law that I have reviewed this document, any attachments, and the SWPPP referenced above. Based on my inquiry of the construction site owner/developer identified above and/or my inquiry of the person directly responsible for assembling this Notice of Intent and SWPPP, I believe the information submitted is accurate. I am aware that this NOI, if approved, makes the above described construction activity subject to NPDES permit number TNR10-0000, and that certain of my activities on-site are thereby regulated. I am aware that there are significant penalties, including the possibility of fine and imprisonment for knowing violations, for failure to comply with these permit requirements.

Contractor – Title Date

Printed Name

10. PLANS

A. Refer to Demolition Plans Sheets C1.5 and C1.6 for existing conditions.

B. Refer to Grading & Drainage Plans see Sheets C3.1 and C3.2.

C. Refer to the Erosion Control Plans Sheets C3.4 and C3.5 for Phase 1 and Phase 2 Erosion Control Plans. The erosion control details are noted on Sheet C3.6. In addition to specified site stabilization techniques, this project will be enhanced with landscaping and planting.

D. Construction specifications related to erosion/sedimentation control devices are made a part of the SWPPP by inference and will be kept at the site at all times during the length of project construction and acceptance.

NOTES

1. REMOVE TREE, GRIND OR REMOVE ENTIRE STUMP. LEAVE NO ORGANIC MATERIAL. FILL VOID WITH COMPACTED FILL MATERIAL.
2. REMOVE CONCRETE WALK
3. REMOVE ASPHALT, GRAVEL, OR CONCRETE PAVING, AND BASE. CONTRACTOR MAY SAMPLE PAVING THICKNESS FOR EVALUATION PURPOSES. EDGES SHALL BE SAWCUT. REMAINING EDGES SHALL BE NEAT, CLEAN AND STRAIGHT.
4. REMOVE SITE LIGHTING INCLUDING CONCRETE BASES AND POLES. SEE ELECTRICAL SITE PLAN FOR HANDLING OF CIRCUITS. MAINTAIN POWER TO REMAINING LIGHT POLES IN PARKING AREA.
5. REMOVE CURB AND/OR GUTTER.
6. REMOVE CONCRETE STEPS.
7. REMOVE SIGNAGE AND TURN OVER TO THE CAMPUS.
8. REMOVE SIDEWALK, CURB/GUTTER, AND ASPHALT IN ORDER TO INSTALL CURB CUT. SAWCUT ASPHALT IN STREET FOR CLEAN TRANSITION.
9. REMOVE MISCELLANEOUS ITEMS.
10. REMOVE PORTION OF IRON FENCE TO ACCOMMODATE DRIVE.

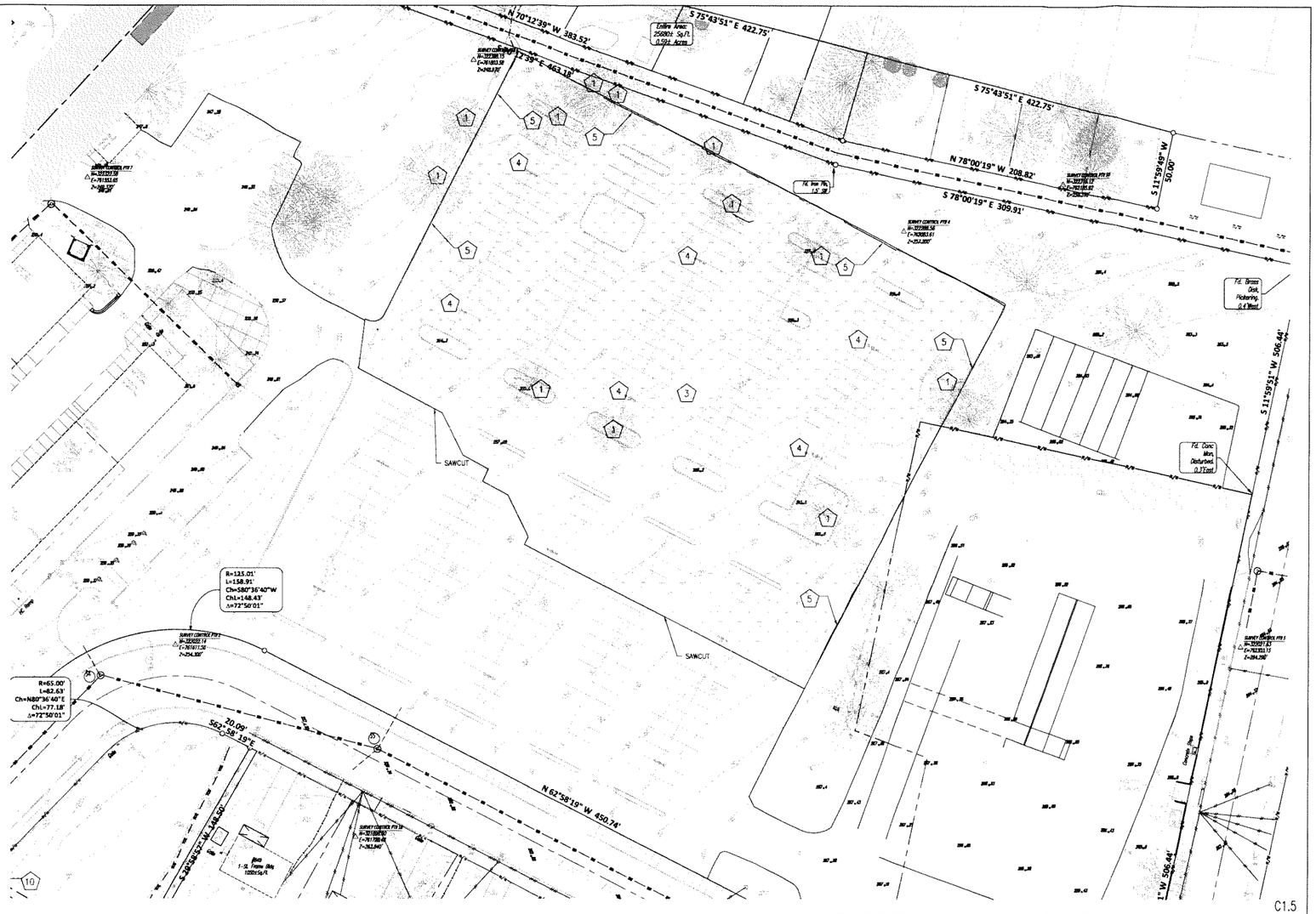
GENERAL:

ALL EXCAVATIONS DURING THE DEMOLITION SHALL BE BACKFILLED WITH CONTROLLED COMPACTED STRUCTURAL FILL.

REMOVE ALL TCAT SIGNAGE AND TURN OVER TO TCAT.

DAMAGE TO REMAINING ACTIVE UTILITIES SHALL BE REPAIRED AT CONTRACTOR'S EXPENSE.

DEMOLITION PLANS HAVE ATTEMPTED TO INDICATE ALL KNOWN DEMOLITION ITEMS. ADDITIONAL ITEMS, NOT INDICATED, THAT ARE IN CONFLICT WITH COMPLETED PROJECT SHALL BE REMOVED.



C1.5

GRAPHIC SCALE

30 0 15 30 60 120

(IN FEET)

1 inch = 30 ft.

VERTICAL DATUM: ELEVATIONS SHOWN HEREON ARE IN REFERENCE TO THE CITY OF MEMPHIS VERTICAL BENCHMARK SYSTEM, NAVD88. PRIMARY VERTICAL BENCHMARK: FOUND CITY BENCHMARK AT THE NORTHWEST CORNER OF DANNY THOMAS AND WASHINGTON STREET. ELEVATION: 229.89'.

FLOOD NOTE

BY GRAPHIC SCALING ONLY, THE SUBJECT PROPERTY SURVEYED DOES NOT LIE WITHIN A FLOOD HAZARD AREA PER THE FLOOD INSURANCE RATE MAP COMMUNITY PANEL NO. 47157C 0070 F WHICH HAS AN EFFECTIVE DATE OF SEPTEMBER 28, 2007. THE SUBJECT PROPERTY LIES WITH A ZONE X DEFINED AS BEING, " AREAS DETERMINED TO BE OUTSIDE THE 0.2% ANNUAL CHANCE FLOODPLAIN." NEAREST 100 YEAR FLOOD ELEVATION = 232'

REVISION		
ITEM NO.	DESCRIPTION of CHANGE	APPROVAL DATE

TENNESSEE COLLEGE OF APPLIED TECHNOLOGY
PHASE 2 RENOVATIONS, SBC 166/000-04-2013Y3
MEMPHIS, TN 38105
OWNER-DEVELOPER: STATE OF TENNESSEE
ENGINEER: BURR & COLE CONSULTING ENGINEERS, INC.

DRAINAGE BASIN: MISSISSIPPI RIVER
DRAINAGE DISTRICT: QUIMBY 1-H, GAYOSO 1-G

SHEET 1 of 1
DIVISION OF ENGINEERING
DEMOLITION PLAN
LOCATION: 550 ALABAMA AVE.
MEMPHIS, TENNESSEE

SURVEY ALLEN & HOSHALL DATE 06/01/2018 BOOK
DESIGN BY: BURR & COLE DATE 01/24/2020 SCALE 1"=30'
REVIEWED

DEPUTY CITY ENGINEER DATE CITY ENGINEER DATE

bd GROUP

braganza design/GROUP
architecture . planning . interiors

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Memphis, Tennessee 38111
(p) 901.452.9676

Plumbing, Mechanical/ Fire Protection:
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1015 Cordova Station Rd.
Cordova, Tennessee 38018
(p) 901.685.2371

Electrical:
Canup Engineering, Inc.
7953 Stage Hills Blvd., Suite 107
Bartlett, Tennessee 38133
(p) 901.379.9782

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Do not scale drawings. Use given dimensions only. If no dimensions, notify Architect. Contractor shall check and verify all dimensions and conditions at job site prior to starting work.

Seal

JOEL T. JOHNSON REGISTERED ENGINEER No. 120318 STATE OF TENNESSEE 1/24/2020

Issues and Revisions

1	10.18.19	50% DESIGN DEVELOPMENT
2	10.31.19	100% DESIGN DEVELOPMENT
3	01.24.20	100% CONSTRUCTION DOCUMENTS

Project Information

TCAT - Memphis
Phase II

TCAT Improvements - West Region
166/000-04-2013Y3

660 Mosby Avenue
Memphis, TN 38105

Drawing Name

DEMOLITION PLAN

Project No. 17012 Date 01.24.20

C1.5

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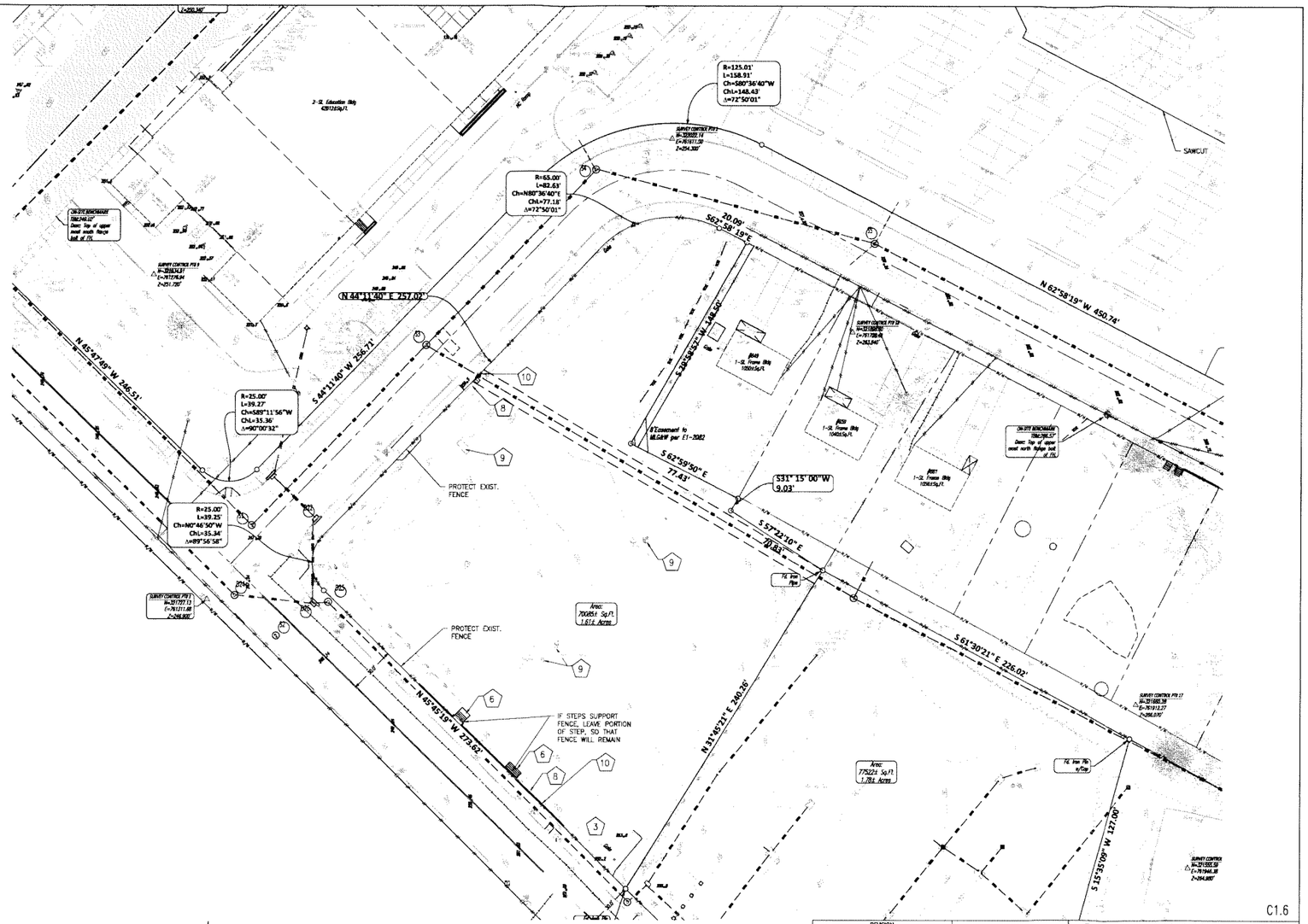

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SHEET 2 of 2
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LOCATION: 550 ALABAMA AVE.
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Plumbing, Mechanical/ Fire Protection:
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Cordova, Tennessee 38018
(p) 901.685.2371

Electrical:
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Bartlett, Tennessee 38133
(p) 901.379.9762

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Seal

JOEL T. JOHNSON REGISTERED ENGINEER 19053 STATE OF TENNESSEE 1/24/2020

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166/000-04-2013Y3

660 Mosby Avenue
Memphis, TN 38105

Drawing Name
DEMOLITION PLAN

Project No. 17012 Date 01.24.20

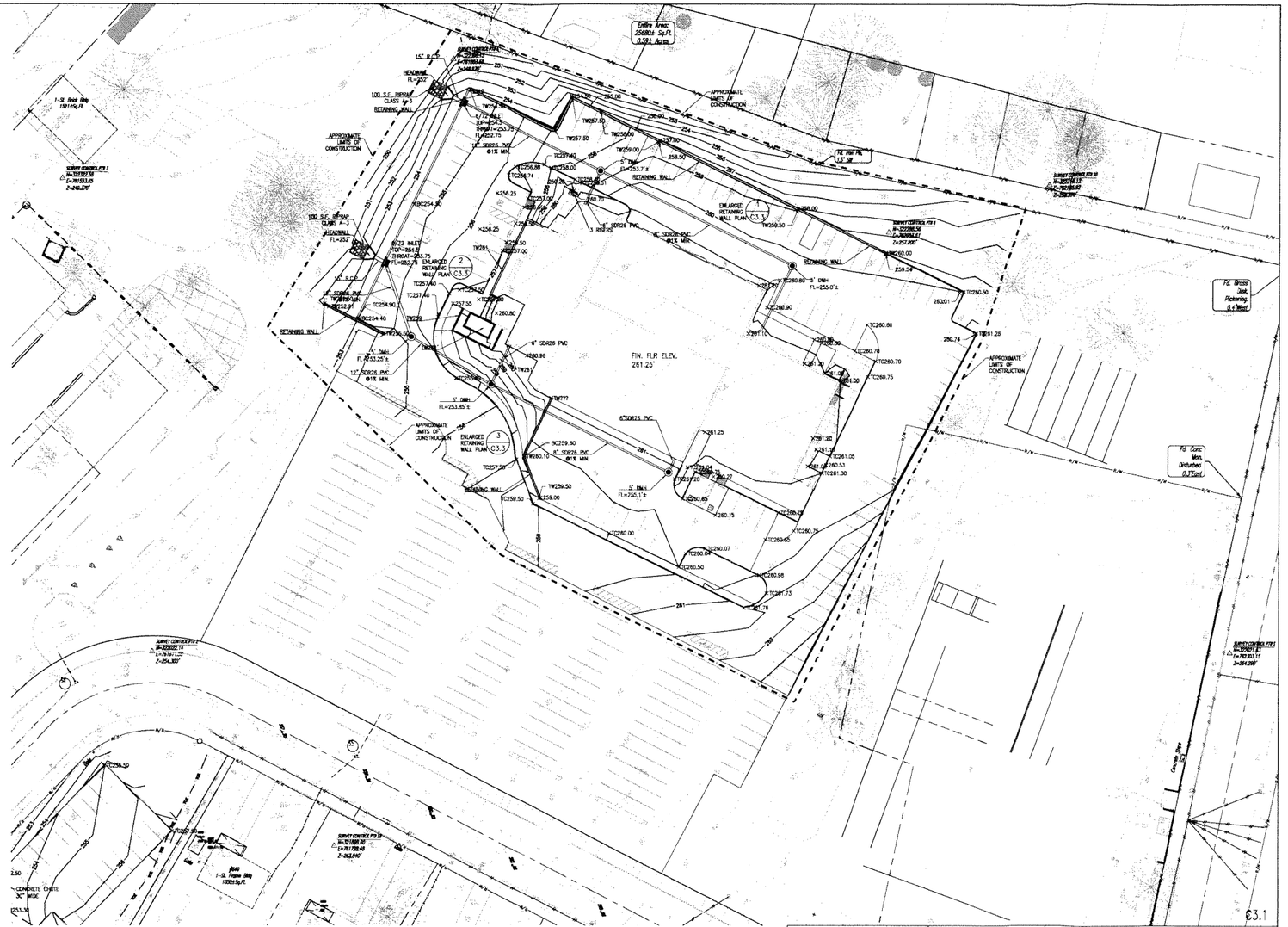
C1.6

GENERAL NOTES

1. A MINIMUM OF 24 HOURS PRIOR TO BEGINNING CONSTRUCTION, THE CONTRACTOR SHALL NOTIFY THE CITY OF MEMPHIS CONSTRUCTION INSPECTION OFFICE AT (901)636-2462.
2. ALL NEWLY CUT OR FILLED AREAS, LACKING ADEQUATE VEGETATION, SHALL BE SEEDED, MULCHED, FERTILIZED AND/OR SODDED AS REQUIRED TO EFFECTIVELY CONTROL SOIL EROSION.
3. THE LOCATION OF EXISTING UNDERGROUND UTILITIES ARE APPROXIMATE AND NOT NECESSARILY ALL OF SAME. THE CONTRACTOR SHALL BE RESPONSIBLE FOR NOTIFYING THE UTILITY COMPANIES WHICH MAINTAIN A UTILITY LINE WITHIN THE BOUNDARIES OF THE PROJECT PRIOR TO THE INITIATION OF ANY CONSTRUCTION ON THE PROJECT OR IN THE STREETS BORDERING THE PROJECT. THE CONTRACTOR SHALL ALSO ASSUME FULL RESPONSIBILITY FOR DAMAGE TO ANY UTILITIES ENCOUNTERED WITHIN CONSTRUCTION PERIMETERS, WHETHER SHOWN ON THE CONSTRUCTION PLANS OR NOT, DURING THE WORK ON THE PROJECT. FOR SITE LOCATION OF EXISTING UTILITIES INVOLVING MLGW&W, SOUTH CENTRAL BELL, AND/OR TEXAS GAS COMPANY, CALL 1-800-351-1111. FOR SEWER LOCATIONS CALL 529-8025.
4. CONTRACTOR SHALL MAINTAIN ACCESS TO ALL PROPERTIES.
5. ALL FILL SOILS SHALL BE COMPACTED TO A MINIMUM OF 95% OF STANDARD PROCTOR DENSITY (ASTM D-698) WITHIN 3% OF OPTIMUM MOISTURE CONTENT IN LIFTS NOT TO EXCEED SIX (6) INCHES OF COMPACTED THICKNESS.
6. ALL CONSTRUCTION MATERIALS AND PROCEDURES SHALL MEET OR EXCEED THE REQUIREMENTS OF THE CONSTRUCTION SPECIFICATIONS.
7. PROPERTY LINES SHALL BE FIELD VERIFIED PRIOR TO CONSTRUCTION. GRADING, CLEARING AND THE ERECTION OR REMOVAL OF FENCES ALONG PROPERTY LINES SHALL BE FULLY COORDINATED WITH ADJACENT PROPERTY OWNERS.
8. VERIFY SITE CONDITIONS PRIOR TO CONSTRUCTION. NOTIFY THE ENGINEER OF ANY VARIATIONS PRIOR TO COMMENCEMENT OF WORK.
9. ALL GRADING WORK SHALL BE PERFORMED IN SUCH A MANNER THAT THE ADJACENT PROPERTIES ARE NOT DAMAGED OR ADVERSELY AFFECTED.
10. LOT DRAINAGE: FINISH GRADE SHALL BE SLOPED AWAY FROM THE FOUNDATION FOR DRAINAGE. THE FINISH GRADE MUST BEGIN AT LEAST 12-INCHES BELOW THE TOP OF THE FOUNDATION WALL OR THE GRADE OF THE CONCRETE SLAB AT THE INTERIOR IN THE CASE OF AN INTEGRAL SLAB AND FOUNDATION. THE MINIMUM GRADE AWAY FROM THE FOUNDATION SHALL BE TWO PERCENT (2%) IN ALL DIRECTIONS.

LEGEND

- INLET
- DRAIN MANHOLE
- PROPOSED PIPE
- APPROXIMATE LIMITS OF CONSTRUCTION
- EXISTING PIPE
- DRAINAGE RIDGELINE
- 282 PROPOSED CONTOUR
- EXISTING CONTOUR
- +284.45 EXISTING SPOT ELEVATION
- PROPOSED SPOT ELEVATION
- PROPERTY LINE



VERTICAL DATUM: ELEVATIONS SHOWN HEREON ARE IN REFERENCE TO THE CITY OF MEMPHIS VERTICAL BENCHMARK SYSTEM, NAVD88. PRIMARY VERTICAL BENCHMARK: FOUND CITY BENCHMARK AT THE NORTHWEST CORNER OF DANNY THOMAS AND WASHINGTON STREET. ELEVATION: 229.89'.

GRAPHIC SCALE

30 0 15 30 60 120

(IN FEET)

1 inch = 30 ft.

FLOOD NOTE

BY GRAPHIC SCALING ONLY, THE SUBJECT PROPERTY SURVEYED DOES NOT LIE WITHIN A FLOOD HAZARD AREA PER THE FLOOD INSURANCE RATE MAP COMMUNITY PANEL NO. 47157C 0235 F WHICH HAS AN EFFECTIVE DATE OF SEPTEMBER 28, 2007. THE SUBJECT PROPERTY LIES WITH A ZONE X DEFINED AS BEING, " AREAS DETERMINED TO BE OUTSIDE THE 0.2% ANNUAL CHANCE FLOODPLAIN."

REVISION		
ITEM NO.	DESCRIPTION of CHANGE	APPROVAL DATE

TENNESSEE COLLEGE OF APPLIED TECHNOLOGY
PHASE 2 RENOVATIONS, SBC 166/000-04-2013Y3
MEMPHIS, TN 38105
OWNER-DEVELOPER: STATE OF TENNESSEE
ENGINEER: BURR & COLE CONSULTING ENGINEERS, INC.

DRAINAGE BASIN: MISSISSIPPI RIVER
DRAINAGE DISTRICT: QUIMBY 1-H, GAYOSO 1-G

SHEET 1 of 1

DIVISION OF ENGINEERING
GRADING & DRAINAGE PLAN
LOCATION: 550 ALABAMA AVE.
MEMPHIS, TENNESSEE

SURVEY ALLEN & MOSHALL DATE 06/01/2018 BOOK
DESIGN BY: BURR & COLE DATE 10/18/2019 SCALE 1"=30'

REVIEWED

DEPUTY CITY ENGINEER DATE CITY ENGINEER DATE

bd GROUP

braganza design/GROUP
architecture . planning . interiors

2029 peabody avenue
memphis, tennessee 38104
(P) 901.458.7600 (F) 901.458.8633

Consultants

Civil/ Structural:
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Memphis, Tennessee 38111
(p) 901.452.9676

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Cordova, Tennessee 38018
(p) 901.685.2371

Electrical:
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7953 Stage Hills Blvd., Suite 107
Bartlett, Tennessee 38133
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Seal

JOEL T. JOHNSON
REGISTERED ARCHITECT
No. 102711
STATE OF TENNESSEE
1/24/2020

Issues and Revisions		
1	10.18.19	50% DESIGN DEVELOPMENT
2	10.31.19	100% DESIGN DEVELOPMENT
3	01.24.20	100% CONSTRUCTION DOCUMENTS

Project Information

TCAT - Memphis
Phase II

TCAT Improvements - West Region
166/000-04-2013Y3

660 Mosby Avenue
Memphis, TN 38105

Drawing Name

GRADING & DRAINAGE PLAN

Project No. 17012 Date 01.24.20

C3.1

GENERAL NOTES

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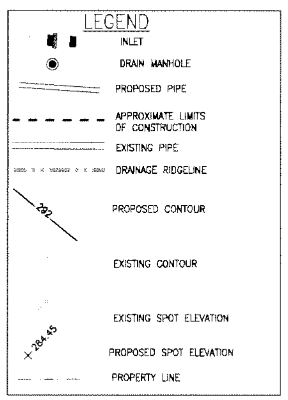

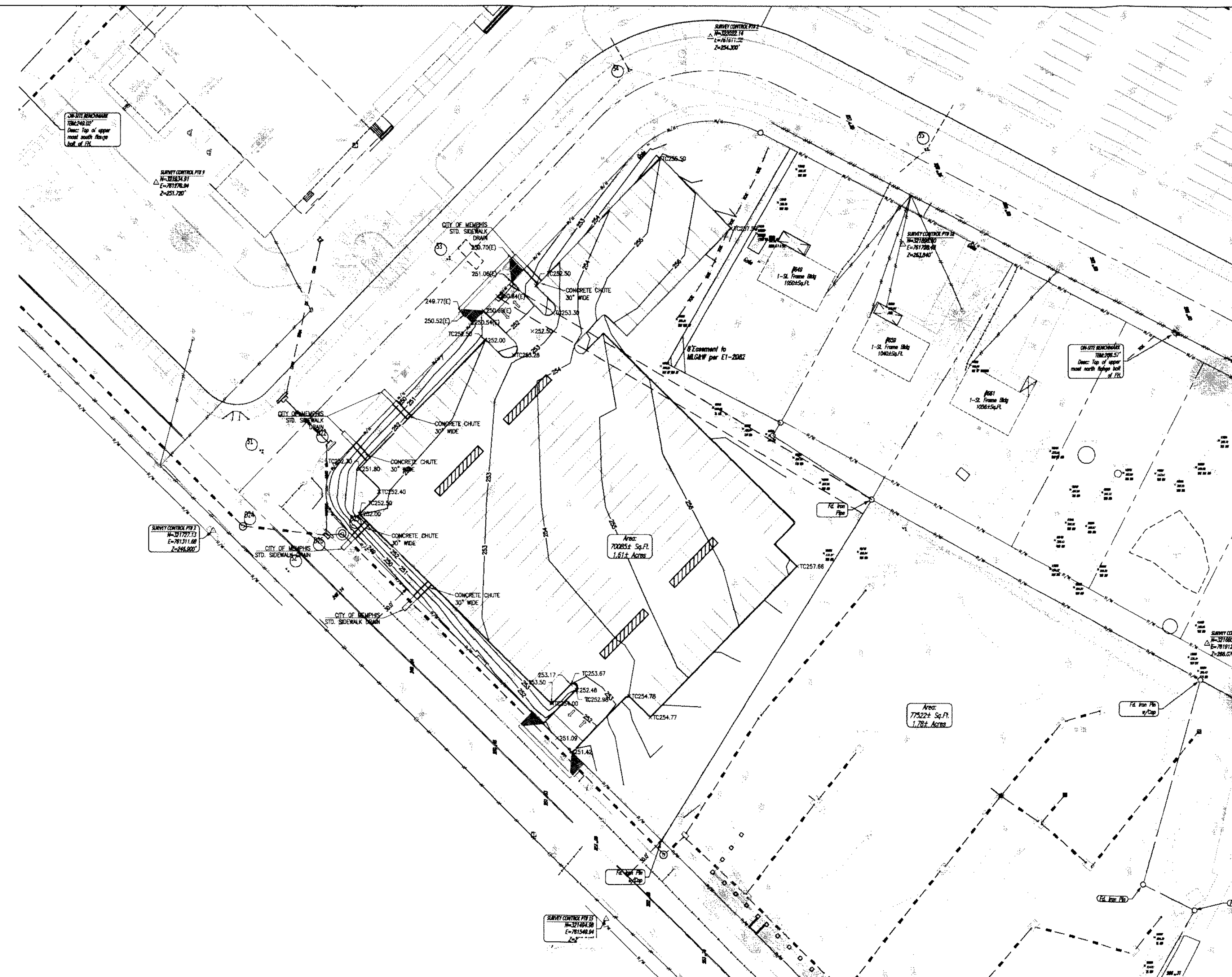

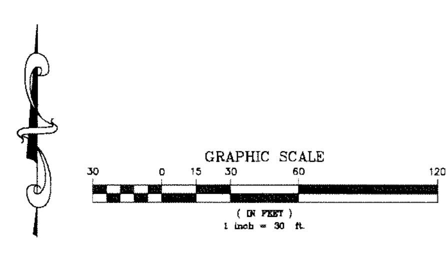

VERTICAL DATUM: ELEVATIONS SHOWN HEREON ARE IN REFERENCE TO THE CITY OF MEMPHIS VERTICAL BENCHMARK SYSTEM, NAVD80. PRIMARY VERTICAL BENCHMARK: FOUND CITY BENCHMARK AT THE NORTHWEST CORNER OF DANNY THOMAS AND WASHINGTON STREET. ELEVATION: 229.89'.

FLOOD NOTE

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NEAREST 100 YEAR FLOOD ELEVATION = 232'

REVISION		
ITEM NO.	DESCRIPTION of CHANGE	APPROVAL DATE

TENNESSEE COLLEGE OF APPLIED TECHNOLOGY
PHASE 2 RENOVATIONS, SBC 166/000-04-2013Y3
MEMPHIS, TN 38105
OWNER-DEVELOPER: STATE OF TENNESSEE
ENGINEER: BURR & COLE CONSULTING ENGINEERS, INC.

DRAINAGE BASIN: MISSISSIPPI RIVER
DRAINAGE DISTRICT: QUIMBY 1-H, GAYOSO 1-G

SHEET 2 of 2

DIVISION OF ENGINEERING
GRADING & DRAINAGE PLAN
LOCATION: 550 ALABAMA AVE.

MEMPHIS, TENNESSEE

SURVEY ALLEN & HOSHALL DATE 06/01/2018 BOOK
DESIGN BY: BURR & COLE DATE 01/24/2020 SCALE 1"=30'

REVIEWED

DEPUTY CITY ENGINEER DATE CITY ENGINEER DATE

bd GROUP
braganza design/GROUP
architecture . planning . interiors

2029 peabody avenue
memphis, tennessee 38104
(P) 901.458.7600 (F) 901.458.6633

Consultants

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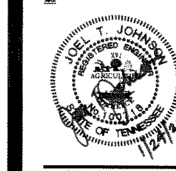
Seal



Issues and Revisions

1	10.18.19	50% DESIGN DEVELOPMENT
2	10.31.19	100% DESIGN DEVELOPMENT
3	01.24.20	100% CONSTRUCTION DOCUMENTS

Project Information

TCAT - Memphis
Phase II

TCAT Improvements - West Region
166/000-04-2013Y3

550 Mosby Avenue
Memphis, TN 38105

Drawing Name

GRADING & DRAINAGE PLAN

Project No. 17012 Date 01.24.20

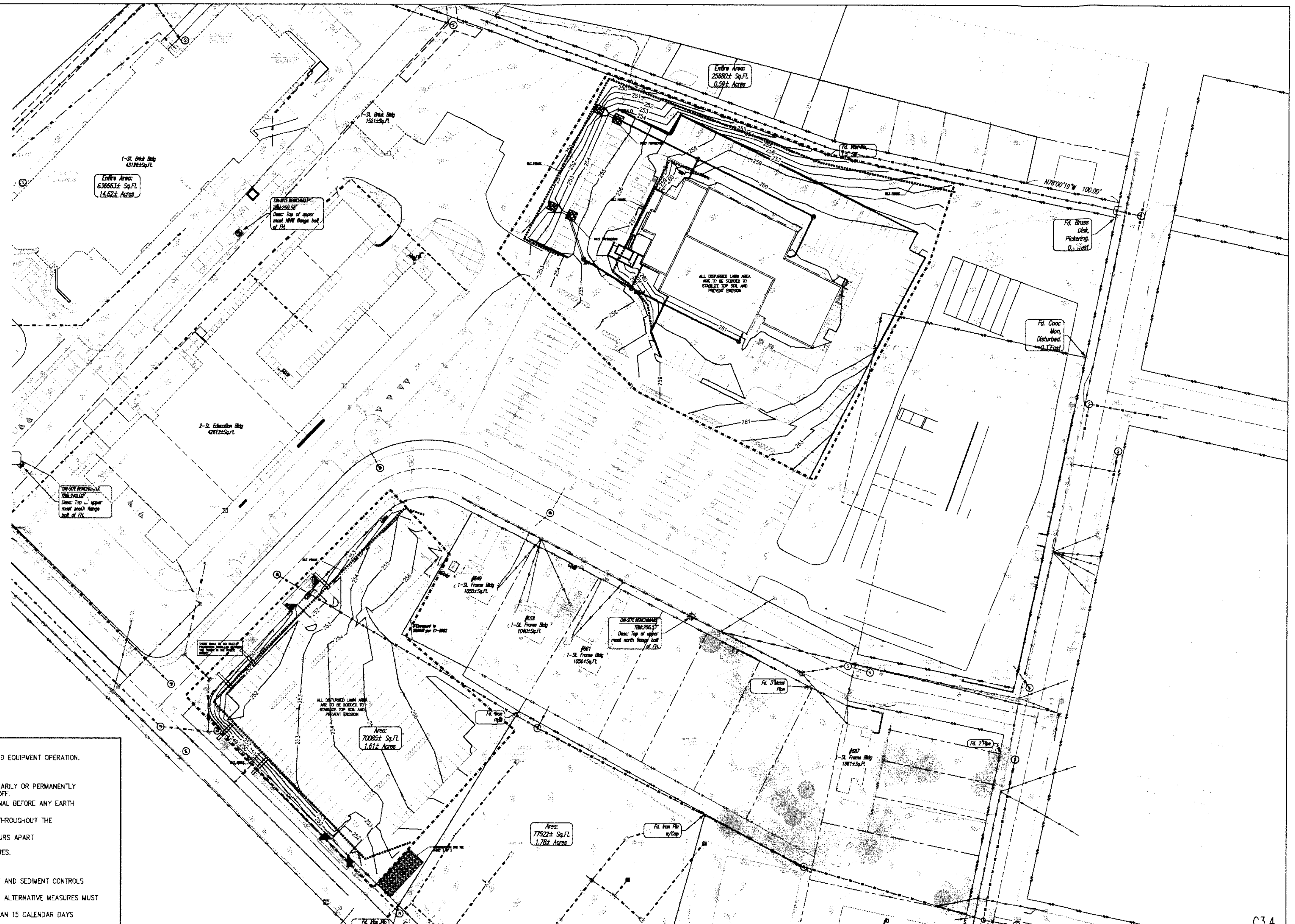
C3.2

DISTURBED AREA=2.1 ACRES

EROSION CONTROL LEGEND PHASE 1

- SILT FENCE SEE SHEET 3 OF 3 FOR DETAILS
- LIMITS OF DISTURBED AREA
- INLET PROTECTION SEE SHEET 5 OF 5 FOR DETAILS

SEE SHEET 3 OF 3 FOR CONSTRUCTION EXIT



C3.4

EROSION CONTROL NOTES

1. CLEARING AND GRUBBING SHALL BE THE MINIMUM NECESSARY FOR GRADING AND EQUIPMENT OPERATION.
2. SEQUENCE CONSTRUCTION TO MINIMIZE EXPOSURE TIME OF CLEARED AREA.
3. AVOID GRADING ACTIVITIES DURING MONTHS OF HIGHLY EROSIVE RAINFALL.
4. STABILIZE CLEARED AREA BEFORE PROCEEDING TO CLEAR ANOTHER BY TEMPORARILY OR PERMANENTLY PROTECTING THE DISTURBED SOIL SURFACE FROM RAINFALL IMPACTS AND RUNOFF.
5. EROSION AND SEDIMENT CONTROL MEASURES MUST BE IN PLACE AND FUNCTIONAL BEFORE ANY EARTH MOVING OPERATIONS BEGIN.
6. ALL CONTROL MEASURES MUST BE PROPERLY CONSTRUCTED AND MAINTAINED THROUGHOUT THE CONSTRUCTION PERIOD.
7. CHECK ALL EROSION AND SEDIMENT CONTROL MEASURES TWICE WEEKLY 72 HOURS APART AND AFTER EACH RAINFALL. DAILY CHECKING IS REQUIRED DURING PROLONGED RAINFALL. MAINTAIN A PERMANENT LOG OF CHECKS AND MAINTENANCE MEASURES.
8. KEEP CONSTRUCTION DEBRIS FROM ENTERING THE DITCH CHANNEL.
9. PROMPTLY BACKFILL AND STABILIZE TRENCHES AND/OR PITS.
10. DESIGNATE A LEVEL 1 CERTIFIED INSPECTOR TO BE RESPONSIBLE FOR EROSION AND SEDIMENT CONTROLS AND TO KEEP THE PERMANENT JOB LOG.
11. EROSION CONTROLS ARE NOT LIMITED TO THE SPECIFIED PRACTICES; HOWEVER, ALTERNATIVE MEASURES MUST BE AT LEAST AS EFFECTIVE IN CONTROLLING EROSION AND SEDIMENTATION.
12. DO NOT DESTROY, REMOVE, OR DISTURB VEGETATIVE GROUND COVER MORE THAN 15 CALENDAR DAYS PRIOR TO GRADING.
13. APPLY AS SOON AS POSSIBLE AFTER FINAL GRADING PERMANENT SOIL STABILIZATION WITH PERENNIAL VEGETATION.
14. INSTALL STAKED AND ENTRENCHED STRAW BALES AND/OR SILT FENCE ALONG THE BASE OF ALL BACKFILLS AND CUTS, ON THE DOWNHILL SIDE OF STOCKPILED SOIL, AND ALONG DITCH BANKS IN CLEARED AREAS TO PREVENT EROSION INTO DITCHES. DO NOT PLACE SILT FENCE IN FLOWING DITCH.
15. DIVERT ALL SURFACE WATER FLOWING TOWARD THE CONSTRUCTION AREA AROUND THE CONSTRUCTION AREA BY THE USE OF DIKES, BERMS, CHANNELS, OR SEDIMENT TRAPS, AS NECESSARY.
16. USE A STABILIZED PAD OF CLEAN AND PROPERLY SIZED ROCK FOR ACCESS ROAD CONSTRUCTION.
17. ALL WORK IS TO ADHERE TO TENNESSEE DEPARTMENT OF ENVIRONMENT & CONSERVATION, THIS PLAN, DETAILS, THE SWPPP, AND CONSTRUCTION GENERAL PERMITS.
18. EROSION CONTROL MEASURES SHALL BE MAINTAINED AT ALL TIMES. IF FULL IMPLEMENTATION OF THE SWPPP DOES NOT PROVIDE EFFECTIVE EROSION CONTROL, ADDITIONAL MEASURES MAY BE REQUIRED.

GRAPHIC SCALE

50 0 25 50 100 200

(IN FEET)
1 inch = 50 ft.

VERTICAL DATUM: ELEVATIONS SHOWN HEREON ARE IN REFERENCE TO THE CITY OF MEMPHIS VERTICAL BENCHMARK SYSTEM, NAVD80. PRIMARY VERTICAL BENCHMARK: FOUND CITY BENCHMARK AT THE NORTHWEST CORNER OF DANNY THOMAS AND WASHINGTON STREET. ELEVATION: 229.89'.

FLOOD NOTE

BY GRAPHIC SCALING ONLY, THE SUBJECT PROPERTY SURVEYED DOES NOT LIE WITHIN A FLOOD HAZARD AREA PER THE FLOOD INSURANCE RATE MAP COMMUNITY PANEL NO. 47157C 0270 F WHICH HAS AN EFFECTIVE DATE OF SEPTEMBER 28, 2007. THE SUBJECT PROPERTY LIES WITH A ZONE X DEFINED AS BEING, " AREAS DETERMINED TO BE OUTSIDE THE 0.2% ANNUAL CHANCE FLOODPLAIN." NEAREST 100 YEAR FLOOD ELEVATION = 232'

REVISION		
ITEM NO.	DESCRIPTION of CHANGE	APPROVAL DATE

TENNESSEE COLLEGE OF APPLIED TECHNOLOGY
PHASE 2 RENOVATIONS, SBC 166/000-04-2013Y3
MEMPHIS, TN 38105
OWNER-DEVELOPER: STATE OF TENNESSEE
ENGINEER: BURR & COLE CONSULTING ENGINEERS, INC.

DRAINAGE BASIN: MISSISSIPPI RIVER
DRAINAGE DISTRICT: QUIMBY 1-H, GAYOSO 1-G

SHEET 1 of 1
DIVISION OF ENGINEERING
EROSION CONTROL PLAN PHASE 1
LOCATION: 550 ALABAMA AVE.

MEMPHIS, TENNESSEE

SURVEY ALLEN & HOSHALL DATE 06/01/2018 BOOK
DESIGN BY: BURR & COLE DATE 01/24/2020 SCALE 1"=50'

REVIEWED

DEPUTY CITY ENGINEER DATE CITY ENGINEER DATE

bd GROUP

braganza design/GROUP
architecture . planning . interiors

2029 peabody avenue
memphis, tennessee 38104
(P) 901.458.7600 (F) 901.458.6633

Consultants

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Seal

JOEL T. JOHNSON REGISTERED ENGINEER AGRICULTURE COMMERCE No. 100118 STATE OF TENNESSEE 1/24/2020

Issues and Revisions

1	10.18.19	50% DESIGN DEVELOPMENT
2	10.31.19	100% DESIGN DEVELOPMENT
3	01.24.20	100% CONSTRUCTION DOCUMENTS

Project Information

TCAT - Memphis
Phase II

TCAT Improvements - West Region
166/000-04-2013Y3

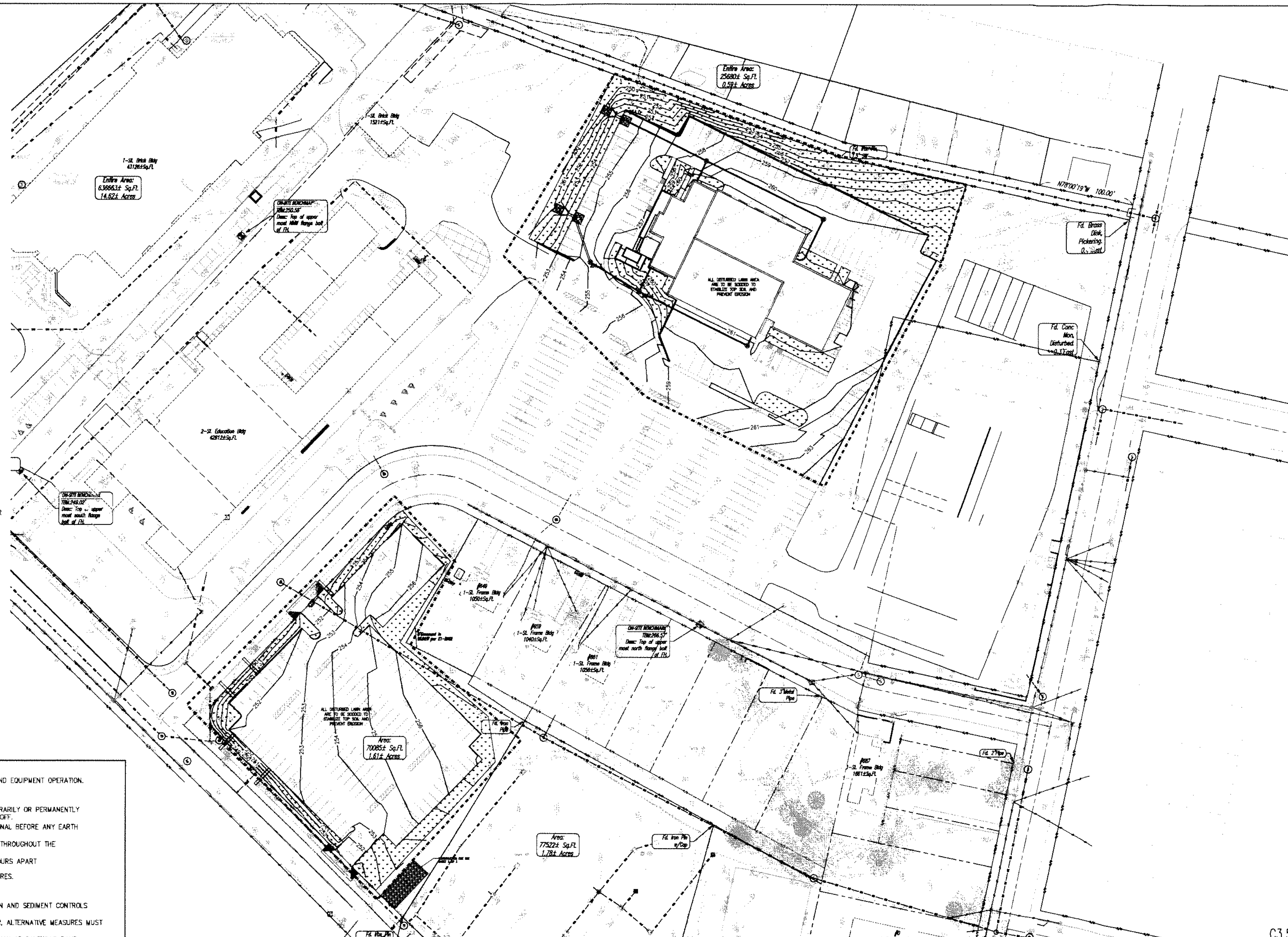
660 Mosby Avenue
Memphis, TN 38105

Drawing Name

EROSION
CONTROL PLAN
PHASE 1

Project No. 17012 Date 01.24.20

C3.4



DISTURBED AREA=2.1 ACRES

EROSION CONTROL LEGEND PHASE 2

- SILT FENCE SEE SHEET 3 OF 3 FOR DETAILS
- LIMITS OF DISTURBED AREA
- SODDED GRASS TURF OR LANDSCAPE PLANTINGS–INSTALL OVER EXPOSED PREPARED SURFACE. MAINTAIN UNTIL ESTABLISHED.

EROSION CONTROL NOTES

1. CLEARING AND GRUBBING SHALL BE THE MINIMUM NECESSARY FOR GRADING AND EQUIPMENT OPERATION.
2. SEQUENCE CONSTRUCTION TO MINIMIZE EXPOSURE TIME OF CLEARED AREA.
3. AVOID GRADING ACTIVITIES DURING MONTHS OF HIGHLY EROSIVE RAINFALL.
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VERTICAL DATUM: ELEVATIONS SHOWN HEREON ARE IN REFERENCE TO THE CITY OF MEMPHIS VERTICAL BENCHMARK SYSTEM, NAVD80. PRIMARY VERTICAL BENCHMARK: FOUND CITY BENCHMARK AT THE NORTHWEST CORNER OF DANNY THOMAS AND WASHINGTON STREET. ELEVATION: 229.89'.

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REVISION		
ITEM NO.	DESCRIPTION of CHANGE	APPROVAL DATE

TENNESSEE COLLEGE OF APPLIED TECHNOLOGY
PHASE 2 RENOVATIONS, SBC 166/000-04-2013Y3
MEMPHIS, TN 38105
OWNER-DEVELOPER: STATE OF TENNESSEE
ENGINEER: BURR & COLE CONSULTING ENGINEERS, INC.

DRAINAGE BASIN: MISSISSIPPI RIVER
DRAINAGE DISTRICT: QUIMBY 1-H, GAYOSO 1-G

SHEET 1 of 1

DIVISION OF ENGINEERING
EROSION CONTROL PLAN PHASE 2
LOCATION: 550 ALABAMA AVE.

MEMPHIS, TENNESSEE

SURVEY ALLEN & HOSHALL DATE 06/01/2018 BOOK
DESIGN BY: BURR & COLE DATE 01/24/2020 SCALE 1"=50'

REVIEWED

DEPUTY CITY ENGINEER DATE CITY ENGINEER DATE

bd GROUP

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architecture . planning . interiors

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Seal

JOEL T. JOHNSON REGISTERED ENGINEER AGRICULTURE COMMERCE No. 100718 STATE OF TENNESSEE 1/24/2020

Issues and Revisions

1	10.16.19	50% DESIGN DEVELOPMENT
2	10.31.19	100% DESIGN DEVELOPMENT
3	01.24.20	100% CONSTRUCTION DOCUMENTS

Project Information

TCAT - Memphis
Phase II

TCAT Improvements - West Region
166/000-04-2013Y3

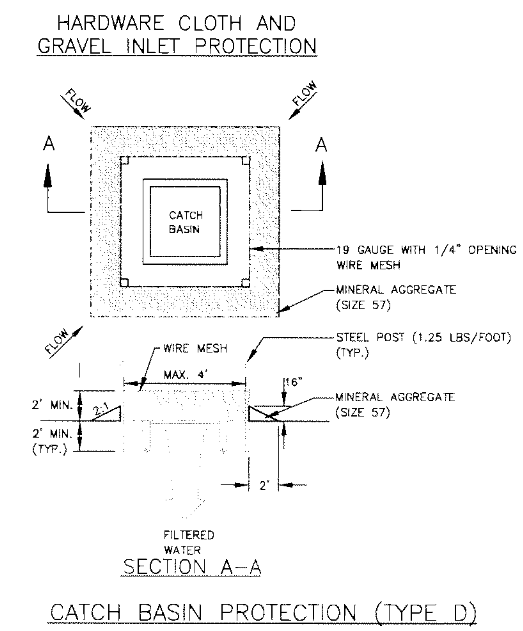
660 Mosby Avenue
Memphis, TN 38105

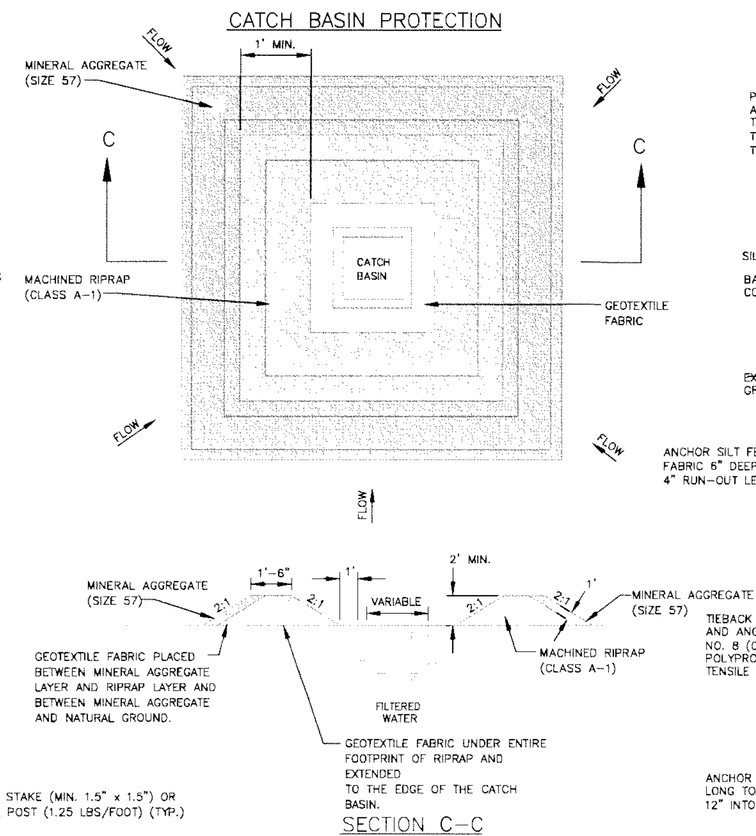
Drawing Name

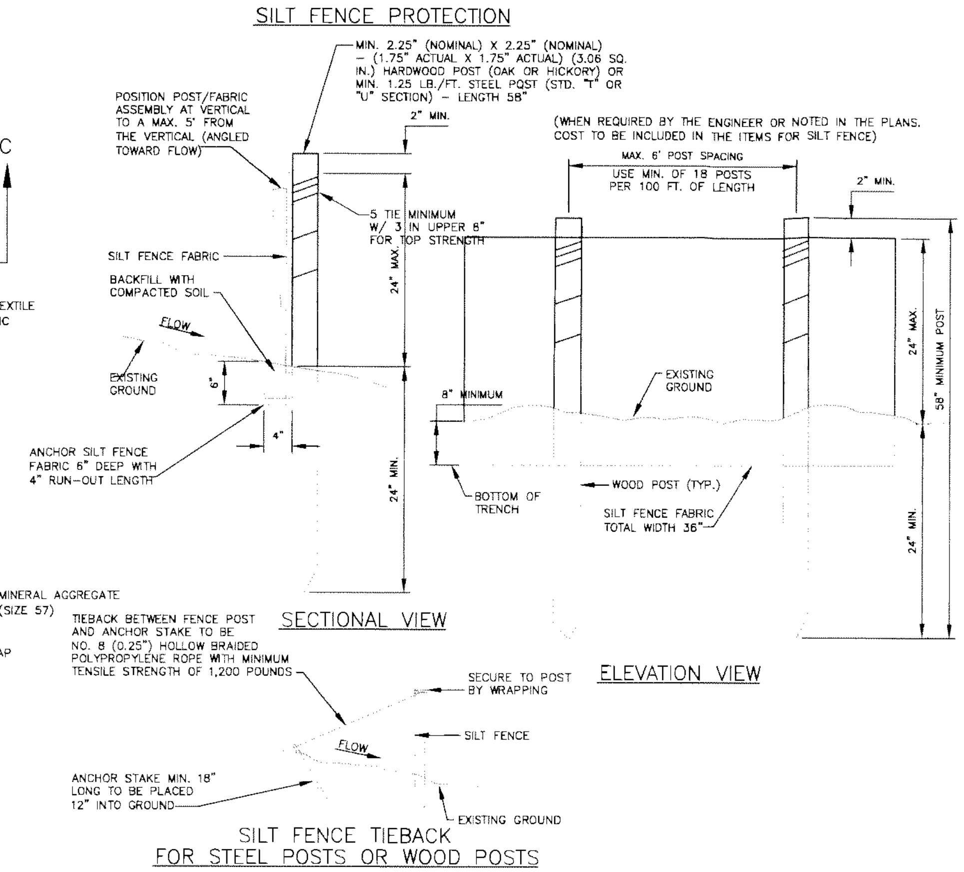
EROSION CONTROL PLAN PHASE 2

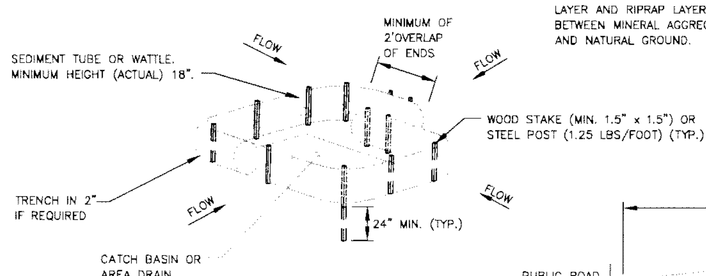
Project No. 17012 Date 01.24.20

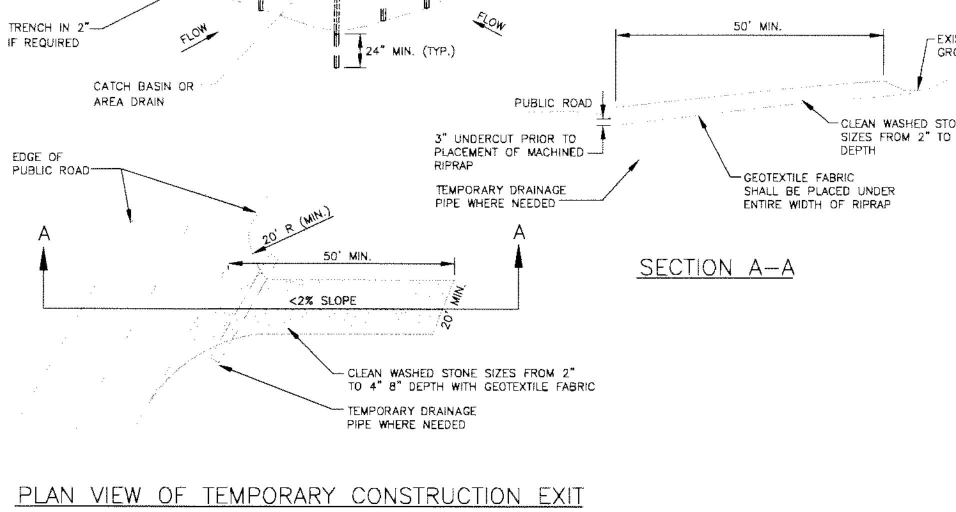
C3.5

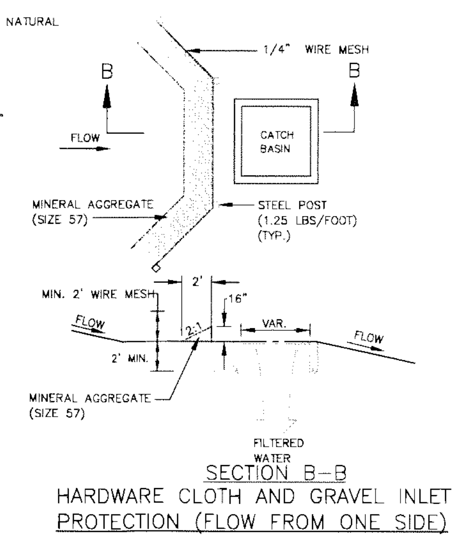












EROSION CONTROL NOTES

1. CLEARING AND GRUBBING SHALL BE THE MINIMUM NECESSARY FOR GRADING AND EQUIPMENT OPERATION.
2. SEQUENCE CONSTRUCTION TO MINIMIZE EXPOSURE TIME OF CLEARED AREA.
3. AVOID GRADING ACTIVITIES DURING MONTHS OF HIGHLY EROSIVE RAINFALL.
4. STABILIZE CLEARED AREA BEFORE PROCEEDING TO CLEAR ANOTHER BY TEMPORARILY OR PERMANENTLY PROTECTING THE DISTURBED SOIL SURFACE FROM RAINFALL IMPACTS AND RUNOFF.
5. EROSION AND SEDIMENT CONTROL MEASURES MUST BE IN PLACE AND FUNCTIONAL BEFORE ANY EARTH MOVING OPERATIONS BEGIN.
6. ALL CONTROL MEASURES MUST BE PROPERLY CONSTRUCTED AND MAINTAINED THROUGHOUT THE CONSTRUCTION PERIOD.
7. CHECK ALL EROSION AND SEDIMENT CONTROL MEASURES TWICE WEEKLY 72 HOURS APART AND AFTER EACH RAINFALL. DAILY CHECKING IS REQUIRED DURING PROLONGED RAINFALL. MAINTAIN A PERMANENT LOG OF CHECKS AND MAINTENANCE MEASURES.
8. KEEP CONSTRUCTION DEBRIS FROM ENTERING THE DITCH CHANNEL.
9. PROMPTLY BACKFILL AND STABILIZE TRENCHES AND/OR PITS.
10. DESIGNATE A LEVEL 1 CERTIFIED INSPECTOR TO BE RESPONSIBLE FOR EROSION AND SEDIMENT CONTROLS AND TO KEEP THE PERMANENT JOB LOG.
11. EROSION CONTROLS ARE NOT LIMITED TO THE SPECIFIED PRACTICES; HOWEVER, ALTERNATIVE MEASURES MUST BE AT LEAST AS EFFECTIVE IN CONTROLLING EROSION AND SEDIMENTATION.
12. DO NOT DESTROY, REMOVE, OR DISTURB VEGETATIVE GROUND COVER MORE THAN 15 CALENDAR DAYS PRIOR TO GRADING.
13. APPLY AS SOON AS POSSIBLE AFTER FINAL GRADING PERMANENT SOIL STABILIZATION WITH PERENNIAL VEGETATION.
14. INSTALL STAKED AND ENTRENCHED STRAW BALES AND/OR SILT FENCE ALONG THE BASE OF ALL BACKFILLS AND CUTS, ON THE DOWNHILL SIDE OF STOCKPILED SOIL, AND ALONG DITCH BANKS IN CLEARED AREAS TO PREVENT EROSION INTO DITCHES. DO NOT PLACE SILT FENCE IN FLOWING DITCH.
15. DIVERT ALL SURFACE WATER FLOWING TOWARD THE CONSTRUCTION AREA AROUND THE CONSTRUCTION AREA BY THE USE OF DIKES, BERMS, CHANNELS, OR SEDIMENT TRAPS, AS NECESSARY.
16. USE A STABILIZED PAD OF CLEAN AND PROPERLY SIZED ROCK FOR ACCESS ROAD CONSTRUCTION.
17. ALL WORK IS TO ADHERE TO TENNESSEE DEPARTMENT OF ENVIRONMENT & CONSERVATION, THIS PLAN, DETAILS, THE SWPPP, AND CONSTRUCTION GENERAL PERMITS.
18. EROSION CONTROL MEASURES SHALL BE MAINTAINED AT ALL TIMES. IF FULL IMPLEMENTATION OF THE SWPPP DOES NOT PROVIDE EFFECTIVE EROSION CONTROL, ADDITIONAL MEASURES MAY BE REQUIRED.

C3.6

REVISION		
ITEM NO.	DESCRIPTION of CHANGE	APPROVAL DATE

TENNESSEE COLLEGE OF APPLIED TECHNOLOGY
PHASE 2 RENOVATIONS, SBC 166/000-04-2013Y3
MEMPHIS, TN 38105
OWNER-DEVELOPER: STATE OF TENNESSEE
ENGINEER: BURR & COLE CONSULTING ENGINEERS, INC.

DRAINAGE BASIN: MISSISSIPPI RIVER
DRAINAGE DISTRICT: QUIMBY 1-H, GAYOSO 1-G

SHEET 1 of 1

DIVISION OF ENGINEERING
EROSION CONTROL DETAILS
LOCATION: 550 ALABAMA AVE.

MEMPHIS, TENNESSEE

SURVEY ALLEN & HOSHALL DATE 06/01/2018 BOOK
DESIGN BY: BURR & COLE DATE 01/24/2020 SCALE N.T.S.
REVIEWED

DEPUTY CITY ENGINEER DATE CITY ENGINEER DATE

bd GROUP
braganza design/GROUP
architecture . planning . interiors

2029 peabody avenue
memphis, tennessee 38104
(P) 901.458.7600 (F) 901.458.6633

Consultants

Civil/ Structural:
Burr & Cole Consulting Engineers, Inc.
3485 Poplar Avenue, Suite 200
Memphis, Tennessee 38111
(p) 901.452.9676

Plumbing, Mechanical/ Fire Protection:
Barham/Cain/Mynatt, Inc.
1815 Cordova Station Rd.
Cordova, Tennessee 38018
(p) 901.685.2371

Electrical:
Canup Engineering, Inc.
7953 Stage Hills Blvd., Suite 107
Bartlett, Tennessee 38133
(p) 901.379.9762

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Seal

JOEL T. JOHNSON
REGISTERED ENGINEER
AGRICULTURE COMMERCE
No. 100719
STATE OF TENNESSEE
1/24/2020

Issues and Revisions

1	10.18.19	50% DESIGN DEVELOPMENT
2	10.31.19	100% DESIGN DEVELOPMENT
3	01.24.20	100% CONSTRUCTION DOCUMENTS

Project Information
TCAT - Memphis
Phase II

TCAT Improvements - West Region
166/000-04-2013Y3

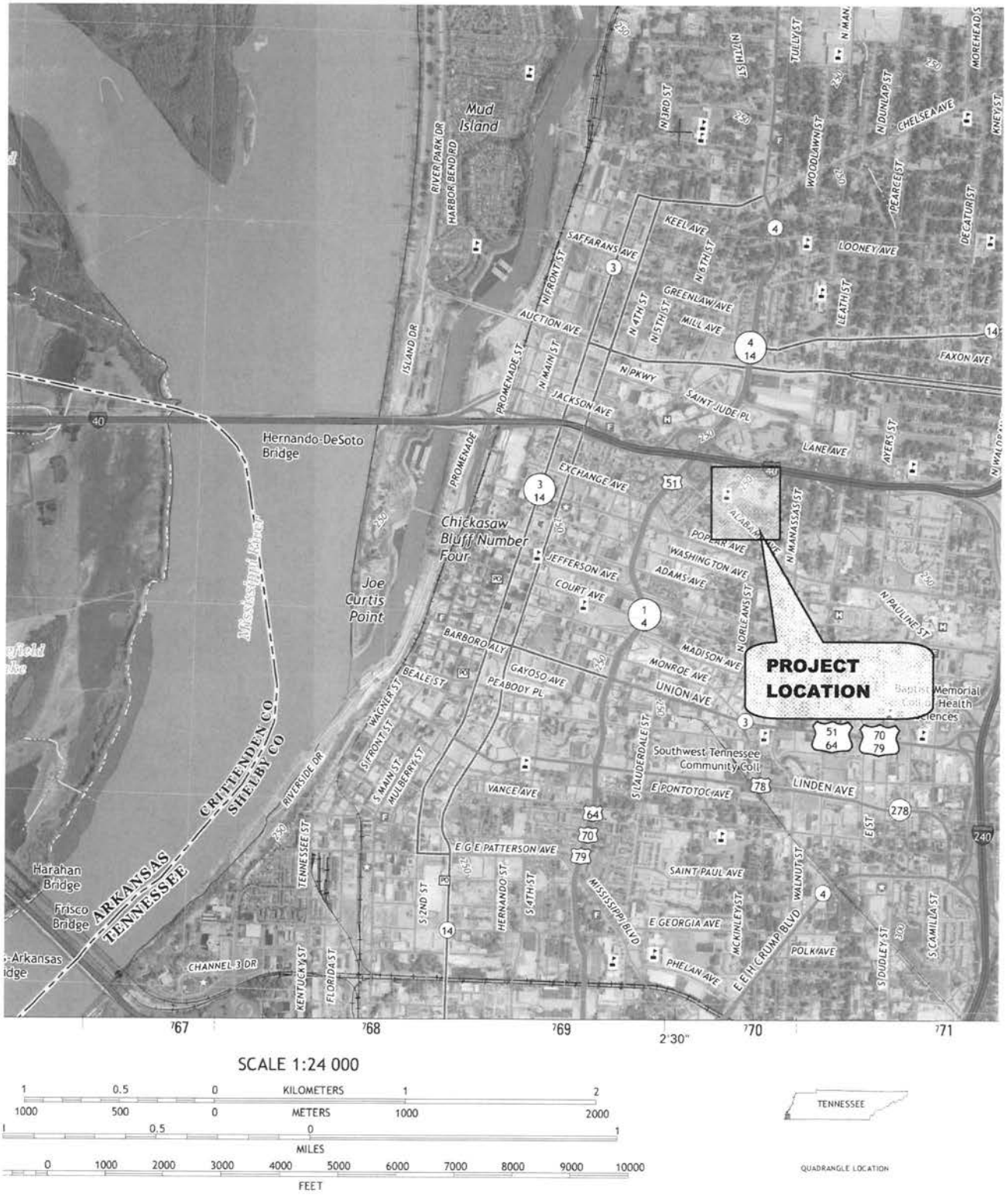
660 Mosby Avenue
Memphis, TN 38105

Drawing Name
Erosion Control Details

Project No. 17012 Date 01.24.20

C3.6

11. USGS 7.5 MINUTE QUAD MAP EXCERPT with SITE LOCATION



12. NOTICE OF INTENT (NOI)

TENNESSEE DEPARTMENT OF ENVIRONMENT AND CONSERVATION
Division of Water Resources
William R. Snodgrass Tennessee Tower, 312 Rosa L. Parks Avenue, 11th Floor, Nashville, Tennessee 37243
1-888-891-8332 (TDEC)

Notice of Intent (NOI) for General NPDES Permit for Stormwater Discharges from Construction Activities (TNR100000)

Site or Project Name: Tennessee College of Applied Technology (TCAT) Memphis		***NPDES Tracking Number: TNR***	
Street Address or Location: 660 Mosby Ave., Memphis, TN 38105		Construction Start Date:	June 1, 2020
		Estimated End Date:	September 1, 2021
Site Description: Construction of educational facility and parking lot.		Latitude (dd.dddd):	35.123479
		Longitude (-dd.dddd):	-89.936184
County(ies): Shelby	MS4 (if applicable): City of Memphis	Acres Disturbed:	3.76
Check box if a SWPPP is attached : ☑	Check box if a site location map is attached: ☑	Total Acres:	3.76
Check the appropriate box(s) if there are streams and/or wetlands on or adjacent to the construction site:		Streams ☐	Wetlands ☐
Has a jurisdictional determination been made by the USACE or EPA identifying waters of the United States?: Yes ☐ No ☐ Note: if yes, attach the jurisdictional determination			
If an Aquatic Resource Alteration Permit (ARAP) has been obtained for this site, what is the permit number? NR(S)			
Receiving waters:			

Site Owner/Developer (Primary Permittee): (Provide person, company, or entity that has operational or design control over construction plans and specifications): Tennessee Board of Regents, State of Tennessee

For corporate entities only, provide correct Tennessee Secretary of State (SOS) Control Number:
(an incorrect SOS control number may delay NOI processing)

Site Owner or Developer Contact Name: (signs the certification below) Roland Rayner, TCAT Memphis		Title or Position: President	
Mailing Address: 550 Alabama Ave., Memphis TN 38105		City: Memphis	State: TN	Zip: 38105
Phone: (901) 543-6100	Fax: (901) 543-2461	E-mail: roland.rayner@tcatmemphis.edu	

Optional Contact: Joel Johnson		Title or Position: Engineer	
Mailing Address: 3485 Poplar Ave. Suite 200		City: Memphis	State: TN	Zip: 38111
Phone: (901) 452-9676	Fax: ( )	E-mail: jjohnson@burrcole.com	

Owner/Developer(s) Certification: (must be signed by president, vice-president or equivalent, or ranking elected official) (Primary Permittee)

I certify under penalty of law that this document and all attachments were prepared by me, or under my direction or supervision. The submitted information is to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment. As specified in Tennessee Code Annotated Section 39-16-702(a)(4), this declaration is made under penalty of perjury.

Owner/Developer Name (print/type): TCAT Memphis Roland Rayner	Signature:	Date: 5/28/2020
Owner/Developer Name (print/type):	Signature:	Date:

Contractor Certification: (must be signed by president, vice-president or equivalent, or ranking elected official) (Secondary Permittee)

I certify under penalty of law that I have reviewed this document, any attachments, and the SWPPP referenced above. Based on my inquiry of the construction site owner/developer identified above and/or my inquiry of the person directly responsible for assembling this NOI and SWPPP, I believe the information submitted is accurate. I am aware that this NOI, if approved, makes the above-described construction activity subject to NPDES permit number TNR100000, and that certain of my activities on-site are thereby regulated. I am aware that there are significant penalties, including the possibility of fine and imprisonment for knowing violations, and for failure to comply with these permit requirements. As specified in Tennessee Code Annotated Section 39-16- 702(a)(4), this declaration is made under penalty of perjury.

Contractor name, address, and SOS control number (if applicable):	Signature:	Date:

OFFICIAL STATE USE ONLY

Received Date:	Reviewer:	Field Office:	Permit Tracking Number: TNR	Exceptional TN Water:
Fee(s):	T & E Aquatic Flora/Fauna:	SOS Corporate Status:	Waters with Unavailable Parameters:	Notice of Coverage Date:

CONSTRUCTION GENERAL PERMIT - NOTICE OF INTENT (NOI) - INSTRUCTIONS

A completed NOI must be submitted to obtain coverage under the CGP. **Requesting coverage under this permit means that an applicant has obtained and examined a copy of this permit, and thereby acknowledges applicant's claim of ability to be in compliance with permit terms and conditions.** CGP coverage is required for stormwater (SW) discharge(s) from construction activities including clearing, grading, filling and excavating (including borrow pits) of one or more acres of land. This form should be submitted at least 30 days prior to the commencement of land disturbing activities, or no later than 48 hours prior to when a new operator assumes operational control over site specifications or commences work at the site.

The application fee must accompany the NOI and is based on total acreage to be disturbed by an entire project, including any associated construction support activities (e.g., equipment staging yards, material storage areas, excavated material disposal areas, borrow or waste sites, etc.). A separate annual maintenance fee is also required for activities that exceed 1 year under CGP coverage. See TN Rules, Chapter 0400-40-11-.02(b)(12).

Acres Disturbed	= or > 150 acres	= or > 50 < 150 acres	= or > 20 < 50 acres	= or > 5 < 20 acres	= or > 1 < 5 acres	Subsequent coverage
Fee	$10,000	$6,000	$3,000	$1,000	$250	$100

Who must submit the NOI form? All site operators must submit an NOI form. "Operator" for the purpose of this permit and in the context of SW associated with construction activity means any person associated with a construction project who meets either or both of the following two criteria: (1) The person has operational or design control over construction plans and specifications, including the ability to make modifications to those plans and specifications. This person is typically the owner or developer of the project or a portion of the project (e.g., subsequent builder), or the person that is the current land owner of the construction site, and is considered the primary permittee; or (2) The person has day-to-day operational control of those activities at a project which are necessary to ensure compliance with a SWPPP for the site or other permit conditions. This person is typically a contractor or a commercial builder who is hired by the primary permittee, and is considered a secondary permittee.

Owners, developers and all contractors that meet the definition of the operator in subsection 2.2 of the permit shall apply for permit coverage on the same NOI, insofar as possible. After permit coverage has been granted to the initial site-wide primary permittee, any subsequent NOI submittals must include the site's previously assigned permit tracking number and the project name. The comprehensive site-specific SWPPP shall be prepared in accordance with the requirements of part 3 of the permit and must be submitted with the NOI unless the NOI being submitted is to add a subsequent permittee to an existing coverage. **Artificial entities (e.g., corporations or partnerships) must submit the correct Tennessee Secretary of State, Division of Business Services, control number. General partnerships. For general partnerships, the NOI must be signed by each general partner in the general partnership.**

The NOI will be considered incomplete without a correct control number, and the division reserves the right to deny coverage to artificial entities that are not properly registered and in good standing with the Tennessee Secretary of State (i.e., listed with an entity status of "active"). The division further reserves the right to issue permit coverage in the correct legal name of the individual or entity seeking coverage and to name each general partner of a general partnership in addition to the general partnership.

Complete the form: Type or print clearly. Answer each item or enter "NA," for not applicable. If you need additional space, attach a separate piece of paper to the NOI form. **The NOI will be considered incomplete without a permit fee and comprehensive site-specific SWPPP (if applicable).**

Describe and locate the project: Use the legal or official name of the construction site. If a construction site lacks street name or route number, give the most accurate information available to describe the location (reference to adjacent highways, roads and structures; eg., intersection of state highways 70 and 100). Latitude and longitude (in decimal degrees) can be found at numerous other web sites. Attach a copy of a map, showing location of site, with boundaries at least one mile outside the site boundaries. Provide estimated starting date of clearing activities and completion date of the project, and an estimate of the number of acres of the site on which soil will be disturbed, including borrow areas, fill areas, stockpiles and the total acres. For linear projects, give location at each end of the construction area.

Name of the receiving waters: Trace the route of stormwater runoff from the site and determine the name of the water course(s) into which the runoff drains. Note that the water course may or may not be located on the construction site. If the first water body receiving construction site runoff is unnamed ("unnamed tributary"), determine the name of the waterbody that the unnamed tributary enters.

An ARAP may be required: **If your work will disturb or cause alterations of a stream or wetland, you must obtain an appropriate Aquatic Resource Alteration Permit (ARAP).** If wetlands are located on-site and may be impacted, attach the wetland delineation report. If you have a question about the ARAP program, contact your local Field Office (EFO).

Submitting the form and obtaining more information: Note that this form must be signed by the company President, Vice-President, or a ranking elected official in the case of a municipality, for details see subpart 2.5. For more information, contact your local EFO at the toll-free number 1-888-891-8332 (TDEC). Submit the completed NOI form (keep a copy for your records) to the appropriate EFO for the county(ies) where the construction activity is located, addressed to **Attention: Stormwater NOI Processing**.

Notice of Coverage: The division will review NOIs for completeness and accuracy and issue an NOC to site-wide primary operators, authorizing SW discharge from the construction site as of the effective date of the NOC. New subsequent operators will not receive an NOC, but are considered covered under the permit when their permit record is published on TDEC's dataviewer as "active" and with an effective date. TDEC Permit Dataviewer can be found at: http://environment-online.tn.gov:8080/pls/enf_reports/f?p=9034:34001:0

EFO	Street Address	Zip Code	EFO	Street Address	Zip Code
Memphis	8383 Wolf Lake Drive, Bartlett	38133-4119	Cookeville	1221 South Willow Ave.	38506
Jackson	1625 Hollywood Drive	38305-4316	Chattanooga	1301 Riverfront Pkwy, Suite 206	37402
Nashville	711 R S Gass Boulevard	37243	Knoxville	3711 Middlebrook Pike	37921
Columbia	1421 Hampshire Pike	38401	Johnson City	2305 Silverdale Road	37601

13. T.D.E.C. CONSTRUCTION STORM WATER INSPECTION REPORT

TENNESSEE DEPARTMENT OF ENVIRONMENT AND CONSERVATION (TDEC)

Division of Water Resources
William R. Snodgrass Tennessee Tower, 312 Rosa L. Parks Avenue, 11th Floor, Nashville, Tennessee 37243
1-888-891-8332 (TDEC)

General NPDES Permit for Stormwater Discharges from Construction Activities (CGP)

Construction Stormwater Inspection Certification (Twice-Weekly Inspections)

Site or Project Name: TN College of Applied Technology Memphis		**NPDES Tracking Number: TNR**
Primary Permittee Name:		Date of Inspection:
Current approximate disturbed acreage:	Has rainfall been checked/documented daily? ☐ Yes ☐ No	Name of Inspector:
Current weather conditions:		Inspector's Training Certification Number:

Please check the box if the following items are on-site:

☐ Notice of Coverage (NOC) ☐ Stormwater Pollution Prevention Plan (SWPPP) ☐ Twice-weekly inspection documentation

☐ Site contact information ☐ Rain Gage ☐ Off-site Reference Rain Gage Location: _____

Best Management Practices (BMPs):

Are the Erosion Prevention and Sediment Controls (EPSCs) functioning correctly: If "No," describe below in Comment Section		
1. Are all applicable EPSCs installed and maintained per the SWPPP?	☐ Yes	☐ No
2. Are EPSCs functioning correctly at all disturbed areas/material storage areas per section 4.1.5?	☐ Yes	☐ No
3. Are EPSCs functioning correctly at outfall/discharge points such that there is no objectionable color contrast in the receiving stream, and no other water quality impacts per section 5.3.2?	☐ Yes	☐ No
4. Are EPSCs functioning correctly at ingress/egress points such that there is no evidence of track out?	☐ Yes	☐ No
5. If applicable, have discharges from dewatering activities been managed by appropriate controls per section 4.1.4? If "No," describe below the measures to be implemented to address deficiencies.	☐ Yes	☐ No
6. If construction activity at any location has temporarily/permanently ceased, was the area stabilized within 14 days per section 3.5.3.2? If "No," describe below each location and measures taken to stabilize the area(s)	☐ Yes	☐ No
7. Have pollution prevention measures been installed, implemented, and maintained to minimize the discharge of pollutants from equipment and vehicle washing, wheel wash water, and other wash waters per section 4.1.5? If "No," describe below the measures to be implemented to address deficiencies.	☐ Yes	☐ No
8. If a concrete washout facility is located on site, is it clearly identified on the project and maintained? If "No," describe below the measures to be implemented to address deficiencies. ☐ N/A	☐ Yes	☐ No
9. Have all previous deficiencies been addressed? If "No," describe remaining deficiencies in Comment section. ☐ Check if deficiencies/corrective measures have been reported on a previous form.	☐ Yes	☐ No

Comment Section. If the answer is "No" for any of the above, please describe the problem and corrective actions to be taken. Otherwise, describe any pertinent observations:

Certification and Signature (must be signed by the certified inspector and the permittee per Sections 3.5.8.2 (g) and 7.7.2 of the CGP)

I certify under penalty of law that this document and all attachments were prepared by me, or under my direction or supervision. The submitted information is to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment. As specified in Tennessee Code Annotated Section 39-16-702(a)(4), this declaration is made under penalty of perjury.

Inspector Name and Title:	Signature:	Date:
Primary Permittee Name and Title:	Signature:	Date:

Construction Stormwater Inspection Certification Form (Twice-Weekly Inspections)

Purpose of this form/ Instructions

An inspection, as described in section 3.5.8.2. of the General Permit for Stormwater Discharges from Construction Activities ("Permit"), shall be performed at least twice every calendar week and documented on this form. Inspections shall be performed at least 72 hours apart. Where sites or portion(s) of construction sites have been temporarily stabilized, or runoff is unlikely due to winter conditions (e.g., site covered with snow or ice), such inspection only has to be conducted once per month until thawing results in runoff or construction activity resumes.

As described in section 3.5.8.1 of the Permit, inspectors performing the required twice weekly inspections must have an active certification by completing the "Fundamentals of Erosion Prevention and Sediment Control Level I" course (http://www.tnepsc.org/). Twice weekly inspections can also be performed by: a licensed professional engineer or landscape architect; a Certified Professional in Erosion and Sediment Control (CPESC) or a person who has successfully completed the "Level II Design Principles for Erosion Prevention and Sediment Control for Construction Sites" course. A copy of the certification or training record for inspector certification should be kept on site.

Qualified personnel, (provided by the permittee or cooperatively by multiple permittees) shall inspect disturbed areas of the construction site that have not been finally stabilized, areas used for storage of materials that are exposed to precipitation, structural control measures, locations where vehicles enter or exit the site, and each outfall.

Disturbed areas and areas used for storage of materials that are exposed to precipitation shall be inspected for evidence of, or the potential for, pollutants entering the site's drainage system. Erosion prevention and sediment control measures shall be observed to ensure that they are operating correctly.

Outfall points (where discharges leave the site and/or enter waters of the state) shall be inspected to determine whether erosion prevention and sediment control measures are effective in preventing significant impacts to receiving waters. Where discharge locations are inaccessible, nearby downstream locations shall be inspected. Locations where vehicles enter or exit the site shall be inspected for evidence of offsite sediment tracking.

Based on the results of the inspection, any inadequate control measures or control measures in disrepair shall be replaced or modified, or repaired as necessary, before the next rain event if possible, but in no case more than 7 days after the need is identified.

Based on the results of the inspection, the site description identified in the SWPPP in accordance with section 3.5.1 of the Permit and pollution prevention measures identified in the SWPPP in accordance with section 3.5.2 of the Permit, shall be revised as appropriate, but in no case later than 7 days following the inspection. Such modifications shall provide for timely implementation of any changes to the SWPPP, but in no case later than 14 days following the inspection.

All inspections shall be documented on this Construction Stormwater Inspection Certification form. Alternative inspection forms may be used as long as the form contents and the inspection certification language are, at a minimum, equivalent to the division's form and the permittee has obtained a written approval from the division to use the alternative form. Inspection documentation will be maintained on site and made available to the division upon request. Inspection reports must be submitted to the division within 10 days of the request.

Trained certified inspectors shall complete inspection documentation to the best of their ability. Falsifying inspection records or other documentation or failure to complete inspection documentation shall result in a violation of this permit and any other applicable acts or rules.

14. T.D.E.C. NOTICE OF TERMINATION (NOT)

TENNESSEE DEPARTMENT OF ENVIRONMENT AND CONSERVATION (TDEC)
Division of Water Resources
William R. Snodgrass Tennessee Tower, 312 Rosa L. Parks Avenue, 11th Floor, Nashville, Tennessee 37243
1-888-891-TDEC (8332)

Notice of Termination (NOT) for General NPDES Permit for Stormwater Discharges from Construction Activities (CGP)

This form is required to be submitted when requesting termination of coverage from the CGP. The purpose of this form is to notify the TDEC that either all stormwater discharges associated with construction activity from the portion of the identified facility where you, as an operator, have ceased or have been eliminated; or you are no longer an operator at the construction site. Submission of this form shall in no way relieve the permittee of permit obligations required prior to submission of this form. Please submit this form to the local DWR Environmental Field Office (EFO) address (see table below). For more information, contact your local EFO at the toll-free number 1-888-891-8332 (TDEC).

Type or print clearly, using ink.

Site or Project Name:	**NPDES Tracking Number: TNR**
Street Address or Location:	County(ies):

Name of Permittee Requesting Termination of Coverage:			
Permittee Contact Name:	Title or Position:		
Mailing Address:	City:	State:	Zip:
Phone:	E-mail:		

Check the reason(s) for termination of permit coverage:

☐	Stormwater discharge associated with construction activity is no longer occurring and the permitted area has a uniform 70% permanent vegetative cover OR has equivalent measures such as rip rap or geotextiles, in areas not covered with impervious surfaces.
☐	You are no longer the operator at the construction site (i.e., termination of site-wide, primary or secondary permittee coverage).

Certification and Signature: (must be signed by president, vice-president or equivalent ranking elected official)

I certify under penalty of law that either: (a) all stormwater discharges associated with construction activity from the portion of the identified facility where I was an operator have ceased or have been eliminated or (b) I am no longer an operator at the construction site. I understand that by submitting this notice of termination, I am no longer authorized to discharge stormwater associated with construction activity under this general permit, and that discharging pollutants in stormwater associated with construction activity to waters of the United States is unlawful under the Clean Water Act where the discharge is not authorized by a NPDES permit. I also understand that the submittal of this notice of termination does not release an operator from liability for any violations of this permit or the Clean Water Act.

For the purposes of this certification, elimination of stormwater discharges associated with construction activity means that all stormwater discharges associated with construction activities from the identified site that are authorized by a NPDES general permit have been eliminated from the portion of the construction site where the operator had control. Specifically, this means that all disturbed soils at the portion of the construction site where the operator had control have been finally stabilized, the temporary erosion and sediment control measures have been removed, and/or subsequent operators have obtained permit coverage for the site or portions of the site where the operator had control.

I certify under penalty of law that this document and all attachments were prepared by me, or under my direction or supervision. The submitted information is to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment. As specified in Tennessee Code Annotated Section 39-16-702(a)(4), this declaration is made under penalty of perjury.

Permittee name (print or type):	Signature:	Date:

EFO	Street Address	Zip Code	EFO	Street Address	Zip Code
Memphis	8383 Wolf Lake Drive, Bartlett, TN	38133	Cookeville	1221 South Willow Ave.	38506
Jackson	1625 Hollywood Drive	38305	Chattanooga	1301 Riverfront Parkway, Ste. 206	37402
Nashville	711 R S Gass Boulevard	37243	Knoxville	3711 Middlebrook Pike	37921
Columbia	1421 Hampshire Pike	38401	Johnson City	2305 Silverdale Road	37601

01 60 00 – PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.01 ENVIRONMENTAL, HAZARDOUS PRODUCTS, MATERIALS, OR WASTES

A. Do not incorporate in the Work hazardous materials or products as currently defined in the Resource Conservation and Recovery Act of 1976 (RCRA), the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), or Environmental Protection Agency (EPA) regulations, rules, or requirements, as amended, and/or State and local regulations, rules, or requirements that are equivalent or more stringent than the Federal regulations, rules, or requirements unless the Contract Documents give no other option than to provide a material or product that contains a hazardous material, component, constituent, waste, or leachate. In studying the Contract Documents and carrying out the Work, report at once to the Designer the discovery of a product or material that contains or is suspected to contain hazardous materials, components, constituents, waste, or leachate.

B. Do not incorporate in the Work a product or material that contains concentrations of a constituent, component, or material above the threshold levels which would require adherence to hazardous waste disposal regulations as currently defined, or could cause a release or threat of release of a hazardous substance at a level that would require a remedial response or removal action as currently defined by RCRA, CERCLA, or the EPA.

C. Select materials and products meeting specified requirements that comply with EPA requirements as regards hazardous materials content. In making requests for substitutions, determine that materials and products proposed for substitution comply with RCRA, CERCLA, and EPA requirements, and supply chemical constituent information and/or Material Safety Data Sheets (MSDS) with the substitution request.

1.02 TRANSPORTATION AND HANDLING

A. Materials, products and equipment shall be properly containerized, packaged, boxed and protected to prevent damage during transportation and handling.

B. More detailed requirements for transportation and handling are specified under the technical sections.

1.03 STORAGE AND PROTECTION

A. Provide suitable temporary weather tight storage facilities as may be required for materials that will be damaged by storage in the open.

B. On-site storage space is limited to the site. Acquisition of any additional off-site space is the responsibility of the Contractor.

C. Allocate the available storage areas and coordinate their use by trades. Maintain a current list showing all items and where they are stored.

D. Store and protect materials delivered to the site from damage. Do not use damaged material in the work.

1.04 INSTALLATION REQUIREMENTS

Manufactured articles, materials and equipment shall be applied, installed, connected, erected, used, cleaned and conditioned as directed by the respective manufacturers, unless otherwise specified.

1.05 IDENTIFYING MARKINGS

Nameplates and other identifying markings shall not be affixed on exposed surfaces of manufactured items installed in finished spaces.

1.06 PRODUCT APPROVAL STANDARDS

A. Definitions:

1. The term “product” shall include material, equipment, assembly methods, manufacturer, brand, trade name or other description.

2. References to approved equal, approved substitution, or similar terms mean that Designer approval is required.

B. Proof of Compliance: Where the specifications require conformance with Federal specification, ASTM designation, ANSI specification or other association standard, the Contractor shall, where requested or specified, submit supporting test data to substantiate compliance.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION

SECTION 01 73 29
CUTTING AND PATCHING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division-1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section specifies administrative and procedural requirements for cutting and patching. Refer to other Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.

1.03 SUBMITTALS

A. Cutting and Patching Proposal: Where approval of procedures for cutting and patching is required before proceeding, submit a proposal describing procedures well in advance of the time cutting and patching will be performed and request approval to proceed. Include the following information, as applicable, in the proposal:
   1. Describe the extent of cutting and patching required and how it is to be performed; indicate why it cannot be avoided.
   2. Indicate dates when cutting and patching is to be performed.
   3. List utilities that will be disturbed of affected, including those that will be relocated and those that will be temporarily out-of-service. Indicate how long service will be disrupted.

1.04 QUALITY ASSURANCE

A. Requirements for Structural Work: Do not cut and patch structural elements in a manner that would reduce their load-carrying capacity or load-deflection ration.
B. Obtain approval before cutting and patching the following structural elements:
   1. Bearing and retaining walls.
   2. Structural steel.

C. Operational and Safety Limitations: Do not cut and patch operating elements or safety related components in a manner that would result in reducing their capacity to perform as intended, or result in increased maintenance, or decreased operational life or safety.
   1. Obtain approval before cutting and patching the following operating elements or safety related systems:
      a. Primary operational systems and equipment.
      b. Fire protection systems.
      c. Communication systems.
      d. Electrical wiring systems.

D. Visual Requirements: Do not cut and patch construction exposed on the exterior or in occupied spaces, in a manner that would, in the Architect's opinion, reduce the building's aesthetics qualities, or result in visually unsatisfactory manner.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Use materials that are identical to existing materials. If identical materials are not available or cannot be used where exposed surfaces are involved, use materials that match existing adjacent surfaces to the fullest extent possible with regard to visual effect. Use materials whose installed performance will equal or surpass that of existing materials.

PART 3 - EXECUTION

3.01 INSPECTION

A. Before cutting existing surfaces examine surfaces to be cut and patched and conditions under which cutting and patching is to be performed. Take corrective action before proceeding, if unsafe or unsatisfactory conditions are encountered.

3.02 PREPARATION

A. Temporary Support: Provide adequate temporary support of Work to be cut.

B. Protection: Fully protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portion of the Project that might be exposed during cutting and patching operations.

C. Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

D. Take all precautions necessary to avoid cutting existing pipe, conduit or ductwork serving the building, but scheduled to be removed or relocated until provisions have been made to bypass them.

3.03 PERFORMANCE

A. General: Employ skilled workmen to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time and complete without delay.

B. Cutting: Cut existing construction using methods least likely to damage elements to be retained or adjoining construction. Where possible review proposed procedures with the original installer; comply with the original installer's recommendations.
   1. In general, where cutting is required use hand or small power tools designed for sawing or grinding, not hammering and chopping. Cut holes and slots neatly to size required with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
   2. To avoid marring existing finished surfaces, cut or drill from the exposed or finished side into concealed surfaces.
   3. Cut through concrete and masonry using a cutting machine such as a carborundum saw or diamond core drill.

C. Patching: Patch with durable seams that are as invisible as possible. Comply with specified tolerances.
   1. Where feasible, inspect and test patched areas to demonstrate integrity of the installation.

2. Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
3. Where removal of walls or partitions extends one finished area into another, patch and repair floor and wall surfaces in the new space to provide an even surface of uniform color and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary to achieve uniform color and appearance.
    a. Where patching occurs in a smooth painted surface, extend final paint coat over entire unbroken containing the patch, after the patched area has received primer and second coat.

3.04 CLEANING

A. Thoroughly clean areas and spaces where cutting and patching is performed or used as access. Remove completely paint, mortar, oils, putty and items of similar nature. Thoroughly clean piping, conduit and similar features before painting or other finishing is applied. Restore damaged pipe covering to its original condition.

END OF SECTION

SECTION 01 74 19
CONSTRUCTION WASTER MANAGAEMENT AND DISPOSAL

PART 1 - GENERAL

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

1.02 SUMMARY

A. Section includes administrative and procedural requirements for the following:
   1. Salvaging nonhazardous construction waste.
   2. Recycling nonhazardous construction waste.
   3. Disposing of nonhazardous construction waste.

1.03 DEFINITIONS

A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.

B. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.

C. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.

D. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.

E. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.04 PERFORMANCE REQUIREMENTS

A. General: Achieve end-of-Project rates for salvage/recycling of 50 percent by weight of total non-hazardous solid waste generated by the Work. Practice efficient waste management in the use of materials in the course of the Work. Use all reasonable means to divert construction and demolition waste from landfills and incinerators. Facilitate recycling and salvage of materials, including the following:

   1. Demolition Waste:
      a. Site-clearing waste.
      b. Asphalt paving.
      c. Concrete.

d. Packaging: Regardless of salvage/recycle goal indicated in paragraph above, salvage or recycle 100 percent of the following uncontaminated packaging materials:
   1. Paper.
   2. Cardboard.
   3. Boxes.
   4. Wood crates.

2. Construction Waste:
   a. Packaging: Regardless of salvage/recycle goal indicated in "General" Paragraph above, salvage or recycle 100 percent of the following uncontaminated packaging materials:
      1. Paper.
      2. Cardboard.
      3. Boxes.
      4. Plastic sheet and film.
      5. Polystyrene packaging.
      6. Wood crates.
      7. Plastic pails.

1.05 ACTION SUBMITTALS

A. Waste Management Plan: Submit plan within 30 days of date established for the Notice to Proceed.

1.06 INFORMATIONAL SUBMITTALS

A. Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit report. Use Form CWM-7 for construction waste. Include the following information:
   1. Material category.
   2. Generation point of waste.
   3. Total quantity of waste in tons.
   4. Quantity of waste salvaged, both estimated and actual in tons.
   5. Quantity of waste recycled, both estimated and actual in tons.
   6. Total quantity of waste recovered (salvaged plus recycled) in tons.
   7. Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste.

B. Waste Reduction Calculations: Before request for Substantial Completion, submit calculated end-of-Project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work.

C. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

1.07 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Waste Management Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to waste management including, but not limited to, the following:
   1. Review and discuss waste management plan including responsibilities of waste management coordinator.
   2. Review requirements for documenting quantities of each type of waste and its disposition.
   3. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
   4. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
   5. Review waste management requirements for each trade.

1.08 WASTE MANAGEMENT PLAN

A. General: Develop a waste management plan according to ASTM E 1609 and requirements of this Section. Plan shall consist of waste identification, waste reduction work plan, and cost/revenue analysis. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.

B. Waste Identification: Indicate anticipated types and quantities of site-clearing and construction waste generated by the Work. Use Form CWM-1 for construction waste. Include estimated quantities and assumptions for estimates.

C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Use Form CWM-3 for construction waste. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.01 PLAN IMPLEMENTATION

A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.
   1. Comply with Division 01 Section "Temporary Facilities and Controls" for operation, termination, and removal requirements.

B. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work occurring at Project site.
   1. Distribute waste management plan to everyone concerned within three days of submittal return.

2. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.

C. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
   1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.
   2. Comply with Division 01 Section "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

3.02 SALVAGING DEMOLITION WASTE

A. Salvaged Items for Owner's Use: Salvage items for Owner's use and handle as follows:
   1. Clean salvaged items.
   2. Pack or crate items after cleaning. Identify contents of containers.
   3. Store items in a secure area until delivery to Owner.
   4. Transport items to Owner's storage area designated by Owner.
   5. Protect items from damage during transport and storage.

3.03 RECYCLING CONSTRUCTION WASTE, GENERAL

A. General: Recycle paper and beverage containers used by on-site workers.

B. Preparation of Waste: Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.

C. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical according to approved construction waste management plan.
   1. Provide appropriately marked containers or bins for controlling recyclable waste until they are removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.
   2. Inspect containers and bins for contamination and remove contaminated materials if found.
   3. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
   4. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
   5. Store components off the ground and protect from the weather.
   6. Remove recyclable waste off Owner's property and transport to recycling receiver or processor.

3.04 RECYCLING CONSTRUCTION WASTE

A. Packaging:
   1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
   2. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply

with requirements for recycling wood.

3. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.

B. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location.
   1. Clean Gypsum Board: Grind scraps of clean gypsum board using small mobile chipper or hammer mill. Screen out paper after grinding.

3.05 DISPOSAL OF WASTE

A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
   1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
   2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. Burning: Do not burn waste materials.

C. Disposal: Transport waste materials and dispose of at designated spoil areas on Owner's property.

D. Disposal: Transport waste materials off Owner's property and legally dispose of them.

END OF SECTION

01 77 70 – CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.01 PRE-CLOSEOUT SUBMITTALS

A. Submit required tabulations when Work reaches seventy-five percent completion; however, regardless of percent completion, submit not later than 30 days prior to the scheduled date on which Substantial Completion is required.

B. Submit tabulations of the following.

1. Equipment and systems for which the specifications require demonstrations or training, indicating relevant specification sections, scheduled time and place for demonstration and training sessions, and intended audience. Adjust schedule if instructed by Designer to do so.

2. Equipment and systems for which operating and maintenance data are required in the Operating and Maintenance Data Binders and related documents are required in the Project Data Binders.

3. Spare parts and extra materials required, indicating the relevant specification sections, and the appropriate party to whom the items are to be delivered.

1.02 REQUEST FOR CLOSEOUT INSPECTION

A. Substantial Completion: When Contractor considers Work substantially complete, Contractor shall submit the following to Designer.

1. Written assertion that Work is Substantially Complete

2. A list of items to be completed or corrected and dates scheduled for completion or correction of each item

3. Certification that orientation and training for facility maintenance personnel is complete or written assertion that such orientation and training will be certified prior to inspection

4. Written assertion that Operating & Maintenance Data Binders are complete and available or will be prior to inspection

5. When a Use and Occupancy Permit applies, a copy of the final approval(s), or written assertion that they will be complete and available prior to inspection

6. A draft of the application for payment corresponding to the Substantial Completion, with written assertion that an application for payment will be ready and submitted at the inspection

7. When there is Commissioning, written assertion that Commissioning requirements have been completed or will be prior to inspection

8. When there is a storm water permit, written statement of the status of final stabilization required under the Storm Water Pollution Prevention Plan (SWPPP) for the TDEC Construction General Permit (CGP) Notice of Termination (NOT).

B. Final Inspection: When Contractor considers Work complete, Contractor shall submit the following to Designer.

1. Certification that a qualified person authorized by Contractor has reviewed the Contract Documents and inspected the Work

2. Written assertion that the Work is complete and in accordance with Contract Documents and ready for Final Inspection

3. Written assertion that additional materials necessary to augment the Operating & Maintenance Data Binders with instructions for adding these to the Binders, or full replacement Binders, are complete and available or will be prior to inspection
4. Written assertion that Project Data Binders and Construction Record Documents are complete and available or will be prior to inspection
5. An application for final payment

C. Upon receipt of an appropriate request for inspection, Designer will schedule an inspection meeting with Contractor, and Owner's representatives to determine the status of completion.

1.03 RESULTS OF CLOSEOUT INSPECTIONS

A. Should the Designer determine that Work is not complete to the degree asserted by Contractor, Designer will promptly notify Contractor in writing stating the deficiencies. Contractor shall take immediate steps to remedy deficiencies and make a request for Re-Inspection.

B. Substantial Completion: Designer will prepare a Certificate of Substantial Completion accompanied by a list of items to be completed or corrected, and will submit Certificate to Contractor and to Owner for signature with an accounting of Liquidated Damages due, when Designer verifies the following.

1. Work is Substantially Complete based on an inspection conducted pursuant to an appropriate request for Closeout inspection
2. Orientation and training for facility maintenance personnel is complete
3. Operating & Maintenance Data Binders are complete and have been delivered to the Owner

C. Final Inspection: Designer will certify that the Work is Complete, and will initiate Final Adjustments, when Designer verifies the following.

1. Work is complete in accordance with Contract Documents based on an inspection conducted pursuant to an appropriate request for Closeout inspection
2. Orientation and training for facility maintenance personnel is complete
3. Additional materials necessary to augment the Operating & Maintenance Data Binders with instructions for adding these to the Binders, or full replacement Binders, are complete and have been delivered to the Owner
4. Project Data Binders and Construction Record Documents are complete and have been delivered to the Designer.

1.04 RE-INSPECTION FEES:

If the Work fails a Closeout inspection, and a subsequent inspection is requested and conducted based on Contractor assertion of the same stage of completion, Owner will compensate Designer for performing such re-inspection as additional services, and deduct the amount of such compensation from the Contract Sum by appropriate modification.

1.05 FINAL ADJUSTMENTS

A. When Designer has certified that the Work is complete, Designer will determine whether modification is needed to reflect appropriate adjustments to Contract Sum

which were not previously effected. If such modification is needed, Designer shall assist the Owner in its preparation and deliver it to Contractor, who in the case of a change order, shall sign and return it to Designer.

B. When Designer has certified that the Work and needed modifications to the Contract are complete, and if necessary, Designer will instruct Contractor to submit a revised final application for payment.

1.06 ONE-YEAR CORRECTIVE INSPECTION

A. An inspection will be scheduled and conducted at project site prior to one year from date Substantial Completion was achieved, but as close to the end of that year as is reasonably possible.

B. The inspection will be attended by at least one representative each of Owner, Designer, and Contractor.

C. The inspection will confirm non-conforming items previously identified for correction by the Owner, and whether corrections have been completed or are still outstanding, and is intended to be an opportunity for Contractor to become aware of any outstanding corrections needed.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION

01 78 01 – CLOSEOUT SUBMITTALS

PART 1 - GENERAL

1.01 DATA BINDERS

A. Provide two complete sets on paper in three ring binders and a complete set in PDF format. Identify project and type of data on face and saddle.

B. Provide information required by Contract Documents, including:

1. Cover sheet giving complete project title and number, Contractor's name, address, phone number, superintendent's name, and related information.

2. Table of Contents identifying material in Binder, and identifying missing materials to be added later or certifying completeness of Binder.

C. Operating & Maintenance Data Binders

1. Provide Product Data. Include: manufacturer; model number; names, addresses, & telephone numbers of suppliers, installers, & servicers; related information for repair, renovation, or additions.

2. Provide Operating and Maintenance Data, including: instructions and schedules for proper operation, maintenance, servicing, and lubrication with manufacturer's parts list, illustrations, assembly drawings, maintenance diagrams, and list of recommended lubricants and cleaning agents; as-installed control diagrams and coordination drawings with color coded piping and wiring diagrams; valve tag charts with numbers, locations, and functions; panel board circuit directories; and, list of materials and parts furnished for Owner. Review brochures and manufacturer’s standard printed information for data pertaining to models other than those actually provided, and mark to clearly omit inapplicable information and identify units actually installed.

3. If Commissioning applies, provide Commissioning functional performance test certifications and data. If separate binders of this information have not been submitted already, provide a third copy in a separate binder.

4. If a SWPPP applies, provide a section into which the Designer can add the Storm Water Operation & Maintenance Plan.

D. Project Data Binders

1. On the form exhibited as Section 01 78 88, provide required information for general contractor and all subcontractors and major material suppliers.

2. Provide a copy of the Certificate of Substantial Completion.

3. Provide a copy of the State Fire Marshal’s Certificate of Occupancy, and other Use and Occupancy Permits, Certificate(s) of Inspection, or letter(s) of acceptance from governing authorities as apply.

4. Provide guarantees, warranties, bonds, certifications, maintenance agreements, service contracts, and related documents, including beginning date, duration, information about instances which might affect validity, and proper procedure in case of failure.

5. If a SWPPP applies, provide the twice-weekly inspection reports and site audit reports.

1.02 CONSTRUCTION RECORD DOCUMENTS

Keep the record copy of Contract Documents required by the Conditions in good condition and in the course of the Work, legibly mark these to record actual conditions of Work, including: location, depth, and identification of new and existing underground items, utilities, valves, tap points, equipment, service access, test points, and related features; field changes in dimensions and detail; changes by addenda or Modification; and, description and details of features for maintenance, service, replacement, or expansion of the Work.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION

01 78 25 – DATA BINDER RECEIPT

PART 1 - GENERAL

1.01 CONTRACTOR PREPARATION AND USE OF THIS FORM

A. Use this form or a reasonable facsimile to verify delivery of Data Binders. Fill in the identifying information following this paragraph, then use the prepared form as a receipt, for signature by the person to whom Data Binders are delivered. Provide a copy of the receipt with the Application for Payment.

1. For the Application for Payment commensurate with Substantial Completion, provide a copy indicating delivery of Operating and Maintenance Data Binders.

2. For the Application for Payment commensurate with Final Completion, provide a copy indicating delivery of Project Data Binders.

B. Identifying Information:

1. For the Work:

Project Name: _____

Institution: _____

Location: _____

SBC No.: _____

2. For the Data Binder(s), mark only one of the boxes below:

	Only **Operating & Maintenance Data Binder** (due at substantial completion inspection)
	Only **Project Data Binder** (due at final inspection)
	Both Data Binders

1.02 RECIPIENT SIGNATURE

A. By signature below, recipient acknowledges receipt of the Data Binder identified above, but does not certify the completeness or correctness of the Data Binder.

Recipient Signature:	
Recipient's name and title or affiliation with Owner or Designer	

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION

01 78 88 – REPORT OF SUBCONTRACTORS AND SUPPLIERS

PART 1 - GENERAL

1.01 REQUIREMENTS

Submit required reports of subcontractors and suppliers on forms similar to the example herein or on forms with equivalent content and detail.

1.02 EXAMPLE REPORT

REPORT OF SUBCONTRACTORS AND SUPPLIERS			
Project:	SBC No.	Report Date:	General Contractor Diversity-Owned? If "Yes", provide classification and certifying agency.
General Contractor Name, Address, Phone, and Principal Contact:			___Yes ___ No
Work of Subcontractor or Major Material Supplied and Dollar Value	Firm Name and Address	Principal Contact and Phone Number	Diversity-Owned Business? If "Yes", provide classification and certifying agency.
			___Yes ___ No
			___Yes ___ No
			___Yes ___ No
			___Yes ___ No
			___Yes ___ No
			___Yes ___ No
			___Yes ___ No
			___Yes ___ No
			___Yes ___ No
			___Yes ___ No

Continue report as required on additional pages. Page ___ of ___.

END OF SECTION

01 79 21 – DEMONSTRATION AND TRAINING

PART 1 – GENERAL

1.01 DEMONSTRATION AND TRAINING

A. Coordinate a schedule of demonstration and training with Designer and Owner's personnel for all installed equipment and systems.

B. Conduct demonstration and instruction as soon as practicable upon installations, and prior to Substantial Completion inspection. Substantial Completion shall not be certified, nor shall Owner be required to assume responsibility for operating, maintaining, or insuring system, prior to complete demonstration and instruction.

C. If conditions (such as season of year) do not allow for a complete demonstration or training of equipment and systems operation during one meeting session prior to Substantial Completion; then coordinate a schedule that shall provide a sufficient number of sessions within the warranty period.

D. Demonstrate operation of installed equipment and systems to Designer and to Owner's representative. All dependent systems must be demonstrated as being operationally coordinated, e.g. energy management controls coordinated with mechanical equipment.

E. Demonstrations shall be complete and detailed; referencing manufacturer's printed O&M instructions and evidencing all required design specifications.

F. All training shall be specific to the actual installed equipment and systems, and be performed by persons approved by equipment manufacturer(s) and/or approved by the Designer to conduct such training.

G. Instruct Owner's personnel with overall equipment and systems assembly and function; using assembly drawings and diagrams which are specific to the actual installed equipment and systems.

H. Instruct Owner's personnel in operation, adjustment, and maintenance of equipment and systems; using the manufacturer's printed operating and maintenance data that is specific to the installed equipment and systems as the basis of instruction.

I. Verify that Owner's personnel have received all spare materials and parts required to be furnished, and provide instruction in replacement procedures.

J. Make lists of persons witnessing equipment and systems demonstration, and persons receiving operating instruction, using a format similar to the form included in section 01 79 25 with project, subject, trainer, session information, and attendees identified. Include copy of lists in the Operating and Maintenance Data Binders.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION

01 79 25 – DEMONSTRATION AND TRAINING VERIFICATION

PART 1 - GENERAL

1.01 INSTRUCTIONS

A. Use a copy of this page as a planning form for demonstrations and training. Fill in the basic identifying information below:

SBC Project Number: _____

Institution/Location: _____

Required date of Substantial

Project Name: _____

Owner's Facility Coordinator: _____ Phone: _____

Owner's Maintenance Contact: _____ Phone: _____

Contractor Contact: _____ Phone: _____

B. If a list of required demonstrations and training has been specified in Division 1, use that list as a starting point, review the project manual for other specifications that require training of the Owner's operators, and complete the list below. Check the box on left if Demonstration and Training is required on the standard listed subjects; add subjects as identified by review of the specifications and check the box to the left of each; and, schedule and indicate a target date for each. If the number of training subjects exceeds the available space provided here, replace or continue the list on a similarly formatted separate page. Submit the list with the initial Progress Schedule, and update as necessary during the Work to ensure that advance notice of the demonstration and training schedule is acceptable to the Designer.

	Spec Reference	Subject	Target Date	Actual Date
		Accessibility		
		Boiler		
		Chiller		
		Controls		
		Data Transmission		
		Electrical		
		Elevator / Conveying		
		Fire Alarm		
		Irrigation		
		Mechanical		
		Plumbing		
		Telecommunications		

1.02 TRAINING VERIFICATION REPORT

For each session conducted, use this page as a training verification report. Fill in the information below prior to the session. "End Time" may be filled in after.

SBC Project Number: _____

Institution/Location: _____

Project Name: _____

Subject Equipment / System:	
Spec Reference	

Demonstration and Training (by whom, where, when)	Trainer Name:	Company:		Phone:
	Place:	Date:	Start Time:	End Time:

A. Minimum Agenda Requirements:

☐ System Walk-through ☐ Operation ☐ Trouble-shooting ☐ Maintenance ☐ Safety

B. Attendance: Each person receiving the demonstration and training shall sign in below, or on a similarly formatted continuation page:

Initials	Legibly print your name	Unit and title or function

END OF SECTION

SECTION 01 81 14 - HIGH PERFORMANCE BUILDING REQUIREMENTS (HPBr)

PART 1 – GENERAL

1.01 DESCRIPTION

A. The State of Tennessee High Performance Building Requirements (HPBr) is an Office of the State Architect (OSA) program acknowledged by the State Building Commission (SBC) whose goal is to provide a minimum standard of high performance building attributes for Designers and Contractors. It is to be used as a mandatory design, construction, and operations tool for all SBC projects including new construction, additions, and renovation / maintenance.

B. The Designer and Owner have selected materials and utilized integrated design processes that achieve the State of Tennessee's objectives for high performance buildings. The Contractor is responsible for maintaining and supporting these objectives in developing means and methods for performing work and in proposing product substitutions or changes to specified processes.

C. A copy of the HPBr checklist is found as an attachment to this section which summarizes the HPBr credits intended to be achieved.

D. The Contractor shall review the project-specific HPBr checklist for those credits for which the Contractor has a responsibility in achieving. The Contractor shall respond to the Designer and the Owner regarding credits that are the responsibility of the Contractor, that depend on product selection or product qualities, or that depend on Contractor's procedures. Contractor shall document responses as informational submittals. Contractor shall inform Designer and/or Owner where credit applicability is questionable or where pursued credits may not be achieved. The Contractor shall also inform the Designer and Owner of credits which are achievable but are not shown as being pursued in the checklist.

1.02 RELATED WORK

A. Section 01 33 00 Submittal Procedures

B. LM2.2 – Site Disturbance: Limit site disturbance during construction to minimum development footprint

1. Submit Construction Access/ Development plan

C. LM5.2 – Heat Island Reduction

1. Gray membrane (high SRI) roofing
    a. Section 07 54 23 Thermoplastic Polyolefin (TPO) Roofing

D. MR2.1 – Construction Waste Management

1. Identify the target diversion rate within the Construction Waste Management Plan in Section 01 74 19 (50%, 75%, 95%).

2. Require the Contractor to track the overall waste diversion rate throughout construction and provide a submittal for the final achieved diversion rate.

E. MR3.1 or MR3.2 – Sustainable Materials: Recycled content
   1. Give preference to materials that are high in Recycled Content, such that at least 10 percent or 20 percent (based on cost) of building materials is recycled (excludes MEP equipment cost).
   2. Research local availability of fly-ash concrete and synthetic gypsum board for use in construction when appropriate
   3. Consider specifying recycled content replacing Portland cement
      a. Section 03 30 00 Cast-in-Place Concrete

F. MR3.3 – Sustainable Materials: Tennessee-produced materials (non-wood)
   1. Give preference to materials that are harvested, manufactured, or both manufactured and harvested, such that at least 10% (based on cost, excluding MEP equipment) is from the State of Tennessee.
   2. Materials which satisfy the MR3.3 requirements can automatically be included in HPBr credit MR3.5 Regional Materials.
   3. Specify regional quarries and/or manufacturers
      a. Section 03 30 00 Cast-in-Place Concrete

G. MR3.4 – Sustainable Materials – Tennessee-produced materials (wood):
   1. Give preference to wood-based materials that are harvested, manufactured, or both manufactured and harvested, such that at least 50% (based on cost, excluding MEP equipment) is from the State of Tennessee.
   2. Materials which satisfy the HPBr credit MR3.4 requirements can automatically be included in HPBr credit MR3.5 Regional Materials.

H. MR3.5 – Sustainable Materials: Regional materials
   1. Give preference to building materials that are regional to the project site, regardless of which state they are produced in, such that at least 20% (based on cost, excluding MEP equipment) of the project is comprised of materials harvested, manufactured, or harvested AND manufactured within 500 miles of the project.
   2. Any materials that qualify for either HPBr credit MR3.3 or MR3.4 can also be counted for this credit
   3. Additional credit is available under HPBr credit ID1.5 for achieving at least 30% Regional Materials.
   4. Specify regional quarries and/or manufacturers
      a. Section 03 30 00 Cast-in-Place Concrete

I. EQ6 – Material VOC Limits

1. The Volatile Organic Compounds (VOC) content of Adhesives, sealants, and paints / coatings used must not exceed the limits established within Part 2 for interior products (those inside the weather barrier).
2. Contractor to meet or exceed (VOC limits lower than the amounts outlined in Part 2) the VOC content limits of Adhesives, sealants, paints / coatings, flooring systems, composite wood and agrifiber products.
3. EQ6.1 – Material VOC Limits: Sealants
   a. VOC-compliant sealants
      i. Section 07 84 13 Penetration Firestopping
      ii. Section 07 84 43 Joint Firestopping
      iii. Section 07 92 00 Joint Sealants
4. EQ6.2 – Material VOC Limits: Paints
   a. VOC-compliant interior paints and coatings
      i. Section 09 91 23 Interior Painting
5. EQ6.4 – Material VOC Limits: Flooring systems
   a. Give preference to carpet systems that meet or exceed the requirements of the Carpet and Rug Institute's Green Label Plus *Indoor Air Quality* Test Program.
   b. Give preference to carpet cushion installed in the building interior that meets the requirements of the Carpet and Rug Institute Green Label program.
   c. Give preference to hard surface flooring that meets the testing and product requirements of FloorScore certification.
   d. Tile, masonry, terrazzo, cut stone and solid wood flooring without coatings or sealant qualify for credit without testing.
   e. Carpet complying with CRI Green Label Plus requirements and installation materials complying with CRI Green Label requirements and VOC-limits. Include a reference to FloorScore certification by Resilient Floor Covering Institute (RFCI) in conjunction with Scientific Certification Systems (SCS).
      i. Section 09 68 13 Tile Carpeting
6. EQ6.5 – Material VOC Limits: Composite Wood and Agrifiber products
   a. Specify products that contain no added Urea-formaldehyde resins.

J. EQ7.2 – Pollutant Control: Hazardous material storage
   1. Door closers at rooms where hazardous gases or chemicals may be present, including copy/print rooms
      a. Section 08 71 11 Door Hardware

1.03 DEFINITIONS

A. Addition – an increase in floor area of a building outside of the existing building envelope.

B. Adhesive - A substance used to bond two surfaces together by attachment. Adhesives include all bonding and adhesive primers.

C. Brownfield – Property with the potential presence of hazardous substances, pollutants or contaminants which may complicate redevelopment efforts. See also www.epa.gov/brownfields.

D. Formaldehyde - Formaldehyde is a naturally occurring volatile organic compound which is carcinogenic and an irritant when present in relatively high concentrations. It has been known to cause headaches, dizziness, mental impairment, and other symptoms. When present in air at levels above 0.1 ppm (parts per million), it may cause watery eyes, burning sensations in the eyes, nose, and throat; nausea; coughing; chest tightness; wheezing; skin rashes; as well as asthmatic and allergic reactions.

E. Indoor Air Quality - The quality of air inside a space or building. Indoor air quality affects the health and well-being of building occupants.

F. Light Pollution - Waste light from building sites and lighting installations produces glare, when directed upward or off site.

G. Outdoor Air - The ambient air that enters a building through a ventilation system, through intentional openings for natural ventilation, or by infiltration.

H. Permanently Installed Building Product - products and materials that create the building or are permanently attached to it. Examples include structure and enclosure elements, installed finishes, framing, interior walls, cabinets and casework, doors, and roofs. Most of these materials and products fall within CSI 2012 MasterFormat Divisions 3-10, 31, and 32.

I. Recycled Content - Recycled Content of materials is defined according to Federal Trade Commission Guides for the Use of Environmental Marketing Claims (16 CFR Part 260). Recycled Content value of a material assembly is determined by weight. Recycled fraction of assembly is multiplied by cost of assembly to determine Recycled Content value.

   1. “Post-Consumer” material is defined as waste material generated by households or by commercial, industrial, and institutional facilities in their role as end users of the product, which can no longer be used for its intended purpose.
   2. “Pre-Consumer” material is defined as material diverted from waste stream during the manufacturing process. Excluded is reutilization of materials such as rework, regrind, or scrap generated in a process and capable of being reclaimed within the same process that generated it.

J. Regional Materials - Materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles (800 km) of project site. If only a fraction of a product or material is extracted or harvested or recovered and manufactured locally, then only that percentage (by weight) must contribute to regional value.

K. Rapidly Renewable Material - Building materials and products which are made from plants that are typically harvested within a 10—year or shorter cycle.

L. Salvaged or Reused Materials - Construction materials recovered from existing buildings or construction sites and reused. Common Salvaged Materials include structural beams and post, flooring, doors, cabinetry, brick, and decorative items.

M. Sealant - Any adhesive with properties that have been specifically formulated to fill, seal, or waterproof gaps or joints between two surfaces. These may include primers and caulks.

N. Solar Reflectance Index (SRI) - SRI is the measure of a material's ability to reject solar heat. It is defined so that a standard black surface (reflectance 0.05, emittance 0.90) is 0 and a standard white surface (reflectance 0.80, emittance 0.90) is 100. Once the maximum and minimum temperature rises of a given material have been computed, the SRI can be found by interpolating between the values for white and black. Materials with the highest SRI values are the coolest choices. Due to the way SRI is defined a relative scale, particularly hot materials may have slightly negative values, and particularly cool materials can sometimes exceed 100. (Lawrence Berkeley National Laboratory Cool Roofing Materials Database)

O. Urea Formaldehyde - A combination of urea and formaldehyde that is used in some adhesives and will sometimes emit formaldehyde at room temperature.

P. Volatile Organic Compounds (VOC) - Chemicals that are emitted as gases from certain solids or liquids. VOCs include a variety of chemicals, some of which may have short- and long-term adverse health effects.

1.04 REFERENCES

A. Tennessee High Performance Building Requirements (HPBr) can be found within the Office of the State Architect's page on the following website (includes the Manual, Checklist Workbook, Owner's Project Requirements, FAQ Guide, and Quick Start Guide): https://www.tn.gov/content/tn/osa/capital---real-estate/capital-projects/high-performance-building-requirements--hpbr-.html

B. Tennessee Erosion and Sediment Control Handbook by the Tennessee Department of Conservation (TDEC).

C. SMACNA – IAQ Guidelines for Occupied Buildings Under Construction, 2nd Edition (2007)

1.05 SUBMITTALS

A. Product submittals to be provided with manufacturer documentation in accordance with Section 01 33 00 and each respective spec section:

1. LM5.2 - Heat Island Reduction. Roof SRI data
2. MR3.1, MR3.2, MR3.5, MR3.7 – Sustainable Materials.
   a. Manufacturer's product data with percentages of sustainable materials, by cost, used to calculate compliance with Materials & Resource credits. Note that credits MR3.6

Salvaged Material and MR3.7 Rapidly Renewable Materials are based on dollar amounts rather than percentage costs.

3. EQ5.1 – Air Quality Management: During Construction.
   a. If permanently installed air handling units are used during construction, provide manufacturer's cut sheets and product data highlighting the Minimum Efficiency Reporting Value (MERV) for filtration media installed at return air grilles.
   b. If ANSI/SMACNA 008-2008, Chapter 3 approaches are employed, take a minimum of 18 construction photographs including six photographs taken on three different occasions during construction along with a brief description of each approach, documenting implementation of IAQ management measures, such as protection of ducts and on-site stored or installed absorptive materials
4. EQ6.1, EQ6.2, EQ6.3,[EQ6.4, EQ6.5 – Material VOC Limits. Manufacturer's product data including VOC content for all adhesives, sealants, paints / coatings, flooring systems, and urea-formaldehyde content of composite wood / agrifiber materials within the weather barrier.

B. As requirement for Final Payment, Contractor shall provide additional closeout submittals as follows:

1. LM2.1 – Site Disturbance: Sediment and Erosion control. Inspection reports confirming compliance with the Erosion and Sedimentation Control Plan
2. MR2.1 – Construction Waste Management. Waste hauler provided construction waste receipts verifying level of diverted waste or salvaged material for the project.
3. MR3.1, MR3.2, MR3.5, MR3.7 – Sustainable Materials. Materials and Resources Calculator, (found within the Checklist Workbook) verifying calculated Recycled Content (pre-consumer and post-consumer), regional content, resource reuse / material reuse, Rapidly Renewable Materials, and Tennessee-based material content (excluding MEP equipment).
4. EQ5.1 – Air Quality Management: During construction. Filter change log showing filters are replaced prior to occupancy
5. Signed Credit Verification Form found within the HPBr Checklist Workbook

PART 2 – PRODUCTS

2.01 PERFORMANCE CRITERIA

A. LM5.2 – Heat Island Reduction: Roof. Finished roof surface shall have an SRI of 78 or greater for at least 75% or more of the roof surface.
   1. Contractor shall include SRI value in submittal documentation.

B. MR2.1 - Construction Waste Management. No less than 50 percent or more waste material (excluding soil, by volume) from construction has been diverted from the landfill to be salvaged or recycled.
   1. Employ processes that ensure the generation of as little waste as possible due to error, poor planning, breakage, mishandling, contamination, or other factors.
   2. Minimize trash/waste disposal in landfills; reuse, salvage, or recycle as much waste as economically feasible.

C. MR3.1– Sustainable Materials: Recycled content. Not less than 10 percent of building materials (by cost, excluding MEP equipment) must contain Recycled Content. For the purposes of documenting credit compliance, pre-consumer recycled content is only worth half of the value of post-consumer recycled content.

D. MR3.3 Regional Materials. Not less than 10 percent of non-wood building materials (by cost, excluding MEP equipment) must be based in and/or manufactured from the state of Tennessee.

E. MR3.4 Regional Materials; not less than 50 percent of wood-based building materials (by cost, excluding MEP equipment) must be based in and/or manufactured from the state of Tennessee.

F. MR3.5 Regional Materials; not less than 20 percent of building materials (by cost) must be regional material.

2.02 VOC Limit Table

EQ Table – Material *VOC* Limits	
Architectural Adhesives (g/L less water):	
a. Indoor Carpet:	50
b. Carpet Pad:	50
c. Wood Flooring	100
d. Rubber Floor:	60
e. Subfloor:	50
f. Ceramic Tile:	65
g. VCT & Asphalt:	50
h. Drywall & Panel:	50
i. Cove Base:	50
j. Multipurpose:	70
k. Structural Glazing:	100
Specialty *Adhesives* (g/L less water):	
a. PVC Welding:	510

b. CPVC Welding:	490
c. ABS Welding:	325
d. Plastic Cement:	250
e. Primer for Plastic:	550
f. Contact:	80
g. Special Purpose Contact:	250
h. Structural Wood Member:	140
i. Sheet Applied Rubber:	850
j. Top & Trim:	250
Substrate Specific (g/L less water):	
a. Metal to Metal:	30
b. Plastic Foams:	50
c. Porous Material (except wood):	50
d. Wood:	30
e. Fiberglass:	80
Sealants (g/L less water):	
a. Architectural:	250
b. Architectural Porous:	775
c. Non-membrane Roof:	300
d. Roadway:	250
e. Single-Ply Roof Membrane:	450
f. Other:	750
g. *Aerosol* General Purpose mist spray:	65% *VOC*s by weight
h. *Aerosol* General Purpose web spray:	55% *VOC*s by weight
i. *Aerosol* Special Purpose:	70% *VOC*s by weight
Paints (g/L less water):	
a. Flats:	50
b. Non-Flats	50
Anti-corrosive and anti-rust paints applied to interior ferrous metal substrates:	
a. *VOC* limit is (g/L less water):	250
Coatings (g/L less water)	

a. Clear wood finish, varnish:	350
b. Clear wood finish, lacquer:	550
c. Floor coatings:	100
d. Sealers and undercoaters:	200
e. Shellac, clear:	730
f. Shellac, pigmented:	550
g. Stain:	250

PART 3 – EXECUTION

3.01 ATTACHMENTS

A. Tennessee HPBr Checklist

B. Tennessee HPBr Credit Verification Form

C. Tennessee HPBr Materials and Resources Calculator

END OF SECTION 01 81 14

High Performance Building Requirements v1.01
CHECKLIST / TRACKING FORM

Phase	Targeted Points
Applicable	54
Minimum	27
Not Applicable	42
Programming	36
SD	0
DD	44
CD	38
Closeout	0

SBC Number:	166/000-04-2013Y3
Project Name:	TCAT Memphis - New Building & Renovations
Date:	07.22.20
Project Type:	New_Construction
Project Phase:	Construction Documentation
Category from Applicability Tree:	Category A

Helpful Hints:

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Project Team Representatives			Initials
O	-	Owner	RB
C	-	Contractor	
ME	-	Mechanical Engineer	TM
EE	-	Electrical Engineer	DC
CE	-	Civil Engineer	JJ
A	-	Architect	CN
Other	-	Other	

					Programming			SD			DD			CD			Closeout				
				Checklist Total	36	14	54	0	0	104	44	3	57	38	6	60	0	0	104		
22 Points			Land Management	LM Total:	6	1	15	0	0	22	6	0	16	6	1	15	0	0	22		Primary Credit Responsibility
Possible Points	Credit ID	Applicable to Building/Site Scope?	Description	Level:	Yes	Maybe	No	Yes	Maybe	No	Yes	Maybe	No	Yes	Maybe	No	Yes	Maybe	No	Comment: Describe implementation approach for each pursued credit. If credits are not pursued, provide justification.	Role	Initials
1	LM1.1	No	Site Selection - Reuse Existing Buildings	Priority 2			1			1	0		1	0		1			1		O	RB
1	LM1.2	No	Site Selection - Show preference for building on developed sites: Preserve farmland/habitat, wetlands, floodplains, public parkland	Priority 1			1			1	0		1	0		1			1		O	RB
1	LM1.3	No	Site Selection - Brownfield Redevelopment - Remediate and Restore contaminated sites when possible	Priority 2			1			1	0		1	0		1			1		O	RB
1	LM1.4	No	Site Selection - Urban Development - Locate building within existing infrastructure	Priority 1			1			1	0		1	0		1			1		O	RB
1	LM2.1	Yes	**Site Disturbance -** Sediment and Erosion control during construction	**Required**	1		0			1	1		0	1		0			1		C	0
1	LM2.2	No	Site Disturbance - Limit site disturbance during construction to minimum development footprint	Priority 1			1			1	0		1	0		1			1		CE	JJ
1	LM3.1	No	Transportation - Plan for access to public transportation	Priority 2			1			1	0		1	0		1			1		O	RB
1	LM3.2	Yes	**Transportation -** Provide bicycle storage for 5% of building occupants and shower/changing facilities for 0.5% of FTE occupants	**Priority 2**		1	0			1			1		1	0			1		CE	JJ
1	LM3.3	No	Transportation - Plan site to include preferred parking for carpooling for 5% of all spaces provided	Priority 2			1			1	0		1	0		1			1		CE	JJ
1	LM3.4	No	Transportation - Plan site to include preferred parking for low-emitting/fuel efficient vehicles for 5% of all spaces provided	Priority 2			1			1	0		1	0		1			1		CE	JJ
1	LM4.1		**Landscape Design -** Maximize vegetated open space	**Priority 2**			1			1			1			1			1		Other	0
1	LM4.2	Yes	**Landscape Design -** Native and drought tolerant planting	**Required**	1		0			1	1		0	1		0			1		Other	0
1	LM5.1	Yes	**Heat Island Reduction -** Non roof surface reflectivity and shading	**Priority 1**			1			1	1		0	1		0			1		A	CN
1	LM5.2	Yes	**Heat Island Reduction -** Reflective roof materials	**Priority 2**			1			1	1		0	1		0			1		A	CN
1	LM6.1		**Stormwater Design -** Post development discharge rate and volume not to exceed Pre-development rate	**Priority 1**			1			1	0		1	0		1			1		CE	JJ
2	LM6.2	No	Stormwater Design - Reduce discharge rate and volume 25% on previously developed sites.	Priority 2			2			2	0		2	0		2			2		CE	JJ
1	LM6.3		**Stormwater Design -** Design to remove 80% Total Suspended solids from the average annual rainfall event. Verify local requirements.	**Priority 1**			1			1	0		1	0		1			1		CE	JJ
1	LM6.4	Yes	**Stormwater Design -** Design per TDEC BMP References	**Required**	1		0			1	1		0	1		0			1		CE	JJ
1	LM7.1	Yes	**Exterior Site Lighting** - Design exterior lighting power to be 10% less than is allowed by ASHRAE 90.1-2010, Section 9.4.3	**Priority 2**	1		0			1	1		0	1		0			1		EE	DC
1	LM7.2	Yes	**Exterior Site Lighting -** Locate fixtures to minimize illuminance above the horizontal plane	**Priority 1**	1		0			1			1			1			1		EE	DC
1	LM7.3	Yes	**Exterior Site Lighting -** Locate exterior fixtures to minimize light trespass at property lines. Document foot-candle levels at site boundary	**Priority 1**	1		0			1			1			1			1		EE	DC
6 Points			Water Effciency	WE Total:	3	1	2	0	0	6	2	1	3	3	0	3	0	0	6		Primary Credit Responsibility
Possible Points	Credit ID	Applicable to Building/Site Scope?	Description	Level:	Yes	Maybe	No	Yes	Maybe	No	Yes	Maybe	No	Yes	Maybe	No	Yes	Maybe	No	Comment: Describe implementation approach for each pursued credit. If credits are not pursued, provide justification.	Role	Initials
1	WE1.1	Yes	**Water Efficient Landscaping**, Utilize efficient irrigation technologies and planting measures	**Required**	1		0			1	1		0	1		0			1		A	CN
1	WE.1.2		**Water Efficient Landscaping**, Non potable sources or no irrigation	**Priority 1**		1	0			1	0		1	0		1			1		A	CN
1	WE2.1	No	Wastewater Treatment & Conveyance: On site treatment	Priority 2	0		1			1	0		1	0		1			1		ME	TM
1	WE2.2	No	Wastewater Treatment & Conveyance: Utilize non potable water	Priority 2	0		1			1	0		1	0		1			1		ME	TM
1	WE3.1	Yes	**Water Use Reduction -** Fixture flow and flush rates	**Required**	1		0			1	1		0	1		0			1		ME	TM
1	WE3.2	Yes	**Water Use Reduction -** Utilize auto-flow / auto-flush valves	**Priority 2**	1		0			1		1	0	1		0			1		ME	TM

High Performance Building Requirements v1.01
CHECKLIST / TRACKING FORM

Phase	Targeted Points
Applicable	54
Minimum	27
Not Applicable	42
Programming	36
SD	0
DD	44
CD	38
Closeout	0

SBC Number:	166/000-04-2013Y3
Project Name:	TCAT Memphis - New Building & Renovations
Date:	07.22.20
Project Type:	New_Construction
Project Phase:	Construction Documentation
Category from Applicability Tree:	Category A

Helpful Hints:

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		Project Team Representatives	Initials
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C	-	Contractor	
ME	-	Mechanical Engineer	TM
EE	-	Electrical Engineer	DC
CE	-	Civil Engineer	JJ
A	-	Architect	CN
Other	-	Other	

					Programming			SD			DD			CD			Closeout				
				Checklist Total	36	14	54	0	0	104	44	3	57	38	6	60	0	0	104		
37 Points			Energy Efficiency	EE Total:	7	3	27	0	0	37	8	1	28	5	4	28	0	0	37		Primary Credit Responsibility	
Possible Points	Credit ID	Applicable to Building/Site Scope?	Description	Level:	Yes	Maybe	No	Yes	Maybe	No	Yes	Maybe	No	Yes	Maybe	No	Yes	Maybe	No	Comment: Describe implementation approach for each pursued credit. If credits are not pursued, provide justification.	Role	Initials
1	EE1.1	Yes	**Commissioning -** Basic commissioning process	Not Required			1			1	0		1	0		1			1		O	RB
3	EE1.2	No	Commissioning - Advanced commissioning process	Required	0		3			3	0		3	0		3			3			
1	EE2.1	Yes	**Energy Efficient Purchasing Policy -** Energy Star qualified appliances & equipment	Required	1		0			1	1		0	1		0			1		O	RB
1	EE3.1	Yes	**Energy Efficiency -** Schematic Design energy modeling	Required	1		0			1	1		0	1		0			1		Other	0
1	EE3.2	Yes	**Energy Efficiency -** Life Cycle Cost Analysis	Priority 1	1		0			1	1		0		1	0			1			
1	EE3.3	Yes	**Minimum Energy Performance -** all projects to demonstrate compliance with ASHRAE 90.1-2010, according to project scope	Required	1		0			1			1	1		0			1		Other	0
8	EE3.4	No	Improved Energy Performance - energy model is used during design, and final design demonstrates energy cost savings that exceed those required by the Minimum Energy Performance credit (EE3.3)	Priority 1			8			8	0		8	0		8			8		Other	0
5	EE4.1	No	Energy Efficiency in Existing Buildings - Lighting Power Reduction	Priority 1			5			5	0		5	0		5			5		EE	DC
2	EE4.2	No	Energy Efficiency in Existing Buildings - Daylight Harvesting Controls	Priority 1			2			2	0		2	0		2			2		EE	DC
2	EE4.3	No	Energy Efficiency in Existing Buildings - Vacancy sensor-controlled lighting	Priority 1			2			2	0		2	0		2			2		EE	DC
2	EE4.4	No	Energy Efficiency in Existing Buildings - High efficiency HVAC Equipment	Priority 1	0		2			2	0		2	0		2			2		ME	TM
1	EE5.1	Yes	**Energy Metering, Monitoring and Reporting:** Building-Level Metering	Required	1		0			1	1		0	1		0			1		Other	0
3	EE5.2	Yes	**Energy Metering, Monitoring and Reporting:** System level energy metering with measurement and verification - New Construction	Priority 1		3	0			3	3		0		3	0			3		Other	0
3	EE5.3	No	Energy Metering, Monitoring and Reporting: System level energy metering with measurement and verification - Existing Buildings	Priority 1			3			3	0		3	0		3			3		Other	0
1	EE6.1	Yes	**Long-Term Energy Reporting -** Maintain energy and water consumption data in Energy Star Portfolio Manager	Required	1		0			1	1		0	1		0			1		O	RB
1	EE7.1	Yes	**Renewable Energy -** Investigate life-cycle cost effectiveness of on-site renewable energy	Required	1		0			1		1	0			1			1		Other	0
1	EE7.2	No	Renewable Energy - Provide Renewable Energy Credits (RECs) equal to 10% of annual site electricity through TVA or RECs equal to 35% from another source	Priority 2			1			1			1			1			1		O	RB
15 Points			Materials and Resources	MR Total:	4	5	6	0	0	15	9	1	5	7	1	7	0	0	15		Primary Credit Responsibility	
Possible Points	Credit ID	Applicable to Building/Site Scope?	Description	Level:	Yes	Maybe	No	Yes	Maybe	No	Yes	Maybe	No	Yes	Maybe	No	Yes	Maybe	No	Comment: Describe implementation approach for each pursued credit. If credits are not pursued, provide justification.	Role	Initials
1	MR1.1	Yes	**Recycling Collection and Storage**	Required	1		0			1	1		0	1		0			1		O	RB
3	MR2.1	Yes	**Construction Waste Management** (50%, 75%, 95%)	Priority 1		1	2			3	2		1	1	1	1			3		C	0
1	MR3.1	Yes	**Sustainable Materials:** Recycled content 10%	Required	1		0			1	1		0	1		0			1		A	CN
1	MR3.2	Yes	**Sustainable Materials:** Recycled content 20%	Priority 2	1		0			1	1		0			1			1		A	CN
3	MR3.3	Yes	**Sustainable Materials:** Tennessee Produced Materials (non-wood) - Harvested AND manufactured in state - 10% of total cost. Harvested OR manufactured in TN, 50% of product cost contributes to credit.	Priority 2		3	0			3	3		0	3		0			3		A	CN
3	MR3.4	No	Sustainable Materials: Tennessee Produced Wood Products -Wood materials harvested AND manufactured in state - 50% of wood products. When harvested OR manufactured in state, 50% of material cost contributes to credit.	Priority 2			3			3	0		3	0		3			3		A	CN
1	MR3.5	Yes	**Sustainable Materials:** Regional materials - 20%	Priority 2	1		0			1	1		0	1		0			1		A	CN
1	MR3.6	No	Sustainable Materials: Material reuse	Priority 2			1			1	0		1	0		1			1		A	CN
1	MR3.7	Yes	**Sustainable Materials:** Rapidly renewables	Priority 2		1	0			1		1	0			1			1		A	CN

High Performance Building Requirements v1.01
CHECKLIST / TRACKING FORM

Phase	Targeted Points
Applicable	54
Minimum	27
Not Applicable	42
Programming	36
SD	0
DD	44
CD	38
Closeout	0

SBC Number:	166/000-04-2013Y3
Project Name:	TCAT Memphis - New Building & Renovations
Date:	07.22.20
Project Type:	New_Construction
Project Phase:	Construction Documentation
Category from Applicability Tree:	Category A

Helpful Hints:

1) Refrain from copying and pasting data in Column C, "Applicable to Building/Site Scope?" as this can cause errors in some rows.
2) If any cell highlights red below, then you have a point allocated to a credit that is "not applicable." This is an error. Simply delete the contents of the cell to reset.
3) In column C, if you have copied or pasted in this column and a cell highlights all red, delete the contents of that cell to correct the error.
4) If no points are available in the dropdown, this means you have listed that credit as "not applicable" and points cannot be attempted.

		Project Team Representatives	Initials
O	-	Owner	RB
C	-	Contractor	
ME	-	Mechanical Engineer	TM
EE	-	Electrical Engineer	DC
CE	-	Civil Engineer	JJ
A	-	Architect	CN
Other	-	Other	

					Programming			SD			DD			CD			Closeout				
				Checklist Total	36	14	54	0	0	104	44	3	57	38	6	60	0	0	104		
19 Points			Indoor Environmental Quality	EQ Total:	15	4	0	0	0	19	18	0	1	16	0	3	0	0	19		Primary Credit Responsibility
Possible Points	Credit ID	Applicable to Building/Site Scope?	Description	Level:	Yes	Maybe	No	Yes	Maybe	No	Yes	Maybe	No	Yes	Maybe	No	Yes	Maybe	No	Comment: Describe implementation approach for each pursued credit. If credits are not pursued, provide justification.	Role	Initials
1	EQ1.1	Yes	**Tobacco Smoke Control**	Required	1		0			1	1		0	1		0			1		O	RB
1	EQ2.1	Yes	**Minimum Ventilation:** Design to meet ASHRAE 62.1-2007 or 2012 IMC	Required	1		0			1	1		0	1		0			1		ME	TM
1	EQ3.1	Yes	**Outdoor Air Delivery Monitoring:** Provide a direct outdoor airflow measurement device	Priority 2	1		0			1	1		0			1			1		ME	TM
1	EQ4.1	Yes	**CO2 Monitoring:** Provide CO2 monitors in all high occupancy areas	Priority 2	1		0			1	1		0	1		0			1		ME	TM
1	EQ5.1	Yes	**Air Quality Management:** During construction	Priority 1		1	0			1	1		0	1		0			1		C	0
1	EQ5.2	Yes	**Air Quality Management:** Before occupancy	Priority 2		1	0			1	1		0	1		0			1		C	0
1	EQ6.1	Yes	**Material VOC Limits:** Adhesives and sealants	Required	1		0			1	1		0	1		0			1		A	CN
1	EQ6.2	Yes	**Material VOC Limits:** Paints	Required	1		0			1	1		0	1		0			1		A	CN
1	EQ6.3	Yes	**Material VOC Limits:** Coatings and anti-corrosive paints	Required	1		0			1	1		0	1		0			1		A	CN
1	EQ6.4	Yes	**Material VOC Limits:** Flooring systems	Required	1		0			1	1		0	1		0			1		A	CN
1	EQ6.5	Yes	**Material VOC Limits:** Composite wood and agrifiber	Required	1		0			1	1		0	1		0			1		A	CN
1	EQ7.1	Yes	**Pollutant Control:** Entryway systems	Priority 1	1		0			1	1		0	1		0			1		A	CN
1	EQ7.2	Yes	**Pollutant Control:** Hazardous material storage	Required	1		0			1			1	1		0			1		A	CN
1	EQ7.3	Yes	**Pollutant Control:** Filtration media	Priority 1	1		0			1	1		0	1		0			1		ME	TM
1	EQ8.1	Yes	**Thermal Comfort:** Design to meet ASHRAE Standard 55-2004	Required	1		0			1	1		0	1		0			1		ME	TM
1	EQ9.1	Yes	**Individual Occupant System Controls:** Lighting controls	Priority 1		1	0			1	1		0	1		0			1		EE	DC
1	EQ9.2	Yes	**Individual Occupant System Controls:** Thermal comfort	Priority 2		1	0			1	1		0	1		0			1		ME	TM
1	EQ10.1	Yes	**Daylight to Occupied spaces**	Priority 1	1		0			1	1		0			1			1		A	CN
1	EQ11.1	Yes	**Views from Occupied spaces**	Priority 1	1		0			1	1		0			1			1		A	CN
5 Points			Innovation in Design and Construction	ID Total:	1	0	4	0	0	5	1	0	4	1	0	4	0	0	5		Primary Credit Responsibility
Possible Points	Credit ID	Applicable to Building/Site Scope?	Description	Level:	Yes	Maybe	No	Yes	Maybe	No	Yes	Maybe	No	Yes	Maybe	No	Yes	Maybe	No	Comment: Describe implementation approach for each pursued credit. If credits are not pursued, provide justification.	Role	Initials
1	ID1.1		**Innovation in Design:** Provide Specific Title	Priority 1			1			1			1			1			1		Other	0
1	ID1.2		**Innovation in Design:** Provide Specific Title	Priority 2			1			1			1			1			1		Other	0
1	ID1.3		**Innovation in Design:** Provide Specific Title	Priority 2			1			1			1			1			1		Other	0
1	ID1.4		**Innovation in Design:** Provide Specific Title	Priority 2			1			1			1			1			1		Other	0
1	ID2.1	Yes	**Environmentally Accredited Design Team**	Priority 1	1		0			1	1		0	1		0			1		Other	0
				Checklist Total:	36	14	54	0	0	104	44	3	57	38	6	60	0	0	104		

Credit Verification Form

Phase: Construction Documentation

HPBr Points Required

27

TN High Performance Building Requirements

In accordance with the State Architect's office, a copy of this form must be submitted at the end of each project phase and accompany required Project Closeout documents. Acceptance by the State Project Manager is required upon review of completed Credit Verification Form.

HPBr Points Achieved

38

Designated Project Team Member	Initials	Team Member Name	Date
Owner:	RB		
Contractor:	0		
Mech. Eng.:	TM		
Elec. Eng.:	DC		
Civil Eng.:	JJ		
Architect:	CN		
Other:	0		

6		Land Management		
# Points	**Credit ID**	**Description**	**Credit Level:**	**Sign-Off** (linked from HPBr Checklist)
0	LM1.1	Site Selection - Reuse Existing Buildings	N/A	N/A
0	LM1.2	Site Selection - Show preference for building on developed sites: Preserve farmland/habitat, wetlands, floodplains, public parkland	N/A	N/A
0	LM1.3	Site Selection - Brownfield Redevelopment - Remediate and Restore contaminated sites when possible	N/A	N/A
0	LM1.4	Site Selection - Urban Development - Locate building within existing infrastructure	N/A	N/A
1	LM2.1	**Site Disturbance - Sediment and Erosion control during construction**	Required	**0**
0	LM2.2	Site Disturbance - Limit site disturbance during construction to minimum development footprint	N/A	N/A
0	LM3.1	Transportation - Plan for access to public transportation	N/A	N/A
0	LM3.2	**Transportation - Provide bicycle storage for 5% of building occupants and shower/changing facilities for 0.5% of FTE occupants**	Priority 2	**N/A**
0	LM3.3	Transportation - Plan site to include preferred parking for carpooling for 5% of all spaces provided	N/A	N/A
0	LM3.4	Transportation - Plan site to include preferred parking for low-emitting/fuel efficient vehicles for 5% of all spaces provided	N/A	N/A
0	LM4.1	**Landscape Design - Maximize vegetated open space**	Priority 2	**N/A**
1	LM4.2	**Landscape Design - Native and drought tolerant planting**	Required	**0**
1	LM5.1	**Heat Island Reduction - Non roof surface reflectivity and shading**	Priority 1	**CN**
1	LM5.2	**Heat Island Reduction - Reflective roof materials**	Priority 2	**CN**
0	LM6.1	**Stormwater Design - Post development discharge rate and volume not to exceed Pre-development rate**	Priority 1	**N/A**
0	LM6.2	Stormwater Design - Reduce discharge rate and volume 25% on previously developed sites.	N/A	N/A
0	LM6.3	**Stormwater Design - Design to remove 80% Total Suspended solids from the average annual rainfall event. Verify local requirements.**	Priority 1	**N/A**
1	LM6.4	**Stormwater Design - Design per TDEC BMP References**	Required	**JJ**
1	LM7.1	**Exterior Site Lighting - Design exterior lighting power to be 10% less than is allowed by ASHRAE 90.1-2010, Section 9.4.3**	Priority 2	**DC**
0	LM7.2	**Exterior Site Lighting - Locate fixtures to minimize illuminance above the horizontal plane**	Priority 1	**N/A**
0	LM7.3	**Exterior Site Lighting - Locate exterior fixtures to minimize light trespass at property lines. Document foot-candle levels at site boundary**	Priority 1	**N/A**

Credit Verification Form

Phase: Construction Documentation

HPBr Points Required	HPBr Points Achieved
27	38

TN High Performance Building Requirements

In accordance with the State Architect's office, a copy of this form must be submitted at the end of each project phase and accompany required Project Closeout documents. Acceptance by the State Project Manager is required upon review of completed Credit Verification Form.

3		Water Efficiency		
# Points	**Credit ID**	**Description**	**Credit Level**	**Sign-Off** (from HPBr Checklist)
1	WE1.1	**Water Efficient Landscaping, Utilize efficient irrigation technologies and planting measures**	Required	**CN**
0	WE1.2	**Water Efficient Landscaping, Non potable sources or no irrigation**	Priority 1	**N/A**
0	WE2.1	Wastewater Treatment & Conveyance: On site treatment	N/A	N/A
0	WE2.2	Wastewater Treatment & Conveyance: Utilize non potable water	N/A	N/A
1	WE3.1	**Water Use Reduction - Fixture flow and flush rates**	Required	**TM**
1	WE3.2	**Water Use Reduction - Utilize auto-flow / auto-flush valves**	Priority 2	**TM**

5		Energy Efficiency		
# Points	**Credit ID**	**Description**	**Credit Level**	**Sign-Off** (from HPBr Checklist)
0	EE1.1	**Commissioning - Basic commissioning process**	Not Required	**N/A**
0	EE1.2	Commissioning - Advanced commissioning process	N/A	N/A
1	EE2.1	**Energy Efficient Purchasing Policy - Energy Star qualified appliances & equipment**	Required	**RB**
1	EE3.1	**Energy Efficiency - Schematic Design energy modeling**	Required	**0**
0	EE3.2	**Energy Efficiency - Life Cycle Cost Analysis**	Priority 1	**N/A**
1	EE3.3	**Minimum Energy Performance - all projects to demonstrate compliance with ASHRAE 90.1-2010, according to project scope**	Required	**0**
0	EE3.4	Improved Energy Performance - energy model is used during design, and final design demonstrates energy cost savings that exceed those required by the Minimum Energy	N/A	N/A
0	EE4.1	Energy Efficiency in Existing Buildings - Lighting Power Reduction	N/A	N/A
0	EE4.2	Energy Efficiency in Existing Buildings - Daylight Harvesting Controls	N/A	N/A
0	EE4.3	Energy Efficiency in Existing Buildings - Vacancy sensor-controlled lighting	N/A	N/A
0	EE4.4	Energy Efficiency in Existing Buildings - High efficiency HVAC Equipment	N/A	N/A
1	EE5.1	**Energy Metering, Monitoring and Reporting: Building-Level Metering**	Required	**0**
0	EE5.2	**Energy Metering, Monitoring and Reporting: System level energy metering with measurement and verification - New Construction**	Priority 1	**N/A**
0	EE5.3	Energy Metering, Monitoring and Reporting: System level energy metering with measurement and verification - Existing Buildings	N/A	N/A
1	EE6.1	**Long-Term Energy Reporting - Maintain energy and water consumption data in Energy Star Portfolio Manager**	Required	**RB**
0	EE7.1	**Renewable Energy - Investigate life-cycle cost effectiveness of on-site renewable energy**	Required	**N/A**
0	EE7.2	Renewable Energy - Provide Renewable Energy Credits (RECs) equal to 10% of annual site electricity through TVA or RECs equal to 35% from another source	N/A	N/A

Credit Verification Form

Phase: Construction Documentation

HPBr Points Required: 27

TN High Performance Building Requirements

In accordance with the State Architect's office, a copy of this form must be submitted at the end of each project phase and accompany required Project Closeout documents. Acceptance by the State Project Manager is required upon review of completed Credit Verification Form.

HPBr Points Achieved: 38

7		Materials and Resources		
# Points	**Credit ID**	**Description**	**Credit Level**	**Sign-Off** (from HPBr Checklist)
1	MR1.1	**Recycling Collection and Storage**	Required	**RB**
1	MR2.1	**Construction Waste Management (50%, 75%, 95%)**	Priority 1	**0**
1	MR3.1	**Sustainable Materials: Recycled content 10%**	Required	**N/A**
0	MR3.2	**Sustainable Materials: Recycled content 20%**	Priority 2	**CN**
3	MR3.3	**Sustainable Materials: Tennessee Produced Materials (non-wood) - Harvested AND manufactured in state - 10% of total cost. Harvested OR manufactured in TN, 50% of**	Priority 2	**N/A**
0	MR3.4	**Sustainable Materials: Tennessee Produced Wood Products -Wood materiasl harvested AND manufactured in state - 50% of wood products. When harvested OR manufactred**	N/A	**N/A**
1	MR3.5	**Sustainable Materials: Regional materials - 20%**	Priority 2	**N/A**
0	MR3.6	**Sustainable Materials: Material reuse**	N/A	**N/A**
0	MR3.7	**Sustainable Materials: Rapidly renewables**	Priority 2	**N/A**

16		Indoor Environmental Quality		
# Points	**Credit ID**	**Description**	**Credit Level**	**Sign-Off** (from HPBr Checklist)
1	EQ1.1	**Tobacco Smoke Control**	Required	**RB**
1	EQ2.1	**Minimum Ventilation: Design to meet ASHRAE 62.1-2007 or 2012 IMC**	Required	**TM**
0	EQ3.1	**Outdoor Air Delivery Monitoring: Provide a direct outdoor airflow measurement device**	Priority 2	**N/A**
1	EQ4.1	**CO2 Monitoring: Provide CO2 monitors in all high occupancy areas**	Priority 2	**TM**
1	EQ5.1	**Air Quality Management: During construction**	Priority 1	**0**
1	EQ5.2	**Air Quality Management: Before occupancy**	Priority 2	**0**
1	EQ6.1	**Material VOC Limits: Adhesives and sealants**	Required	**CN**
1	EQ6.2	**Material VOC Limits: Paints**	Required	**CN**
1	EQ6.3	**Material VOC Limits: Coatings and anti-corrosive paints**	Required	**CN**
1	EQ6.4	**Material VOC Limits: Flooring systems**	Required	**CN**
1	EQ6.5	**Material VOC Limits: Composite wood and agrifiber**	Required	**CN**
1	EQ7.1	**Pollutant Control: Entryway systems**	Priority 1	**CN**
1	EQ7.2	**Pollutant Control: Hazardous material storage**	Required	**CN**
1	EQ7.3	**Pollutant Control: Filtration media**	Priority 1	**TM**
1	EQ8.1	**Thermal Comfort: Design to meet ASHRAE Standard 55-2004**	Required	**TM**
1	EQ9.1	**Individual Occupant System Controls: Lighting controls**	Priority 1	**DC**
1	EQ9.2	**Individual Occupant System Controls: Thermal comfort**	Priority 2	**TM**
0	EQ10.1	**Daylight to Occupied spaces**	Priority 1	**N/A**
0	EQ11.1	**Views from Occupied spaces**	Priority 1	**N/A**

Credit Verification Form

Phase: Construction Documentation

HPBr Points Required

27

TN High Performance Building Requirements

In accordance with the State Architect's office, a copy of this form must be submitted at the end of each project phase and accompany required Project Closeout documents. Acceptance by the State Project Manager is required upon review of completed Credit Verification Form.

HPBr Points Achieved

38

1		Innovation in Design and Construction		
# Points	**Credit ID**	**Description**	**Credit Level**	**Sign-Off** (from HPBr Checklist)
0	ID1.1	**Innovation in Design: Provide Specific Title**	Priority 1	**N/A**
0	ID1.2	**Innovation in Design: Provide Specific Title**	Priority 2	**N/A**
0	ID1.3	**Innovation in Design: Provide Specific Title**	Priority 2	**N/A**
0	ID1.4	**Innovation in Design: Provide Specific Title**	Priority 2	**N/A**
1	ID2.1	**Environmentally Accredited Design Team**	Priority 1	**0**
38	**Total HPBr Points Achieved by Project**			

01 91 13 – COMMISSIONING

PART 1 - GENERAL

1.01 REQUIREMENTS

Complete the processes of commissioning selected equipment and systems as specified. These should be listed in a companion section following this section. The absence of such a section does not negate the commissioning responsibilities. In the absence of such a section, review the specifications for commissioning requirements and provide a summary list as a submittal to the Designer for approval prior to performing the required commissioning.

1.02 SUBMITTALS

A. Functional Performance Testing: Prepare and submit to the Designer Functional Performance Testing Procedures for approval of equipment and systems. Contractor will use forms provided in this section of the specifications. Testing procedures will be detailed step-by-step and specific to each system. The approved procedures will be used to conduct the Functional Performance Testing. Functional Performance Testing will be completed prior to Substantial Completion.

B. Commissioning Data: Upon completion of the Functional Performance Testing, the Contractor will submit to the Designer the commissioning section of the Operation and Maintenance Binder. The binder will be divided into sections. The binder will contain copies of the manufacturer's installation and start-up procedures utilized by the installer and/or contractor, completed Functional Performance Testing Procedures and associated forms from Sections 23 08 xx and 26 08 xx, signed Functional Performance Test Certificates, and equipment and maintenance records for equipment and systems operated prior to Owner acceptance.

1.03 ROLES:

A. Designer, using its Consultants will:

1. Review and approve the contractors Functional Performance Testing Procedures.
2. Report on field observations and report deficiencies to the contractor.
3. Observe the Contractor's Functional Performance Testing.
4. Report on Functional Performance Testing deficiencies, ensure sign off on completion of testing, and perform recheck of deficiencies.
5. Review final Commissioning Data.

B. Contractor:

1. Prepare and provide Functional Performance Testing Procedures for Designer approval.
2. Provide installation and start-up of all equipment and systems as prescribed by the manufacturer's procedures.
3. Perform and maintain a maintenance and service log for equipment and systems that are being operated prior to Owner acceptance.
4. Provide manpower, supplies, testing instruments, etc. required to perform Functional Performance Testing.

5. Perform, in the presence of the Designer/Consultants and Owner, Functional Performance Testing.
6. Prepare three sets of Commissioning Data for Designer review and approval.

1.04 SYSTEMS TO BE COMMISSIONED:

A. The following mechanical systems and associated equipment are to be commissioned as specified. These include but are not limited to:
   1. Mechanical (HVAC) air and water
   2. Associated controls and building automation
   3. Domestic hot water

B. The following Electrical systems and associated equipment are to be commissioned as specified. These include but are not limited to:
   1. Electrical panel boards.
   2. Power circuits.
   3. Lighting levels.
   4. Generator and/or back-up power sources.

PART 2 – PRODUCTS (Not used)

PART 3 – EXECUTION

3.01 COMMISSIONING CONSTRUCTION PHASE:

Complete the following commissioning activities during the construction phase of the project. Submit for review and provide notification of activities.

A. Manufacturer's system/equipment start-up procedures.

B. Specified manufacturer's and/or independent testing agency reports.

C. Project schedule that included dates for start-up of equipment and systems, and Functional Performance Testing.

D. Minimum seven day notification of code required testing and specified cleaning of systems.

E. Minimum seven day notification of system and equipment start-up.

F. Control submittal on systems and equipment including drawings, sequences and programming.

G. Prepare detailed Functional Performance Testing Procedures for systems and equipment. Utilize the forms provided in this section of the specifications. Procedures will be detailed, step-by-step, and include description of expected results for verification. Modify test procedures as required by the Designers' comments. Coordinate and schedule tests so that all parties involved will be present for final testing and acceptance.

H. Correct all deficiencies prior to final acceptance.

I. Prepare a list of all system and equipment warranties specified in the contract documents. Provide the warranty item and the contract document section number. Provide the Designer with an update list throughout the project.

J. Prepare a list of all deliverables specified in the contract documents. Provide the deliverable item and the contract document section number. Provide the Designer with an updated list throughout the project.

K. Prepare a list of all Training and Demonstrations specified in the contract documents. Provide the type of Training and/or Demonstration and the contract document section number. Provide the Designer with an updated list throughout the project.

L. Prepare a list of all tests, reports, services, etc. whether required by codes, independent authorities, or manufacturers as specified in the contract documents. Provide the type of test, report, services, etc. and the contract document section number. In the case that the test is required by state or local codes, update the list as soon as the information is available. Provide the Designer with an updated list throughout the project.

M. Systems and/or equipment will not be used for temporary purposes of any kind until authorized by the Designer in writing to ensure that required maintenance and warranties remain in force. The Contractor will be responsible for maintenance of all systems and equipment until final acceptance and will maintain on site a binder containing schedules of maintenance activities, items checked, repairs or replacements made and documents to verify that the work was performed. The documentation contained in this binder will become part of the commissioning binder.

3.02 COMMISSIONING ACCEPTANCE PHASE:

Complete the following commissioning activities during the acceptance phase of the project. The activities described in this section must be completed prior to Substantial Completion.

A. Perform Functional Performance Tests of mechanical and electrical systems and equipment as specified utilizing the testing procedure prepared by the Contractor and approved by the Designer to verify proper calibration, operation and performance. The Contractor is responsible for providing all manpower, equipment and/or testing instruments required to perform tests. Functional Performance Testing will be performed in the presence of the Designer/Consultant and the Owner. Tests that fail to perform as required will be retested upon correction. If retesting has to be rescheduled, the Contractor will be responsible for any additional charges.

B. All deliverables prescribed in the contract documents will be delivered to the Owner at the location designated by the Owner.

C. Perform all training and demonstrations prescribed in the contract documents.

D. Provide three final commissioning binders to the Designer for review and approval. Ensure that all forms are completely filled out and all testing results documented. If missing or incomplete information and/or data is identified by the Designer, reassemble replacement manuals with complete information prior to project final payment.

END OF SECTION

01 91 23 - PERFORMANCE TESTING IDENTIFICATION FORM

Project:	TCAT Memphis Phase II Renovations	Page		of
SBC Number:	166/000-04-2013Y3	Date:		
Campus/Institution	Tennessee College of Applied Technology	Tests Run By:		
Installer:				
System/Unit Identifier:				
Location				

	List Each Piece of Equipment Associated with This System and/or Unit by Tag Number	
	Piece of Equipment	Tag Number
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		

01 91 26 - PERFORMANCE TESTING PROCEDURES FORM

Project:	TCAT Memphis Phase II Renovations	Page		of
SBC Number:	166/000-04-2013Y3	Date:		
Campus/Institution	Tennessee College of Applied Technology - Memphis	Tests Run By:		
Installer:				
System/Unit Identifier:				
Location				

Step by Step Detailed Procedure	Expected Result	Observations

01 91 29 – FUNCTIONAL PERFORMANCE TEST CERTIFICATION

Project Name: TCAT Memphis Phase II Renovations

SBC Number: 166/000-04-2013Y3

Identification of Equipment or System:

Location of Equipment or System:

Manufacturer /Supplier:

This Date:

Functional Performance Test Procedure Number:

Components Included:

The above systems and components integral to this equipment are complete and have undergone functional performance tests. All functional performance test procedures are complete and have been checked off only by parties having direct knowledge of the event, as indicted below, respective to each responsible contractor. This functional performance test is submitted for approval and is subject to the attached list of outstanding items not completed successfully. Contractor shall submit a deficiency form upon completion of any outstanding or deficient items. None of the outstanding items preclude safe and reliable functional tests being performed.

Check One: ☐ Deficiency listing attached; or, ☐ No deficiencies found.

All Designer and Contractor punch list items for this system and related equipment have been addressed and corrected prior to functional performance testing.

The functional performance test procedures were reviewed and approved by the installer and applicable subcontractors prior to testing.

CONTRACTOR'S CERTIFICATION OF PERFORMANCE:

I hereby certify that the above described equipment or system, has been energized, operated, adjusted, and balanced in accordance with requirements of the Contract Documents and the manufacturer's recommendations for a sufficient period to confirm that operation complies in all respects with the contract requirements.

	Signature	Printed Name	Date
Installer:	_____	_____	_____
General Contractor:	_____	_____	_____
Designer / Consultant:	_____	_____	_____

END OF SECTION

SECTION 02 40 00
EXISTING CONDITIONS & DEMOLITION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Includes materials and procedures needed during demolition of non-asbestos containing materials and parts of existing buildings and site conditions.

1.02 QUALITY ASSURANCE

A. Coordinate demolition and cutting times to cause minimum disruption to Owners continuing operations within the building. Schedule any Mechanical and Electrical shut down at least 7 days in advance. Notify Owner at least 24 hours in advance of the start of any work which will produce excessive noise, vibration, dust, power outage, HVAC shutdown, plumbing shutdown, etc.

B. Conform to all local, state and national codes and ordinances including OSHA and EPA. Secure necessary permits and approvals. Post signs and erect barricades to fully protect all persons on and around the project. Where hazardous substances are encountered or suspected, refer to OSHA and EPA regulations for proper procedures.

C. Maintain all active mechanical, communication and electrical services which pass through or across project area. Restore all services which are cut off by demolition. Should a question exist regarding the function of any lines, request direction prior to demolition. Upon completion of project all services throughout the building to be operational.

D. Remove trash from building by way of a temporary chute to control dust and blowing trash. Dump trash directly into truck bed or commercial type waste removal container. Provide cover over truck bed or around waste container opening to control dust. Dispose of trash in accordance with local ordinances. Do not allow excessive trash to accumulate on the building and site or in such a way as to overload the structural system.

E. Erect temporary canopies and covers over unfinished work areas to prevent rain/ wind/ weather damage to building interiors or uncompleted site work. Contractor is to repair all damage to building or site which may result from the areas not being properly covered or protected. Contractor shall be mindful that the cover may need to stay in place for several days.

F. At completion of project repair all damage to site and site improvements. Repair damage to curbs, walks, asphalt and concrete parking/ drives, landscaping, irrigation lines, sprinkler heads, existing structures, outdoor furniture, and vehicles. Sod all bare earth.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Provide Barricades and Signage in accordance with Temporary Construction Facilities Section 01 50 00.

B. Provide construction chutes, as needed, from sturdy materials. They should be properly braced and extend from the dumping point to slightly above truck or container rail, to control dust and trash during removal from the site.

C. Provide adequate dust screens to protect existing spaces utilizing heavy plastic sheeting and wood framing. Tape joints and edges to make dust tight.

D. Where existing materials to remain are damaged during demolition, repair damage utilizing materials equal to original material in new condition.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Demolish and dispose of all materials and equipment as indicated on the drawings.

B. Use proper trades for decommissioning existing services. Do not remove active services which pass through or over the project area. Reroute these services where necessary, utilizing appropriate materials.

C. Patch around openings to match existing. Where demolition exposes holes in walls, floors, ceilings, roofs, etc., that are to remain, close opening with material to match existing. Provide structural members, reinforcing, etc. necessary to close the opening and maintain structural integrity as approved by the Architect or Engineer.

D. Where services and equipment must pass through roofs, walls or other floors, do minimum demolition. When cutting structural slabs, make holes minimum in size. Take extreme care to avoid fires when utilizing cutting torches. Re-grout and seal all holes after services and equipment are installed.

E. All salvageable materials become the property of the Contractor, unless otherwise indicated. Where existing materials are indicated to be salvaged for reuse, use extreme care in their removal and storage. Carefully cull and clean materials prior to reuse.

3.02 CLEANUP

A. Upon completion of the demolition work, all removed materials shall be either relocated to their proper storage facility, sent to proper salvage yards, or placed in proper trash containers, leaving the project area neat, clean, straight and ready for the install of new construction.

END OF SECTION

SECTION 03 30 00
CAST IN PLACE CONCRETE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:

1. Foundations.
2. Foundation walls.
3. Slabs-on-grade.
4. Tie beams and grade beams.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Mix Designs: For each concrete mix.

C. Steel Reinforcement Shop Drawings: Placing drawings that include all information necessary for complete fabrication and placement of all reinforcing steel and bar supports. Indicate the number, sizes, lengths, and locations of reinforcing steel including material, grade, bar schedules, bent bar diagrams, bar arrangements, splices, mechanical connections; stirrup, tie, and hoop spacings; rebar supports, and dimensions necessary for proper placement, etc. Prepare placing drawings in accordance with ACI 315 including, but not limited to, the following:

1. Foundation Plans: Indicate footings, grade beams, piers, columns, walls, slabs-on-grade and related reinforced members at scale of 1/8 inch per foot.
2. Elevations: Indicate all reinforced masonry walls, grade beams, and all concrete walls over 2 feet tall at scale of 1/4 inch per foot.
3. Sections and Details: Indicate all pertinent construction features and related reinforcing to scale as large as practicable.
4. Reinforcing Supports and Accessories: Indicate the number, size, type, arrangement and quantities required of bar supports in the areas in which they are used. Where indicated, provide bar supports of the type shown. Provide accessory and bar support placing layouts for typical slab panels, and beams.
5. Miscellaneous Items: Indicate openings, depressions and related reinforcing. Draw other reinforced concrete items at sufficient scale to clearly show reinforcing and location.

D. Reproduction of Contract Documents is not acceptable for use as placing drawings.

E. Construction Joint Layout: Indicate proposed construction joints required to construct the structure. Location of construction joints is subject to approval of the Architect.

1.04 INFORMATIONAL SUBMITTALS

A. Welding Certificates.

B. Material Certificates: For each of the following, signed by manufacturers:

1. Cementitious materials.
2. Admixtures.
3. Form materials and form-release agents.
4. Steel reinforcement and accessories.
5. Fiber reinforcement.
6. Waterstops.
7. Curing compounds.
8. Floor and slab treatments.
9. Bonding agents.
10. Adhesives.
12. Vapor retarders.
13. Semirigid joint filler.
14. Joint-filler strips.
15. Repair materials.

C. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.

D. Minutes of pre-installation conference.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm experienced in manufacturing ready-mix concrete products and that complies with ASTM C 94 requirements for production facilities and equipment.

B. Testing Agency Qualifications: An independent agency, acceptable to Architect/Engineer, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

1. Personnel conduction field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.

C. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.

D. Welding Qualifications: Qualify procedures and personnel according to AWS D 1.4, "Structural Welding Code - Reinforcing Steel."

E. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:

1. ACI 301, "Specifications for Structural Concrete".
2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

F. Maintain temperature of cast-in-place concrete at not less than 50°F nor more than 90°F for time period sufficient to assure proper hydration and curing.

G. Refer to Part 3 for hot and cold-weather concreting requirements.

H. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

I. Pre-installation Conference: Arrange conference at Project site with Special Inspector, Testing and Inspection Agency Inspectors, Architect, Engineer, Contractor, and concrete and rebar Subcontractors a minimum of one week prior to start of concrete construction to review Project conditions and Contract requirements for work.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 - PRODUCTS

2.01 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.

1. Plywood, metal, or other approved panel materials.

B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

C. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch minimum, unless noted otherwise.

D. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.

E. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

F. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

2.02 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615, Grade 60, deformed, except #2 and #3 bars to be Grade 40.

B. Low-Alloy-Steel Reinforcing Bars: ASTM A 706, deformed; required for the following.

1. Bars installed in epoxy adhesive.
2. Welded bars; conform to AWS D 1.4.

2.03 REINFORCEMENT ACCESSORIES

A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.

2.04 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:

1. Portland Cement: ASTM C 150, Type I. Supplement with the following:
   a. Fly Ash: ASTM C 618, Class F or C.

B. Normal Weight Aggregates: ASTM C 33 from a single source.

1. Maximum nominal size of coarse aggregate shall not exceed:
   a. 1/5 the narrowest dimension between sides of forms.
   b. 1/3 the depth of slabs.
   c. 3/4 the minimum clear spacing between individual reinforcing bars or wires, bundles of bars, individual tendons, bundled tendons, or ducts.

C. Lightweight Aggregate: ASTM C 330 from a single source.

D. Water: ASTM C 94 and potable.

2.05 ADMIXTURES

A. Air-Entraining Admixture: ASTM C 260.

B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C 494, Type A.
2. Retarding Admixture: ASTM C 494, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C 494, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494, Type G.
6. Plasticizing and Retarding Admixture: ASTM C 1017, Type II.

2.06 WATERSTOPS

A. Self-Expanding Butyl Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, 3/4 by 1 inch.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Carlisle Coatings & Waterproofing, Inc.; MiraSTOP.
   b. CETCO; Volclay Waterstop-RX.
   c. Concrete Sealants Inc.; Conseal CS-231.
   d. Greenstreak; Swellstop.
   e. Henry Company, Sealants Division; Hydro-Flex.
   f. W.R. Grace & Co.; Adcor ES.

2.07 VAPOR RETARDERS

A. Sheet Vapor Retarder: ASTM E 1745, Class A. Include manufacturer's recommended adhesive or pressure-sensitive tape.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Fortifiber Building Systems Group; Moistop Ultra 15.
   b. Grace Construction Products, W.R. Grace & Co.; Florprufe 120.
   c. Insulation Solutions, Inc.; Viper VaporCheck 16.
   d. Meadows, W.R., Inc.; Perminator 15 mil.
   e. Raven Industries, Inc.; Vapor Block 15.
   f. Reef Industries, Inc.; Griffolyn 15 mil Green.
   g. Stego Industries, LLC; Stego Wrap 15 mil Class A.

2.08 UNDER SLAB GRANULAR MAT

A. Granular Fill: 4" compacted thickness of free draining, clean, coarse, granular fill.

2.09 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

C. Water: Potable.

D. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

E. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

2.10 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.

B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 or aromatic polyurea with a Type A shore durometer hardness range of 90 to 95 per ASTM D 2240.

C. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

D. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:

1. Types I and II, non-load bearing, Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

E. Reglets: Fabricate reglets of not less than 0.022-inch- thick, galvanized-steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.

F. Dovetail Anchor Slots: Hot-dip galvanized-steel sheet, not less than 22 gauge, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

2.11 CONCRETE MIXES, GENERAL

A. Prepare design mixes for each type and strength of concrete, proportioned on the basis of laboratory trial mixes or field test data, or both, according to ACI 301.

1. Use a qualified independent testing agency for preparing and reporting proposed mix designs based on laboratory trial mixes.

B. Limit water-soluble, chloride-ion content in hardened concrete in accordance with ACI 301.

2.12 CONCRETE MIXES & PROPORTIONING

Location	Minimum Compressive Strength at 28 days	Maximum Permissible Water/Cementitious Materials Ratio		Slump Limit
		Non Air-Entrained	Air-Entrained	
Footings, Foundation Walls, and Piers	4,000 psi	0.49	0.44	3" ± 1"
Slabs-on-Grade	4,000 psi	0.49	0.44	3" ± 1"
Exterior Concrete including Walks and Paving	4,000 psi	0.49	0.44	3" ± 1"
All Other Locations	4,000 psi	0.49	0.44	3" ± 1"

A. Admixtures: Use in accordance with manufacturer's written instructions. Use of all admixtures is subject to Architect's prior approval.

1. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
2. Use accelerating admixture in concrete slabs placed at ambient temperatures below 50°F.

B. Required Admixtures:

1. All concrete: Water-reducing, high-range water-reducing or plasticizing admixture.
2. Air-entrained concrete: Air-entraining admixture.
   a. Air Content: 4.5 to 7.0 percent for exterior exposed concrete; 4.5 to 9.0 percent for lightweight concrete. Air content of trowel-finished floors not to exceed 3 percent.
3. Pumped concrete, architectural concrete, fiber-reinforced concrete: High-range water-reducing or plasticizing admixture.

C. Fly Ash may be substituted for up to 20 percent, by weight, of cement content in mixes.

D. Maximum concrete slump using high-range water-reducing or plasticizing admixture may be increased to 9 inches.

E. Lightweight Concrete: Dry Unit Weight not less than 100 lb /cu. ft. or more than 115 lb /cu. ft. as determined by ASTM C 567. Limit shrinkage to 0.03 percent in 28 days.

2.13 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.14 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94, and furnish batch ticket information.

1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.01 FORMWORK

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:

1. Class A, 1/8 inch for smooth-formed finished surfaces.
2. Class C, 1/2 inch for rough-formed finished surfaces.

D. Construct forms tight enough to prevent loss of concrete mortar.

E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.

1. Install keyways, reglets, recesses, and the like, for easy removal.
2. Do not use rust-stained steel form-facing material.

F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

H. Unless otherwise noted, chamfer exterior corners and edges of permanently exposed concrete.

I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.02 EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."
2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
3. In all locations where brick or concrete block adjoins the concrete structure, install dovetail anchor slots in concrete structure.

3.03 REMOVING AND REUSING FORMS

A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations and curing and protection operations need to be maintained.

1. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved its 28-day design compressive strength.
2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.04 SHORES AND RESHORES

A. Comply with ACI 318 and ACI 301 for design, installation, and removal of shoring and reshoring.

B. Plan sequence of removal of shores to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.05 VAPOR RETARDERS

A. Sheet Vapor Retarders: Install under interior slabs on grade. Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.

1. Lap joints 6 inches and seal with manufacturers recommended tape.

3.06 UNDER SLAB GRANULAR MAT

A. Place granular fill under all slabs on grade within building.

B. Place granular fill evenly and uniformly to required grade and compact with mechanical equipment.

3.07 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.

1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.

1. Weld reinforcing bars according to AWS D 1.4, where indicated.

D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction.

3.08 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated.
2. Form keyed joints as indicated. Unless otherwise indicated, embed keys at least 1-1/2 inches into concrete.
3. Locate joints for beams, slabs, joists, and girders in the middle third of spans.
4. Unless otherwise indicated, locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.

C. Control Joints in Slabs-on-Grade: Construct control joints to the depths and spacing indicated.

1. Sawed Joints: Sawcut control joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut joints as soon as the concrete has hardened sufficiently to prevent dislodgment of aggregates. Complete sawing within 12 hours of placement.
2. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.

D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, as indicated.

1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.

3.09 WATERSTOPS

A. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated, according to manufacturer's written instructions, adhesive bonding, mechanically fastening, and firmly pressing into place. Install in longest lengths practicable.

3.10 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Engineer.

C. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

D. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
2. Maintain reinforcement in position on chairs during concrete placement.
3. Screed slab surfaces with a straightedge and strike off to correct elevations.
4. Slope surfaces uniformly to drains where required.
5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

E. Cold-Weather Concreting: Comply with ACI 306.1.

F. Hot-Weather Concreting: Comply with ACI 305.1.

G. Slab Tolerances: Comply with ACI 117.

1. Interior Slabs-on-Grade: Specified overall values of flatness, F(F) 25; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 17; and of levelness, F(L) 15.
2. Unshored Elevated Slabs: Specified overall values of flatness, F(F) 20 minimum.

3.11 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces not exposed to view in the finished structure or concealed by other construction.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces exposed to view, to receive a rubbed finish, or to be covered with a coating or covering material applied directly to concrete.

C. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete:

1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
2. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix one part portland cement to one and one-half parts fine sand with a 1:1 mixture of bonding admixture and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.

3. Cork-Floated Finish: Wet concrete surfaces and apply a stiff grout. Mix one part portland cement and one part fine sand with a 1:1 mixture of bonding agent and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Compress grout into voids by grinding surface. In a swirling motion, finish surface with a cork float.

D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.12 FINISHING FLOORS AND SLABS

A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Roughen surface in one direction before final set with stiff brushes, brooms, or rakes.

1. Apply scratch finish to surfaces to receive concrete floor toppings or mortar setting beds for tile, Portland cement terrazzo, or other bonded applied cementitious finish flooring material, and as otherwise indicated.

C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.

1. Apply float finish to monolithic slab surfaces to receive trowel finish and other finishes as hereinafter specified; slab surfaces to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo; and as otherwise indicated.

D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

1. Apply a trowel finish to monolithic slab surfaces to be exposed to view and slab surfaces to be covered with resilient flooring, carpet, ceramic or quarry tile, paint, or another thin-film finish coating system.

E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces where ceramic or quarry tile is to be installed by either thickset or thin-set method. While concrete is still plastic, slightly scarify surface with a fine broom.

F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

3.13 MISCELLANEOUS CONCRETE ITEMS

A. Equipment Bases and Housekeeping Pads:

1. Coordinate sizes and locations of concrete bases and pads with actual equipment provided.
2. Extend bases and pads not less than 6 inches in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated or unless required for seismic anchor support.
3. Connect concrete pads to concrete slabs as indicated.
4. Prior to pouring concrete, place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

3.14 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.

B. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.

C. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

D. Cure concrete according to ACI 308.1, by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
   a. Water.
   b. Continuous water-fog spray.
   c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
   a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
   b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.

c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
   a. If finish materials are to be applied to the surface of concrete, follow manufacturer's recommendations to remove membrane curing compound, unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.

4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.15 LIQUID FLOOR TREATMENTS

A. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller according to manufacturer's written instructions.

3.16 JOINT FILLING

A. Prepare, clean, and install joint filler according to manufacturer's written instructions.

1. Defer joint filling until concrete has aged at least one month. Do not fill joints until construction traffic has permanently ceased.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.

C. Install semi-rigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.17 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part Portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete. Limit cut depth to 3/4 inch. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
2. Repair defects on surfaces exposed to view by blending white Portland cement and standard Portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
2. After concrete has cured at least 14 days, correct high areas by grinding.
3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
4. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
5. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.18 FIELD QUALITY CONTROL

A. Testing and Inspecting: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

B. Special Inspections: Special Inspections for concrete construction shall be in accordance with quality assurance inspection requirements listed in the Statement of Special Inspections Schedule.

C. Concrete Tests: Testing of samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. Testing Frequency: Samples for strength tests of each class of concrete placed each day shall be taken not less than once a day, nor less than once for each 150 cu. yd. of concrete, nor less than once for each 5000 sq. ft. of surface area for slabs or walls.
    a. When frequency of testing provides less than five compressive-strength tests for a given class of concrete, tests shall be made from at least five randomly selected batches or from each batch if fewer than five are used.

2. Slump: ASTM C 143; one test at point of placement for each sample, but not less than one test for each day's pour of each concrete mix. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; ASTM C 173, volumetric method, for structural lightweight concrete; one test for each sample, but not less than one test for each day's pour of each concrete mix.
4. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each sample.
5. Unit Weight: ASTM C 567, fresh unit weight of structural lightweight concrete; one test for each sample, but not less than one test for each day's pour of each concrete mix.

6. Compression Test Specimens: ASTM C 31.
    a. Cast and laboratory cure three sets of two standard cylinder specimens for each sample.

7. Compressive-Strength Tests: ASTM C 39; test one set of two laboratory-cured specimens at 7 days; test one set of two specimens at 28 days; and hold one set of two specimens for testing at 56 days, if needed.
8. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests and, if needed, 56-day tests.
9. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42 or by other methods as directed by Architect.
10. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
11. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

D. Measure floor and slab flatness and levelness according to ASTM E 1155 within 24 hours of finishing.

END OF SECTION

SECTION 04 05 10
MORTAR AND MASONRY GROUT

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Includes furnishing materials, mixing and application of mortar and masonry grout for masonry work required for the masonry construction.

1.02 RELATED SECTIONS

A. Section 03 30 00 - Cast-In-Place Concrete: Requirements for aggregate sizes for grout.

B. Section 04 05 23 - Masonry Accessories: Coordination of the placement/embedment of the masonry accessories and reinforcement with the placement of the mortar and grout.

C. Section 04 20 00 - Unit Masonry: Mortar and grout for erection of the concrete unit masonry.

D. Section 04 21 00 – Brick Masonry Veneer: Mortar and grout for erection of brick masonry veneer.

1.03 QUALITY ASSURANCE

A. Mix Design:
   1. Proposed mix designs shall be submitted to testing agency for approval prior to commencement of work.
   2. Tests of proposed mixes will be performed to ensure conformance with requirements stated herein.
   3. Where mortar and grout mixes do not conform with requirements stated herein, Contractor must re-submit for further testing, and pay all costs for required retesting.

B. Referenced Standards - Mortar and grout (materials, manufacture and installation) shall comply with the following standards:
   1. ASTM C 150 - Portland Cement
   2. ASTM C 595 - Specifications for Blended Hydraulic Cements
   3. ASTM C 260 - Specifications for Air Entraining Admixtures for Concrete
   4. ASTM C 91 - Masonry Cement
   5. ASTM C 5 - Quicklime for Structural Purposes
   6. ASTM C 207 - Hydrated Lime for Masonry Purposes
   7. ASTM C 144 - Aggregate for Masonry Mortar
   8. ASTM C 387 - Packaged, Dry, Combined Materials for Mortar and Concrete
   9. ASTM C 476 - Grout for Masonry
   10. ASTM C 270 - Mortar for Unit Masonry
   11. ASTM C 404 - Aggregates for Masonry Grout
   12. ASTM E 447 - Methods for Compression Strength of Masonry Prisms

C. Copies of ASTM C 270 and ASTM C 476 shall be kept on the project site for ready reference.

1.04 SUBMITTALS

A. Submit copies of technical data describing materials to be used for review in accordance with Section 01 33 00 - Submittals.

PART 2 - PRODUCTS

2.01 CONCRETE UNIT MASONRY MORTAR MATERIALS

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.
   1. Do not use calcium chloride in mortar or grout.
   2. Use portland cement-lime, masonry cement, or mortar cement mortar unless otherwise indicated.
   3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

      Preblended, Dry Mortar Mix. Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

2.02 MORTAR AND GROUT MATERIALS

A. Regional Materials: Provide aggregate for mortar and grout, cement, and lime that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site.

B. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.

C. Hydrated Lime: ASTM C 207, Type S.

D. Masonry Cement: ASTM C 91.
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Cemex S.A.B. de C.V.; Richmortar.
      b. Holcim (US) Inc.; Rainbow Mortamix Masonry Cement.
      c. Lafarge North America Inc.; Lafarge Masonry Cement.
      d. Lehigh Cement Company; Lehigh Masonry Cement.

E. Mortar Cement: ASTM C 1329.
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Lafarge North America Inc.; Lafarge Mortar Cement.

F. Aggregate for Mortar: ASTM C 144.

1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
2. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.

G. Aggregate for Grout: ASTM C 404.

H. Water: Potable.

I. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and hold reinforcing bars in center of cells. Units are formed from 0.148-inch (3.77-mm) steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.

2.03 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.
1. Do not use calcium chloride in mortar or grout.
2. Use portland cement-lime mortar unless otherwise indicated.
3. For exterior masonry, use portland cement-lime or mortar cement mortar.
4. For reinforced masonry, use portland cement-lime or mortar cement mortar.

B. Mortar for Unit Masonry: Comply with ASTM C 270, Property Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.
1. For masonry below grade or in contact with earth, use Type S.
2. For reinforced masonry, use Type S.
3. For exterior, above-grade, load-bearing and non-load-bearing walls and parapet walls; for interior load-bearing walls; for interior non-load-bearing partitions; and for other applications where another type is not indicated, use Type N.

C. Grout for Unit Masonry: Comply with ASTM C 476.
1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
2. Proportion grout in accordance with ASTM C 476, paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi.
3. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143/C 143M.

PART 3 - EXECUTION

3.01 GENERAL

A. Measurement of materials shall be such that the specified proportions are controlled and accurately maintained. Work ability or consistency of mortar on the board shall be such that the mortar is sufficiently wet to be worked under the trowel. Mortar which has begun to "set" or is not used

within two and one-half (2-1/2) hours after initial mixing shall be discarded. Mortar which has stiffened due to evaporation within the two and one-half (2.5) hour period shall be re-tempered to restore its work ability.

3.02 MIXING AND PLACING

A. Mortar and grout ingredients shall be thoroughly mixed, in quantities needed for immediate use.

B. Mortar coloring shall be added in accordance with manufacturer's recommendations. Care shall be exercised to ensure uniformity of mixes and coloration.

C. Mortar shall be machine mixed in approved type mixer in which quantity of water can be accurately and uniformly controlled. Mixing time shall be not less than 5 minutes, approximately 2 minutes of which shall be for mixing dry materials and not less than 3 minutes continuing mixing after water has been added.

D. For work requiring only small batches of mortar or grout and when specifically approved by the Architect, mortar may be mixed by hand in watertight mortar mixing boxes. Materials of each batch shall be well raked and turned over together before water is added, until mix is an even color throughout mass after which water shall be gradually added until a thoroughly mixed mortar of required plasticity is obtained.

E. Pointing mortar shall be as dry a consistency as will produce mortar sufficiently plastic to be worked into joints.

F. All mixing boxes and equipment shall be kept clean. Mortar and grout shall be prepared in batches or volumes that will be used before initial set takes place, and in no case longer than 45 minutes before delivery to point of use. Mortar must be used within 2 hours of mixing at temperatures over 80°F, and 2-1/2 hours at temperatures under 50°F. Re-tempering after initial set will not be permitted.

END OF SECTION

SECTION 04 05 23

MASONRY ACCESSORIES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Includes furnishing materials and installation of the masonry accessories and reinforcement required for the construction of the masonry walls and partitions and masonry veneer.
   1. Anchor Ties & Reinforcement
   2. Embedded flashing.
   3. Miscellaneous masonry accessories.
   4. Cavity-wall insulation.

1.02 RELATED SECTIONS

A. Division 03 Section "Cast-in-Place Concrete" for installing dovetail slots for masonry anchors.

B. Section 04 05 10 - Mortar and Masonry Grout: Coordination of placement of reinforcing with installation of mortar and grout.

C. Section 04 20 00 - Unit Masonry: Reinforcing and anchorages for concrete unit masonry.

D. Section 04 21 00 – Brick Masonry Veneer: Brick veneer installed in conjunction masonry accessories.

E. Section 05 12 00 - Structural Steel Framing: Installing anchor sections of adjustable masonry anchors for connecting to structural steel frame.

F. Section 05 55 00 - Metal Fabrications: Steel lintels for unit masonry.

G. Section 07 62 00 Sheet Metal Flashing and Trim: Exposed sheet metal flashing and for furnishing manufactured reglets installed in masonry joints.

1.03 SUBMITTALS

A. Submit the following to the Architect for review:
   1. Copies of technical data describing the herein specified materials.
   2. Shop Drawings for fabrication, bending and placement of reinforcement bars. Comply with ACI 315 "Manual of Standard Practice for Detailing Reinforced Concrete Structures". Show bar schedules, diagrams of bent bars, stirrup spacing, lateral ties and other arrangements and assemblies as required for fabrication and placement of reinforcement for unit masonry system.
   3. Shop drawings shall include wall elevations on all load-bearing walls showing placement of all reinforcement and shall indicate size, length, spacing, laps and hooks (field and otherwise). Wall elevations shall show all openings greater than 8"x8" with placement of reinforcement around openings indicated to show size, length and laps as required.

1.04 REFERENCE STANDARDS

A. The following shall be complied with in the materials used, fabrication and placement of the reinforcing steel specified herein:
   1. ASTM A 82 - Cold Drawn Steel Wire for Concrete Reinforcement.
   2. ASTM A 153 - Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
   3. ASTM A 615 - Deformed and Plain Billet Steel Bars for Concrete Reinforcement.

PART 2 - PRODUCTS

2.01 REINFORCEMENT

A. Masonry Joint Reinforcement, General: ASTM A 951/A 951M.
   1. Exterior Walls: Hot-dip galvanized, carbon steel.
   2. Wire Size for Side Rods: 0.187-inch diameter.
   3. Wire Size for Cross Rods: 0.187-inch diameter.
   4. Wire Size for Veneer Ties: 0.187-inch diameter.
   5. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.
   6. Provide in lengths of not less than 10 feet, with prefabricated corner and tee units.

B. Masonry Joint Reinforcement for Veneers Anchored with Seismic Masonry-Veneer Anchors: Single 0.187-inch- diameter, hot-dip galvanized, carbon -steel continuous wire.

2.02 TIES AND ANCHORS

A. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated.
   1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82/A 82M; with ASTM A 153/A 153M, Class B-2 coating.

B. Wire Ties, General: Unless otherwise indicated, size wire ties to extend at least halfway through veneer but with at least 5/8-inch cover on outside face. Outer ends of wires are bent 90 degrees and extend 2 inches parallel to face of veneer.

C. Adjustable Anchors for Connecting to Structural Steel Framing: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
   1. Anchor Section for Welding to Steel Frame: Crimped 1/4-inch- diameter, hot-dip galvanized steel wire.
   2. Tie Section: Triangular-shaped wire tie, sized to extend within 1 inch of masonry face, made from 0.187-inch- diameter, hot-dip galvanized steel wire.

D. Adjustable Anchors for Connecting to Concrete: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
   1. Tie Section: Triangular-shaped wire tie, sized to extend within 1 inch of masonry face, made from 0.25-inch- diameter, hot-dip galvanized steel wire.

E. Adjustable Masonry-Veneer Anchors:
   1. General: Provide anchors that allow vertical adjustment but resist tension and compression forces perpendicular to plane of wall, for attachment over sheathing to wood or metal studs, and as follows:
      a. Structural Performance Characteristics: Capable of withstanding a 100-lbf load in both tension and compression without deforming or developing play in excess of 0.05 inch.
   2. Contractor's Option: Unless otherwise indicated, provide any of the following types of anchors:
   3. Seismic Masonry-Veneer Anchors: Units consisting of a metal anchor section and a connector section designed to engage a continuous wire embedded in the veneer mortar joint.
      a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
         1. Dayton Superior Corporation, Dur-O-Wal Division; D/A 213S.
         2. Anchor Section: Rib-stiffened, sheet metal plate with screw holes top and bottom, 2-3/4 inches wide by 3 inches high; with projecting tabs having slotted holes for inserting vertical leg of connector section.
         3. Connector Section: Rib-stiffened, sheet metal bent plate with down-turned leg designed to fit in anchor section slot and with integral tabs designed to engage continuous wire. Size connector to extend at least halfway through veneer but with at least 5/8-inch cover on outside face.
         4. Anchor Section: Rib-stiffened, sheet metal plate with screw holes top and bottom, 2-3/4 inches wide by 3 inches high; with projecting tabs having slotted holes for inserting vertical legs of wire tie specially formed to fit anchor section. Size wire tie to extend at least 1-1/2 inches into veneer but with at least 5/8-inch cover on outside face.
         5. Connector Section: Sheet metal clip welded to wire tie with integral tabs designed to engage continuous wire.
         6. Anchor Section: Gasketed sheet metal plate, 1-1/4 inches wide by 6 inches long, with screw holes top and bottom; top and bottom ends bent to form pronged legs to bridge insulation or sheathing and contact studs; and raised rib-stiffened strap, 5/8 inch wide by 6 inches long, stamped into center to provide a slot between strap and plate for inserting wire tie. Provide anchor manufacturer's standard, self-adhering, modified bituminous gaskets manufactured to fit behind anchor plate and extend beyond pronged legs.
            i. Connector Section: Triangular wire tie and rigid PVC extrusion with snap-in grooves for inserting continuous wire. Size wire tie to extend at least halfway through veneer but with at least 5/8-inch (16-mm) cover on outside face.
            ii. Fabricate sheet metal anchor sections and other sheet metal parts from 0.075-inch- (1.90-mm-) thick, steel sheet, galvanized after fabrication.
            iii. Fabricate wire connector sections from 0.187-inch- (4.76-mm-) diameter, hot-dip galvanized, carbon -steel wire.

F. EMBEDDED FLASHING MATERIALS

   1. Application: Unless otherwise indicated, use the following:
      a. Where flashing is indicated to receive counterflashing, use metal flashing.
      b. Where flashing is indicated to be turned down at or beyond the wall face, use metal flashing.
      c. Where flashing is partly exposed and is indicated to terminate at the wall face, use metal flashing with a drip edge.

d. Where flashing is fully concealed, use flexible flashing.
e. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

G. MISCELLANEOUS MASONRY ACCESSORIES

1. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from PVC.
   a. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).
      1. Mortar Net USA, Ltd.; Mortar Net Weep Vents.
      2. Wire-Bond
      3. Hohmann & Barnard, Inc.
   b. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.
      1. Products: Subject to compliance with requirements, provide one of the following:
         i. Advanced Building Products Inc.; [Mortar Break] [Mortar Break II].
         ii. Archovations, Inc.; CavClear Masonry Mat.
         iii. Dayton Superior Corporation, Dur-O-Wal Division; Polytite MortarStop.
         iv. Mortar Net USA, Ltd.; Mortar Net.
2. MASONRY CLEANERS
   a. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.
      1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
         i. Diedrich Technologies, Inc.
         ii. EaCo Chem, Inc.
         iii. ProSoCo, Inc.

H. Weeps:
1. QV – Quadro-Vent weep hole, as manufactured by Hohmann & Barnard, Inc.
   a. Color: Almond.
   b. Provide with 5/16" braided cotton sash cord or plastic rope.

I. Cavity Drainage Netting:
1. Mortar Net – 2", as manufactured by MasonPro, Inc.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Cavity Protection: Provide means and methods to prevent bridging of cavity with mortar. Use "Clean

out" Board or other means to keep cavity clean of mortar and mortar droppings. Strike off back of face veneer to remove excess, extruded mortar. Omit brick at regular intervals for cavity inspection.

B. Provide continuous horizontal joint reinforcing in concrete unit masonry foundation walls and other areas shown. Fully embed longitudinal side rods in mortar for their entire length with a minimum cover of 5/8" on exterior side of walls and 1/2" at other locations. Lap reinforcement a minimum of 6". Do not bridge control and expansion joints with reinforcing, unless otherwise indicated. Provide continuity at corners and wall intersections by use of prefabricated "L" and "T" sections. Cut and bend units as directed by the manufacturer for continuity at returns, offsets, pipe enclosures and other special conditions.

C. All openings in masonry walls resting on footings shall be reinforced with a minimum of one (1) #5 bar at top, bottom and both sides in grouted cells. Continue reinforcing 24" minimum beyond edges of opening.

D. All joint reinforcement shall be placed at 16" o.c. vertical in concrete unit masonry walls. Place joint reinforcement at 8" o.c. vertically in all reinforced sections of concrete unit masonry walls.

END OF SECTION

SECTION 04 20 00
UNIT MASONRY

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
   1. Concrete masonry units.
   2. Concrete building brick.
   3. Mortar and grout.
   4. Steel reinforcing bars.
   5. Masonry joint reinforcement.
   6. Ties and anchors.
   7. Miscellaneous masonry accessories.

1.03 DEFINITIONS

A. CMU(s): Concrete masonry unit(s).

B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.04 PERFORMANCE REQUIREMENTS

A. Provide structural unit masonry that develops indicated net-area compressive strengths at 28 days.
   1. Determine net-area compressive strength of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) according to Table 2 in ACI 530.1/ASCE 6/TMS 602.

1.05 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For the following:
   1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
   2. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement." Show elevations of reinforced walls, per requirements listed in Section 03 30 00 "Cast-in-Place Concrete".
   3. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.

1.06 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency

B. Material Certificates: For each type and size of the following:
   1. Masonry units.
      a. Include data on material properties and material test reports substantiating compliance with requirements.
      b. For masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.
   2. Cementitious materials. Include brand, type, and name of manufacturer.
   3. Pre-blended, dry mortar mixes. Include description of type and proportions of ingredients.
   4. Grout mixes. Include description of type and proportions of ingredients.
   5. Reinforcing bars mill test.
   6. Joint reinforcement.
   7. Anchors, ties, and metal accessories.

C. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
   1. Include mix designs indicating type and proportions of ingredients for mortar mixes required to comply with proportions specification of ASTM C270.
   2. Include grout mix designs and strength test performed in accordance with ASTM C476.

D. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to Table 2 in ACI 530.1/ASCE 6/TMS 602.

E. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.07 QUALITY ASSURANCE

A. Furnish Sample Panel:
   1. Prior to the erection of any brick masonry, erect where indicated by the Designer, a four (4) foot long by four (4) foot high square sample panel. Panel face shall show mortar, bond, joint tooling, etc. The approved panel shall represent standards of workmanship for all work covered under this Section and shall remain intact until all masonry has been installed and approved. The sample panel may be incorporated into the Work if approved in writing by the Designer.
      a. When required, provide a separate panel for each type of brick or mortar.
      b. Do not start work until Designer has accepted sample panel.
      c. Use panel as standard of comparison for all masonry work built of same material.
      d. Do not destroy or move panel until work is completed and accepted by Owner.

B. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.

C. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

D. Masonry Standard: Comply with ACI 530.1/ASCE 6/TMS 602 unless modified by requirements in the Contract Documents.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

D. Deliver pre-blended, dry mortar mix in moisture-resistant containers designed for use with dispensing silos. Store pre-blended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in covered weatherproof dispensing silos.

E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.09 PROJECT CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
   1. Extend cover a minimum of 24 inches down both sides of walls and hold cover securely in place.
   2. Where one wythe of multi-wythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches down face next to unconstructed wythe and hold cover in place.

B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.

C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.

1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
2. Protect sills, ledges, and projections from mortar droppings.
3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
   1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F (4 deg C) and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.

E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

PART 2 - PRODUCTS

2.01 MASONRY UNITS, GENERAL

A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects will be exposed in the completed Work,

B. Fire-Resistance Ratings: Where indicated, provide units that comply with requirements for fire-resistance ratings indicated as determined by testing according to ASTM E 119, by equivalent masonry thickness, or by other means, as acceptable to authorities having jurisdiction.

2.02 CONCRETE MASONRY UNITS

A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.
   1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
   2. Provide square-edged units for outside corners unless otherwise indicated.

B. CMUs: ASTM C 90.
   1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2800 psi.
   2. Density Classification: Lightweight, unless otherwise indicated.
   3. Size (Width): Manufactured to dimensions 3/8 inch less than nominal dimensions.
   4. Size (Width): Manufactured to the following dimensions:

5. Exposed Faces: Provide color and texture matching the range represented by Architect's sample.
6. Faces to Receive Plaster: Where units are indicated to receive a direct application of plaster, provide textured-face units made with gap-graded aggregates.

C. Concrete Building Brick: ASTM C 55.
1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2800 psi.
2. Density Classification: Lightweight.
3. Size (Actual Dimensions): 3-5/8 inches wide by 2-1/4 inches high by 7-5/8 inches long.

2.03 MASONRY LINTELS

A. Masonry Lintels: Built-in-place masonry lintels made from standard lintel CMUs with reinforcing bars placed as indicated and filled with coarse grout. Temporarily support built-in-place lintels until cured.

2.04 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction.

B. Hydrated Lime: ASTM C 207, Type S.

C. Portland Cement-Lime Mix: Packaged blend of Portland cement and hydrated lime containing no other ingredients.

D. Aggregate for Mortar: ASTM C 144.

E. Aggregate for Grout: ASTM C 404. F. Water: Potable.

2.05 REINFORCEMENT

A. Uncoated Steel Reinforcing Bars: ASTM A 706 or ASTM A 615, Grade 60. Actual yield strength of reinforcing shall not exceed 1.3 multiplied by specified yield strength.

B. Masonry Joint Reinforcement, General: ASTM A 951.
1. Interior and Exterior Walls: Hot-dip galvanized, carbon steel.
2. Wire Size for Side Rods: 0.148-inch diameter.
3. Wire Size for Cross Rods: 0.148-inch diameter.
4. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.
5. Provide in lengths of not less than 10 feet, with prefabricated corner and tee units.

C. Masonry Joint Reinforcement for Single-Wythe Masonry: Provide ladder type with single pair of side rods.

2.06 TIES AND ANCHORS

A. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated.
   1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82; with ASTM A 153, Class B-2 coating.
   2. Steel Plates, Shapes, and Bars: ASTM A 36.

B. Rigid Anchors: Fabricate from steel bars minimum 2 inches wide by 1/8 inch thick by length, as indicated, with ends turned up 2 inches.

2.07 MISCELLANEOUS ANCHORS

A. Weld plates and anchors as indicated.

B. Anchor Bolts, as indicated.

2.08 MISCELLANEOUS MASONRY ACCESSORIES

A. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and hold reinforcing bars in center of cells. Units are formed from 0.148-inch (3.77-mm) steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.

2.09 MASONRY CLEANERS

A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.

2.10 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.
   1. Do not use calcium chloride in mortar or grout.
   2. Use Portland cement-lime, masonry cement, or mortar cement mortar unless otherwise indicated.
   3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Pre-blended, Dry Mortar Mix. Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

C. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.
   1. For reinforced masonry, use Type S.

2. For masonry below grade or in contact with earth, use Type S.

D. Grout for Unit Masonry: Comply with ASTM C 476.
   1. Proportion grout in accordance with ASTM C 476 for 3000 psi minimum 28-day compressive strength.
   2. Use coarse type grout except where fine grout is required by Grout Space Requirements Table in ACI 530.1/ASCE 6/TMS 602.
   3. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
   1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
   2. Verify that foundations are within tolerances specified.
   3. Verify that reinforcing dowels are properly placed.

B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION, GENERAL

A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.

B. Build chases and recesses to accommodate items specified in this and other Sections.

C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.

D. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

E. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.
   1. Mix units from several pallets or cubes as they are placed.

F. Matching Existing Masonry: Match coursing, bonding, color, and texture of existing masonry.

3.03 TOLERANCES

A. Dimensions and Locations of Elements:
   1. For dimensions in cross section or elevation do not vary by more than plus 1/2 inch or minus 1/4 inch.
   2. For location of elements in plan do not vary from that indicated by more than plus or minus 1/2 inch.
   3. For location of elements in elevation do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.

B. Lines and Levels:
   1. For bed joints and top surfaces of bearing walls do not vary from level by more than 1/4 inch in 10 feet, or 1/2 inch maximum.
   2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
   3. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.
   4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
   5. For lines and surfaces do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.
   6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet, or 1/2 inch maximum.
   7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch except due to warpage of masonry units within tolerances specified for warpage of units.

C. Joints:
   1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.
   2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
   3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
   4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch. Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch.
   5. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch from one masonry unit to the next.

3.04 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.

C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 4-inches. Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.

D. Stopping and Resuming Work: Stop work by racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.

E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

F. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below and rod mortar or grout into core.

H. Fill cores in hollow CMUs with grout 24 inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

3.05 MORTAR BEDDING AND JOINTING

A. Lay hollow CMUs as follows:
   1. With face shells and webs fully bedded in mortar in all courses and with head joints of depth equal to bed joints.

B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

E. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

3.06 CAVITY WALLS

A. Bond wythes of cavity walls together using one of the following methods:
   1. Individual Metal Ties: Provide ties as shown installed in horizontal joints, but not less than one metal tie for 1.77 sq. ft. of wall area spaced not to exceed 16 inches o.c. horizontally and 16 inches o.c. vertically. Stagger ties in alternate courses. Provide additional ties within 12 inches

of openings and space not more than 36 inches apart around perimeter of openings. At intersecting and abutting walls, provide ties at no more than 24 inches o.c. vertically.
   a. Where bed joints of wythes do not align, use adjustable (two-piece) type ties.
2. Masonry Joint Reinforcement: Installed in horizontal mortar joints.
   a. Where bed joints of both wythes align, use truss-type reinforcement extending across both wythes.
   b. Where bed joints of wythes do not align, use adjustable (two-piece) type reinforcement.

B. Keep cavities clean of mortar droppings and other materials during construction. Bevel beds away from cavity, to minimize mortar protrusions into cavity. Do not attempt to trowel or remove mortar fins protruding into cavity.

C. Coat cavity face of backup wythe to comply with Section 071113 "Bituminous Dampproofing" where indicated.

3.07 MASONRY JOINT REINFORCEMENT

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.
   1. Space reinforcement not more than 16 inches o.c.
   2. Space reinforcement not more than 8 inches o.c. in foundation walls and parapet walls.
   3. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings.

B. Provide continuity at wall intersections by using prefabricated T-shaped units.

C. Provide continuity at corners by using prefabricated L-shaped units.

D. Cut and bend reinforcing units as directed by manufacturer for continuity at corners, returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.08 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

A. Anchor masonry to structural steel and concrete where masonry abuts or faces structural steel or concrete to comply with the following:
   1. Provide an open space not less than 2 inches wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
   2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
   3. Space anchors as indicated, but not more than 24 inches o.c. vertically and 36 inches o.c. horizontally.

3.09 LINTELS

A. Install steel lintels where indicated.

B. Provide masonry lintels where shown and where openings of more than 24 inches for block-size units are shown without structural steel or other supporting lintels.

C. Provide minimum bearing of 8 inches at each jamb unless otherwise indicated.

3.10 REINFORCED UNIT MASONRY INSTALLATION

A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.
   1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
   2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other loads that may be placed on them during construction.

B. Placing Reinforcement: Comply with requirements in ACI 530.1/ASCE 6/TMS 602.

C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
   1. Comply with requirements in ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
   2. Limit height of vertical grout pours to not more than 48 inches.

3.11 FIELD QUALITY CONTROL

A. Testing and Inspecting: Engage a qualified independent testing and inspecting agency to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.
   1. Special Inspections: Comply with Statement of Special Inspections Schedule for Masonry Construction.

B. Inspections: Level B special inspections according to the "International Building Code", except full time inspections shall be provided for all reinforcing placement.
   1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
   2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
   3. Place grout only after inspectors have verified proportions of site-prepared grout.

C. Grout Test (Compressive Strength): For each mix provided, according to ASTM C1019.

D. Testing Frequency: One set of tests for each 5000 sq. ft. of wall area or portion thereof.

3.12 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
   1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
   2. Protect adjacent masonry and non-masonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
   3. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
   4. Clean brick by bucket and brush hand cleaning method described in BIA Technical Notes 20.
   6. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.
   7. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.
   8. Clean stone trim to comply with stone supplier's written instructions.
   9. Clean limestone units to comply with recommendations in ILI's "Indiana Limestone Handbook".

3.15 MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

B. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.
   1. Crush masonry waste to less than 4 inches in each dimension.
   2. Mix masonry waste with at least two parts of specified fill material for each part of masonry waste. Fill material is specified in Section 312000 "Earth Moving."
   3. Do not dispose of masonry waste as fill within 18 inches of finished grade.

C. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION

SECTION 04 21 00

BRICK MASONRY VENEER

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Includes furnishing materials, labor and equipment for the installation of the brick masonry. Installed in conjunction with the work but specified in other sections of this project manual are the following:
   1. Concrete unit masonry.
   2. Thru-wall flashing.
   3. Loose lintels bearing plates, hangers, anchor bolts, sleeves, etc. Which are anchored to bear on, or built into masonry.
   4. Hollow metal door frames.

1.02 RELATED SECTIONS

A. Section 04 05 10 - Mortar and Masonry Grout: Mortar and grout used in the erection of the brick masonry.

B. Section 04 05 23 - Masonry Accessories and Reinforcement: Wall ties for securing brick masonry.

C. Section 04 22 00 - Unit Masonry: Concrete block installed as a component of the wall system.

D. Section 05 50 00 – Metal Fabrications: Items built into masonry.

E. Section 07 60 00 – Flashing and Sheet Metal: Thru-wall flashings installed in conjunction with brick masonry erection.

F. Section 07 92 00 - Sealants and Caulking: Sealants installed in masonry expansion joints and control joints.

G. Section 08 11 13 – Hollow Metal Doors and Frames: Hollow metal work installed in conjunction with the erection of the brick masonry.

H. Section 08 43 13 – Aluminum Window Framing and Storefront Systems: Coordination of the aluminum framing system installation with the erection of the brick masonry.

1.03 QUALITY ASSURANCE

A. Furnish Sample Mock Up Wall:
   1. Prior to the erection of any brick masonry, erect where indicated by the Designer, a eight (8) feet long by eight (8) feet high square sample panel. Panel face shall show mortar, bond, joint tooling, thru-wall flashing, dampproofing, mortar net, weep holes, etc. The approved panel shall represent standards of workmanship for all work covered under this Section and shall remain intact until all masonry has been installed and approved. The sample panel may be incorporated into the Work if approved in writing by the Designer.
      a. When required, provide a separate panel for each type of brick or mortar.
      b. Do not start work until Designer has accepted sample panel.
      c. Use panel as standard of comparison for all masonry work built of same material.
      d. Do not destroy or move panel until work is completed and accepted by Owner.
      e. Provide all metal studs, insulation, weather barrier thru-wall flashing, mortar nets, weeps holes, etc.

1.04 SUBMITTALS

A. Submit not less than five (5) samples of the selected brick masonry showing extreme variations in color and texture. Include the full range of exposed color and texture expected in the completed work.

B. Test Reports:
   1. Test reports for each type of building and facing brick are to be submitted to the Architect Engineer for approval.
   2. Testing and reports are to be completed by an independent laboratory.
   3. Test reports shall show: a. Compressive strength.
   4. 24 - hr. cold water absorption.
   5. 5 - hr. boil absorption. d. Saturation coefficient.
   6. Initial rate of absorption (suction).

C. Certificates attesting compliance with the applicable Specifications for grades, types and classes.

D. Copies of manufacturer's recommended brick cleaning agent and application procedure.

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Store brick off ground to prevent contamination by mud, dust or materials likely to cause staining or other defects.

B. Cover materials as necessary to protect from elements.

C. Protect anchors, ties, and reinforcements from elements.

1.06 PRODUCT DELVIERY, STORAGE AND HANDLING:

A. Store brick off ground to prevent contamination by mud, dust or materials likely to cause staining or other defects.

B. Cover materials when necessary to protect from elements.

C. Protect reinforcement from elements

1.07 JOB CONDITIONS:

A. Protection of Work:
   1. Wall covering:
      a. During erection, cover top of wall with strong waterproof membrane at end of each day or shutdown.
      b. Cover partially completed walls at any time the Contractor's superintendent is not on site.
      c. Cover partially completed walls when work is not in progress.
      d. Extend cover minimum of 24 in. down both sides.
      e. Hold cover securely in place.
   2. Load application:
      a. Do not apply uniform floor or roof loading for at least 12 hr. after building masonry columns or walls.
      b. Do not apply concentrated loads for at least 3 days after building masonry columns or walls.
   3. Staining:
      a. Prevent grout or mortar from staining the face of masonry to be left exposed or painted:
         1. Remove immediately grout or mortar in contact with face of such masonry.
         2. Protect all sills, ledges and projections from droppings of mortar, protect door jambs and corners from damage during construction.
   4. Protection:
      a. Preparation:
         1. If ice or snow has formed on masonry bed, remove by carefully applying heat until top surface is dry to the touch.
         2. Remove all masonry deemed frozen or damaged.
   5. Products:
      a. When brick suction exceeds recommendations of Section 1.03.B.3, sprinkle with heated water:
         1. When units are above 32°F., heat water above 70°F.
         2. When units are below 32°F., heat water above 130°F.
      b. Use dry masonry units.
      c. Do not use wet or frozen units.
   6. Construction requirements while work is progressing:
      a. Air temperature 40°F. to 32°F:
         1. Heat sand or mixing water to produce mortar temperatures between 40°F and 120°F.
      b. Air temperature 32°F. to 25°F:
         1. Heat sand and mixing water to produce mortar temperatures between 40°F. and 120° F.

2. Maintain temperatures of mortar on boards above freezing.

c. Air temperatures 25°F to 20°F:
   1. Heat sand and mixing water to produce mortar temperatures between 40°F. and 120°F.
   2. Maintain mortar temperatures on boards above freezing.
   3. Use salamanders or other heat sources on both sides of walls under construction.
   4. Use windbreaks when wind is in excess of 15 mph.

d. Air temperature 20°F. and below:

e. Heat sand and mixing water to produce mortar temperatures between 40°F. and 120°F.

f. Provide enclosures and auxiliary heat to maintain air temperature above 32°F.

g. Minimum temperature of units when laid: 20°F.

7. Protection requirements for completed masonry and masonry not being worked on:
   a. Mean daily air temperature 40°F. to 32°F:
      1. Protect masonry from rain or snow for 24 hr. by covering with weather-resistive membrane.
   b. Mean daily air temperature 32°F. to 25°F:
      1. Completely cover masonry with weather-resistive membrane for 24 hr.
   c. Mean daily air temperature 25°F. to 20°F:
      1. Completely cover masonry with insulating blankets or equal protection for 24 hr.
   d. Mean daily air temperature 20°F. and below:
      1. Maintain masonry temperature above 32°F. for 24 hr. by:
         i. Enclosure and supplementary heat.
         ii. Electric heating blankets.

PART 2 - PRODUCTS

2.01 BRICK

A. Approved Manufacturer:
   1. ACME Brick Tile & Stone, 9400 Macon Road, Cordova, TN 38016;
      a. Contact: Ron Spurlin – (901) 755-9400.

B. Brick Veneer: Match Existing.
   1. ACME Burnt Pumpkin Mod Smooth or Red Sunset Mod Smooth
   2. ASTM C 216; Grade SW; Type FBS.
   3. Dimensions: Utility Size - 3 5/8” x 2 5/16” x 11 5/8”

C. Provide solid bricks at all areas where the ends of the bricks are exposed to view (doors, windows, corners, etc.).

D. Provide brick similar in texture and physical properties to those available for inspection at the Designer's office.

E. Do not exceed variations in color and texture of samples accepted by the Designer.

F. Cleaning agents shall be as recommended by the brick manufacturer.

2.02 CLEANING AGENTS

A. Do not use cleaning agent other than water on brick, except with concurrence of Designer.

B. Acceptable cleaner for light and dark brick equal Diedrich Technologies Van-Stop New Masonry Cleaner. Refer to manufacturer's instructions for dilution and cleaning.

2.03 SEALER

A. Clear sealer application over all exterior surfaces of exterior brick masonry to be Prosoco Sure Clean Weather Seal or BASF Environseal™ PBT protective treatment.

PART 3 - EXECUTION

3.01 INSPECTION

A. Condition of Surfaces: Inspect foundations to assure surfaces to support brick work are as follows:
   1. To proper grades and elevations and free of all dirt and other deleterious material.
   2. All surfaces not properly prepared have been satisfactorily corrected.

B. Verify initial absorption rate of brick is within acceptable limits.

3.02 PREPARATION

A. Wetting Brick:
   1. Wet brick with absorption rates in excess of 30 g./30 sq. in./min. determined by ASTM C 67, so that rate of absorption when laid does not exceed this amount.
   2. Recommended procedure to insure that brick are nearly saturated, surface dry when laid is to place a hose on the pile of brick until the water runs from the pile. This should be done one day before brick are to be used. In extremely warm weather, place hose on pile several hours before brick are to be used.

B. Cleaning Reinforcement: Before being placed, remove loose rust, ice and other coatings from reinforcement.

3.03 GENERAL ERECTION REQUIREMENTS:

A. Pattern Bond:
   1. Lay exposed masonry in running bond.
   2. Bond unexposed masonry units in a wythe by lapping at least 2 in.

B. Joining of Work:
   1. Where fresh masonry joins partially set masonry:
      a. Remove loose brick and mortar.
      b. Clean and lightly wet exposed surface of set masonry.
   2. Stop off horizontal run of masonry by racking back 1/2 length of unit in each course.

3. Toothing is not permitted except upon written acceptance of the Designer.

C. Tooling and Tuck Pointing:
   1. Tooling:
      a. Tool exposed joints when "thumb-print" hard with a round jointer, slightly larger than width of joint.
      b. Trowel-point or concave-tool exterior joints below grade.
      c. Flush cut all joints not tooled.
   2. Tuck pointing:
      a. Rake mortar joints to a depth of not less than 1/2 in. nor more than 3/4 in.
      b. Saturate joints with clean water.
      c. Fill solidly with pointing mortar.
      d. Tool joints.
   3. Flashing:
      a. Clean surface of masonry smooth and free from projections which might puncture flashing material.
         1. Place through-wall flashing on bed of mortar.
         2. Cover flashing with mortar.
         3. Flashing shall extend through rigid insulation and attach to sheathing.
   4. Weep Holes:
      a. Provide weep holes in head joints in first course immediately above all flashing by:
         1. Leaving head joint free and clean of mortar
         2. Maximum spacing: 24 in. o.c.
         3. Keep weep holes and area above flashing free of mortar droppings.
   5. Sealant Recesses:
      a. Leave joints around outside perimeters of exterior doors, window frames and other wall openings:
         1. Depth: uniform 3/4 in.
         2. Width: 1/4 in. to 3/8 in.
   6. Movement Joints:
      a. Keep clean from all mortar and debris.
      b. Locate as shown on drawings.
   7. Cutting Brick:
      a. Cut exposed brick with motor-driven saw.
   8. Mortar Joint Thickness:
      a. Lay all brick with 3/8 in. joint.

3.04 BRICK INSTALLATION

A. Brick Installation:
   1. Lay brick plumb and true to lines.
   2. Lay with completely filled mortar joints.
   3. Do not furrow bed joints.
   4. Butter ends of brick with sufficient mortar to fill head joints.
   5. Slightly bevel mortar bed to incline towards cavity.
   6. Rock closures into place with head joints thrown against two adjacent brick in place.

7. Do not pound corners and jambs to fit stretcher units after they are set in position. Where an adjustment must be made after mortar has started to harden, remove mortar and replace with fresh mortar.

B. Forms and Shores:
   1. Provide substantial and tight forms.
   2. Leakage of mortar or grout is not permitted.
   3. Brace or tie forms to maintain position and shape.
   4. Do not remove forms and shores until masonry has hardened sufficiently to carry its own weight and other temporary loads that may be placed on it during construction:
      a. For girders and beams: Minimum 10 days.
      b. Under brick slabs: Minimum 7 days.

C. Placing Reinforcement:
   1. Position metal reinforcement accurately.
   2. Secure against displacement:
      a. Hold vertical reinforcement firmly in place by means of frames or other suitable devices.
      b. Horizontal reinforcement may be placed as brickwork progresses.
   3. Spacing:
      a. Minimum clear distance between longitudinal bars, except in columns: Nominal diameter of bar or 1 in.
      b. Minimum clear distance between bars in columns: Not less than 1/2 times bar diameter or 1/2 in.
   4. Minimum thickness of mortar or grout between brick and reinforcement:
      a. 1/4 in., except:
         1. 1/4 - in. bars may be laid in 1/2-in. horizontal mortar joints.
         2. No. 6 gage or smaller wires may be laid in 3/8-in. mortar joints.
   5. Minimum width of collar Joints containing both horizontal and vertical reinforcement:
      a. 1/2 in. larger than sum of diameters of horizontal and vertical reinforcement.
   6. Splice reinforcement or attach reinforcement to dowels by placing in contact and wiring.
   7. Do not splice reinforcement at points other than shown on drawings, unless approved by the structural engineer.
   8. Shape and dimension reinforcement as shown on drawings:
      a. Cold bend all bars.
      b. Do not straighten or repair in a manner that will injure material.
      c. Do not use bars with kinks or bends not shown on drawings.
      d. Reinforcement can be heated when entire operation is approved by structural engineer.

3.05 GROUTING:

A. Low-Lift Grouting:
   1. Keep grout core clean from mortar and drippings.
   2. Grout spaces less than 2 in. in width at intervals of not more than 24 in. in lifts of 6 to 8 in. as the wall is built.
   3. In grout spaces more than 2 brick in thickness:
      a. Place or float brick in grout.
      b. Minimum grout between brick: 3/8 in.

4. Agitate or puddle grout during and after placement to insure complete filling.
5. Stop grout 1/2 in. below top of masonry:
    a. If grouting is stopped for 1 hr. or more.
    b. Except when completing grouting of finished wall.
6. If brick headers are used for ties in low-lift grouting space:
    a. Maximum: 8% of wall area.

B. High-Lift Grouting:
1. For running bond, provide one metal tie for each 3 sq. ft. of wall with maximum spacing:
    a. Vertically: 16 in.
    b. Horizontally: 24 in.
2. For stack bond, provide one metal tie for each 2 sq. ft. of wall with maximum spacing:
    a. Vertically: 12 in.
    b. Horizontally: 24 in.
3. Keep grout core clean from mortar and droppings.
4. Provide cleanout holes by omitting every other brick in bottom course on one side of wall.
5. Prior to closing cleanout holes and pouring grout, use high-pressure jet stream of water or high-pressure air to remove excess mortar from grout space and to clean reinforcement.
6. Do not plug cleanout holes until condition of area to be grouted has been approved.
7. Before pouring grout, plug cleanout holes with masonry units and brace against grout pressure.
8. Grout spaces 2 in. or more in width in lifts not exceeding 4 ft. at intervals:
    a. Coarse grout: Not more than 48 times the least clear dimension of grout space.
    b. Do not place grout until the entire wall has been in place 3 days.
    c. Vibrate or agitate grout during, and after placement to insure complete filling of grout space.
    d. Stop grout 1 1/2 in. below top of masonry:
        1. If grouting is stopped for 1 hr. or more.
        2. Except when completing grouting of finished wall.
    e. Provide grout blocks at convenient intervals to meet project requirements.

C. Mortar Net Installation:
1. Cavity shall be no more than 1/4" wider than the mortar net being installed.
2. The installed mortar net shall touch both the outer wither and the inner wall/ substrate.
3. Install one (1) continuous row of mortar net at the base of the wall and over all wall openings directly on the flashing.
4. Install flashings under the mortar net and extend from the bottom of the mortar net to minimum of 6” above the top of the mortar net.
5. Cut the mortar net to accommodate the wall ties and wall masonry reinforcing and any other items penetrating the masonry cavity.

D. Weeps:
1. Provide weep holes in head joints in first course immediately above all flashing, maximum spacing, 24" o.c. Refer to Section 04 05 23 for weeps.
2. Keep weep holes and area above flashing free of mortar droppings.

E. Sealant / Control Joints:
   1. Locate masonry control joints as indicated on Drawings. Where not indicated, place control joints at maximum of 30' centers and 4' from inside and outside corners, after consulting with Designer at project site to verify locations. Refer to Section 07 92 00 for joint sealants.

3.06 POINTING AND CLEANING

A. Cut out any defective joints and holes in exposed masonry and repoint with mortar.

B. Dry brush masonry surface after mortar has set at end of each days work and after final pointing. Clean exposed unglazed masonry with stiff brush and clear water.

C. Apply cleaning agent to sample wall area of 20 square feet in location acceptable to the Designer, if cleaning by water does not produce satisfactory results:
   1. Do not proceed with cleaning until sample area is acceptable to the Designer.
   2. Follow manufacturer's recommendation for use of cleaning agent. Thoroughly wet surface of masonry on which no efflorescence appears before using cleaning agent. Scrub with acceptable cleaning agent and immediately rinse with clear water. Work small sections at a time, working from top to bottom.
   3. Protect railings, metal lintels, and other materials which may corrode when masonry is cleaned with recommended solution.
   4. Remove efflorescence in accordance with brick manufacturer's recommendations.

D. Leave work area and surrounding surfaces clean and free of mortar spots, droppings, and broken masonry.

3.07 SEALING

A. Brick Veneer Sealer:
   1. Surfaces should be clean and dry, and free of alkali, efflorescence, sand, surface dust or dirt, oil, grease, chemical films, and other contaminants. Concrete surfaces should be fully cured.
   2. Air, material and surface temperatures should be 40° F or higher during application and cure. Surfaces can be slightly damp prior to application. Do not apply sealer when temperatures are expected to fall below 40° F within 4 hours of completed application.
   3. Repoint any loose or disintegrated mortar and allow a minimum of 72 hours drying time before application. Install caulking and sealant before application, allowing a minimum of 6 – 12 hours curing time (or until set).

END OF SECTION

SECTION 05 12 00
STRUCTURAL STEEL FRAMING

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Structural steel.
2. Grout.

1.03 DEFINITIONS

A. Structural Steel: Elements of structural-steel frame, as classified by AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show fabrication of structural-steel components.

1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
2. Include embedment drawings.
3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical high-strength bolted connections.
5. Indicate type, size, length, spacing, and location of shear connector studs and deformed bar anchors.
6. For structural-steel connections indicated to comply with design loads, include structural design calculations signed and sealed by a professional engineer licensed in the State of Tennessee.

C. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide according to AWS D1.1, "Structural Welding Code - Steel," for each welded joint whether prequalified or qualified by testing, including the following:

1. Power source (constant current or constant voltage).

2. Electrode manufacturer and trade name, for demand critical welds.

1.05 QUALITY ASSURANCE

A. Comply with applicable provisions of the following specifications and documents:

1. AISC 303 "Code of Standard Practice for Steel Buildings and Bridges".
2. AISC 360 "Specification for Structural Steel Building".
3. AISC 341 "Seismic Provisions for Structural Steel Buildings".
4. RCSC's "Specifications for Structural Joints Using High-Strength Bolts".

B. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD.

C. Erector Qualifications: Minimum 5 years successful experience acceptable to Architect.

D. Preinstallation Conference: Conduct conference at Project site.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.

1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.

1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
2. Clean and relubricate bolts and nuts that become dry or rusty before use.
3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

1.07 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

PART 2 - PRODUCTS

2.01 STRUCTURAL-STEEL MATERIALS

A. Wide Flange Shapes: ASTM A 992.

B. Angles and Channels: ASTM A 36.

C. Plates and Bars: ASTM A 36.

D. Steel Pipe: ASTM A 53, Grade B or ASTM A 501.

E. Round Steel Hollow Structural Sections (HSS): ASTM A 500, Grade C.

F. Square or Rectangular Steel Hollow Structural Sections (HSS): ASTM A 500, Grade B.

2.02 BOLTS, CONNECTORS, AND ANCHORS

A. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade C, heavy-hex carbon-steel nuts; and ASTM F 436, Type 1, hardened carbon-steel washers; all with plain finish.

1. Direct-Tension Indicators: ASTM F 959, Type 325, compressible-washer type with plain finish.

B. Anchor Rods: ASTM A 1554, Grade 55 with weldability Supplement S1 and the carbon equivalent formula in ASTM F1554 Section S1.5.2.1 as indicated.

C. Shear Connector Studs: Headed shear connector studs, headed concrete stud anchors, and threaded stud connectors: ASTM A 108, Grades C-1010 through C-1020 cold-drawn steel conforming to requirements of AWS D1.1.

D. Deformed Bar Anchors: Cold-rolled, deformed reinforcing bars conforming to requirements of AWS D1.1 and ASTM A 496 with a minimum yield strength of 70 ksi and tensile strength of 80 ksi.

E. Clevises and Turnbuckles: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1035.

2.03 PRIMER

A. Primer: Fabricator's standard lead and chromate-free, non-asphaltic, rust inhibiting type compatible with finish coat where specified in Division 09.

2.04 GROUT

A. Non-shrink Grout: Premixed non-metallic, non-corrosive, non-staining grout conforming to ASTM C 1107 or Corps of Engineers CRD C 621 with a minimum 28-day compressive strength of 7,000 psi.

2.05 FABRICATION

A. Structural Steel: Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC 360. Fabricate and assemble in shop to greatest extent possible.

1. Camber structural-steel members where indicated.
2. Fabricate cantilever beams with mill camber down; all other beams, unless noted otherwise, with mill camber up.
3. Identify high-strength structural steel according to ASTM A 6 and maintain markings until structural steel has been erected.
4. Mark and match-mark materials for field assembly.
5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.

B. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.

C. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

D. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel framing members.

1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.06 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.

1. Joint Type: Pretensioned, unless otherwise indicated.

B. Weld Connections: Comply with AWS D1.1 and AWS D1.8 for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

C. Headed Concrete Stud Anchors and Threaded Stud Connectors: Prepare steel surfaces and use automatic end welding in accordance with manufacturer's recommendations.

2.07 SHOP PRIMING

A. Shop prime steel surfaces except the following:

1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
2. Surfaces to be field welded or high-strength bolted with slip-critical connections.

3. Surfaces to receive spray-on fireproofing.
4. Tops of beams which are to receive welded shear studs.

B. Surface Preparation: Clean surfaces to be painted. Remove loose rust, loose mill scale, and spatter, slag, or flux deposits. Prepare surfaces per SSPC specifications.

1. SP-1 "Solvent Cleaning" for all steel.
2. SP-2 "Hand Tool Cleaning" for fireproofed, concrete encased or hot dipped galvanized steel.
3. SP-3 "Power Tool Cleaning" steel receiving normal primer.
4. SP-6 "Commercial Blast Cleaning" for exterior steel receiving paint.

C. Priming: Immediately after surface preparation, apply primer according to manufacturer recommendations and at rate recommended by SSPC to provide dry film thickness of minimum 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify, with steel Erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.

1. Prepare a certified survey of bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.

3.03 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.

B. Base Bearing and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.

1. Support column base and large bearing plates with double nuts until supported members have been plumbed. Set loose base and bearing plates on wedges, shims, or other adjusting devices.
2. Weld plate washers to top of baseplate.

3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

C. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."

D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure.

E. Splice members only where indicated.

F. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

3.04 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.

1. Joint Type: Pre-tensioned, unless noted otherwise.

B. Weld Connections: Comply with AWS D1.1 and AWS D1.8 for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
2. Remove backing bars or runoff tabs where indicated, back gouge, and grind steel smooth.
3. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances in AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.

C. Headed Shear Connector Studs: Weld headed shear connector studs in field, located and spaced as indicated, to beams and girders in composite construction. Welding of all studs shall be done by means of automatically timing stud welding equipment in accordance with AWS D1.1. Weld studs directly to steel beam (or girder) or through one layer of No. 16 gage or thinner steel deck. Weld only on clean, dry surfaces. Studs shall not be manually fillet welded except where specifically permitted by the Engineer.

3.05 FIELD QUALITY CONTROL

A. Testing and Inspecting: Engage a qualified testing and inspection agency for welding inspection and nondestructive testing; inspection of high-strength bolting; inspection of placement and installation of headed shear connectors; and prepare test reports.

B. Special Inspections: Special Inspections for structural steel shall be in accordance with the quality assurance inspection requirements of Statement of Special Inspection Schedule.

C. Bolted Connections: Bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using High-Strength Bolts."

D. Welded Connections: Field welds will be visually inspected according to AWS D1.1.

1. In addition to visual inspection, complete-joint-penetration and partial-joint-penetration groove field welds will be tested and inspected according to AWS D1.1 and the following inspection procedures, at testing agency's option:
   a. Ultrasonic Inspection: ASTM E 164.
   b. Radiographic Inspection: ASTM E 94.

E. Field-welded headed shear connectors: Field inspection shall include verification of correct number, size, length, spacing, arrangement and welding technique. Inspection of stud welding shall be in accordance with AWS D1.1 plus the following. Perform ping test on all studs by striking with a hammer to determine soundness of the weld. A non-pinging sound is cause for further inspection consisting of additional bend test where stud is bent to an angle of approximately 15 degrees from its original axis. Bending without fracture indicates a satisfactory weld. Acceptable bent studs may be left bent.

F. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

3.06 REPAIRS AND PROTECTION

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint. Apply paint to exposed areas with same material as used for shop painting to provide minimum dry film thickness of 1.5 mils. Where exposed, leave surface clean and suitable to receive finish as scheduled in Division 09.

END OF SECTION

SECTION 05 21 00
STEEL JOISTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 SECTION INCLUDES

A. Open web steel joists.

B. Bridging and accessories.

C. Framing for floor and/or roof openings greater than 8 inches wide.

D. Loose bearing plates and anchor bolts for site placement.

1.03 SUBMITTALS

A. Provide submittals in accordance with Division 01.

B. Shop Drawings: Each type of joist and accessory.

1. Show layout of joist units, special connections, joining and accessories, locations of chord extensions.
2. Indicate both design camber for final work and additional camber for construction purposes.
3. Include mark, number, type, location and spacing of joists and bridging.
4. Show locations and details of anchorage devices to be embedded in concrete or masonry.

C. Welder certificates.

1.04 QUALITY ASSURANCE

A. Reference Standard: Perform Work in accordance with Steel Joist Institute (SJI) "Standard Specifications, Load Tables and Weight Tables for Steel Joists and Joist Girders," including accessories, headers, and other supplementary framing.

B. Welding Standards: Comply with applicable provisions of AWS D1.1 “Structural Welding Code—Steel” and AWS D1.3 “Structural Welding Code—Sheet Steel.”

C. Manufacturer Qualifications: Certified by SJI to manufacture joists conforming to SJI standard specifications and load tables.

D. Welding Qualifications: Qualify welders, inspectors, and welding processes per AWS "Standard Qualification Procedure".

1. Provide certification that welders to be employed on the Work have satisfactorily passed AWS qualification tests. Certifications shall be current within last 12 months.

E. Inspection: Inspect joists and girders in accordance with SJI specifications.

F. Connections not detailed on Drawings shall be designed under direct supervision of a Tennessee registered Professional Engineer experienced in structural design of steel joist structures.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, and handle products as recommended in SJI Specifications.

B. Handle and store joists in manner to prevent deformation of members and excessive stresses.

C. Deliver steel bearing plates and other devices to be built into concrete and masonry.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Steel: As required by SJI Specifications.

B. Erection Bolts and Nuts: ASTM A307, Grade A, hex-head bolts and threaded fasteners, nuts, and washers.

1. Finish: Plain, uncoated.

C. Welding Materials: Comply with AWS standards.

2.02 ACCESSORIES

A. Primer: SSPC-Paint 15, Type I, red oxide, or manufacturer's standard shop primer meeting performance requirements of SSPC-Paint 15, Type I.

2.03 STEEL JOISTS

A. Manufacture steel joists in accordance with SJI Specifications with steel double angle top and bottom chord members.

1. Joist Type: K and KCS series.
   a. End Arrangement: Underslung.
   b. Top Chord Arrangement: Parallel, Multi-Pitched, and Double-Pitched.

2. Joist Type: LH-series.
   a. End Arrangement: Underslung.
   b. Top Chord Arrangement: Parallel and Double-Pitched.

B. Comply with AWS requirements and procedures for shop welding, appearance, quality of welds, and methods used in correcting welding work.

C. Extend bearing ends of joists with SJI Type R extended ends where indicated.

D. Camber K-series steel joists per SJI Specifications.

E. Furnish bearing ends of joists with manufacturer's standard beveled ends or sloped shoes when joist slope exceeds 1/4 inch in 12 inches (1:48).

2.04 FABRICATION

A. Weld threaded lugs to chords for attachment of wood nailers.

B. Provide bottom chord extensions where indicated.

C. Extended Ends: Provide extended ends on joists where shown, conforming to requirements of SJI Specifications.

2.05 JOIST ACCESSORIES

A. Bridging: Provide bridging anchors and number of rows of horizontal or diagonal bridging of material, size, and type required by SJI Specifications for type of joist, chord size, spacing, and span.

1. Supply additional bridging as needed to ensure stability of structure during construction period.
2. Provide additional bridging needed to resist indicated uplift forces.

B. Provide bridging anchors for ends of bridging lines terminating at walls or beams.

C. Ceiling Extensions: Fabricate joists with ceiling extensions in areas having ceilings attached directly to joist bottom chord. Provide either extended bottom chord element or separate unit of sufficient strength to support ceiling construction. Extend ends to within 1/2 inch of finished wall surface unless otherwise indicated.

D. Supply miscellaneous accessories, including splice plates and bolts recommended by joist manufacturer to complete joist installation.

2.06 SHOP FINISHING

A. Do not shop paint joists that will receive fireproofing.

B. Omit paint on surfaces to be field welded.

C. Remove loose scale, heavy rust, and other foreign materials from fabricated joists and accessories before application of shop paint.

1. Surface Preparation: Hand tool cleaning, SSPC-SP 2, or power tool cleaning, SSPC-SP 3.

D. Apply primer paint to steel joists and accessories in shop to provide continuous dry paint film thickness of not less than 1 mil.

PART 3 - EXECUTION

3.01 ERECTION

A. Erect steel joists in accordance with SJI Specifications.

B. Do not install joists until supporting construction is in place and secure.

C. Provide temporary bracing and bridging, connections, and anchors needed for erection loads and for stability during construction period.

1. Provide means for adequate distribution of concentrated construction loads so that carrying capacities of joists are not exceeded.

D. Do not field cut or alter structural members without prior approval of joist fabricator and Architect/Engineer.

E. Splice joists delivered to site in more than one piece before installation.

F. Space, adjust, and align joists accurately in location before permanently fastening.

G. Coordinate placement of anchors in concrete and/or masonry for securing bearing plates and/or angles.

H. Field weld joists to supporting steel framework and steel bearing plates. Coordinate welding sequence and procedure with placing of joists.

I. Where indicated, bolt joists to supporting steel framework using carbon steel bolts, unless noted otherwise.

J. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords where terminating at walls or beams.

K. Touch-Up Painting: After installation, clean, prepare, and prime field connections, rust spots, and abraded areas of prime-painted components, including adjacent structural steel.

1. Clean and prepare surfaces by SSPC-SP 2 hand tool cleaning or SSPC-SP 3 power tool cleaning.

2. Apply compatible primer of same type used in shop.

3.02 FIELD QUALITY CONTROL

A. Testing and Inspecting: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

B. Inspections:

1. Inspection of welds in accordance with AWS D1.3.
2. Bolted Connections will be visually inspected.
3. High strength, field-bolted connections will be tested and verified per procedures in RCSC "Specification for Structural Joints Using ASTM A325 or ASTM A490 Bolts."

C. Correct deficiencies in Work that inspections indicate are not in conformance to specified requirements.

END OF SECTION

SECTION 05 31 00
STEEL DECK

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes the following:

1. Roof deck.
2. Fasteners and accessories.

1.03 SUBMITTALS

A. Provide submittals in accordance with Division 01.

B. Product Data: Submit manufacturer's technical data and installation instructions for each type of decking, accessory, and product.

C. Shop Drawings Include:

1. Deck layout and orientation, supporting steel framing and supports with dimensions and section details.
2. Deck type and profile, dimensions, supports, projections, openings and reinforcement.
3. Welds and mechanical fastener types, sizes and patterns.
4. Side lap connector types, sizes and patterns.
5. Accessory details.

D. Welder certificates.

E. Field quality-control test and inspection reports.

1.04 QUALITY ASSURANCE

A. Quality Standards: Fabricate and erect steel decking and accessories in accordance with SDI recommendations.

B. Manufacturer Qualifications: Deck manufacturer is member producer of SDI.

C. Testing Agency Qualifications: An independent agency qualified according to ASTM E329 for testing indicated.

D. Welding: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code - Sheet Steel."

E. Fire-Test-Response Characteristics: Where indicated, provide steel deck units identical to those tested for fire resistance per ASTM E119 by a testing and inspecting agency acceptable to authorities having jurisdiction.

F. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."

1.05 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of Steel Deck Institute – "Manual of Construction with Steel Deck" (SDI – MOC2).

B. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.

PART 2 - PRODUCTS

2.01 ROOF DECK

A. Steel Roof Deck: Fabricate panels with or without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 30, and with the following:

1. Sheet Steel for Galvanized Roof Deck and Accessories: ASTM A653 Structural Quality, Grade 33 minimum. Galvanizing: ASTM A924 G60 zinc coating.
2. Deck Profile: Wide rib (Type B).
3. Profile Depth: 1 ½".
4. Design Uncoated Steel Thickness: 20 gage.
5. Section Modulus: S = as indicated.
6. Side Laps: Overlapping or nestable.
7. For Type BA Deck: Provide inert, non-organic, glass fiber, sound absorbing batts, field installed.

B. Where fire resistance rated assemblies are required, provide UL-listed units. Identify steel deck bundles with labels bearing the UL Mark and UL Design Number as indicated on the drawings.

2.02 ACCESSORIES

A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.

B. Welds:

1. Material: Electric shielded arc process using minimum E70XX electrodes in accordance with

AWS D1.3 procedures.

2. Weld Washers: Uncoated steel sheet, shaped to fit deck rib, 0.0598 inch thick, with factory-punched hole of 3/8-inch minimum diameter. Use on steel deck thinner than 22 gage.

C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws.

D. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, of same thickness, material, and finish as deck; of profile indicated or required for application.

E. Plates at deck connections where indicated: Galvanized G-60 minimum steel sheet, minimum yield strength of 33,000 psi, of thickness and profile as indicated.

F. Column Closures, End Closures, Z-Closures, and Cover Plates: Unless otherwise indicated, galvanized G-60 minimum steel sheet of same thickness as deck, but no less than 20 gage.

G. Galvanizing Repair Paint: SSPC-Paint 20 or DOD-P-21035, with dry film containing a minimum of 94 percent zinc dust by weight.

H. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

PART 3 - EXECUTION

3.01 INSTALLERS

A. Qualifications:

1. All steel deck welders AWS certified for welding of sheet steel.

3.02 EXAMINATION

A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.

3.03 INSTALLATION, GENERAL

A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 30, manufacturer's written instructions, and requirements in this Section.

B. Install temporary shoring before placing deck panels, if required to meet deflection limitations.

C. Locate deck bundles to prevent overloading of supporting members.

D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.

E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.

F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.

G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.

H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

3.04 ROOF-DECK INSTALLATION

A. Fasten roof-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated or arc seam welds with an equal perimeter that is not less than 1-1/2 inches long and as follows:

1. Weld Diameter: 5/8 inch, nominal.
2. Weld Spacing: Weld edge and interior ribs of deck units to supporting steel framing at 6 inches on center maximum

B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports with No. 10 diameter screws as indicated.

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches with end joints lapped 2 inches minimum or butted.

E. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. Weld or mechanically fasten to substrate to provide a complete deck installation.

1. Weld cover plates at changes in direction of roof-deck panels, unless otherwise indicated.

3.05 FIELD QUALITY CONTROL

A. Testing and Inspecting: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

B. Inspections:

1. Inspect deck welds in accordance with AWS D1.3 and Statement of Special Inspection Schedule for steel construction other than structural steel. Visually inspect deck side lap and perimeter edge fastenings for size and spacing. Ensure deck is clamped to supporting steel framing.

C. Correct deficiencies in Work that inspections indicate are not in conformance to specified requirements.

D. Additional inspection, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

3.06 REPAIRS AND PROTECTION

A. Welds: Repair all portions of the steel deck coating damaged due to weld heat with compatible paint type or zinc rich compound.

END OF SECTION

SECTION 05 40 00
COLD-FOROMED METAL FRAMING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Exterior non-load-bearing wall framing.

B. Related Requirements:
   1. Section 055000 "Metal Fabrications" for masonry shelf angles and connections.
   2. Section 092116.23 "Gypsum Board Shaft Wall Assemblies" for interior non-load-bearing, metal-stud-framed, shaft-wall assemblies.
   3. Section 092216 "Non-Structural Metal Framing" for interior non-load-bearing, metal-stud framing and ceiling-suspension assemblies.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of cold-formed steel framing product and accessory.

B. Shop Drawings:
   1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
   2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

1.03 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Welding certificates.

C. Product Test Reports: For each listed product, for tests performed by a qualified testing agency.
   1. Steel sheet.
   2. Expansion anchors.
   3. Power-actuated anchors.
   4. Mechanical fasteners.
   5. Vertical deflection clips.
   6. Horizontal drift deflection clips
   7. Miscellaneous structural clips and accessories.

D. Research Reports: For non-standard cold-formed steel framing, from ICC-ES.

1.04 QUALITY ASSURANCE

A. Product Tests: Mill certificates or data from a qualified independent testing agency indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.

B. Welding Qualifications: Qualify procedures and personnel according to the following:
   1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
   2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

1.05 DELIVERY, STORAGE, AND HANDLING

A. Protect cold-formed steel framing from corrosion, moisture staining, deformation, and other damage during delivery, storage, and handling.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide cold-formed steel framing capable of withstanding design loads within limits and under conditions indicated. See Structural drawings for Design Criteria
   1. Design Loads: Use ASCE 7 for stud design
   2. Deflection Limits: Design framing systems in accordance with ASCE 7 to withstand design loads without deflections greater than the following:
      a. Exterior Non-Load-Bearing Framing: Horizontal deflection of L/360 (for studs supporting material other than brick or stone) and L/480 (for studs supporting brick or stone) of the wall height.
   3. Design framing systems to provide for movement of framing members located outside the insulated building envelope without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F.
   4. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:
      a. Upward and downward movement of 1 inch (25 mm).
   5. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.

B. Cold-Formed Steel Framing Design Standards:
   1. Wall Studs: AISI S211.

C. AISI Specifications and Standards: Unless more stringent requirements are indicated, comply with AISI S100 and AISI S200.

D. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of

another qualified testing agency.

2.02 COLD-FORMED STEEL FRAMING, GENERAL

A. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:
   1. Grade: As required by structural performance. Minimum ST33H.
   2. Coating: G90 or equivalent for studs backing up brick or stone veneer.

B. Steel Sheet for Vertical Deflection Drift Clips: ASTM A 653/A 653M, structural steel, zinc coated, of grade and coating as follows:
   1. Grade: As required by structural performance. Minimum 33.
   2. Coating: G90 (Z275) for studs backing up brick or stone veneer.

2.03 EXTERIOR NON-LOAD-BEARING WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
   1. Minimum Base-Metal Thickness: As required by structural performance, but not less than 0.0428 inch (1.09 mm).
   2. Flange Width: As required by structural performance, but not less than 1-5/8 inches.
   3. Section Properties: As required by structural performance.

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:
   1. Minimum Base-Metal Thickness: Matching steel studs.
   2. Flange Width: Matching steel studs.

C. Double Deflection Tracks: Manufacturer's double, deep-leg, U-shaped steel tracks, consisting of nested inner and outer tracks; unpunched, with unstiffened flanges.
   1. Outer Track: Of web depth to allow free vertical movement of inner track, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:
      a. Minimum Base-Metal Thickness: As required by structural performance, but not less than 0.0538 inch.
      b. Flange Width: 1 inch plus twice the design gap for other applications (3”).
   2. Inner Track: Of web depth indicated, and as follows:
      a. Minimum Base-Metal Thickness: Match Outer Track.
      b. Flange Width: 4”.

2.04 FRAMING ACCESSORIES

A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.

B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:
   1. Supplementary framing.

2. Bracing, bridging, and solid blocking.
3. Web stiffeners.
4. Anchor clips.
5. End clips.
6. Foundation clips.
7. Gusset plates.
8. Stud kickers and knee braces.
9. Joist hangers and end closures.
10. Hole reinforcing plates.
11. Backer plates.

2.05 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123/A 123M.

B. Anchor Bolts: ASTM F 1554, Grade 36, threaded carbon-steel hex-headed bolts and carbon-steel nuts; and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A 153/A 153M, Class C.

C. Expansion Anchors: Fabricated from corrosion-resistant materials, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing per ASTM E 488 conducted by a qualified testing agency.

D. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with allowable load capacities calculated according to ICC-ES AC70, greater than or equal to the design load, as determined by testing per ASTM E 1190 conducted by a qualified testing agency.

E. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.
   1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.

F. Welding Electrodes: Comply with AWS standards.

2.06 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: SSPC-Paint 20 or MIL-P-21035B.

B. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, and plasticizing and water-reducing agents, complying with ASTM C 1107/C 1107M, with fluid consistency and 30-minute working time.

C. Shims: Load bearing, high-density multimonomer plastic, and nonleaching; or of cold-formed steel of same grade and coating as framing members supported by shims.

D. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to match width of bottom track or rim track members.

2.07 FABRICATION

A. Fabricate cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.
   1. Fabricate framing assemblies using jigs or templates.
   2. Cut framing members by sawing or shearing; do not torch cut.
   3. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.
      a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
      b. Locate mechanical fasteners and install according to Shop Drawings, with screw penetrating joined members by no fewer than three exposed screw threads.
   4. Fasten other materials to cold-formed steel framing by welding, bolting, pneumatic pin fastening, or screw fastening, according to Shop Drawings.

B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.

C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:
   1. Spacing: Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
   2. Squareness: Fabricate each cold-formed steel framing assembly to a maximum out-of-square tolerance of 1/8 inch (3 mm).

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION, GENERAL

A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.

B. Install cold-formed steel framing according to AISI S200 and to manufacturer's written instructions

unless more stringent requirements are indicated.

C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.
   1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch (1.6 mm).

D. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.
   1. Cut framing members by sawing or shearing; do not torch cut.
   2. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.
   3. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
   4. Locate mechanical fasteners and install according to Shop Drawings, and complying with requirements for spacing, edge distances, and screw penetration.

E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.

F. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

G. Do not bridge building expansion joints with cold-formed steel framing. Independently frame both sides of joints.

H. Install insulation, specified in Section 072100 "Thermal Insulation," in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.

I. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.

J. Erection Tolerances: Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:
   1. Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.03 EXTERIOR NON-LOAD-BEARING WALL INSTALLATION

A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure as indicated.

B. Fasten both flanges of studs to top and bottom track unless otherwise indicated. Space studs as

follows:
1. Stud Spacing: As required by structural design, but no greater than 16 inches.

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.

D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.

E. Install horizontal bridging in wall studs, spaced vertically in rows indicated on Shop Drawings but not more than 48 inches apart. Fasten at each stud intersection.
1. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 12 inches of single deflection track. Install a combination of bridging and stud or stud-track solid blocking of width and thickness matching studs, secured to stud webs or flanges.
   a. Install solid blocking at mid height of studs, but not more than 8'-0" O/C.
2. Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
3. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.

F. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.04 FIELD QUALITY CONTROL

A. Field and shop welds will be subject to testing and inspecting.

B. Testing agency will report test results promptly and in writing to Contractor and Architect.

C. Remove and replace work where test results indicate that it does not comply with specified requirements.

D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.05 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION

SECTION 05 50 00
METAL FABRICATIONS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Includes, but is not limited to the following:
   1. All miscellaneous metals indicated or required to complete the work and not specified in other Sections.
   2. Supplementary structural steel incorporated in the project and shown on the Drawings.
   3. Miscellaneous metal items which are fully described on the drawings and not necessarily named herein, but shall be provided as shown and subject to applicable requirements of this Section.
   4. Miscellaneous support and clip angles, including deck and joist support and clip angles.
   5. Metal frames for framed openings.
   6. Pipe handrails.
   7. Sleeves as required for the passage of utilities through the structure and as required.
   8. Prefabricated roof access ladders.
   9. Other items as required to complete the Work.

1.02 RELATED SECTIONS

A. Section 03 30 00 - Cast-In-Place: Metal items built into or resting on concrete.

B. Section 05 12 00 - Structural Steel Framing: Metal fabrications required for complete installation of structural steel.

C. Section 05 21 00 - Steel Joists: Metal fabrications required for complete installation of steel joists.

D. Section 05 31 00 - Steel Decking: Metal fabrications required for the roof deck installation. Metal frames for openings installed in conjunction with the roof deck.

E. Section 09 91 00 - Painting: Painting of exposed metal fabrications.

1.03 QUALITY ASSURANCE

A. Materials shall be free from defects impairing strength, durability, or appearance, of best commercial quality for purposes specified. Exposed surfaces throughout the building shall have the same inherent texture and color for like location. Fastenings shall, insofar as practicable, be non-corrosive, non-staining, and concealed. Fastenings which must be exposed shall be of the same material, color and finish as material to which applied, shall be countersunk and finish flush. Exposed welds shall be ground smooth to form a neat uniform fillet without weakening base metal. Molded, bent or shaped members shall be formed with clean sharp arises, without dents, scratches, cracks or other defects. Provide all anchors, bolts, shims, and accessory items required for building into fastening to adjacent work.

1.04 SUBMITTALS

A. Copies of shop drawings and complete installation data shall be furnished to the Architect on all items specified in this Section. Submit shop drawings in accordance with Section 01 33 00 - Submittals, prior to any fabrication.

1.05 FIELD MEASUREMENTS

A. Take all necessary field measurements to verify or supplement dimensions shown on the drawings. Furnish templates as required or directed. The Contractor shall be responsible for furnishing all necessary instructions for the setting of anchors, bearing plates and miscellaneous items and he shall ascertain that all materials are properly set during the progress of work.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Structural steel shapes, plates, and bars shall meet ASTM A 992/A 572-50.

B. Hollow structural tubing shall meet ASTM A 500, Grade B (yield strength 46,000 PSI).

C. Steel pipe shall meet ASTM A 501 or ASTM A 53 for standard weight (Schedule 40) pipe.

D. Steel tubing and Miscellaneous Steel: ASTM A 7.

E. Steel handrails and guards shall be designed to resist a linear load of 50 pounds per linear foot in accordance with Section 4.5.1 of ASCE 7.

F. Steel handrails and guards shall be designed to resist a concentrated load of 200 pounds in accordance with Section 4.5.1 of ASCE 7.

G. Steel intermediate rails shall be designed to resist a concentrated load of 50 pounds in accordance with Section 4.5.1 of ASCE 7.

H. Structural steel angles for miscellaneous bracing, reinforcement, etc., shall be provided as indicated on drawings. Steel clip angles shall conform to ASTM A 36. Steel angles exposed to weather or built into exterior walls shall be hot-dipped galvanized.

I. Steel Railings: Configuration as detailed on drawings, match design of existing railings. Fabricate railings using steel shapes, plates and hollow steel tubing complying with ASTM A 7. Railings shall have a rust inhibiting primer applied after fabrication.

J. Pipe Sleeves: All metal posts and pipes set in concrete shall be inserted into pipe sleeve. Sleeves shall be length as required by 1-1/2 inches larger than the item they are to receive and the same shape (round, square or rectangle) as the conduit. Fabricate sleeves from 18 gauge steel; provide

two hairpin anchors per sleeve. All joints and connections shall be full welded, and the entire sleeve assembly will be hot-dipped galvanized after fabrication. Steel sleeves exposed to weather and built into concrete shall be hot-dipped galvanized.

K. Primer used to touch up galvanized surfaces shall be manufacturer's standard or ZRC Cold Galvanizing Compound as manufactured by ZRC Chemical Products Company of Quincy, Massachusetts.

L. Frames for Roof Openings and Supports: Fabricate all miscellaneous roof frames to sizes shown on the drawings.

M. Provide and install all other metal items, required to complete the Work, not specifically mentioned herein or specified in other divisions.

N. Rough Hardware: Furnish custom fabricated bolts, plates, anchors, hangers, dowels, and other miscellaneous steel and iron shapes for framing and supporting and anchoring woodwork.

O. Primer used to touch up galvanized surfaces shall be manufacturer's standard or ZRC Cold Galvanizing Compound as manufactured by ZRC Chemical Products Company of Quincy, Massachusetts.

P. Steel Handrails and Railings:
   1. All handrails and railings shall be fabricated in the sizes and shapes shown on the drawings. Steel railings shall have all connections welded and all welds shall be ground smooth. After fabrication, all handrails and railings shall receive the specified paint finish.
   2. Anchor railings (in concrete) in sleeves with "PorRok" anchoring cement as manufactured by Hallemite of Montvale, New Jersey.
   3. Clean field welds, bolted connections and abraded areas and apply primer compatible with shop applied primer.

Q. Sleeves: Shall be installed in proper locations prior to the placing of the concrete. Set sleeves at proper elevations, spread hairpin anchors and tie into place. Sleeves are not to be elevated with any material foreign to that used in normal concrete placement. Prior to concrete placement pack all sleeves with paper or cloth wadding. Final installation shall leave sleeves flush with top of the concrete and in true vertical position. Wadding is to remain in the sleeves until items are set into sleeves.

R. Roof Access Ladders:
   1. Fixed Ladder with Cage, Parapet Platform & Roof Side Return.
      a. ½" x 2" safety cage
      b. Security gate
   2. Fixed Ladder with Parapet Platform & Roofside Return.
      a. 2 ½" aluminum channel siderails.
      b. 2 ¼" serrated aluminum rungs.
      c. Platform surface.
      d. 12" maximum between rungs.
      e. All anchors/ fasteners.

f. Factory finished aluminum mil finish.

PART 3 - EXECUTION

3.01 FABRICATION AND INSTALLATION

A. General:
   1. Weld corners and seams continuously, complying with AWS recommendations. At exposed connections, grind exposed welds smooth and flush to match and blend with adjoining surfaces.
   2. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners wherever possible. Use exposed fasteners of type indicated or, if not indicated, flathead (countersunk) screws or bolts. Fasteners for exterior work shall be stainless steel. All other fasteners shall be compatible with the material(s) being secured, anchored, etc.
   3. Provide for anchorage of type indicated, coordinated with supporting structure. Fabricate and space anchoring devices to provide adequate support for intended use.
   4. Cut, reinforce, drill and tap miscellaneous metal work as indicated to receive finish hardware and similar items.

B. Steel Handrails and Railings:
   1. All handrails and railings shall be fabricated in the sizes and shapes shown on the drawings. Steel railings shall have all connections welded and all welds shall be ground smooth. After fabrication, all handrails and railings shall receive the specified paint finish.
   2. Anchor railings (in concrete) in sleeves with "PorRok" anchoring cement as manufactured by Hallemite of Montvale, New Jersey.
   3. Clean field welds, bolted connections and abraded areas and apply primer compatible with shop applied primer.

C. Sleeves: Shall be installed in proper locations prior to the placing of the concrete. Set sleeves at proper elevations, spread hairpin anchors and tie into place. Sleeves are not to be elevated with any material foreign to that used in normal concrete placement. Prior to concrete placement pack all sleeves with paper or cloth wadding. Final installation shall leave sleeves flush with top of the concrete and in true vertical position. Wadding is to remain in the sleeves until items are set into sleeves.

3.02 PAINTING AND PROTECTIVE COATING

A. All ferrous metal, except stainless steel and galvanized surfaces, shall be properly cleaned and given one shop coat of Zinc Rich primer. Anchors that are built into masonry shall be coated with asphalt paint unless specified to be galvanized. Metal work to be encased in concrete shall be left unpainted unless specified or noted otherwise. Where hot-dip galvanized or zinc-coated metal is specified or shown, it shall not be shop-primed unless specifically required.

B. Hot-dip galvanizing or zinc coatings applied on products fabricated from rolled, pressed, and forged steel shapes, plates, bars and strips shall comply with ASTM Specification A 123. Hot-dip galvanizing or zinc coatings on assembled steel products shall comply with ASTM Specification A 386. Galvanized surfaces for which a coat of paint is specified shall be chemically treated to

provide a bond for the paint. Except for bolts and nuts, all galvanizing shall be done after fabrication.

3.03 TOLERANCES FOR EXPOSED WORK

A. Machine filed and shop assembled mechanical joints to fit within 1/32". Install free-standing items to 1/4" of correct position. Items enclosed or recessed in finished surfaces shall be centered in openings unless detailed otherwise. Sizes of each element of an assembly shall be correct within 1/8"; total size of an enclosed assembly shall be correct with 1/4" (clear of opening not more than 1/8" all around); total size of a free-standing assembly shall be correct within 1/2". No part of hole shall show around screws or bolts, and no extra (unused) holes shall show on faces of item.

3.04 PROTECTION

A. Protect miscellaneous metal items from damage until date of Substantial Completion. Damaged factory prime coats on ferrous metals shall be corrected immediately. Remove all rust before repriming. Where touch-up is required sand or steel wool prime coat to feather edge and brush out touch-up to provide a smooth finish surface ready for job painting.

3.05 CLEANING

A. Before Date of Substantial Completion, remove all protective maskings and coverings and clean exposed surfaces of foreign matter. At the completion of this work, remove from the site all excess materials and debris. Leave entire work area in a neat workmanlike condition ready for final inspection.

B. Clean field welds, bolted connections and abraded areas and apply cold galvanizing compound to comply with ASTM A 780, except that the paint shall be brushed on or spray applied in multiple coats until a dry film thickness of 8 mils minimum has been achieved.

END OF SECTION

SECTION 05 58 00

EXPANSION CONTROL

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Includes expansion control devices for exterior walls.

1.02 RELATED SECTIONS

A. Section 04 21 00 – Brick Masonry Veneer: Installation of expansion joint material in masonry walls.

B. Section 07 92 00 – Sealants and Caulking: Coordination of sealant and caulking installations with the installation of the expansion joint systems.

C. Section 09 91 00 - Painting: Application of finish painting over all exposed surfaces. Protection of expansion devices during painting operations.

1.03 REFERENCES

A. ASTM B221: Aluminum and Aluminum Alloy, Extruded Bar, Rod, Wire, Shape and Tube.

B. ASTM B308: Aluminum Alloy, 6061iT6 Standard Structural Shapes, Rolled or Extruded.

1.04 SUBMITTALS

A. Submit shop drawings in accordance with Section 01 33 00, prior to any fabrication.

B. Product Data: Submit manufacturer's technical data describing materials and installation instructions; submit independent laboratory test reports certifying test results for fire-rated assemblies.

C. Shop Drawings: Indicate device profiles, finishes, dimensions, locations, and show relationship to adjacent materials/work. Copies of shop drawings and complete erection data shall be furnished to the Designer on all items specified in this Section. Shop drawings shall bear the seal of a licensed structural engineer, licensed in the State of Tennessee.

1.05 QUALITY ASSURANCE

A. Provide UL listed closures with joint devices to ensure integrity of fire-rated assemblies.

1.06 PRODUCT DELIVERY, STORAGE & HANDLING

A. Deliver products in manufacturer's original packaging with labels intact. Store under cover in dry location until installed. Store off ground, protect from weather, intrusion of foreign materials and construction activities.

B. Cover exposed metal/ aluminum surfaces with manufacturer's standards protective paper or wrapping.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. The following manufacturers are acceptable for use on this project subject to compliance with project requirements:
   1. Construction Specialties, Inc. (C/S Group) of Atlanta, Georgia.
   2. Balco Inc. of Wichita, Kansas
   3. Metalines, Inc. of Oklahoma City, Oklahoma
   4. MM Systems Corporation of Pendegrass, Georgia

2.02 MATERIALS

A. Basis-of-Design:
   1. Exterior cavity wall: C/S Group #HS-series.
   2. Threaded Fasteners: Aluminum or stainless steel.

2.03 TYPES & LOCATIONS

A. Refer to drawings for expansion joint/ joint covers types and locations.

2.04 FINISH

A. Exposed Extruded Sections on Walls: Clear Anodized.

B. Elastomeric Fillers: Dark gray or black.

2.05 FABRICATION

A. Back paint components in contact with cementitious materials to prevent electrolysis.

B. Shop assemble components and package with anchors and fittings.

C. Provide joint components in single lengths wherever practical. Minimize site splicing.

D. Fabricate seismic joint covers capable of movement in all directions.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are properly aligned and suitable to receive expansion joint devices.

3.02 PREPARATION

A. Furnish appropriate components for embedment into cast-in-place concrete.
   1. Closed cell ethylene vinyl acetate foam:
      a. Store material at a minimum of 68°F (20°C) for a minimum of 24 hours prior to installation, regardless of temperature at location of installation.
      b. Store materials in a dry, enclosed area. Make sure materials are off the ground and out of direct sunlight.
      c. Use a sharp knife to cut the material square. All starting and ending pieces must be square to the termination point.
      d. Prepare material for heat seams (if necessary).
      e. Verify the joint is clean, sound, and will provide an appropriate surface for installation of the joint sealant.
      1. Use compressed air to clean any loose debris from the joint.
      2. Apply water or alcohol to a clean cloth and wipe the joint walls to the depth of the sealant material plus 1”.
      f. Verify that the joint is uniform and repair any spalls prior to installation.
      g. Apply duct tape to both edges of the substrate face to prevent the epoxy from contacting the deck surface.
      h. Check the material for appropriate length, width, and depth.
   2. Interior Flush gasketed wall covers: Refer to manufacturer’s installation instructions.

3.03 INSTALLATION

A. Install expansion joint devices and components in accordance with manufacturers’ printed instructions.

   1. Closed cell ethylene vinyl acetate foam:
      a. Sealant:

1. Begin installation at one end of the joint and work to the opposite end using butt seams.
2. When fully prepared to install, apply a 40mils (1mm) coating of the epoxy mixture to both joint walls using a 1" margin trowel to a depth of the sealant material plus 1/2".
3. Verify that the material is cut square at both ends for proper seams. All pieces must be square to the termination point.
4. Apply a 40mils coating of the epoxy adhesive to both sides of the material.
5. Begin installing the material by inserting one side of the HS B approximately 1" into the joint.
6. Use a blunt putty knife or your hand to compress the opposite side of the material and slide it into the joint
7. Continue to compress and work the material into the joint until the material is approximately 1/4" back from the substrate surface.

b. Hot Seams:
1. Verify that the new piece of material is cut square and not at an angle to the previous material installed.
2. Apply both ends of the seam to the welding iron.
3. Once heated sufficiently, remove both ends from the welding iron and press firmly together.
4. Allow to cool before mixing the epoxy adhesive.

c. Finish:
1. Use the supplied Flexible Seal to run a bead along each edge of the joint to fill any irregularities in the substrate.
2. Remove any excess Flexible Seal or epoxy left on the surface of the material or substrate.

2. Interior Flush gasketed wall covers: Refer to manufacturer's installation instructions.

B. Align work plumb and level, flush with adjacent finish except where detailed otherwise.

C. Rigidly anchor to substrate to prevent movement or misalignment.

3.04 CLEANING

A. Before Substantial Completion Inspection, remove all protective maskings and coverings and clean exposed surfaces of foreign matter. At the completion of this work, remove from the site all excess materials and debris. Upon removal, clean exposed surfaces with suitable cleaner that will not harm factory applied finishes.

B. Leave entire work area in a neat workmanlike condition ready for final inspection.

3.05 PROTECTION

A. Protect completed installation from damage by construction operations. Replace damaged items prior to date of Substantial Completion inspection.

END OF SECTION

SECTION 06 10 53
MISCELLANEOUS ROUGH CARPENTRY

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Rooftop equipment bases and support curbs.
   2. Wood blocking and nailers.
   3. Wood sleepers.
   4. Plywood backing panels.

1.02 DEFINITIONS

A. Boards or Strips: Lumber of less than 2 inches nominal size in least dimension.

B. Dimension Lumber: Lumber of 2 inches nominal or greater size but less than 5 inches nominal size in least dimension.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
   1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
   2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
   3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5664.
   4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

B. Sustainable Design Submittals:
   1. Product Certificates: For materials manufactured within 100 miles of Project, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to Project and cost for each raw material.
   2. Chain-of-Custody Certificates: For certified wood products. Include statement of costs.
   3. Chain-of-Custody Qualification Data: For manufacturer and vendor.
   4. Product Data: For installation adhesives, indicating VOC content.
   5. Laboratory Test Reports: For installation adhesives, indicating compliance with requirements

for low-emitting materials.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody by an FSC-accredited certification body.

B. Vendor Qualifications: A vendor that is certified for chain of custody by an FSC-accredited certification body.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Stack lumber flat with spacers beneath and between each bundle to provide air circulation. Protect lumber from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.01 WOOD PRODUCTS, GENERAL

A. Regional Materials: Dimension lumber, except treated materials, shall be manufactured within 100 miles of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 100 miles of Project site.

B. Certified Wood: Lumber and plywood shall be certified as "FSC Pure" or "FSC Mixed Credit" according to FSC STD-01-001 and FSC STD-40-004.

C. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
   1. Factory mark each piece of lumber with grade stamp of grading agency.
   2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece.
   3. Dress lumber, S4S, unless otherwise indicated.

D. Maximum Moisture Content of Lumber: 15 percent for 2-inch nominal thickness or less, 19 percent for more than 2-inch nominal thickness unless otherwise indicated.

2.02 WOOD-PRESERVATIVE-TREATED MATERIALS

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground.
   1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic

or chromium. Do not use inorganic boron (SBX) for sill plates.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or does not comply with requirements for untreated material.

C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

D. Application: Treat items indicated on Drawings, and the following:
   1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
   2. Wood sills, sleepers, blocking, and similar concealed members in contact with masonry or concrete.
   3. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
   4. Wood framing members that are less than 18 inches above the ground in crawlspaces or unexcavated areas.
   5. Wood floor plates that are installed over concrete slabs-on-grade.

2.03 FIRE-RETARDANT-TREATED MATERIALS

A. General: Where fire-retardant-treated materials are indicated, materials shall comply with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.
   1. Treatment shall not promote corrosion of metal fasteners.
   2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.
   3. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity. Use where exterior type is not indicated.

C. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Kiln-dry plywood after treatment to a maximum moisture content of 15 percent.

D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.
   1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece.

E. Application: Treat items indicated on Drawings, and the following:
   1. Framing for raised platforms.
   2. Concealed blocking.
   3. Plywood sheathing in concealed spaces.
   4. Roof framing and blocking.
   5. Wood cants, nailers, curbs, equipment support bases, blocking, and similar members in connection with roofing.
   6. Plywood backing panels.

2.04 MISCELLANEOUS LUMBER

A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
   1. Blocking.
   2. Nailers.
   3. Rooftop equipment bases and support curbs.
   4. Cants.
   5. Dimension Lumber Items: Construction or No. 2 Standard, Stud, or No. 3 grade lumber of any species. any of the following species: Mixed southern pine or southern pine; SPIB.
   6. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
   7. Eastern softwoods; NeLMA.

B. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.

C. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

D. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.05 PLYWOOD BACKING PANELS

A. Equipment Backing Panels: Plywood, DOC PS 1, Exterior, A-C, fire-retardant treated, in thickness indicated or, if not indicated, not less than 1/2-inch (13-mm) nominal thickness.

2.06 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
   1. Where carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.

B. Nails, Brads, and Staples: ASTM F 1667.

C. Screws for Fastening to Metal Framing: ASTM C 1002 ASTM C 954, length as recommended by screw manufacturer for material being fastened.

D. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

E. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01 or ICC-ES AC308 as appropriate for the substrate.
   1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.
   2. Material: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.

B. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry accurately to other construction. Locate [furring,] nailers, blocking, [grounds,] and similar supports to comply with requirements for attaching other construction.

C. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels. [Install fire-retardant-treated plywood backing panels with classification marking of testing agency exposed to view.]

D. Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.

E. Do not splice structural members between supports unless otherwise indicated.

F. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
   1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches o.c.

G. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:
   1. Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than 96 inches o.c. with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.

2. Fire block concealed spaces of wood-framed walls and partitions at each floor level, at ceiling line of top story, and at not more than 96 inches o.c. Where fire blocking is not inherent in framing system used, provide closely fitted solid wood blocks of same width as framing members and 2-inch nominal thickness.
3. Fire block concealed spaces between floor sleepers with same material as sleepers to limit concealed spaces to not more than 100 sq. ft. and to solidly fill space below partitions.
4. Fire block concealed spaces behind combustible cornices and exterior trim at not more than 20 feet o.c.

H. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

I. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.
1. Use inorganic boron for items that are continuously protected from liquid water.
2. Use copper naphthenate for items not continuously protected from liquid water.

J. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

K. Securely attach carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.
2. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's International Residential Code for One- and Two-Family Dwellings.
3. ICC-ES evaluation report for fastener.

L. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

3.02 WOOD BLOCKING AND NAILER INSTALLATION

A. Install where indicated and where required for [screeding or] attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

C. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than 1-1/2 inches (38 mm) wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

3.03 PROTECTION

A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

B. Protect miscellaneous rough carpentry from weather. If, despite protection, miscellaneous rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION

SECTION 06 16 00
SHEATHING

PART 1 - GENERAL

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

1.01 SUMMARY

A. Section Includes:
1. Wall sheathing.
2. Parapet sheathing.
3. Underlayment.
4. Sheathing joint and penetration treatment.

1.02 Related Requirements:

1. Section 06 10 53 - "Miscellaneous Rough Carpentry" for plywood backing panels.

2. Section 07 28 00 - "Fluid-Applied Membrane Weather Barriers" for water-resistive barrier applied over wall sheathing.

1.03 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.
1. Review air-barrier and water-resistant glass-mat gypsum sheathing requirements and installation, special details, transitions, mockups, air-leakage testing, protection, and work scheduling that covers air-barrier and water-resistant glass-mat gypsum sheathing.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
1. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Include physical properties of treated materials.
2. For fire-retardant treatments, include physical properties of treated plywood both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5516.
3. For products receiving waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
4. For air-barrier and water-resistant glass-mat gypsum sheathing, include manufacturer's technical data and tested physical and performance properties of products.

B. Sustainable Design Submittals:
   1. Chain-of-Custody Certificates: For certified wood products. Include statement of costs.
   2. Chain-of-Custody Qualification Data: For manufacturer and vendor.
   3. Product Data: For installation adhesives, indicating VOC content.

C. Shop Drawings: For air-barrier and water-resistant glass-mat gypsum sheathing assemblies.
   1. Show locations and extent of sheathing, accessories, and assemblies specific to Project conditions.
   2. Include details for sheathing joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
   3. Include details of interfaces with other materials that form part of air barrier.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer. including list of ABAA-certified installers and supervisors employed by Installer, who work on Project.

B. Product Certificates: From air-barrier and water-resistant glass-mat gypsum sheathing manufacturer, certifying compatibility of sheathing accessory materials with Project materials that connect to or that come in contact with the sheathing.

C. Product Test Reports: For each air-barrier and water-resistant glass-mat gypsum sheathing assembly, indicating compliance with specified requirements, for tests performed by a qualified testing agency.

D. Evaluation Reports: For the following, from ICC-ES:
   1. Wood-preservative-treated plywood.
   2. Fire-retardant-treated plywood.
   3. Foam-plastic sheathing.
   4. Air-barrier and water-resistant glass-mat gypsum sheathing.

E. Field quality-control reports.

1.06 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer of air-barrier and water-resistant glass-mat gypsum sheathing.
   1. Installer shall be licensed by ABAA according to ABAA's Quality Assurance Program and shall employ ABAA-certified installers and supervisors on Project.

B. Mockups: Build mockups to set quality standards for materials and execution.
   1. Build integrated mockups of exterior wall assembly, 150 sq. ft. (14 sq. m), incorporating backup wall construction, window, storefront, door frame and sill, ties and other penetrations, and flashing to demonstrate crack and joint treatment and sealing of gaps, terminations, and penetrations of air-barrier sheathing assembly.
      a. Coordinate construction of mockups to permit inspection and testing of sheathing before external insulation and cladding are installed.

b. Include junction with roofing membrane, building corner condition.
c. If Architect determines mockups do not comply with requirements, reconstruct mockups until mockups are approved.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

C. Testing Agency Qualifications:
1. For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.
2. For testing and inspecting agency providing tests and inspections related to air-barrier and water-resistant glass-mat gypsum sheathing: an independent agency, qualified according to ASTM E 329 for testing indicated, and certified by Air Barrier Association of America, Inc.

D. Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody by an FSC-accredited certification body.

E. Vendor Qualifications: A vendor that is certified for chain of custody by an FSC-accredited certification body.

1.07 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Owner will engage a qualified testing agency to perform preconstruction testing on field mockups.

B. Mockup Testing: Air-barrier and water-resistant glass-mat gypsum sheathing assemblies shall comply with performance requirements indicated, as evidenced by reports based on mockup testing by a qualified testing agency.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Stack panels flat with spacers beneath and between each bundle to provide air circulation. Protect sheathing from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Fire-Resistance Ratings: As tested according to ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.
2. Air-Barrier Performance: Air-barrier and water-resistant glass-mat gypsum sheathing assembly, and seals with adjacent construction, shall be capable of performing as a continuous air barrier

and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air-barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

2.02 WOOD PANEL PRODUCTS

A. Certified Wood: The following wood products shall be certified as "FSC Pure" or "FSC Mixed Credit" according to FSC STD-01-00 and FSC STD-40-004.
   1. Plywood.
   2. Particleboard underlayment.
   3. Hardboard underlayment.

B. Thickness: As needed to comply with requirements specified, but not less than thickness indicated.

C. Factory mark panels to indicate compliance with applicable standard.

2.03 PRESERVATIVE-TREATED PLYWOOD

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground.
   1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.

B. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.

C. Application: Treat all plywood unless otherwise indicated.

2.04 FIRE-RETARDANT-TREATED PLYWOOD

A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire-Retardant-Treated Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.
   1. Use treatment that does not promote corrosion of metal fasteners.
   2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.

3. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201/D 3201M at 92 percent relative humidity. Use where exterior type is not indicated.

C. Kiln-dry material after treatment to a maximum moisture content of 15 percent. Do not use material that is warped or does not comply with requirements for untreated material.

D. Identify fire-retardant-treated plywood with appropriate classification marking of qualified testing agency.

E. Application: Treat plywood indicated on Drawings, and the following:
1. Roof and wall sheathing within 48 inches (1220 mm) of fire walls.
2. Roof sheathing.
3. Subflooring and underlayment for raised platforms.

2.05 WALL SHEATHING

A. Air-Barrier and Water-Resistant Glass-Mat Gypsum Sheathing: ASTM C 1177/1177M, coated fiberglass mat gypsum sheathing with integral weather-resistant barrier and air barrier complying with ASTM E 2178.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Georgia-Pacific Building Products. DensGlass Sheathing
   b. USG Corporation. Securock
2. Thickness: 1/2 inch (15.9 mm) thick.
3. Size: 48 by 96 inches (1219 by 2438 mm) for vertical installation.
4. Edges: Square.
5. Flashing and Transitions Strips: As acceptable to sheathing manufacturer.
6. Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. (0.02 L/s x sq. m of surface area at 75-Pa) pressure difference when tested according to ASTM E 2178.
7. Vapor Permeance: Minimum 20 perms (580 ng/Pa x s x sq. m) when tested according to ASTM E 96/E 96M, Desiccant Method, Procedure A.
8. Sheathing Assembly Air Leakage: Maximum 0.04 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft. (0.2 L/s x sq. m of surface area at 75 Pa) when tested according to ASTM E 2357.
9. Fire Propagation Characteristics: Complies with NFPA 285 testing as part of an approved assembly.
10. UV Resistance: Can be exposed to sunlight for 30 days according to manufacturer's written instructions.
11. Provide primers, transition strips, termination strips, joint reinforcing fabric and strips, joint sealants, counterflashing strips, flashing sheets and metal termination bars, termination mastic, substrate patching materials, adhesives, tapes, foam sealants, lap sealants, and other accessory materials that are recommended in writing by sheathing manufacturer to produce a complete air-barrier assembly and that are compatible with primary air-barrier material and adjacent construction to which they may seal.

B. Glass-Mat Gypsum Parapet Sheathing: ASTM C 1177/1177M.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the

following:
   a. Georgia-Pacific Building Products. DensDeck Prime Roof Board
   b. CertainTeed Corporation.
   c. Continental Building Products, LLC.
   d. National Gypsum Company.
   e. Temple-Inland Building Products by Georgia-Pacific.
   f. USG Corporation.
2. Type and Thickness: 1/2 inch (15.9 mm) thick; non-combustible.
3. Size: 48 by 96 inches (1219 by 2438 mm) 48 by 108 inches (1219 by 2743 mm) 48 by 120 inches (1219 by 3048 mm) for vertical installation.

2.06 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
   1. For roof parapet and wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.

B. Nails, Brads, and Staples: ASTM F 1667.

C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

D. Screws for Fastening Sheathing to Wood Framing: ASTM C 1002.

E. Screws for Fastening Wood Structural Panels to Cold-Formed Metal Framing: ASTM C 954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.

F. Screws for Fastening Gypsum Sheathing to Cold-Formed Metal Framing: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing to be attached.

G. For steel framing less than 0.0329 inch (0.835 mm) thick, use screws that comply with ASTM C 1002.

H. For steel framing from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick, use screws that comply with ASTM C 954.

I. Screws for Fastening Composite Nail Base Insulated Roof Sheathing to Metal Roof Deck: Steel drill screws, in type and length recommended by sheathing manufacturer for thickness of sheathing to be attached, with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117. Provide washers or plates if recommended by sheathing manufacturer.

2.07 SHEATHING JOINT-AND-PENETRATION TREATMENT MATERIALS

A. Sealant for Paper-Surfaced Glass-Mat Gypsum Sheathing: Elastomeric, medium-modulus, neutral-curing silicone joint sealant compatible with joint substrates formed by gypsum sheathing and other materials, recommended by sheathing manufacturer for application indicated and complying with requirements for elastomeric sealants specified in Section 07 92 00 "Joint Sealants."

B. Sealant for Glass-Mat Gypsum Sheathing: Silicone emulsion sealant complying with ASTM C 834, compatible with sheathing tape and sheathing and recommended by tape and sheathing manufacturers for use with glass-fiber sheathing tape and for covering exposed fasteners.
   1. Sheathing Tape: Self-adhering glass-fiber tape, minimum 2 inches (50 mm) wide, 10 by 10 or 10 by 20 threads/inch (390 by 390 or 390 by 780 threads/m), of type recommended by sheathing and tape manufacturers for use with silicone emulsion sealant in sealing joints in glass-mat gypsum sheathing and with a history of successful in-service use.

C. Sheathing Tape for Foam-Plastic Sheathing: Pressure-sensitive plastic tape recommended by sheathing manufacturer for sealing joints and penetrations in sheathing.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.

B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.

C. Securely attach to substrate by fastening as indicated, complying with the following:
   1. Table 2304.9.1, "Fastening Schedule," in the ICC's International Building Code.
   2. ICC-ES evaluation report for fastener.

D. Use common wire nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections. Install fasteners without splitting wood.

E. Coordinate wall parapet and roof sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.

F. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

G. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is

forecast.

3.02 GYPSUM SHEATHING INSTALLATION

A. Comply with GA-253 and with manufacturer's written instructions.
   1. Fasten gypsum sheathing to cold-formed metal framing with screws.
   2. Install panels with a 3/8-inch (9.5-mm) gap where non-load-bearing construction abuts structural elements.
   3. Install panels with a 1/4-inch (6.4-mm) gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.

B. Apply fasteners so heads bear tightly against face of sheathing, but do not cut into facing.

C. Horizontal Installation: Install sheathing with V-grooved edge down and tongue edge up. Interlock tongue with groove to bring long edges in contact with edges of adjacent panels without forcing. Abut ends over centers of studs, and stagger end joints of adjacent panels not less than one stud spacing. Attach at perimeter and within field of panel to each stud.
   1. Space fasteners approximately 8 inches (200 mm) o.c. and set back a minimum of 3/8 inch (9.5 mm) from edges and ends of panels.

D. Vertical Installation: Install vertical edges centered over studs. Abut ends and edges with those of adjacent panels. Attach at perimeter and within field of panel to each stud.
   1. Space fasteners approximately 8 inches (200 mm) o.c. and set back a minimum of 3/8 inch (9.5 mm) from edges and ends of panels.

E. Seal sheathing joints according to sheathing manufacturer's written instructions.
   1. Apply elastomeric sealant to joints and fasteners and trowel flat. Apply sufficient amount of sealant to completely cover joints and fasteners after troweling. Seal other penetrations and openings.
   2. Apply glass-fiber sheathing tape to glass-mat gypsum sheathing joints and apply and trowel sealant to embed entire face of tape in sealant. Apply sealant to exposed fasteners with a trowel so fasteners are completely covered. Seal other penetrations and openings.
   3. Air-Barrier and Water-Resistant Glass-Mat Gypsum Sheathing:
   4. Install accessory materials according to sheathing manufacturer's written instructions and details to form a seal with adjacent construction, to seal fasteners, and ensure continuity of air and water barrier.
      a. Coordinate the installation of sheathing with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
      b. Install transition strip on roofing membrane or base flashing, so that a minimum of 3 inches of coverage is achieved over each substrate.
   5. Connect and seal sheathing material continuously to air barriers specified under other Sections as well as to roofing-membrane air barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.
   6. Apply joint sealants forming part of air-barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within

these temperature ranges.

7. Wall Openings: Prime concealed, perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply transition strip preformed silicone extrusion, so that a minimum of 3 inches of coverage is achieved over each substrate. Maintain 3 inches of full contact over firm bearing to perimeter frames, with not less than 1 inch of full contact.
   a. Transition Strip: Roll firmly to enhance adhesion.
   b. Preformed Silicone Extrusion: Set in full bed of silicone sealant applied to walls, frame, and air-barrier material.
8. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, doors, and miscellaneous penetrations of sheathing material with foam sealant.
9. Seal strips and transition strips around masonry reinforcing or ties and penetrations with termination mastic.
10. Seal top of through-wall flashings to sheathing with an additional 6-inch- wide, transition strip.
11. Seal exposed edges of strips at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.
12. Repair punctures, voids, and deficient lapped seams in strips and transition strips extending 6 inches beyond repaired areas in strip direction.

3.03 FIELD QUALITY CONTROL

A. ABAA Quality Assurance Program: Perform examinations, preparation, installation, testing, and inspections under ABAA's Quality Assurance Program.

B. Testing and Inspecting Agency: Owner will engage a qualified testing agency to perform tests and inspections.

C. Inspections: Air-barrier and water-resistant glass-mat gypsum sheathing, accessories, and installation are subject to inspection for compliance with requirements. Inspections may include the following:
   1. Continuity of air-barrier system has been achieved throughout the building envelope with no gaps or holes.
   2. Laps in strips and transition strips have complied with minimum requirements and have been shingled in the correct direction (or mastic has been applied on exposed edges), with no fishmouths.
   3. Termination mastic has been applied on cut edges.
   4. Strips and transition strips have been firmly adhered to substrate.
   5. Compatible materials have been used.
   6. Transitions at changes in direction and structural support at gaps have been provided.
   7. Connections between assemblies (sheathing and sealants) have complied with requirements for cleanliness, surface preparation & priming, structural support, integrity, and continuity of seal.
   8. All penetrations have been sealed.

D. Air barriers will be considered defective if they do not pass tests and inspections.

E. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.

F. Prepare test and inspection reports.

END OF SECTION

SECTION 06 40 23
INTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes the following:
   1. Solid-surfacing-material countertops.

B. Related Sections include the following:
   1. Division 06 Section "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing woodwork and concealed within other construction before woodwork installation.
   2. Division 06 Section "Interior Architectural Woodwork" for interior carpentry exposed to view that is not specified in this Section.

1.02 DEFINITIONS

A. Interior architectural woodwork includes wood furring, blocking, shims, and hanging strips for installing woodwork items unless concealed within other construction before woodwork installation.

1.03 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
   1. Show details full size.
   2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
   3. Show locations and sizes of cutouts and holes for plumbing fixtures faucets and other items installed in architectural woodwork.

C. Samples for Initial Selection:
   1. Shop-applied transparent finishes.
   2. Shop-applied opaque finishes.
   3. Plastic laminates.
   4. PVC edge material.
   5. Thermoset decorative panels.
   6. Solid-surfacing materials.

D. Samples for Verification:
   1. Lumber with or for transparent finish, not less than 5 inches wide by 24 inches long, for each species and cut, finished on 1 side and 1 edge.
   2. Veneer leaves representative of and selected from flitches to be used for transparent-finished

woodwork.

3. Veneer-faced panel products with or for transparent finish, 8 by 10 inches (200 by 250 mm), for each species and cut. Include at least one face-veneer seam and finish as specified.
4. Plastic laminates, 8 by 10 inches (200 by 250 mm), for each type, color, pattern, and surface finish and specified edge material applied to 1 edge.
5. Thermoset decorative-panels, 8 by 10 inches (200 by 250 mm), for each type, color, pattern, and surface finish, with edge banding on 1 edge.
6. Solid-surfacing materials, 6 inches (150 mm) square.
7. Corner pieces as follows:
   a. Cabinet-front frame joints between stiles and rails, as well as exposed end pieces, 18 inches (450 mm) high by 18 inches (450 mm) wide by 6 inches (150 mm) deep.
   b. Miter joints for standing trim.
8. Exposed cabinet hardware and accessories, one unit for each type and finish.

E. Product Certificates: For each type of product, signed by product manufacturer.

F. Woodwork Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

1.04 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance. Shop is a certified participant in AWI's Quality Certification Program.

B. Installer Qualifications: Certified participant in AWI's Quality Certification Program.

C. Source Limitations: Engage a qualified woodworking firm to assume undivided responsibility for production of interior architectural woodwork with sequence-matched wood veneers

D. Quality Standard: Unless otherwise indicated, comply with AWI's "Architectural Woodwork Quality Standards" for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.
   1. Provide AWI Quality Certification Program labels indicating that woodwork complies with requirements of grades specified.

E. Quality Standard: Unless otherwise indicated, comply with WI's "Manual of Millwork" for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.
   1. Provide WI-certified compliance labels indicating that woodwork complies with requirements of grades specified.
   2. The Contract Documents contain selections chosen from options in the quality standard and additional requirements beyond those of the quality standard. Comply with such selections and requirements in addition to the quality standard.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver woodwork until painting and similar operations that could damage woodwork have

been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Project Conditions" Article.

1.06 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F (16 and 32 deg C) and relative humidity between 43 and 70 percent during the remainder of the construction period.

C. Field Measurements: Where woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
   1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being enclosed, and indicate measurements on Shop Drawings.

1.07 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that interior architectural woodwork can be supported and installed as indicated.
   1. Coordinate locations of utilities that will penetrate countertops or backsplashes.

PART 2 - PRODUCTS

2.01 SOLID SURFACE COUNTERTOP, WALL, AND BENCHTOP MATERIALS

A. Solid-Surfacing: Homogeneous solid sheets of filled plastic resin complying with ICPA SS-1.

   1. Manufacturers: Subject to compliance with requirements, provide products indicated in the Finish Legend or by one of the following and sample approved by the Architect:
      a. Avonite, Inc.
      b. E.I. du Pont de Nemours and Company
      c. Formica Corporation
      d. Nevamar Company, LLC; Decorative Products Div.
      e. Wilsonart International; Div. of Premark International, Inc.
   2. Type: Provide Standard type or Veneer type made from material complying with requirements for Standard type, as indicated unless Special Purpose type is indicated.
   3. Colors and Patterns: As indicated by manufacturer's designations in Finish Legend.

B. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged and touch sanded.

2.02 MISCELLANEOUS MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln dried to less than 15 percent moisture content.

B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.

C. VOC Limits for Installation Adhesives and Glues: Use installation adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
   1. Wood Glues: 30 g/L.
   2. Contact Adhesive: 250 g/L.

2.03 FABRICATION, GENERAL

A. Interior Woodwork Grade: Custom.

B. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to ambient relative humidity during fabrication and in installation areas.

C. Complete fabrication, including assembly, finishing, and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
   1. Notify Architect seven days in advance of the dates and times woodwork fabrication will be complete.
   2. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements indicated on Shop Drawings before disassembling for shipment.

D. Shop-cut openings to maximum extent possible to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.
   1. Seal edges of openings in countertops with a coat of varnish.

2.04 SOLID-SURFACING-MATERIAL COUNTERTOPS

A. Grade: Custom.

B. Solid-Surfacing-Material Thickness: 1/2 inch (13 mm).

C. Colors, Patterns, and Finishes: Provide materials and products that result in colors of solid-surfacing material complying with the following requirements:
   1. As selected by Architect from manufacturer's full range.

D. Fabricate tops in one piece, unless otherwise indicated. Comply with solid-surfacing-material manufacturer's written recommendations for adhesives, sealers, fabrication, and finishing.
   1. Fabricate tops with shop-applied edges of materials and configuration indicated.
   2. Fabricate tops with loose backsplashes for field application.

E. Install integral sink bowls in countertops in shop.

F. Drill holes in countertops for plumbing fittings and soap dispensers in shop.

PART 3 - EXECUTION

3.01 PREPARATION

A. Before installation, condition woodwork to average prevailing humidity conditions in installation areas.

B. Before installing architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and back priming.

3.02 INSTALLATION

A. Grade: Install woodwork to comply with requirements for the same grade specified in Part 2 for fabrication of type of woodwork involved.

B. Assemble woodwork and complete fabrication at Project site to comply with requirements for fabrication in Part 2, to extent that it was not completed in the shop.

C. Install woodwork level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb (including tops) to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm).

D. Scribe and cut woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

E. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing as required for complete installation. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork and matching final finish if transparent finish is indicated.

F. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other

supports into underside of countertop.

1. Align adjacent solid-surfacing-material countertops and form seams to comply with manufacturer's written recommendations using adhesive in color to match countertop. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
2. Install countertops with no more than 1/8 inch in 96-inch (3 mm in 2400-mm) sag, bow, or other variation from a straight line.
3. Secure backsplashes to walls with adhesive.
4. Calk space between backsplash and wall with sealant specified in Division 07 Section "Joint Sealants."

G. Refer to Division 09 Sections for final finishing of installed architectural woodwork not indicated to be shop finished.

3.03 ADJUSTING AND CLEANING

A. Repair damaged and defective woodwork, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.

B. Clean, lubricate, and adjust hardware.

C. Clean woodwork on exposed and semi-exposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION

SECTION 07 14 16
COLD FLUID-APPLIED WATERPROOFING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Single-component polyurethane waterproofing.

1.02 RELATED SECTIONS

A. Section 03 30 00 – Cast-in-Place Concrete: Waterproofing membrane applied over concrete foundation.

B. Section 04 21 00 – Brick Masonry Veneer: Brick veneer installed over waterproofing.

C. Section 07 21 00 – Thermal Insulation: Waterproofing applied of rigid insulation board.

D. Section 07 28 00 - Fluid-Applied Membrane Weather Barriers: Weather barrier used in conjunction with waterproofing.

1.03 SUBMITTALS

A. Product Data: For each type of product indicated. Include manufacturer's written instructions for evaluating, preparing, and treating substrate, technical data, and tested physical and performance properties of waterproofing.

B. Product Test Reports: For waterproofing, based on evaluation of comprehensive tests performed by a qualified testing agency.

C. Field quality-control reports.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: A firm that is acceptable to waterproofing manufacturer for installation of waterproofing required for this Project and with a minimum of 5 years' experience.

B. Source Limitations: Obtain waterproofing materials from single source from single manufacturer.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver liquid materials to Project site in original containers with seals unbroken, labeled with manufacturer's name, product brand name and type, date of manufacture, shelf life, and directions for storing and mixing with other components.
B. Store liquid materials in their original undamaged containers in a clean, dry, protected location

and within the temperature range required by waterproofing manufacturer.

C. Remove and replace liquid materials that cannot be applied within their stated shelf life.

D. Protect stored materials from direct sunlight.

1.06 PROJECT CONDITIONS

A. Environmental Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended by waterproofing manufacturer. Do not apply waterproofing to a damp or wet substrate, when relative humidity exceeds 85 percent, or when temperatures are less than 5 °F above dew point.
   1. Do not apply waterproofing in snow, rain, fog or mist, or when such weather conditions are imminent during application and curing period.

B. Maintain adequate ventilation during application and curing of waterproofing materials.

PART 2 - PRODUCTS

2.01 SINGLE-COMPONENT POLYURETHANE WATERPROOFING

A. Basis-of-Design Product: Carlisle Coatings & Waterproofing; MiraSEAL or comparable product by one of the following:
   1. Carlisle Coatings & Waterproofing Inc.
   2. W.R. Meadows Inc: Hydralastic 836
   3. Tremco Incorporated: TREMproof 250GC

B. Single-Component, Elastomeric Waterproofing: Coal-tar and solvent-free, modified polymer that cures to form a flexible, monolithic, waterproof membrane. Comply with ASTM C 836-06 and with manufacturer's written physical requirements.
   1. Waterproofing membrane shall be CCW-MIRASEAL for horizontal surfaces applied at 60 mils for each coat, reinforced by CCW LiquiFiber reinforcing fabric between coats and CCW-MIRASEAL for vertical surfaces applied at 60 mils for each coat, reinforced by CCW LiquiFiber reinforcing fabric between coats and shall meet or exceed the requirements of ASTM C 836.

2.02 ACCESSORY PRODUCTS

A. Surface Primer: is not required for concrete or wood all other surfaces as recommended by manufacturer for each surface encountered.

B. Sealants: Shall be CCW-201 two-component Polyurethane Sealant.

C. Backing Rod: Shall be closed-cell polyethylene foam rod.

D. Flexible Flashing: Shall be as recommended and supplied by coating manufacturer.

E. Protection Course: Shall be CCW Protection Board-H/HS for horizontal surfaces or CCW Protection Board-V for vertical surfaces.

F. Drainage Composite: Shall be CCW MiraDrain as recommended by the manufacturer for each condition.

G. Perimeter Drainage System: Where required shall be CCW Quick DRAIN.

H. Reinforcing: Shall be CCW LiquiFiber reinforcing fabric.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Before any waterproofing work is started the waterproofing applicator shall thoroughly examine all surfaces for any deficiencies. Should any deficiencies exist, the architect, owner, or general contractor shall be notified in writing and corrections made.

B. Condition of Concrete Surfaces:
1. The concrete surfaces shall be of sound structural grade, minimum of 2500 PSI compressive strength, and shall have a wood float or fine broom finish, free of fins, ridges, voids or entrained air holes.
2. Concrete shall be cured by water curing method. Curing compounds must be of the pure sodium silicate type and be approved by the Carlisle representative.
3. Concrete shall be cured at least three (3) days and shall be sloped for proper drainage.
4. Control joints and/or expansion joints shall have been properly installed at strategic points throughout the field of the deck to control cracking caused by deflection and shrinkage.
5. Any required crickets or drains should be installed at the time the main deck is poured. Deck should be monolithic.
6. Voids, rock pockets and excessively rough surfaces shall be repaired with approved non-shrink grout or ground to match the unrepaired areas.
7. Two-stage drains shall have a minimum 3" flange and be installed with the flange flush and level with the concrete surface.
8. Surfaces at cold joints shall be on the same plane.

3.02 SURFACE PREPARATION

A. The concrete surface must be thoroughly clean, dry and free from any surface contaminates or cleaning residue that may harmfully affect the adhesion of the membrane.

B. Install a 1" face, 45 degree cant of CCW-201 polyurethane sealant at all angle changes and inside corners including projections through the deck, walls, curbs, bumpers, etc.

C. All cracks over 1/16" in width and all moving cracks under 1/16" in width shall be saw cut to 1/4" minimum in width and depth. Saw cut a 1/4" by 1/4" kerf around drain flanges. Clean, prime

and fill saw cuts flush with CCW-201 polyurethane sealant.

D. All moving cracks over 1/16" wide and all expansion joints less than 1" wide shall be cleaned, primed, fitted with a backing rod and caulked with CCW-201 polyurethane sealant. For larger joints, contact Carlisle representative.

E. Allow all sealant to cure thoroughly.

F. Apply a 6" wide, 45 mils thick stripe-coat of CCW-MIRASEAL centered over all sealed cracks, hairline cracks, joints, and outside corners.

G. Apply a 45 mil thick stripe-coat of CCW-MIRASEAL over sealant cants and extending 4" onto the horizontal deck and up the vertical wall to the height called out on the drawings (minimum 8" recommended).

H. Allow all detail work to cure overnight.

I. All required metal shall be installed at this time. Apply a stripe coat of CCW-MIRASEAL, 45 mils thick, 6" wide, centered over all transitions from concrete to metal flashings and reinforce with CCW LiquiFiber reinforcing fabric. Allow the stripe coat to cure a minimum of three (3) hours to a firm consistency.

3.03 APPLICATION

A. Priming: Primer is not required for adhesion to dry surfaces, non-porous concrete or wood. Consult CCW for other substrates.

B. Apply the CCW-MIRASEAL in one uniform coat at the rate of one gallon minimum per 25 square feet or as needed in order to obtain a minimum thickness of 60 wet mils, including coverage of detail work. Use a ¼-inch notch squeegee to achieve a uniform thickness, then back roll to smooth coating.

C. Immediately install Carlisle's CCW LiquiFiber reinforcing fabric working the fabric into the wet CCW-MIRASEAL until fabric is saturated, avoiding trapped air, wrinkles and fishmouths. Cut and lay flat wrinkles and fishmouths.

D. In the event the entire surface is not completed in one day and becomes contaminated, prior to beginning application clean an area 6" wide along the edge of the previously applied membrane with a cloth wet with xylene solvent. New work shall overlap the existing work by 6".

E. Allow the first coat of CCW-MIRASEAL to cure three (3) hours minimum to a firm consistency.

F. Apply the second coat of CCW-MIRASEAL at 25 sf/gallon in a uniform consistency of 60 mils over the first coat of CCW-MIRASEAL. Cover the CCW LiquiFiber reinforcing fabric for complete encapsulation.

3.04 PROTECTION COURSE

A. Install Mira-Drain Drainage Composite and CCW Protection Board immediately after flood testing on horizontal surfaces. If flood testing is delayed, install a temporary covering to protect the CCW-MIRASEAL membrane from damage by other trades.

3.05 CURING, PROTECTION, AND CLEANING

A. Cure waterproofing according to manufacturer's written recommendations, taking care to prevent contamination and damage during application stages and curing.
   1. Do not permit foot or vehicular traffic on unprotected membrane.

B. Protect waterproofing from damage and wear during remainder of construction period.

C. Protect installed insulation drainage panels from damage due to ultraviolet light, harmful weather exposures, physical abuse, and other causes. Immediately after installation, provide temporary coverings where insulation will be subject to abuse and cannot be concealed and protected by permanent construction.

D. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION

SECTION 07 21 00
THERMAL INSULATION

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Extruded polystyrene foam-plastic board.
   2. Glass-fiber blanket.
   3. Spray-foam insulation.

B. Related Requirements:
   1. Section 03 30 00 "Brick Masonry" for insulation installed in masonry cells.
   2. Section 06 16 00 "Sheathing" for foam-plastic board sheathing installed directly over steel framing.
   3. Section 07 53 23 “Ethylene-Propylene-Diene-Monomer (EPDM) roofing" for insulation specified as part of roofing construction.
   4. Section 09 29 00 "Gypsum Board" for sound attenuation blanket used as acoustic insulation.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:
   1. Product Data: For adhesives, indicating VOC content.
   2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.

1.03 DELIVERY, STORAGE, AND HANDLING

A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

B. Protect foam-plastic board insulation as follows:
   1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
   2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site until just before installation time.
   3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

1.04 REFERENCES

A. NFPA 285-[06]: Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components, Using the

Intermediate-Scale, Multistory Test Apparatus

B. ASTM E331-[00]: Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors and Curtain Walls by Uniform Static Air Pressure Difference

C. ASTM E2357-[05]: Standard Test Method for Determining Air Leakage of Air Barrier Assemblies

PART 2 - PRODUCTS

2.01 EXTRUDED POLYSTYRENE FOAM-PLASTIC BOARD

A. Extruded Polystyrene Board, Type X: ASTM C 578, Type X, 15-psi (104-kPa) minimum compressive strength; unfaced; maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E 84. R = 7.5 minimum
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. DiversiFoam Products.
      b. Dow Chemical Company (The)
      c. Owens Corning.
   2. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

2.02 GLASS-FIBER BLANKET

A. Glass-Fiber Blanket, Unfaced: ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics. R = 15 minimum.
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. CertainTeed Corporation.
      b. Johns Manville; a Berkshire Hathaway company.
      c. Owens Corning.

2.03 SPRAY-FOAM INSULATION

A. Closed cell polyurethane
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. Dow Chemical Company (The).
      b. Owens Corning.
   2. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
   3. Water Vapor Permeability, ASTM E96, perm-inch = 2.2.
   4. Thermal Resistance, ASTM C518, 75°F mean temp., aged R-value(2) ft2 • h • °F/Btu, Aged Value @ 2" thick = 13.0 min.

2.04 ACCESSORIES

A. Insulation for Miscellaneous Voids:
   1. Glass-Fiber Insulation: ASTM C 764, Type II, loose fill; with maximum flame-spread and smoke-developed indexes of 5, per ASTM E 84.

PART 3 - EXECUTION

3.01 PREPARATION

A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing insulation or vapor retarders, or that interfere with insulation attachment.

3.02 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and applications.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

C. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

D. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

3.03 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION

A. Blanket Insulation: Install in cavities formed by framing members according to the following requirements:
   1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
   2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
   3. Maintain 3-inch (76-mm) clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
   4. For metal-framed wall cavities where cavity heights exceed 96 inches (2438 mm), support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.
   5. Vapor-Retarder-Faced Blankets: Tape joints and ruptures in vapor-retarder facings and seal each continuous area of insulation to ensure airtight installation.
      a. Exterior Walls: Set units with facing placed toward exterior of construction.

b. Interior Walls: Set units with facing placed toward areas of high humidity.

B. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:
   1. Glass-Fiber Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft. (40 kg/cu. m).

3.04 INSTALLATION OF SPRAY-FOAM INSUALTION

A. Install closed-cell spray-foam polyurethane insulation in manufacturer's written instructions.
   1. Maintain proper ventilation.
   2. Apply to the wall cavity once all blocking, insulation board and veneer fasteners have been installed.
   3. Fill all voids solids around openings in exterior walls including windows, storefronts, curtain walls, man doors and overhead doors.
   4. Apply spray polyurethane foam in the cavity and the inside of the stud flanges to ensure that all fastener penetrations are covered.
   5. Apply in two consecutive 1 ½" layers to achieve 3" minimum thickness. Allow foam to cool completely before applying successive layers.

3.04 PROTECTION

A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION

SECTION 07 28 00
FLUID-APPLIED MEMBRANE WEATHER BARRIER

PART 1 - GENERAL

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

1.02 SECTION INCLUDES

A. A 40-mil thickness fluid-applied vapor-permeable membrane of synthetic polymer, fire retardant composition for use as an air and water resistive barrier in exterior walls.

B. Monolithic, fully-adhered membrane and accessory products installed as a continuous air and water resistive barrier assembly over substrates of the Project's opaque walls as indicated on Drawings

C. Air and water resistive barrier assembly providing air and water tight coverage over these conditions
1. Joints between building materials such as sheathing joints, mortar joints and dissimilar materials.
2. Joints around windows, curtain walls, louvers, door frames and other service openings
3. Junctions between walls and floors, between walls at building corners and between walls, roofs and ceilings.
4. Mechanical and electrical penetrations
5. Structural penetrations for canopies, decks, walkways and similar horizontal projections or junctions to the exterior walls
6. Fastener and hardware penetrations used to attach insulation, cladding, trim or other overburden.
7. Termination at footing, roof deck and existing construction
8. Junction to air & water barrier in roof, below grade or other adjacent systems

D. Air and water resistive barrier assembly providing air and water tight coverage while accommodating designed movement at expansion and control joints.

E. E. Air and water resistive barrier assembly performing as a liquid water drainage plane flashed to discharge to the exterior any incidental condensation or water penetration

1.03 RELATED REQUIREMENTS

A. Section 07 14 16 – "Fluid-Applied Waterproofing"

B. Section 07 21 00 – "Thermal Insulation"

C. Section 07 62 00 – "Sheet Metal Flashing and Trim": Metal through-wall flashings

D. Section 07 65 00 – "Flexible Flashings": Self-adhering and EPDM through-wall flashing

E. Section 07 92 00 – “Joint Sealants”for sealant materials and installation.

F. Section 08 11 13 – “Hollow Metal Doors & Frames” for flashing.

G. Section 08 43 13 – “Aluminum Storefronts for flashing.

H. Section 06 16 00 – “Sheathing” for exterior glass-mat sheathing over metal studs.

I. Section 04 20 00 - "Brick Masonry" for masonry ties and flashing installation.

J. Section 06 16 00 - "Sheathing" for wall sheathings and wall sheathing joint-and-penetration treatments.

K. Section 07 21 00 - "Thermal Insulation" for installation of exterior insulation.

1.04 DEFINITIONS

A. Weather Barrier: A combination of materials and accessories that do the following:
   1. Prevent the accumulation of water as a water-resistive barrier.
   2. Minimize the air leakage into or out of the building envelope as a continuous weather barrier.
   3. Provide sufficient water vapor transmission to enable drying as a vapor permeable membrane.

B. Water-Resistive Barrier: A combination of materials and accessories that prevent the accumulation of water within the wall assembly in accordance with IBC Section 1403.2.
   1. Primary Layer: Water-resistive barrier (fluid-applied) installed closest to building interior with all flashings and terminations integrated to this layer.
   2. Secondary Layer: Outermost part of a double-layer system and where drainage is required behind claddings such as stucco, adhered masonry, and installation methods utilizing a lath.

C. Continuous Weather Barrier: The combination of interconnected materials, assemblies, and sealed joints and components of the building envelope that minimize air leakage into or out of building envelope in accordance with ASHRAE 90.1 Section 5.4.3.1.

D. Vapor-Permeable Membrane: The property of having a water-vapor permeance rating of 10 perms or greater, when tested in accordance with the desiccant method using Procedure A of ASTM E 96 in accordance with definition in International Building Code. Vapor-permeable material permits passage of moisture vapor through vapor diffusion.

E. Vapor Diffusion: A slow movement of individual water vapor molecules from regions of higher to lower water vapor concentration (higher to lower vapor pressure).

1.05 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.
   1. Meet with Owner, Architect, Manufacturer's Certified Installer, weather barrier manufacturer's designated field representative, and installers of work that interfaces with or affects weather

barrier.
2. Review methods and procedures related to weather barrier installation, including manufacturer's written instructions.
3. Review and finalize construction, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Examine substrate conditions and finishes for compliance with requirements.
5. Review flashings, special weather barrier details, weather barrier penetrations, and condition of other construction that affects weather barrier.
6. Review weather barrier manufacturer's Project registration and observation process.

1.06 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. For weather barrier, include data on air and water-vapor permeance based on testing in accordance with referenced standards.

B. Sustainable Design Submittals:
   1. Product Data: Including the following information:
      a. Provide Health Product Declarations (HPDs).
      b. Provide Environmental Product Declarations (EPD's).
      c. SDS (formerly MSDS), third-party certifications, or product technical data confirming systems that meet or exceed emissions guidelines for volatile organic compounds (VOCs) and hazardous air pollutants (HAPs), as follows:
   2. Show details of weather barrier at terminations, openings, and penetrations.
   3. Show details of weather barrier applications.

1.07 INFORMATIONAL SUBMITTALS

A. Manufacturer's Instructions: For installation of each product specified.

B. Qualification Data: For Installer

C. Sample Warranty: For manufacturer's warranty.

D. Reports: Field test and inspection reports.

E. Installer's weather barrier manufacturer training certificate.

1.08 PERFORMANCE REQUIRMENTS

A. Installed product and accessories shall exhibit an air leakage rate, infiltration and exfiltration modes, measured after pressure cycling, not to exceed 0.2 L/s*m2 at 75 Pa [0.040 CFM/ft2 at 1.57 PSF] according to ASTM E 2357.

B. Product shall meet the water vapor transmission requirement water resistive coatings used as water resistive barriers: minimum 35 g/m2 /24h (5 Perms), tested to ASTM E 96 water method (B), ICC-ES AC-212, Section 4.4

C. Installed product and accessories shall be tested to NFPA 285 and pass in wall assemblies of the Project or shall pass by engineering judgement.

D. Installed product and accessories shall be recommended by manufacturer for at least 180 days of outdoor exposure.

E. Installed product and accessories shall have an upper service temperature limit of 180°F or higher.

F. Manufacturer shall provide product and accessories which have a minimum installation temperature of 25°F or lower.

G. Product shall be of fire-retardant, non-asphalt synthetic polymer composition.

H. Product shall be minimum 0.040 inch (40 mils) dry thickness membrane. Dry membrane thickness shall be calculated based on field-measured wet mil thickness using a comb gauge and volume % solids of the product. [Example 66% solids membrane applied at minimum 60 wet mils yields a minimum 40 mil thickness membrane].

1.09 QUALITY ASSURANCE

A. Installer Qualifications: A qualified firm that is certified by weather barrier system manufacturer to install manufacturer's product and with a minimum of 5 years' experience.

B. Mockups: Build mockups to set quality standards for materials and execution.
   1. Build integrated mockups of exterior wall assembly as indicated on Drawings, incorporating backup wall construction, external cladding, window, storefront, door frame and sill, insulation, ties and other penetrations, and flashing to demonstrate surface preparation, crack and joint treatment, application of weather barriers, and sealing of gaps, terminations, and penetrations of weather-barrier assembly.
      a. If Architect determines that mockups do not comply with requirements, reconstruct mockups and apply weather barrier until mockups are approved.
   2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
   3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.

1.010 DELIVERY, STORAGE, AND HANDLING

A. Remove and replace liquid materials that cannot be applied within their stated shelf life.

B. Protect stored materials from direct sunlight.

C. Store in a dry environment between 50 and 80 deg F .

1.011 WARRANTY

A. Manufacturer's Product Warranty: Manufacturer agrees to repair or replace weather barrier product that fails in materials within specified warranty period.
   1. Warranty Period: 10 years from date of product purchase.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Source Limitations: Obtain weather barrier assembly components, including weather barrier, weather barrier flashing and foam insulation from same manufacturer as weather barrier.

2.02 WEATHER BARRIER

A. Basis-of-Design Product: Carlisle Coatings & Waterproofing; Barritech VP Air & Vapor Barrier or comparable product by one of the following:
   1. Carlisle Coatings & Waterproofing Inc.
   2. W.R. Meadows Inc
   3. Tremco Incorporated

B. Fluid-Applied Membrane: ASTM E 2357 passed, Air Barrier Association of America (ABAA) evaluated air barrier assembly, and assembly water resistance in accordance with ASTM E 331; with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, when tested in accordance with ASTM E 84; UV stabilized for nine-month exposure; and acceptable to authorities having jurisdiction.
   1. Air Permeance, Product: Not more than 0.001 cfm/sq. ft. at 1.57 lbf/sq. ft. when tested in accordance with ASTM E 2178.
   2. Air Permeance, Assembly: Not more than 0.04 cfm/sq. ft. at 1.57 lbf/sq. ft. when tested in accordance with ASTM E 2357 and evaluated by the ABAA.
   3. Water Penetration Resistance, Product: Hydrostatic-head resistance greater than 92.5 inches in accordance with AATTC 127.
   4. Water Penetration Resistance, Assembly: Assembly wall specimen described in ASTM E 2357 to water resistance in accordance with ASTM E 331 to 10.4 lbf/sq. ft..
   5. Water-Vapor Permeance: Not less than 10 perms in accordance with ASTM E 96/E 96M, Desiccant Method (Procedure A) or not less than 20 perms in accordance with ASTM E 96/E 96M, Water Method (Procedure B).

6. Allowable UV Exposure Time: Not less than nine months, when tested in accordance with ASTM G 155 (accelerated weathering).
7. Flame Propagation Test: Test materials and construction in accordance with NFPA 285.
8. Weather barrier system shall have a VOC content of 50 g/L or less.

2.03 WEATHER BARRIER FLASHING

A. Conformable Weather Barrier Flashing: Composite flashing material composed of micro-creped, polyethylene laminate with a 100 percent butyl-based adhesive layer; AAMA 711 Class A (no primer), Level 3 thermal exposure of 176 deg F for seven days.
   1. Basis-of-Design Product: Carlisle Coatings & Waterproofing; Barribond VP Air & Vapor Barrier or comparable product by one of the following:
      a. Carlisle Coatings & Waterproofing Inc.
      b. W.R. Meadows Inc
      c. Tremco Incorporated
   2. Conformability: Able to create a seamless sill pan extending up the jambs without cuts, patches, or fasteners.
   3. Water Penetration: No leakage at 15 psf in accordance with ASTM E 331.
   4. Low Temperature Adhesion: Exceeds minimum value of 1.5 lb./in. at 25 deg F as Class A (without primer use).
   5. Adhesion After Water Immersion: Exceeds minimum value of 1.5 lb./in., after AAMA 800, Sections 2.4.1.3.1/2.4.1.4.3 Test B.

B. ACCESSORIES
   1. Liquid Detail Flashing: Carlisle Coatings & Waterproofing: Barribond
      a. Silane-terminated polyether, minimum 90% solids.
      b. ASTM C 920 Type S, Grade NS, Class 25,
      c. NT. 0.040 inch (40 mil) thickness application
   2. Detail Sealant: Barribond
   3. Transition Membrane: CCW SURE-SEAL Pressure-Sensitive Elastoform
   4. Transition Membrane Primer: SURE-SEAL HP-250 Primer, SURESEAL EP-95 Splicing Cement or SURE-SEAL Low VOC EPDM Primer
   5. Fill Compound: 2-part, non-sag polyurethane sealant: CCW-703
      a. Insultation Adhesive: Barribond

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
   1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
   2. Verify that substrates have cured and aged for minimum time recommended in writing by weather barrier manufacturer.
   3. Verify that substrates are visibly dry and frost-free.

4. Apply accessory products only to clean and dry surfaces.
5. Verify that substrates are free of efflorescence and mold.
6. Verify that masonry joints are flush and filled with mortar.
7. Verify that top-of-wall system has been capped or covered to prevent water getting behind the facade and into wall cavity.
8. Verify continuous path for moisture drainage.
    a. Verify that continuous path for drainage is not blocked or disrupted, which results in excess moisture buildup in wall cavity.
9. Verify that surfaces to receive weather barrier are above grade.

B. Verify that substrate and surface conditions are in accordance with commercial weather barrier manufacturer recommendations prior to installation.
    1. Verify that rough sill framing for doors and windows slopes downward towards the exterior and is level across width of opening.

C. Verify air and surface temperatures are above 25 deg F with a maximum surface temperature of 140 deg F . Do not install once ambient temperature exceeds 95 deg F , unless surface is shaded.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Clean, prepare, treat, fill, and seal substrate and joints and cracks in substrate in accordance with manufacturer's written instructions and details. Provide clean, dust-free, and dry substrate for air-barrier application.

B. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.

C. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate-patching material.

D. Remove excess mortar from masonry ties, shelf angles, and other obstructions.

E. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.

F. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless-steel sheet mechanically fastened to structural framing to provide continuous support for air barrier.

G. When spraying is method of application, taper ends of the joint treatment to assist maintaining a wall system free of pinholes and voids.

H. Treat all non-moving transition joints to beams, columns, and dissimilar materials by applying a 3-inch- (50-mm-) wide by 60-mil- (1.5-mm-) thick coat of fluid-applied flashing across the joint.
    1. Apply 25-mil- thick coat of fluid-applied flashing, extending a minimum 3 inches on each surface, and treat the following conditions:

2. Joints up to 1/4 inch.
3. Joints 1/4- to 1/2-inch; reinforce with fiberglass-mesh tape.
4. Joints and transitions up to 1 inch; treat using strip flashing.

I. Bridge isolation joints and discontinuous wall-to-wall, deck-to-wall, and deck-to-deck joints with air-barrier accessory material that accommodates joint movement in accordance with manufacturer's written instructions and details.

J. When spraying is method of application, taper ends of fluid applied corner treatment to wall substrate.

K. Treat inside and outside corners by applying a 25-mil- thick coat of fluid applied weather barrier a minimum 3 inches on each adjoining surface. Apply fillet bead of fluid-applied sealant to inside corners to ensure continuity. Alternatively, treat corners using strip flashing. Press strip flashing into inside corners; ensure that it is fully adhered to substrate.

L. Seal penetrations using fluid-applied flashing or sealant. Extend fillet bead 1/2 inch onto both surfaces.

M. Treat embedded masonry anchors by applying a coat of fluid-applied weather barrier or fluid-applied flashing around base of the anchor.

3.03 ACCESSORIES INSTALLATION

A. Install accessory materials in accordance with air-barrier manufacturer's written instructions and details to form a seal with adjacent construction and ensure continuity of air and water barrier.
1. Coordinate installation of air barrier with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
2. Install transition strip on roofing membrane or base flashing, for a minimum 3 inches coverage over each substrate.
3. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate and allow to dry.
4. Use recommended primer when applying self-adhered flashing products on concrete, masonry, and fiber faced exterior gypsum board substrates. Priming is generally not required for adhering self-adhered flashing products to wood. However, adverse weather conditions or colder temperatures may require a primer to promote adhesion. Priming is not required when applying fluid-applied products, except on cut edges of exterior gypsum sheathing.
5. Apply pressure along entire surface of strip flashing for good bond using a J-roller or firm hand pressure. Remove all wrinkles and bubbles by smoothing surface and repositioning as necessary.

B. Connect and seal exterior wall air-barrier material continuously to roofing-membrane air barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.

C. When applying self-adhered flashing products over a cured fluid-applied membrane, first apply a

wet bed of fluid-applied product.

1. Apply double-sided butyl tape to back of support bracket at fastener location.
2. Embed support bracket into an additional wet bed of fluid applied product.
3. Adhere butyl-based flashing patch to wall at fastener location.
4. Use alternate method as approved by the manufacturer.

D. At end of each working day, seal top edge of strips and transition strips to substrate with manufacturer approved product.

E. Apply joint sealants forming part of air-barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

F. Flashing Sill Area for Windows and Doors:

1. Use 8-inch- wide conformable flashing. Install rigid back dams are required or desired, one option to use is a 3/4-inch corner guard (back dam), cut to length of sill, and nailed into place on interior edge of sill prior to installation of 9-inch- wide conformable flashing. Afterward, install 9-inch- wide conformable flashing over sill and corner guard back dam.
2. Install without stretching conformable flashing when installing along sills or jambs. Conformable flashing is intended to be stretched when covering corners or curved sections.

G. Apply fluid-applied flashing products from head of opening down. Use a corner trowel to smooth corners.

H. Repairs:

1. Coat small damaged areas with layer of fluid-applied product.
2. Reinforce large damaged areas with fiberglass mesh or replace damaged substrate before reapplying fluid-applied product.

3.04 PRIMARY WEATHER BARRIER MATERIAL INSTALLATION

A. Apply air-barrier material to form a seal with strips and transition strips, and to achieve a continuous air barrier in accordance with air-barrier manufacturer's written instructions and details. Apply air-barrier material within manufacturer's recommended application temperature ranges.

1. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate and allow it to dry.
2. Limit priming to areas that will be covered by air-barrier material on same day. Reprime areas exposed for more than 24 hours.
3. Where multiple prime coats are needed to achieve required bond, allow adequate drying time between coats.
    a. Fluid applied products may be overcoated once a touch-free skin has formed. Exterior insulation and cladding may be installed once the membrane has cured sufficiently to resist damage during installation.

B. Apply weather barrier material in accordance with weather barrier manufacturer's written instructions and recommendations.

1. Roller Application:
   a. Nap rolling: Use a roller cover with a 1/2- to 3/4-inch nap.
2. Spray Application:
   a. Mask off adjoining surfaces not covered by weather barrier to prevent spillage and overspray affecting other construction.
   b. Use spray guard.
   c. Back Rolling: Use a roller cover with a 1-1/2- to 3/4-inch nap. Apply fluid-applied product in a single coat at 25 mils thick. Control thickness by applying appropriate volume over a marked area and spot checking with a wet-mil gauge.

C. Integrate fluid-applied product with through-wall flashing and window and door flashing by overlapping flashing with fluid-applied product a minimum 3 inches.

D. Inspect surfaces to ensure that fluid-applied products are continuous and free of any voids or pinholes.

E. Do not cover air barrier until it has been tested and inspected by the testing agency.

F. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air-barrier components.

3.05 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified third-party testing agency to perform tests and inspections.

B. Inspections: Air-barrier materials, accessories, and installation are subject to inspection for compliance with requirements. Inspections may include the following:
   1. Continuity of air-barrier system has been achieved throughout the building envelope without gaps, holes, or pinholes.
   2. Air-barrier dry film thickness.
   3. Continuous structural support of air-barrier system provided.
   4. Masonry and concrete surfaces are smooth, clean, and free of cavities, protrusions, and mortar droppings.
   5. Site conditions for application temperature, and dryness of substrates are maintained.
   6. Maximum exposure time of materials to UV deterioration not exceeded.
   7. Surfaces primed, where applicable.
   8. Laps in strips and transition strips comply with minimum requirements, are shingled in correct direction (or mastic applied on exposed edges), and are without fishmouths.
   9. Termination mastic applied on cut edges.
   10. Strips and transition strips firmly adhered to substrate.
   11. Compatible materials used.
   12. Transitions at changes in direction and structural support at gaps provided.
   13. Connections between assemblies (air-barrier and sealants) comply with requirements for cleanliness, surface preparation and priming, structural support, integrity, and continuity of seal.
   14. Each penetration sealed.

C. Field Quality Control Testing: Perform the following test on representative areas of structural sealant glazed curtain walls.
   1. Air Infiltration Whole Building: ASTM E 779 at not more than 0.40 cfm/sf.
   2. Water Penetration: ASTM E 1105 at a minimum uniform static-air-pressure differential of 0.67 times the static-air-pressure differential specified for laboratory testing in "Performance Requirements" Article in Part 2, but not less than 10.4 lbf/sq. ft.. No water penetration shall occur as defined in ASTM E 1105.
   3. Perform a minimum of two tests in areas as directed by Architect.
   4. Adhesion Testing: Air-barrier assemblies will be tested for required adhesion to substrate in accordance with ASTM D 4541 for each 600 sq. ft. of installed air barrier or part thereof.

D. Air barriers will be considered defective if they do not pass tests and inspections.
   1. Apply additional air-barrier material, in accordance with manufacturer's written instructions, where inspection results indicate insufficient thickness.
   2. Remove and replace deficient air-barrier components for retesting as specified above.

E. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.

F. Prepare test and inspection reports.

3.06 CLEANING AND PROTECTION

A. Protect air-barrier system from damage during application and remainder of construction period, in accordance with manufacturer's written instructions.
   1. Protect air barrier from exposure to UV light and harmful weather exposure as recommended in writing by manufacturer. If exposed to these conditions for longer than recommended, remove and replace air barrier or install additional, full-thickness, air-barrier application after repairing and preparing the overexposed materials in accordance with air-barrier manufacturer's written instructions.
   2. Protect air barrier from contact with incompatible materials and sealants not approved by air-barrier manufacturer.

B. Clean spills, stains, and soiling from construction that would be exposed in the completed work using cleaning agents and procedures recommended in writing by manufacturer of affected construction.

C. Remove masking materials after installation.

END OF SECTION

SECTION 07 42 13
METAL COMPOSITE WALL PANELS

PART 1 - GENERAL

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

1.02 SUMMARY

A. Section includes metal composite material wall panels.

1.03 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.
   1. Meet with Owner, Architect, Owner's insurer if applicable, metal composite material panel Installer, metal composite material panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects metal composite material panels, including installers of doors, windows, and louvers.
   2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
   3. Review methods and procedures related to metal composite material panel installation, including manufacturer's written instructions.
   4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
   5. Review flashings, special siding details, wall penetrations, openings, and condition of other construction that affect metal composite material panels.
   6. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
   7. Review temporary protection requirements for metal composite material panel assembly during and after installation.
   8. Review procedures for repair of panels damaged after installation.
   9. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.

B. Shop Drawings:
   1. Include fabrication and installation layouts of metal composite material panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment assembly, trim, flashings, closures, and accessories; and special details.

2. Accessories: Include details of the flashing, trim and anchorage, at a scale of not less than 1-1/2 inches per 12 inches.

C. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.
   1. Metal Composite Material Panels: 12 inches x 12 inches long by actual panel width. Include fasteners, closures, and other metal composite material panel accessories.

1.05 CLOSEOUT SUBMITTALS

A. Maintenance Data: For metal composite material panels to include in maintenance manuals.

1.06 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.07 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide metal composite material panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 330:
   1. Wind Loads: As indicated on Drawings.
   2. Other Design Loads: As indicated on Drawings
   3. Deflection Limits: For wind loads, no greater than 1/180 of the span.

B. ASTM E 331 in "Water Penetration under Static Pressure" Paragraph below indicates that "water contained within drainage flashings, gutters, and sills is not considered failure."

C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E 331 at the following test-pressure difference:
   1. Value in first option in "Test-Pressure Difference" Subparagraph below is equivalent to a 34-mph (55-km/h) wind and is ASTM E 331 default. Products tested to value in second option below, equivalent to a 50-mph wind (80-km/h), are widely available. Revise to suit Project.
   2. Test-Pressure Difference: 6.24 lbf/sq. ft..

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
   1. Differential values (for aluminum in particular) in "Temperature Change (Range)" Subparagraph below are suitable for most of the U.S.; revise to suit Project.
   2. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces

E. Fire Propagation Characteristics: Metal composite material wall panel system passes NFPA 285 testing.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, metal composite material panels, and other manufactured items so as not to be damaged or deformed. Package metal composite material panels for protection during transportation and handling.

B. Unload, store, and erect metal composite material panels in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack metal composite material panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal composite material panels to ensure dryness, with positive slope for drainage of water. Do not store metal composite material panels in contact with other materials that might cause staining, denting, or other surface damage.

D. Retain strippable protective covering on metal composite material panels during installation.

E. Copper Panels: Wear gloves when handling to prevent fingerprints and soiling of surface.

1.09 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal composite material panels to be performed according to manufacturers' written instructions and warranty requirements.

1.010 COORDINATION

A. Coordinate metal composite material panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.011 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal composite material panel systems that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Structural failures including rupturing, cracking, or puncturing.
      b. Deterioration of metals and other materials beyond normal weathering.
   2. Finish Warranty Period: 20 years from date of Substantial Completion.

B. Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal composite material panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
   1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
      a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
      b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
      c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

PART 2 - PRODUCTS

2.01 METAL COMPOSITE MATERIAL WALL PANELS

A. Metal Composite Material Wall Panel Systems: Provide factory-formed and -assembled, metal composite material wall panels fabricated from two metal facings that are bonded to a solid, extruded thermoplastic core; formed into profile for installation method indicated. Include attachment assembly components, panel stiffeners, and accessories required for weathertight system.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide or comparable product by one of the following:
      a. Alcoa Architectural Products (USA).; Reynobond FR ColorWeld 500
      b. Alucobond; 3A Composites USA, Inc.; Alucobond Plus.

B. Aluminum-Faced Composite Wall Panels Formed with 0.020-inch- thick, coil-coated aluminum sheet facings.
   1. Panel Thickness: 0.157 inches.
   2. Core: FR.
   3. Exterior Finish: Two-coat fluoropolymer minimum.
   4. Color:
      a. Reynobond – ColorWeld 500 - Konig Blue.
      b. Alucobond – Architect will select from Classic Collection

C. Attachment Assembly Components: Formed from extruded aluminum.

2.02 MISCELLANEOUS MATERIALS

A. Miscellaneous Metal Subframing and Furring: ASTM C 645, cold-formed, metallic-coated steel sheet ASTM A 653/A 653M, G90 coating designation or ASTM A 792/A 792M, Class AZ50 aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal composite material panel system.

B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal composite material panels unless otherwise indicated.

C. Flashing and Trim: Provide flashing and trim formed from same material as metal composite material panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal composite material panels.

D. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal composite material panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.

E. Panel Sealants: ASTM C 920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal composite material panels and remain weathertight; and as recommended in writing by metal composite material panel manufacturer.

2.03 FABRICATION

A. General: Fabricate and finish metal composite material panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

B. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.
   1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
   2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
   3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
   4. Sealed Joints: Form non-expansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
   5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
   6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.
      a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal wall panel manufacturer for application but not less than thickness of metal being secured.

2.04 FINISHES

A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in

same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Aluminum Panels and Accessories:
   1. Two-Coat Fluoropolymer: AAMA 620. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal composite material panel supports, and other conditions affecting performance of the Work.
   1. Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal composite material wall panel manufacturer.
      a. Ensure that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

B. Examine roughing-in for components and assemblies penetrating metal composite material panels to verify actual locations of penetrations relative to seam locations of metal composite material panels before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and metal composite material panel manufacturer's written recommendations.

3.03 METAL COMPOSITE MATERIAL PANEL INSTALLATION

A. General: Install metal composite material panels according to manufacturer's written instructions in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to supports unless otherwise indicated. Anchor metal composite material panels and other components of the Work securely in place, with provisions for thermal and structural movement.
   1. Shim or otherwise plumb substrates receiving metal composite material panels.
   2. Flash and seal metal composite material panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal composite material panels are installed.
   3. Install screw fasteners in predrilled holes.
   4. Locate and space fastenings in uniform vertical and horizontal alignment.

5. Install flashing and trim as metal composite material panel work proceeds.
6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
7. Align bottoms of metal composite material panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.

B. Fasteners:
   1. Aluminum Panels: Use aluminum or stainless-steel fasteners for surfaces exposed to the exterior; use aluminum or galvanized-steel fasteners for surfaces exposed to the interior.

C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal composite material panel manufacturer.

D. Usually retain "Attachment Assembly, General" Paragraph below with either "Installation" Paragraph or one of "Clip Installation," "Subgirt-and-Spline Installation," "Track-Support Installation," or "Rainscreen-Principle Installation" paragraphs below.

E. Attachment Assembly, General: Install attachment assembly required to support metal composite material wall panels and to provide a complete weathertight wall system, including subgirts, perimeter extrusions, tracks, drainage channels, panel clips, and anchor channels.

   1. Include attachment to supports, panel-to-panel joinery, panel-to-dissimilar-material joinery, and panel-system joint seals.

F. Retain "Installation" Paragraph below for manufacturer's standard installation method, or delete and retain one of "Clip Installation," "Subgirt-and-Spline Installation," "Track-Support Installation," or "Rainscreen-Principle Installation" paragraphs.

G. Installation: Attach metal composite material wall panels to supports at locations, spacings, and with fasteners recommended by manufacturer to achieve performance requirements specified.
   1. Wet Seal Systems: Seal horizontal and vertical joints between adjacent metal composite material wall panels with sealant backing and sealant. Install sealant backing and sealant according to requirements specified in Section 07 92 00 "Joint Sealants."
   2. Dry Seal Systems: Seal horizontal and vertical joints between adjacent metal composite material wall panels with manufacturer's standard gasket system.
   3. Rainscreen Systems: Do not apply sealants to joints unless otherwise indicated.

H. "Subgirt-and-Spline Installation" Paragraph below describes Firestone's "UNA-FAB Series 1500" panels.

I. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
   1. Install components required for a complete metal composite material panel assembly including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal composite material panel manufacturer; or, if not

indicated, provide types recommended in writing by metal composite material panel manufacturer.

J. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.
   1. Install exposed flashing and trim that is without buckling and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof performance.
   2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

3.04 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align metal composite material wall panel units within installed tolerance of 1/4 inch in 20 feet, non-accumulative, on level, plumb, and location lines as indicated, and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.05 FIELD QUALITY CONTROL

A. Water-Spray Test: After installation, test area of assembly where identified by Architect for water penetration according to AAMA 501.2.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect completed metal composite material wall panel installation, including accessories.

C. Metal composite material wall panels will be considered defective if they do not pass test and inspections.

D. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.

E. Prepare test and inspection reports.

3.06 CLEANING AND PROTECTION

A. Remove temporary protective coverings and strippable films, if any, as metal composite material panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal composite material panel installation, clean finished surfaces as recommended by metal composite material panel manufacturer. Maintain in a clean condition during construction.

B. After metal composite material panel installation, clear weep holes and drainage channels of

obstructions, dirt, and sealant.

C. Replace metal composite material panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

07 50 36 - TOTAL ROOFING SYSTEM WARRANTY

State of Tennessee

SBC Project Number	30 Warranty Period (Years)	Warranty Number

Institution (Owner) Campus, Building and address

Roofing System Manufacturer ("Manufacturer") and address

Roofing System Manufacturer Contact	Phone	email

Manufacturer Authorized Roofing Applicator ("Roofing Contractor):, and address

Designer	General Contractor (if different from applicator above)

The Roofing System Manufacturer, (Manufacturer) warrants to the State of Tennessee, Institution identified above (Owner) of the above building, that subject to the Terms, Conditions, and Limitations stated in this no dollar limit (NDL) warranty, the Manufacturer will repair any leak in the Total Roofing System installed by a Manufacturer authorized roofing applicator (Roofing Contractor) for a period stated above commencing with the date of Substantial Completion. The Manufacturer will repair or replace system defects or failures.

THE TOTAL ROOFING SYSTEM COMPONENTS are defined as the following; all materials as manufactured or authorized by the Manufacturer: including, but not limited to: membrane, flashings, counterflashings, adhesives and sealants, insulation, cover boards, fasteners, fastener plates, fastening bars, metal work, insulation adhesives, and any other products utilized in this installation. (Note below additional materials or exceptions from above)**:**

THE ROOFING CONTRACTOR CERTIFIES that the Total Roofing System was installed in strict accordance with the Manufacturer's recommendations utilizing only the Manufacturer's authorized products to install the Total Roofing System and that all products were protected while in their possession prior to installation and had no moisture or water trapped in the Total Roofing System. The Roofing Contractor certifies that all necessary steps were taken to ensure that all conditions were met for the issuance of The Total Roofing System Warranty by the Manufacturer.

Roofing Contractor	Authorized Signature

Print or Type Name	Title	Date

THE MANUFACTURER WARRANTS that if it cannot supply a specified product for inclusion in a Total Roofing System Warranty, the Roofing Contractor must obtain prior written approval from the Manufacturer for all products not supplied by the Manufacturer to be incorporated in the Total Roofing System Warranty. The Manufacturer will issue a Total Roofing System Warranty. In addition to a final inspection of the completed installation by the Manufacturer, the Manufacturer is also entitled to supplement their final field inspection with the Roofing Contractors above certification. There will be NO exceptions or exclusions to the Total Roofing System Warranty based upon products used or installation issues by the authorized Roofing Contractor, provided all materials installed are provided or authorized by the Roofing System Manufacturer.

Manufacturer	Authorized Signature

Print or Type Name	Title	Date

07 50 36 - TOTAL ROOFING SYSTEM WARRANTY

ROOFING SYSTEM INFORMATION

☐ New Roof ☐ Reroof

Warranty Number

Area of Roof Installed (SF) | Date of Substantial Completion | Date of Warranty Expiration

TOTAL ROOFING SYSTEM COMPONENTS – list all that apply:

Type of Roof deck(s)

Type of metal flashing / trim / coping, etc.

Type of vapor barrier

Type of air barrier

Type and thickness of flat insulation | Method of attachment

Type and slope of tapered insulation | Method of attachment

Type of recovery board | Method of attachment

Type of flashing | Method of attachment

Membrane type and color

MANUFACTURER'S MEMBRANE INFORMATION
List manufacturer's roll identification for ALL rolls of used: If additional space is needed, attach additional sheet

MANUFACTURER FINAL INSPECTION performed by**:**

Print or type name and title | Date | Signature

Designer Representative present for Final Inspection:

Print or type name and title

Owner Representative present for Final Inspection: (when practical)

Print or type name and title

07 50 36 - TOTAL ROOFING SYSTEM WARRANTY

TERMS, CONDITIONS, AND LIMITATIONS

Warranty Number

1. Owner shall provide the Manufacturer with written notice within thirty (30) days of the discovery of any leak(s) in the roof system.

2. The Manufacturer shall within fourteen (14) calendar days, commencing with receipt of written notice from the Owner, inspect the roofing system in the presence of the Owner's representative (when practical) and if the cause(s) of the leak(s) is found the responsibility of the Manufacturer under this warranty, promptly make or cause to be made, the repair(s) or replacements(s) necessary to return the roofing system to the condition which is watertight and remediate moisture. All repair expenses incurred in connection herewith will be the responsibility of and borne by the Manufacturer.

3. If upon joint inspection by the Manufacturer and the Owner's representative of the roofing system as provided in Paragraph 2, the cause(s) of any leak(s) is found not the responsibility of the Manufacturer under this warranty, the Manufacturer will immediately advise the Owner of the type and extent of repair(s) required to be made at the Owner's expense and if such repair(s) be promptly and reasonably made by the Manufacturer, this warranty will remain in effect for the unexpired portion of the warranty period; otherwise, this warranty will become null and void with respect to the area(s) or item(s) affected.

4. In the event the Manufacturer and Owner disagree as to the cause(s) and responsibility of the leak(s), then the Owner, without prejudice to any other remedy Owner may have, may make repair(s) of any leak(s) in accordance with Manufacturer recommendations if timely made available. Such action by the Owner shall not constitute a violation of this warranty. The Owner reserves the right to pursue reimbursement from the Manufacturer for all cost(s) and expense(s) of such repair(s), subject to the Manufacturer's responsibility under this warranty. If it is determined that the Manufacturer has no responsibility for the leak(s) under this warranty, the Owner will reimburse the Manufacturer for direct expenses encountered for trips requested by the Owner after the initial inspection.

5. In the event an emergency condition arises where, in the reasonable opinion of the Owner immediate reasonable repair(s) are necessary to avoid substantial damage to the building or its contents and the Manufacturer advises the Owner in writing of its inability, for reasons beyond its control, to inspect and repair the roof system as necessary within fourteen (14) days of written notification from the Owner, then the Owner may make such temporary repair(s) as in the opinion of the Owner are essential and necessary and such action by the Owner shall not constitute a violation of this warranty. In these circumstances, the Manufacturer shall reimburse the Owner for all reasonable costs and expenses of such temporary repair(s) subject to the Manufacturer's responsibility under this warranty.

6. In the event the Manufacturer fails to respond to written notification of known or suspected leak(s) as provided in Paragraph 2, the Owner may, after fourteen (14) days following receipt by the Manufacturer of an additional written notice and without prejudice to any other remedy he may have, make permanent repair(s) of any leak(s) and recover all reasonable costs and expenses of such repair(s) from the Manufacturer. The Manufacturer will, upon demand by the Owner, promptly reimburse the Owner these reasonable repair costs and expenses. Such action by the Owner shall in no way negate the responsibilities of the Manufacturer under this warranty for the unexpired portion of the warranty period.

7. Except as provided in Paragraphs 4, 5 & 6, any alterations of the roofing system after completion and acceptance including the placement of fixtures, utilities and equipment on or through the roof or additions thereto, will render this warranty null and void with respect to the area(s) or item(s) affected unless prior written authorization of such alterations of the roof system or additions thereto is given by the Manufacturer. Such authorization will not be unreasonably withheld.

8. This warranty shall not be applicable to the extent the roofing system sustains damage(s) by any of the following:

- **(a)** Acts of God and natural disasters, including but not limited to lightning, hurricanes, tornadoes, and earthquakes, winds of (3 second) peak gust speeds of 72 MPH or higher (determined by the nearest US Weather Station measured at 10 meters above ground or at the given address if reliable pinpoint wind data is available for the address), hail with a diameter greater than two inches;
- **(b)** Acts of negligence (whether of omission or commission), fire, accidents, or misuse, including but not limited to vandalism, civil disobedience, or acts of war, provided same are not caused by the Manufacturer and/or the Contractor.
- **(c)** Failure by the Owner to use reasonable care in maintaining the roof and appurtenances, provided same caused the leak(s) or item(s) affected; or,
- **(d)** For built-up and modified bitumen roofs: A roof design or specification authorized by the Owner with less than 1/8" per foot slope for drainage.
- **(e)** Building design issues that affect the performance of the Total Roofing System.

9. When the roof system has been damaged by any of the foregoing causes, repair(s) shall be at the Owner's expense and such repair(s) shall be made as provided in Paragraph 3; otherwise, this warranty will become null and void with respect to the area(s) or item(s) affected.

Warranty Number

10. Until such time as the third year of this warranty has expired, the Manufacturer's obligations hereunder shall be joint and several with the Contractor. For the purpose of this paragraph, all of the Contractor's actions, whether of omission or commission, that are subject to this warranty are likewise the actions of the Manufacturer hereunder and shall in no way negate or reduce the responsibilities of the Manufacturer under this warranty.

11. As part of the repair of leaks, the Manufacturer shall replace roof insulation included in the this warranty that become damaged as a result of a roof leak, provided the roof leak is not excluded under the Terms, Conditions, and Limitations set forth in this warranty. The replacement of damaged roof insulation shall be limited to those boards that have lost the structural integrity necessary to support and restrain the System when it is subjected to dynamic loads such as typical roof service traffic, winds up to 72 mph, hail up to two inched in diameter, and periodic accumulations of water, snow, or ice. In the event that roof insulation is damaged as a result of a roof leak excluded under the Terms, Conditions and Limitations set forth in this warranty, the Manufacturer will advise the Owner of the type and extent of insulation and recovery board replacement to be made at the Owner's expense. Failure by the Owner to properly make these repairs in a reasonable manner using a Manufacturer licensed applicator and within a reasonable period of time shall render this Warranty null and void in the area of the damage. Neither the Manufacturer nor the Owner shall have any obligation to replace roof insulation and recovery board if the area affected by the leak is less than fifty (50) square feet.

12. The Manufacturer certifies that it:

- **(a)** Manufacturers or purchases products for the purpose of designing, developing, and marketing a roof system;
- **(b)** Provides recommendations, specifications, and details for the roofing system materials and installation;
- **(c)** Trains and authorizes Roofing Contractors;
- **(d)** Provides technical assistance to Roofing Contractors;
- **(e)** Approves or prepares shop drawings; and,
- **(f)** Provides a technical representative employed by the Manufacturer for the final inspection, and to all inspections required by this warranty.

13. During the period of this warranty, the Manufacturer, its agents or employees, will have free access to the roof during regular business hours of the Owner.

14. Owner shall be responsible for the costs associated with the removal and replacement, as well as any damage caused by the removal and replacement of any overburden, super strata, or overlays, either permanent or temporary, excluding accepted stone ballast or pavers, as necessary to expose the system for inspection and/or repair.

15. Alterations or repairs to the System that are not completed in accordance with Manufacturer's published specifications, not completed by an authorized contractor, and/or where current notification procedures were not followed are excluded and this warranty will become null and void with respect to the area(s) or item(s) affected.

16. For a 30 year single ply membrane roof system, the Total Roofing System Warranty shall cover the proper repair of leaks caused by unintentional, accidental and occasional puncture damage to the membrane as a result of normal rooftop inspection, maintenance or service; however, it does not cover damage caused by snow removal or damage caused by other trades during construction. There shall be no man hour limitation per year on accidental puncture repairs covered by this provision of the warranty. Resulting wet insulation shall be treated as set forth in Paragraph 11 above.

TOTAL ROOFING SYSTEM MANUFACTURER

Roofing System Manufacturer name

Authorized Signature & Date

Print or Type Name & Title

SECTION 07 53 23
ETHYLENE-PROPYLENE-DIENE-MONOMER (EPDM) ROOFING

PART 1 - GENERAL

1.01 SUMMARY

A. This contractor shall furnish all labor and materials and perform all work required for the installation of a 90 mil. Fully-Adhered Non-reinforced Single-Ply EPDM Membrane roof system including but not limited to:
   1. Single-Ply Membrane Roof System
   2. Roof & Deck Rigid Insulation.
   3. Roof terminations and expansion joints.
   4. Pre-manufactured parapet coping.
   5. Roof Edge Flashing.
   6. Walkway pads

1.02 RELATED SECTIONS

A. Division 05 Section “Steel Deck” for steel deck.

B. Division 06 Section "Rough Carpentry " for wood nailers, curbs, and blocking.

C. Division 07 Section "Sheet Metal Flashing and Trim" for metal roof penetration flashings, flashings, and counter flashings.

D. Division 07 Section "Joint Sealants" for joint sealants, joint fillers, and joint preparation.

1.03 DEFINITIONS

A. Roofing Terminology: See ASTM D 1079 and glossary of NRCA's "The NRCA Roofing and Waterproofing Manual" for definitions of terms related to roofing work in this Section.

1.04 PERFORMANCE REQUIREMENTS

A. General Performance: Installed membrane roofing and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Membrane roofing and base flashings shall remain watertight.

B. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by membrane roofing manufacturer based on testing and field experience.

C. The Sure-White EPDM membrane meets the CRRC (Cool Roof Rating Council) requirements for

reflectance and emittance. When tested in accordance with ASTM C1549, the Sure-White material has an initial solar reflectance of .76 and a 3-year aged reflectance of .64. The material has also been tested for emittance in accordance with ASTM C1371; an initial emittance of .90 and a 3-year aged emittance of .87 were achieved.

D. The Sure-Seal EPDM Membrane exceeds 41,580 kJ/m2 under Xenon-Arc UV Light testing used for testing "Resistance to Outdoor (Ultraviolet) Weathering." (ASTM D 4637 Specification requires a 7560 kJ/m2 minimum total radiant exposure at 70 W/m2 irradiance at 176oF black panel temperature to pass.) The membrane shows no visible signs of cracking or crazing.

E. Sure-White Membrane achieves a zero (no growth) rating in the ASTM G21 test for fungi growth.

1.05 REFERENCES

A. ANSI/ SPRI ES-1 - Wind Design Standard for Edge Systems Used with Low Slope Roof Systems".

B. American Society for Testing and Materials (ASTM):
1. ASTM C 209 - Methods of Testing Insulating Board, Structural and Decorative.
2. ASTM C 518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
3. ASTM C 1289 - Standard Specification for Faced Rigid Cellular Thermal Insulation Board.
4. ASTM D 312 - Standard Specification for Asphalt Used in Roofing.
5. ASTM D 1621 - Test Methods for Compressive Properties of Rigid Cellular Plastics.
6. ASTM D 2126 - Test Method for Response of Rigid Cellular Plastics to Thermal and Humid Aging.
7. ASTM E 84 - Surface Burning Characteristics of Building Materials.
8. ASTM E 96 - Test Method for Water Vapor Transmission of Materials.
9. ASTM E 108 - Standard Tests Method for Fire Tests of Roof Coverings.
10. ASTM E 119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
11. FM Approval Guide - FM 4450 Approval Standard - Class I Insulated Steel Roof Decks.
12. FM Approval Guide - FM 4470 Approval Standard - Class I Roof Covering.
13. UL 263 - Fire Tests of Building Construction and Materials.
14. UL 790 - Tests for Fire Resistance of Roof Covering Material.

1.06 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For roofing system. Include plans, elevations, sections, details, and attachments to other work.
1. Base flashings and membrane terminations.
2. Tapered insulation, including slopes.
3. Roof plan showing orientation of steel roof deck and orientation of membrane roofing and fastening spacings and patterns for mechanically fastened membrane roofing.
4. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.

C. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and

witnessed by a qualified testing agency, for components of membrane roofing system.

D. Maintenance Data: For membrane roofing system to include in maintenance manuals.

1.07 QUALITY ASSURANCE

A. Installer Qualifications: The roofing system must be installed by an applicator authorized and trained by the manufacturer in compliance with shop drawings as approved by the manufacturer. The roofing applicator shall be thoroughly experienced and upon request be able to provide evidence of having at least five (5) years successful experience installing single-ply EPDM roofing systems and having installed at least one (1) EPDM roofing application or several similar systems of equal or greater size within one year.

B. Source Limitations: Obtain components including roof insulation for membrane roofing systemapproved by membrane roofing manufacturer.

C. The Roofing System must achieve a UL Class C.

D. Provide roof assembly successfully tested by a qualified testing agency to resist the design uplift pressures calculated according to International Building Code (IBC) and American Society of Civil Engineers (ASCE 7) ANSI/SPRI WD-1 "Wind Design Standard Practice for Roofing Assemblies" and ANSI/SPRI ES-1 "Wind Design Standard for Edge Systems Used with Low Slope Roof Systems".

E. Preliminary Roofing Conference: Before starting roof deck construction, conduct conference at Project site.
   1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
   2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
   3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
   4. Review requirements for deck substrate conditions and finishes, including flatness and fastening.
   5. Review structural loading limitations of roof deck during and after roofing.
   6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.
   7. Review governing regulations and requirements for insurance and certificates if applicable.
   8. Review temporary protection requirements for roofing system during and after installation.
   9. Review roof observation and repair procedures after roofing installation.

F. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
   1. Review methods and procedures related to roofing installation, including manufacturer's

written instructions.

2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
3. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
4. Review structural loading limitations of roof deck during and after roofing.
5. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.
6. Review governing regulations and requirements for insurance and certificates if applicable.
7. Review temporary protection requirements for roofing system during and after installation.
8. Review roof observation and repair procedures after roofing installation.

G. The membrane must be manufactured by the material supplier. Manufacturer's supplying membrane made by others are not acceptable.The manufacturer must have a minimum of 20 years' experience in the manufacturing of vulcanized thermoset sheeting.

H. Unless otherwise noted in this specification, the roofing contractor must strictly comply with the manufacturer's current specifications and details.

I. The roofing system must be installed by an applicator authorized and trained by the manufacturer in compliance with shop drawings as approved by the manufacturer. The roofing applicator shall be thoroughly experienced and upon request be able to provide evidence of having at least five (5) years successful experience installing single-ply EPDM roofing systems and having installed at least one (1) EPDM roofing application or several similar systems of equal or greater size within one year.

J. Provide adequate number of experienced workmen regularly engaged in this type of work who are skilled in the application techniques of the materials specified. Provide at least one thoroughly trained and experienced superintendent on the job at all times roofing work is in progress.

K. There shall be no deviations made from this specification or the approved shop drawings without the prior written approval of the specifier. Any deviation from the manufacturer's installation procedures must be supported by a written certification on the manufacturer's letterhead and presented for the specifier's consideration.

L. Upon completion of the installation, the applicator shall arrange for an inspection to be made by a non-sales technical representative of the membrane manufacturer in order to identify any needed corrective repairs that will be required for warranty issuance. Notify the building owner seventy-two (72) hours prior to the manufacturer's final inspection.

M. Inspector shall be employed and trained by the manufacturer and have received product-specific training from the manufacturer of the products.

N. The Sure-White EPDM membrane meets the CRRC (Cool Roof Rating Council) requirements for reflectance and emittance. When tested in accordance with ASTM C1549, the Sure-White material has an initial solar reflectance of .76 and a 3-year aged reflectance of .64. The material has also been tested for emittance in accordance with ASTM C1371; an initial emittance of .90 and a 3-year aged emittance of .87 were achieved.

O. The Sure-Seal EPDM Membrane exceeds 41,580 kJ/m2 under Xenon-Arc UV Light testing used for testing "Resistance to Outdoor (Ultraviolet) Weathering." (ASTM D 4637 Specification requires a 7560 kJ/m2 minimum total radiant exposure at 70 W/m2 irradiance at 176oF black panel temperature to pass.) The membrane shows no visible signs of cracking or crazing.

P. Sure-White Membrane achieves a zero (no growth) rating in the ASTM G21 test for fungi growth.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to the job site in the manufacturer's original, unopened containers or wrappings with the manufacturer's name, brand name and installation instructions intact and legible. Deliver in sufficient quantity to permit work to continue without interruption.

B. Comply with the manufacturer's written instructions for proper material storage.

C. Store materials between 60°F and 80°F in dry areas protected from water and direct sunlight. If exposed to lower temperature, restore to 60°F minimum temperature before using.

D. Store materials containing solvents in dry, well ventilated spaces with proper fire and safety precautions. Keep lids on tight. Use before expiration of their shelf life.

E. Insulation and underlayment products must be on pallets, off the ground and tightly covered with 6 mil. poly and tarps to provide waterproof enclosure. Manufacturer's wrap does not provide sufficient waterproofing. Insulation and underlayment products that become wet or saturated are to be discarded.

F. Any materials which are found to be damaged shall be removed and replaced at the applicator's expense.

G. Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.

1.09 PROJECT CONDITIONS

Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.010 WARRANTY

A. Provide manufacturer's 30year Total System Warranty covering both labor and all materials with no dollar or man-hour limitation per year. The maximum wind speed coverage shall be peak gusts of 72 mph measured at 10 meters above ground level. Certification is required with bid submittal indicating the manufacturer has reviewed and agreed to such wind coverage.

Warranty Length	Minimum Membrane Thickness
30 year	90-mil

B. The Warranty shall also meet all requirements as outlined in the State of Tennessee's Total Roofing System Warranty Section 07 50 36 and complete all associated forms and procedures.

C. Warranty shall also cover leaks caused by accidental punctures: No man-hours per year for 90-mil Sure-Seal or Sure-White membranes.

D. Warranty shall also cover leaks caused by hail:
   1. Hail up to 2" diameter hail when 90-mil Sure-White is installed over Carlisle Securshield HD, adhered with FAST adhesive (For Adhered Systems Only).
   2. Pro-rated System Warranties will shall not be accepted.

PART 2 - PRODUCTS

2.01 GENERAL

A. All components of the specified roofing system shall be products of the single accepted Roofing System Manufacturer or accepted by them as compatible.

B. Unless otherwise approved by the specifier and accepted by the membrane manufacturer, all products (including insulation, fasteners, fastening plates and edgings) must be manufactured and supplied by the roofing system manufacturer and covered by the warranty.

C. Manufacturer of roof membrane shall also manufacture all polymeric components for the roofing system, including, but limited to, membrane, adhesives, primers, flashings, caulks and tapes.

2.02 EPDM MEMBRANE ROOFING

A. Basis of Design: Furnish Sure-Seal White, 90-mil thick non-reinforced, EPDM (Ethylene, Propylene, Diene Terpolymer) in the largest sheet possible with 6" Factory-Applied Tape (FAT). The membrane shall conform to the minimum physical properties of ASTM D4637. When a 10 foot wide membrane is to be used, the membrane shall be manufactured in a single panel with no factory splices to reduce splice intersections.
   1. 90-mil. EPDM Fully-Adhered Air Barrier strip in b/w deck and parapet walls/perimeter and all field penetrations.
   2. 1/2" HD Cover Board (R-2.5 min.).
   3. (2) layers of 1.75" base (R-10.3 min. per layer).

B. Acceptable Manufactures:
   1. Carlisle SynTec.
   2. Firestone.
   3. Versico.

2.03 INSULATION / UNDERLAYMENT

A. When applicable, insulation shall be installed in multiple layers. The first and second layer of

insulation shall be mechanically fastened or adhered to the substrate in accordance with the manufacturer's published specifications and drawings.

B. Insulation shall be as identified in Part 1 of this specification per Building as supplied by approved manufacturer. Minimum R-value required is R-25 for total system. (Note: The insulation must meet ASHRAE 90.1 minimums per IBC-International Building Code.)
   1. Insulbase Polyiso – A foam core insulation board covered on both sides with a medium weight fiber-reinforced felt facer meeting ASTM C 1289-06, Type II, Class 1, Grade 3 (25 psi). The product is available in 4' x 8' standard size with a thickness from 1 to 4 inches. 4' x 4' tapered panels are also available.
   2. Carlisle SecurShield HD Cover Board – A rigid insulation panel composed of a high-density, closed-cell polyisocyanurate foam core laminated to moisture resistant coated-glass fiber-mat facer for use as a cover board or recover board meeting ASTM 1289-06, Type II, Class 2 (100 psi). Available 1/2" thick 4' x 8' panel weight 11 lbs. with a minimum R-value of 2.5.

C. Crickets and Edge Strips: Shop fabricated or field tapered to provide proper drainage/taper/crickets indicated. Comply with requirements of ASTM C 1289.

2.04 FASTENING COMPONENTS

A. Fasteners, Plates and Bars
   1. HP-X Fasteners: A heavy duty #15 threaded fastener with a #3 phillips drive used for insulation securement into steel, wood plank or minimum 15/32 inch thick plywood when increased pullout resistance is desired.
   2. Pre-Assembled ASAP Fasteners: A pre-assembled 3" diameter Plastic Plate and # 12 threaded fastener with a #3 drive used for insulation attachment into steel or wood decks. Installed using OMG Fastening Tools.
   3. InsulFast Fasteners: A threaded #12 fastener with #3 phillips drive used for insulation attachment into steel or wood decks.
   4. HP Term Bar Nail-Ins: A 1-1/4" long expansion anchor with a zinc plated steel drive pin used for fastening the Carlisle Termination Bar or Seam Fastening Plates to concrete, brick, or block walls.
   5. Seam Fastening Plate: A 2" diameter metal fastening plate used in conjunction with RUSS or EPDM membrane for additional membrane securement.
   6. Polymer Seam Plate: A 2" diameter plastic fastening plate incorporating barbs on the underside of the plate. This plate is required for membrane and RUSS attachment installed in conjunction with steel roof decks. May also be used for insulation attachment.
   7. Insulation Fastening Plates: A nominal 3 inch diameter metal plate used for insulation attachment.
   8. Sure-Seal Pressure-Sensitive RUSS: a 6" wide, nominal 45-mil thick clean, cured, black reinforced EPDM membrane with 3" wide SecurTAPE laminated along one edge. Used on Sure-Seal Adhered Roofing Systems.

B. Insulation Adhesives:
   1. FAST Adhesive: A two component insulating urethane adhesive used to attach insulation. Packaging formats include 50 and 15 gallon drums as well as Dual Tanks, Dual Cartridges and 5 gallon Bag in a Box formats.

2.05 ADHESIVES, CLEANERS AND SEALANTS

A. All products shall be furnished by accepted Manufacturer and specifically formulated for the intended purpose.
   1. 90-8-30A Bonding Adhesive: A high-strength, yellow colored, synthetic rubber adhesive used for bonding Sure-Seal EPDM membranes to various surfaces. Available in 5 gallon pails.
   2. Carlisle Weathered Membrane Cleaner: A clear, solvent-based cleaner used to loosen and remove dirt and other contaminants from the surface of exposed EPDM membrane (for repairs, etc.) prior to applying EPDM Primer. Available in 1 and 5-gallon pails.
   3. Sure-Seal SecurTAPE™ (Factory Applied): A 6" wide by 100' long splice tape used for splicing adjoining sections of EPDM membrane. Complies with the South Coast Air Quality Management District Rule 1168.
   4. HP 250 EPDM Primer: A solvent-based primer used to prepare the surface of EPDM membrane for application of Splice Tape or Pressure-Sensitive products. Available in 1 gallon pails.
   5. Lap Sealant: A heavy-bodied material used to seal the exposed edges of a membrane splice. Available in tubes.
   6. Water Cut-Off Mastic: A one-component, low viscosity, self-wetting, Butyl blend mastic used to achieve a compression seal between the EPDM membrane or Elastoform Flashing and applicable substrates. Available in tubes.
   7. Pourable Sealer: A black, two-component, solvent-free, polyurethane based product used for tie-ins and as a sealant around hard-to-flash membrane penetrating objects such as clusters of pipes and for a daily seal when the completion of flashings and terminations cannot be completed by the end of each work day.
   8. One-Part Pourable Sealer: Available in black, a one-component, moisture curing, elastomeric polyether sealant used for attaching lightning rod bases and ground cable clips to the membrane surface and as a sealant around hard-to-flash penetrations such as clusters of pipes.
   9. Universal Single-Ply Sealant: A one-part polyether, non-sagging sealant designed for sealing expansion joints, control joints and counterflashings. Available in white only.
   10. CavGrip Primer: a low VOC contact adhesive used to prime surfaces prior to the application of 725TR.

2.06 METAL EDGING AND MEMBRANE TERMINATIONS

A. General: All metal edgings shall be tested and meet ANSI/SPRI ES-1 standards and comply with International Building Code. All metal work is to be supplied and warranted by the manufacturer.

B. Metal Coping:
   1. SecurEdge 300: a coping or fascia, snap-on edge system consisting of a 24 gauge galvanized metal water dam and .050” or .063” thick Kynar 500, clear and colored anodized finish or 24 gauge steel, Kynar 500 finish. Metal fascia color shall be as designated by the Architect. ANSI/SPRI ES-1 Certified. Coping FM Approved 1-90 with 20 ga. Cleat, 1-180 with 16 ga. Cleat. Fascia FM Approved 1-225.

C. Termination Bar: a 1” wide and .098” thick extruded aluminum bar pre-punched 6” on center; incorporates a sealant ledge to support Lap Sealant and provide increased stability for membrane terminations.

D. Drip Edge: a metal fascia/edge system with a 22 or 24 gauge continuous anchor cleat and .032 inch thick aluminum or 24 gauge steel fascia. Metal fascia color shall be as designated by the Architect.

E. Flashing / Counter flashing: Provide configuration and system per details and desired warranty. 24 gauge Kynar coated galvanized steel.

2.07 OTHER MATERIALS

A. Perimeter Edge & Penetration Air Barrier:

B. Carlisle 725TR Air & Vapor Barrier / Temporary Roof: 725TR is a 40-mil composite consisting of 35-mils of self-adhering rubberized asphalt factory laminated to a 5-mil polyethylene film with an adhesion textured surface. 725TR roll dimensions are 39" x 75' and the product is applied after priming an acceptable substrate with Cav-Grip primer.

C. Install high-density closed-cell polyurethane foam or filler insulation pieces to support the edge stripping.

PART 3 - EXECUTION

3.01 GENERAL

A. Comply with the manufacturer's published instructions for the installation of the membrane roofing system including proper substrate preparation, jobsite considerations and weather restrictions.

B. Position sheets to accommodate contours of the roof deck and shingle splices to avoid bucking water.

3.02 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with the following requirements and other conditions affecting performance of roofing system:
   1. Verify that roof openings and penetrations are in place and curbs are set and braced and that roof drain bodies are securely clamped in place.
   2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.

3.03 PREPARATION

A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.

B. Prevent materials from entering and clogging roof drains and conductors and from spilling or

migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.

3.04 Installation of Wood Nailers:

A. Install treated lumber at the same heights as adjacent construction ± 1/4 inch Continuoustreated wood nailers are to be installed around roof projections and penetrations asshown in approved details.
   1. Where wood nailers are installed directly on the substrate, the substrate shall be carefully examined to confirm that the entire area provides a suitable fastening surface. All defects shall be repaired by the appropriate trade prior to installation.
   2. Nailers shall be at least 2x6 inches nom. high and installed and anchored in such a manner to resist a force of 250 lbs. per linear foot of wood blocking in any direction.

B. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

3.05 AIR BARRIER (Perimeter and penetration only)

A. Consult the latest publications by ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.) and NRCA (National Roofing Contractors Association) for specific information.

B. If insulation is to be adhered to the vapor retarder with FAST Adhesive, the 725 TR vapor retarder must be compatible and shall be fully adhered to the substrate. Available products include Carlisle supplied “peel and stick” rubberized asphalt membrane with compatible film coating (Carlisle 725 Air and Vapor Barrier), and spray or roller applied butyl coatings. Installation requirements for Carlisle’s 725 Air and Vapor Barrier are identified in Carlisle published specification.

3.06 Installation:

A. Surface Preparation:
   1. The surface shall have a smooth finish and be free of voids, spalled areas, sharp protrusions, loose aggregate, latence and form release agents. In the event of rain, concrete must be allowed to dry before primer is applied.
   2. Primer: Surfaces to receive Carlisle 725TR Air and Vapor Barrier must be clean and dry. Prime with Cav-Grip Primer. Apply Primer by spray, brush or with a long nap roller at the applicable coverage rate noted above. At 75□ F allow primer to dry 1 hour minimum. Primer has a satisfactory cure when it will not transfer when touched. Prime only areas to be waterproofed the same day. Re-prime if area becomes dirty.
   3. Application: Apply Carlisle 725TR Air and Vapor Barrier from low to high point, in a shingle fashion, so that laps will shed water. Overlap all edges at lease 2-1/2". End laps shall be staggered. Place membrane carefully so as to avoid wrinkles and fishmouths. Immediately after installation, roll with a 100-150 pound weighted steel roller. Refer to Manufacture’s Detail G-01.
   4. Insulation Installation: Ensure surface of Carlisle 725TR Air and Vapor Barrier is dry prior to

installing insulation. Place insulation over the surface and adhere to the vapor barrier with FAST Adhesive in accordance with this Carlisle Specification.

3.07 INSULATION PLACEMENT & INSTALLATION

A. Install insulation or membrane underlayment over the substrate with boards butted tightly together with no joints or gaps greater than 1/4 inch. Stagger joints both horizontally and vertically if multiple layers are provided.

B. Secure insulation to the substrate with the required mechanical fastener or insulation adhesive Carlisle FAST Adhesive in accordance with the manufacturer's specifications and drawings.

C. Butt units tightly together and against wood blocking and nailers; trim to fit penetrations and interruptions, so that gaps between units and between insulation and adjacent construction do not exceed 1/4 inch. Fasteners shall be spaced a maximum of 2'-0" o.c., and there shall be one fastener installed at each and every corner of each board, and in addition, the pattern of fasteners shall conform to specified requirements for wind uplift per ANSI/SPRI ES-1 for the specific project location and field, perimeter and corner conditions.

D. Shape insulation or provide preformed units to provide crickets, saddles, and tapered areas as indicated or as required to provide drainage. Taper insulation around all roof drains and projections to ensure proper drainage.

3.08 MEMBRANE PLACEMENT AND BONDING

A. Unroll and position membrane without stretching. Allow the membrane to relax for approximately 1/2 hour before bonding. Fold the sheet back onto itself so half the underside of the membrane is exposed.

B. Apply the Bonding Adhesive in accordance with the manufacturer's published instructions and coverage rates, to both the underside of the membrane and the substrate. Allow the adhesive to dry until it is tacky but will not string or stick to a dry finger touch.

C. Roll the coated membrane into the coated substrate while avoiding wrinkles. Brush down the bonded half of the membrane sheet with a soft bristle push broom to achieve maximum contact.

D. Fold back the unbonded half of the membrane sheet and repeat the bonding procedure.

E. Install adjoining membrane sheets in the same manner, overlapping edges approximately 4 inches. Do not apply bonding adhesive to the splice area.

3.09 MEMBRANE SPLICING

A. Position membrane sheet to allow for required splice overlap. Mark the bottom sheets with an indelible marker approximately 1/4" to 1/2" from the top sheet edge. The pre-marked line on the membrane edge can also be used as a guide for positioning splice tape.

B. When the membrane is contaminated with dirt, fold the top sheet back and clean the dry splice area (minimum 6" wide) of both membrane sheets by scrubbing with clean natural fiber rags saturated with Sure-Seal Weathered Membrane Cleaner. When using Sure-Seal (black) PRE-KLEENED membrane, cleaning the splice area is not required unless contaminated with field dirt or other residue.

C. Apply EPDM Primer to splice area and permit to flash off.

D. When adhering Factory Applied Tape (FAT), pull the poly backing from FAT beneath the top sheet and allow the top sheet to fall freely onto the exposed primed surface. Press top sheet on to the bottom sheet using firm even hand pressure across the splice towards the splice edge

E. For end laps, apply 6" SecurTAPE to the primed membrane surface in accordance with the manufacturer's specifications. Remove the poly backing and roll the top sheet onto the mating surface.

F. Tape splices must be a minimum of 2-1/2" wide using 6" wide SecurTAPE extending 1/8" minimum to 1/2" maximum beyond the splice edge. Field splices at roof drains must be located outside the drain sump.

G. Provide splice reinforcement where required to obtain 30-year or longer System Warranty is specified, splice enhancements are required. Refer to Carlisle Sure-Seal Roofing System Specification.

H. Immediately roll the splice using positive pressure when using a 2" wide steel roller. Roll across the splice edge, not parallel to it. When FAT is used, Carlisle's Stand-Up Seam Roller can be used to roll parallel to the splice edge.

I. At all field splice intersections, apply Lap Sealant along the edge of the membrane splice to cover the exposed SecurTAPE 2" in each direction from the splice intersection. Install Carlisle's Pressure-Sensitive "T" Joint Covers or a 6" wide section (with rounded corners) of Sure-Seal Pressure-Sensitive Elastoform Flashing over the field splice intersection.

3.010 FLASHING

A. Wall and curb flashing shall be cured EPDM membrane. Continue the deck membrane as wall flashing where practicable. Use Pressure-Sensitive Curb Wrap when possible to flash curb units.

B. Follow manufacturer's typical flashing procedures for all wall, curb, and penetration flashing including metal edging/coping and roof drain applications.

3.011 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing agency to perform inspections.

B. A roof inspection is required by manufacturer before warranty issue. Revise scope of inspection and source of report to a qualified roofing consultant or an independent testing and inspecting

agency if preferred.

C. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion.

D. Repair or remove and replace components of membrane roofing system where inspections indicate that they do not comply with specified requirements.

E. Additional inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.012 PROTECTING AND CLEANING

A. Perform daily clean-up to collect all wrappings, empty containers, paper, and other debris from the project site. Upon completion, all debris must be disposed of in a legally acceptable manner.

B. Where completion of flashings and terminations is not achieved by the end of the work day, a daily seal must be performed. Note: A temporary seal should be performed at the conclusion of daily work and use of the appropriate method will vary based on project and project conditions. Contact manufacturer for various methods that may be utilized.

C. Prior to the manufacturer's inspection for warranty, the applicator must perform a pre-inspection to review all work and to verify all flashing has been completed as well as the application of all caulking.

D. Protect membrane roofing system from damage and wear during remainder of construction period. When remaining construction will not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.

E. Correct deficiencies in or remove membrane roofing system that does not comply with requirements, repair substrates and repair or reinstall membrane roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

F. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION

SECTION 07 62 00
SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Manufactured Products:
      a. Manufactured through-wall flashing and counterflashing.
   2. Formed Products:
      a. Formed low-slope roof sheet metal fabrications.
      b. Formed wall sheet metal fabrications.

B. Related Sections:
   1. Section 07 53 23 – "Ethylene-Propylene-Diene-Monomer (EPDM) Roofing for installing sheet metal flashing and trim integral with roofing.
   2. Section 07 65 00 – "Flexible Flashing" installed integral to metal flashing and trim.

1.02 REFERENCES

A. SPRI Sheet Membrane and Component Suppliers to the Commercial Roofing Industry, 175 Highland Ave., Needham, MA 02194, 617-444-0242, fax: 617-444-6111.

B. Sheet Metal & Air Conditioning Contractor's National Association (SMACNA); Architectural Sheet Metal Standards; 2012 - 7th Edition.

1.03 PERFORMANCE REQUIREMENTS

A. General: Sheet metal flashing and trim assemblies as indicated shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.

B. Fabricate and install roof edge flashing capable of resisting the following forces according to recommendations in FMG Loss Prevention Data Sheet 1-49:
   1. Wind Zone 2: For velocity pressures of 31 to 45 lbf/sq. ft. (1.48 to 2.15 kPa): 90-lbf/sq. ft. (4.31-kPa) perimeter uplift force, 120-lbf/sq. ft. (5.74-kPa) corner uplift force, and 45-lbf/sq. ft. (2.15-kPa) outward force.

C. Thermal Movements: Provide sheet metal flashing and trim that allows for thermal movements from ambient and surface temperature changes.
   1. Differential values (for aluminum in particular) in subparagraph below are suitable for most of the U.S.
   2. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

1.04 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.

B. Shop Drawings: Show fabrication and installation layouts of sheet metal flashing and trim, including plans, elevations, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work. Include the following:
   1. Identification of material, thickness, weight, and finish for each item and location in Project.
   2. Details for forming sheet metal flashing and trim, including profiles, shapes, seams, and dimensions.
   3. Details for joining, supporting, and securing sheet metal flashing and trim, including layout of fasteners, cleats, clips, and other attachments. Include pattern of seams.
   4. Details of termination points and assemblies, including fixed points.
   5. Details of edge conditions, including eaves, ridges, valleys, rakes, crickets, and counterflashings as applicable.
   6. Details of special conditions.
   7. Details of connections to adjoining work.

C. Qualification Data: For qualified fabricator.

1.05 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.

B. Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" unless more stringent requirements are specified or shown on Drawings.
   1. The contractor is required to submit project specific details which show adaptation of SMACNA detail to specific condition.

C. Sheet metal installer and fabricator shall have a minimum of 5 years' experience.

D. All flashing shall be installed as indicated on drawings. All flashings, including flashings not particularly shown, but required for finish work shall be furnished and installed in strict accordance with Sheet Metal and Air Conditioning Contractors National Association recommendations. Where not otherwise shown, all exposed (exposed to view) flashing shall be prefinished 24 gauge (minimum) galvanized steel. Roof area flashing not exposed to view shall be minimum 24 gauge galvanized steel.

E. All concealed flashings shall be inspected while visible before work may continue. Alternatively, photographic evidence may be provided by the contractor showing proper installation.

F. Definition: The term "pre-finished" shall be interpreted to mean Kynar 500 full strength Fluoropolymer.

G. High performance coping shall be certified by the coping manufacturer to meet performance design criteria according to the following test standards:
   1. ANSI/SPRI ES-1 Test RE-3 for Coping:
      a. The coping system shall be tested simultaneously on horizontal and vertical surfaces and shall exceed horizontal and vertical design wind pressure as calculated in accord with the ANSI/SPRI ES-1 Test RE-3. Use the current edition of *ANSI/SPRI ES-1 Wind Design Standard for Edge Systems Used with Low Slope Roofing Systems.*

   2. The coping product shall be UL Classified by Underwriters Laboratories, Inc.® or other 3rd party verification of compliance with the ANSI/SPRI ES-1 Wind Design Standard.

1.06 JOB CONDITIONS

A. Verify that other trades with related work are complete before mounting coping covers

B. Mounting surfaces shall be straight and secure; substrates shall be of proper width.

C. Refer to the construction documents, shop drawings and manufacturer's installation instructions.

D. Coordinate installation with roof membrane manufacturer's instructions before starting.

E. Observe all appropriate OSHA safety guidelines for this work.

1.07 WARRANTY/GUARANTEE

A. Manufacturer's Standard Warranty: Warranted materials shall be free of defects in material and workmanship for five years after shipment. If, after inspection, the manufacturer agrees that materials are defective, the manufacturer shall at their option repair or replace them. For decorative finish warranty, consult manufacturer.

B. Standard Permasnap 2 with 20 gauge cleat - 30-Year Excel Warranty: Manufacturer shall guarantee that a standard size roof edge system, when installed per manufacturer's instructions, will not blow off, leak, or cause membrane failure, even in wind conditions up to 110 mph, or the manufacturer shall at their option repair or replace their materials.

C. Exposed materials may be prefinished steel, prefinished aluminum, stainless steel, or copper. Coating system shall have a 20 year warranty and be field repairable. Typically, the through wall material does not have a prefinished coating. Aluminum may be anodized. Stainless steel and copper may be mill finish.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry.

B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to the extent necessary for the period of sheet metal flashing and trim installation.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Gutters and Downspouts:
   1. Gutters and downspouts exposed to view, etc., shall be fabricated from standard pre-finished Kynar-500 as selected by the Architect.
      a. Fabricate all joints similar to SMACNA Architectural Sheet Metal Manual, 7th Edition, similar to Figure 2-5C.
   2. Provide flashing in 10' lengths, minimum. Provide cleats to prevent wind uplift and peel-off.

B. THRU-WALL FLASHING:
   1. Provide self-adhered thru-wall flashing per Section 07 65 00 – Flexible Flashing.
   2. Install flashing over 28-gauge (Type 304/ 2B ASTM a 167 & ASTM A240) stainless steel metal drip edge.
      a. 3” seat and 1/2” hemmed drip edge.
      b. Provide minimum 4” overlap with two (2) beads of non-skinning butyl sealant.

C. THRU-WALL OVERFLOW SCUPPERS
   1. Through Wall Scupper as manufactured by A.W.P. Hickman Company.
   2. Metal: .050” aluminum for all sizes; 24 gauge galvanized steel with Kynar coating. Color shall be selected from manufacturer’s standard color palette.

D. ACCESSORIES:
   1. Corners, end caps, pier caps, etc. shall be fabricated by the coping manufacturer.
   2. Welded or METAL-LOCK® assembly shall be used to maintain watertight integrity.
   3. Gas and Fluid-Bearing Pipe Flashings: Gas and fluid-bearing pipe flashings shall be accomplished by fabricating and installing "pipe projection boxes", constructed using wood curbs, flashing sleeves with rain shields, draw bands and sealant. Construction shall be as recommended by the National Roofing Contractors Association and Sheet Metal and Air Conditioning Contractors Association. This type construction shall also be used at all pipe supports and other penetrations. Material thickness shall be as required by the girth dimension in accordance with SMACNA.
   4. Washers, nails and screws, type suited to material being attached.
   5. Flashing cement compatible with the roof membrane and suitable for the intended application.

E. Compressible Filler: Pre-molded filler strips complying with ASTM D1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene.

2.02 SHEET METALS

A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying a strippable, temporary protective film before shipping.

B. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304, dead soft, fully annealed.
   1. Finish: 2D (dull, cold rolled) except where harder temper is required for forming or performance; minimum 0.0187 inch (.5 mm) thick, unless otherwise noted.

C. Metallic-Coated Steel Sheet: Restricted flatness steel sheet, metallic coated by the hot-dip process and pre-painted by the coil-coating process to comply with ASTM A 755/A 755M.
   1. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M, Class AZ50 coating designation, Grade 40 (Class AZM150 coating designation, Grade 275); structural quality.
   2. Surface: Smooth, flat.
   3. Exposed Coil-Coated Finish:
      a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
   4. Color: As selected by Architect from manufacturer's full range.
   5. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil (0.013 mm).

2.03 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.

B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.
   1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
      a. Use the same metal as sheet metal flashing or other noncorrosive metal as recommended by sheet metal manufacturer. Match finish of exposed heads with material being fastened.
      b. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating.
      c. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
      d. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.

C. Solder:
   1. For Stainless Steel: ASTM B 32, Grade Sn60, with an acid flux of type recommended by stainless-steel sheet manufacturer.

D. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.

E. Elastomeric Sealant: ASTM C 920, manufacturer's standard elastomeric sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

F. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.

G. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

2.04 FABRICATION, GENERAL

A. General: Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, geometry, metal thickness, and other characteristics of item indicated. Fabricate items at the shop to greatest extent possible.
   1. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
   2. Obtain field measurements for accurate fit before shop fabrication.
   3. Form sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.
   4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces exposed to view.

B. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines as indicated and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

C. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."

D. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant.

E. Expansion Provisions: Where lapped expansion provisions cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with butyl sealant concealed within joints.

F. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

G. Fabricate cleats and attachment devices of sizes as recommended by SMACNA's "Architectural Sheet Metal Manual" for application, but not less than thickness of metal being secured.

H. Seams: Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.

2.05 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

A. Roof-Edge Flashing and Fascia Cap: Fabricate in minimum 96-inch- (2400-mm-) long, but not exceeding 10-foot- (3-m-) long, sections. Furnish with 6-inch- (150-mm-) wide, joint cover plates. Meet ES-1 requirements.
   1. Options in first subparagraph below represent middle range of styles recognized by SMACNA. Revise to suit Project. Insert descriptions here or show special corner and edge styles on Drawings if required.
   2. Retain first subparagraph below if combining scuppers with roof edge flashing (gravel stop) or fascia caps. These scuppers discharge into hanging gutters or conductor heads.
   3. Fabricate with scuppers of dimensions required with 4-inch- wide flanges and base extending 4 inches beyond can't or tapered strip into field of roof.
   4. Fabricate from the following materials:
      a. Retain thickness of roof edge components that will suit wind-uplift performance requirements.
      b. Wall Trim Exposed to View: Coil Coated Galvanized Steel: 0.276 inch thick.
      c. Other Components: Aluminum-Zinc Alloy-Coated Steel: 0.028 inch (0.71 mm) thick.

B. Roof to Wall Transition Expansion-Joint Cover: Fabricate from the following materials:
   1. Aluminum-Zinc Alloy-Coated Steel: 0.034 inch thick.

C. Base Flashing: Fabricate from the following materials:
   1. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch (0.71 mm) thick.

D. Counterflashing: Fabricate from the following materials:
   1. Aluminum-Zinc Alloy-Coated Steel: 0.022 inch (0.56 mm) thick.

E. Flashing Receivers: Fabricate from the following materials:
   1. Aluminum-Zinc Alloy-Coated Steel: 0.022 inch (0.56 mm) thick.

F. Roof-Penetration Flashing: Fabricate from the following materials:
   1. Aluminum-Zinc Alloy-Coated

G. Roof-Drain Flashing: Fabricate from the following materials:
   1. Stainless Steel: 0.0156 inch (0.4 mm) thick.

2.06 MISCELLANEOUS SHEET METAL FABRICATIONS

A. Equipment Support Flashing: Fabricate from the following materials:
   1. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch thick.

PART 3 - EXECUTION

3.01 INSPECTION

A. Verify that coping installation will not disrupt other trades. Verify that substrate is dry, clean and free of foreign matter. Report and correct defects prior to any installation.

3.02 FABRICATION

A. Make all joints watertight. Seams in flashing which cannot be effectively locked shall be welded (welding permitted only on items not designated to be pre-finished). Oxy-gas welding in which paste fluxes are used shall be done in the shop.

B. Fabricate sheet metal items in maximum 10' lengths, with straight runs maximum 20' long, joining pieces with locked seams. Join units with loose-lock seams filled with elastic cement as expansion joint.

3.03 INSTALLATION

A. Submit product design drawings for review and approval to Architect or Specifier before fabrication.

B. Installing contractor shall check as-built conditions and verify the manufacturer's coping details for accuracy to fit the wall assembly prior to fabrication. The installer shall comply with the coping manufacturer's installation guide when setting copings.

C. Installer shall use mechanical fasteners with minimum 240 # (109 kg) pull-out resistance suitable for parapet substrates.

D. Gutters & Downspouts:
   1. Exposed edge of all flashing shall be bent back at least 1/2". Cap Flashing shall lap over base flashing as shown on drawings.
   2. Seams: All seams, except required welded seams, shall be loose lock seams filled with elastic cement.
      a. All seams shall be made in the direction of flow. Loose lock seams shall be loose flat lock seams and shall be completely filled with sealant. Seams shall conform to the following requirements:
      b. Flat Lock seams shall finish not less than 3/4" wide.
      c. Plain Lap seams shall lap not less than 3".
      d. Cross Folded Seams: Where sheet metal is folded in one direction and then folded at right angles to the first fold, as for example the slip joint of base flashings, expansion joints and similar cross folded joints, the folded portion of the sheet metal at the cross fold shall be split and a patch of sheet metal shall be welded over the split to avoid binding at the cross fold.
         1. Support gutters using specified support brackets spaced at 18" centers. Anchor to wall

using non-corrosive, non-bleeding anchors.

2. Support downspouts using specified anchor straps spaced at 48" centers. Anchor to wall using non-corrosive, non-bleeding anchors.

E. Vent Pipe Flashing: Extend a minimum of 12" beyond the vent stack and/or roof drain on all sides. The top of the flashing shall be turned down inside the vent pipe, two (2) piece design. Comply with the requirements of the Copper Development Association, Inc. of New York, New York, for the particular installations.

F. Thru-wall Scuppers:
   1. Slide scupper through wall from face side of building, cut back and turn up flanges on back side.
   2. Attach scupper to wall and flash to roofing membrane according to the roof manufacturer's instructions.
   3. Flash the roof side of tube per roofing membrane manufacturer's guidelines & requirements.

G. Electrolysis: All sheet metal subject to electrolysis action shall be fully protected by approved insulating coatings against dissimilar metals.

H. All flashing and related metal work shall be installed in a manner to produce a neat appearance and shall be completely water-tight.

3.04 FLASHING, WEEP HOLES, AND CAVITY DRAINAGE

A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated.

B. Install flashing as follows unless otherwise indicated:
   1. Peel and stick must be terminated at the top of the through-wall flashing, and must have a stainless steel drip through-wall flashing, since it must be held back one-half inch (1/2") minimum from the face of the brick. Peel and stick through-wall flashings should have a termination bar where attached to the back-up wall, sheathing, etc. This can be left sticking out past the face of the brick until the designer sees it in place, and then trimmed flush with the brick.
   2. No through-wall flashing shall be cut off to fall within a brick core hole.
   3. The exposed edge of through-wall flashings shall extend a minimum of 3/4" past face of wall and turn down forming a drip to prevent water from re-entering the building. If the through wall is above roofing, form a receiver for the counter flashings.
   4. Through-wall flashing in cavity walls shall be the full width of the brick and turn up in the back. Flashings shall be turned behind the sheathing on framed walls. Flashings shall be turned back at a mortar joint on CMU walls. Termination bars may be used. Flashings shall turn up a minimum of 8" within the cavity.
   5. Through-wall flashings shall be run continuous through control joints. Provide for expansion by lapping sections a minimum of 6 inches and seal with 3 rows of the appropriate sealant, one

at each side and one in the middle of the lap. Provide for expansion at wall joints and at every 20 feet.

6. Through-wall flashing shall be a minimum of 8 inches above finished roof surfaces.
7. Joints must be sealed water-tight.
8. Flashings shall terminate with end dams. End dams shall be indicated on drawings and be detailed.
9. Two-piece flashing is desirable to allow for tolerances in construction and to facilitate reroofing.
10. Counter flashings in masonry shall be inserted into a raggle/reglet joint, secured with appropriate wedges, and sealed with polyurethane sealant. (Reference SMACNA Architectural Sheet Metal Manual Figure 4-3B (1995)).
11. Protect ledges with sloped metal flashings.
12. At steel lintel, if sealant is to be used to conceal the lintel lower leg termination, seal below the through wall flashing. Do not seal mortar joint where through wall flashings are located.
13. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
14. At multi-wythe masonry walls, including cavity walls, extend flashing through outer wythe, turned up a minimum of 4 inches, and through inner wythe to within 1/2 inch of the interior face of wall in exposed masonry.
15. At masonry-veneer walls, extend flashing through veneer, across air space behind veneer, and up face of sheathing at least 8 inches; with upper edge tucked under building paper or building wrap, lapping at least 4 inches.
16. At lintels and shelf angles, extend flashing a minimum of 6 inches into masonry at each end; at heads and sills, extend flashing 6 inches at ends and turn up not less than 2 inches to form end dams.
17. Interlock end joints of ribbed sheet metal flashing by overlapping ribs not less than 1-1/2 inches or as recommended by flashing manufacturer, and seal lap with elastomeric sealant complying with requirements in Section 07 92 00 for application indicated.

C. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.

D. Install weep holes in head joints in exterior wythes of first course of masonry immediately above embedded flashing and as follows:
   1. Use rope weeps for limestone and open head weeps for rubble stone.
   2. Space weep holes 24 inches o.c. unless otherwise indicated.
   3. Space weep holes formed from wicking material 16 inches o.c.
   4. Cover cavity side of weep holes with plastic insect screening at cavities insulated with loose-fill insulation.
   5. Trim wicking material flush with outside face of wall after mortar has set.

6. Do NOT use tube weeps.
7. Do NOT allow weep holes to be drilled after the fact.
8. Do NOT seal joint where through wall flashing terminates at exterior face of the wall, obstructing weep drainage.
9. Locate weep holes/joints at, (on top of), the through wall flashing level.

E. Place cavity drainage material in cavities to comply with configuration requirements for cavity drainage material in "Miscellaneous Masonry Accessories" Article.

3.05 PENETRATIONS

A. Install through-wall flashings and weeps above and below windows, doors and other openings.

B. Windows and other openings shall have sealed head flashing with sealed end-dams and full head joint weeps. Windows shall have sub-sills with back dams and end-dams.

C. Sill flashings should extend from the inside face of the window or storefront section and direct all water beyond the outside face. Turn back edge and sides to form dams, at least 1 inch in height. Sill flashings shall be bedded in sealant. Fasteners penetrating sill flashing shall have fastener heads sealed completely. Sill weeps on the window or storefront shall remain open.

D. Steel lintels over openings greater than 42” wide shall be free to move laterally on one side.

3.06 CONDITION OF SURFACES

A. Check surfaces to which flashings and trim are to be applied. Verify whether surfaces are smooth, properly prepared and have adequate provisions for fastening metal into position.

B. Surfaces to be covered with sheet metal shall be free from defects of every description. Clean of dirt, rubbish, other foreign materials before sheet metal work is started. Drive projecting nails flush.

3.07 CLEANING AND PROTECTION

A. Cleaning: After installation, all flashing shall be thoroughly cleaned and rinsed with potable water.

B. Protection:
1. Protect metal flashing from damage, stains, etc. during the progress of the Work. Damaged flashing shall be replaced prior to date of Substantial Completion at no additional expense to the Owner.
2. Remove peel strip from prefinished materials just prior to Substantial Completion Inspection.

END OF SECTION

SECTION 07 65 00
FLEXIBLE FLASHING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes
   1. EPDM through-wall flashing and accessory products by Carlisle Coatings & Waterproofing.

B. Materials and installation methods for EPDM through-wall flashing assemblies as indicted on drawings.

C. Through-wall flashing and accessories for installation in cavity wall construction in the following locations:
   1. Wall bases
   2. Windowsills
   3. Heads of openings
   4. Shelf angles
   5. Tops of walls
   6. Parapets
   7. At other discontinuities in the cavity

1.02 REFERENCES

A. American Society for Testing and Materials
   1. ASTM E 96 _ Test Methods for Water Vapor Transmission of Materials
   2. ASTM D 412 _ Test Method Vulcanized Rubber and Thermoplastic Elastomers - Tension
   3. ASTM D 746 _ Test Method for Brittleness Temperature of Plastics and Elastomers by Impact.
   4. ASTM D 624 _ Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers.
   5. ASTM D 741 _ Methods of Measuring Dimensions of Rigid Rods Used in Electrical Insulation
   6. ASTM D 4637 _ Standard Specification for EPDM Sheet Used in Single-Ply Roof Membrane
   7. ASTM D 1149 _ Standard Test Method for Rubber Deterioration – Surface Ozone Cracking in a Chamber

1.03 SUBMITTALS

A. Provide in accordance with Section 01 33 00

B. Product Data and Shop Drawings: Submit for each product; Spec-Data®/Data Sheets, details and installation procedures.

C. Test Reports: Indicating compliance with the performance requirements of this section.

D. Samples of flashing minimum 3 inch by 4-inch size.

E. Manufacturer's documentation of volatile organic compounds (VOC) content Product and Accessories.

F. Certification of compatibility by Manufacturer, listing all materials on the Project with which the Product and Accessories may come into contact.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Comply with manufacturer's recommendations for storage and handling of each product.

1.05 WARRANTY

A. Standard Product Warranty:
   1. Submit manufacturer's warranty that flashing, and accessories are free of defects at time of delivery and are manufactured to meet manufacturer's published physical properties and material specifications.
   2. Installer to warrant that flashing and accessories have been installed in accordance with manufacturer's recommendations.

1.06 WASTE MANAGEMENT AND DISPOSAL

A. Separate and recycle waste materials in accordance with Section 01 74 12 – Construction Waste Management and Disposal.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Provide a membrane constructed to perform as a through-wall flashing durably integrated with the wall assembly's water resistive barrier and cavity drainage system. The installed through-wall flashing shall perform as a liquid water drainage plane to discharge incidental condensation or water penetration to the exterior through the cavity drainage system.

B. Provide a waterproof EPDM membrane through-wall flashing of minimum 0.060-inch (60 mils) thickness consisting of cured, dimensionally stable, non-reinforced EPDM with talc removed from surfaces. It shall meet the following requirements:

C. Performance Requirements:
   1. Water Vapor Transmission: ASTM E 96, Method B not more than 0.06 perms maximum
   2. Ozone Resistance: ASTM D 1149 _ No cracks
   3. Tear Resistance: ASTM D 624, Die C _ not less than 200 lbs.
   4. Resistance to Water: ASTM D 741_ Not more than 2% volume change after 7 days immersion at 158 degrees F
   5. Brittleness Temperature: ASTM D 746 _ Not more than minus 65 degrees F
   6. Resistance to UV: ASTM D 4637 _ No cracks

7. Tensile Strength: ASTM D 412, Not less than 1600 psi
8. Elongation, Ultimate Failure of Rubberized Asphalt: Not less than 500%

D. Basis of Design Product: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
   1. Pre-Kleened™ EPDM Thru-wall Flashing as manufactured by Carlisle Coatings & Waterproofing, Inc.
   2. Accessories as manufactured by Carlisle Coatings & Waterproofing Inc.
      a. Splice Tape: SURE SEAL™ SecurTape
      b. Splice Compound: SURE SEAL™ In-Seam Sealant
      c. Splice Tape Primer: SURE SEAL™ EP-95 Splicing Cement
      d. Splice Cleaner: SURE SEAL™ Weathered Membrane Cleaner
      e. Bonding Adhesive: SURE SEAL™ Aqua Base 120
      f. Corner Patch: SURE SEAL™ Inside/Outside Corners
      g. Lap Sealant: SURE SEAL™ Lap Sealant
      h. Termination Bar: SURE SEAL™ Termination Bar
      i. Mastic: SURE SEAL™ Water Cutoff Mastic

E. Acceptable Manufacturers:
   1. Firestone Building Products
   2. Johns Manville

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine conditions, with installer present, for compliance with requirements for installation, tolerances and other specific conditions affecting performance of flashing. Remove all deleterious materials from surfaces to be flashed.

3.02 INSTALLATION

A. General: Install flashing to dry surfaces at air and surface temperatures of -4ºC (25ºF) and above in accordance with manufacturer's recommendations at locations indicated on Construction Documents.
B. Apply Product and Accessories according to Manufacturer's instructions and drawings.
C. Apply Product to sound substrate. Do not apply over mechanically attached water resistive barrier such as felt, paper or house wrap.
D. Adhere, fasten or cast in place vertical termination of Product according to Manufacturer's instructions and drawings.
E. Form watertight splices between neighboring pieces of Product using splice Tape or Splice Compound, according to instructions in Manufacturer's literature.
F. Accessories:
   1. Apply a bead of sealant along flashing top edge at termination bar.

END OF SECTION

SECTION 07 71 00
ROOF SPECIALITIES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Copings.
   2. Roof-edge specialties.

1.02 RELATED REQUIREMENTS:

A. Section 05 50 00 "Metal Fabrications" for downspout guards and downspout boots.

B. Section 06 10 53 "Miscellaneous Rough Carpentry" for wood nailers, curbs, and blocking.

C. Section 07 62 00 "Sheet Metal Flashing and Trim" for custom- and site-fabricated sheet metal flashing and trim.

D. Section 07 72 00 "Roof Accessories" for set-on-type curbs, equipment supports, roof hatches, vents, and other manufactured roof accessory units.

E. Section 07 92 00 "Joint Sealants" for field-applied sealants between roof specialties and adjacent materials.

F. Preinstallation Conference: Conduct conference at Project site
   1. Meet with Owner, Architect, Owner's insurer if applicable, roofing-system testing and inspecting agency representative, roofing Installer, roofing-system manufacturer's representative, Installer, structural-support Installer, and installers whose work interfaces with or affects roof specialties, including installers of roofing materials and accessories.
   2. Examine substrate conditions for compliance with requirements, including flatness and attachment to structural members.
   3. Review special roof details, roof drainage, and condition of other construction that will affect roof specialties.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For roof specialties.
   1. Include plans, elevations, expansion-joint locations, keyed details, and attachments to other work. Distinguish between plant- and field-assembled work.
   2. Include details for expansion and contraction; locations of expansion joints, including

direction of expansion and contraction.
3. Indicate profile and pattern of seams and layout of fasteners, cleats, clips, and other attachments.
4. Detail termination points and assemblies, including fixed points.
5. Include details of special conditions.

1.04 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer.

B. Product Test Reports: For [copings] [and] [roof-edge flashings], for tests performed by a qualified testing agency.

C. Sample Warranty: For manufacturer's special warranty.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer offering products meeting requirements that are [FM Approvals listed for specified class] [and] [SPRI ES-1 tested to specified design pressure].

B. Source Limitations: Obtain roof specialties approved by manufacturer providing roofing-system warranty specified in Section <Insert Section number and title>.

C. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and set quality standards for fabrication and installation.
1. Build mockup of typical roof edge as shown on Drawings.
2. Build mockup of typical roof edge as part of Integrated Exterior Mockup specified in Section 01 40 00 "Quality Requirements"
3. Build mockup of typical roof edge, including [fascia] [gutter] [and] [downspout] <Insert item>, approximately [10 feet] <Insert dimension> long, including supporting construction, seams, attachments,[underlayment,] and accessories.
4. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
5. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Do not store roof specialties in contact with other materials that might cause staining, denting, or other surface damage. Store roof specialties away from uncured concrete and masonry.

B. Protect strippable protective covering on roof specialties from exposure to sunlight and high humidity, except to extent necessary for the period of roof-specialty installation.

1.07 FIELD CONDITIONS

A. Field Measurements: Verify profiles and tolerances of roof-specialty substrates by field measurements before fabrication and indicate measurements on Shop Drawings.

B. Coordination: Coordinate roof specialties with flashing, trim, and construction of parapets, roof deck, roof and wall panels, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.08 WARRANTY

A. Roofing-System Warranty: Roof specialties are included in warranty provisions in Section 07 50 36 “Total Rood System Warranty”.

B. Special Warranty on Painted Finishes: Manufacturer agrees to repair finish or replace roof specialties that show evidence of deterioration of factory-applied finishes within specified warranty period.
   1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:
      a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
      b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
      c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
   2. Finish Warranty Period: [10] years from date of Substantial Completion.

1.09 PERFORMANCE REQUIREMENTS

A. General Performance: Roof specialties shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

B. FM Approvals' Listing: Manufacture and install copings roof-edge specialties that are listed in FM Approvals' "RoofNav" and approved for windstorm classification, Class 1-90. Identify materials with FM Approvals' markings.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of thermal movements. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
   1. Differential values in "Temperature Change (Range)" Subparagraph below (for aluminum in particular) are suitable for most of the United States.
   2. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

PART 2 - PRODUCTS

2.01 COPINGS

A. Permasnap 2 Coping as manufactured by A.W.P. Hickman Company.
   a. Pre-manufactured metal coping cap with galvanized steel anchor cleats with 26 gauge

stainless steel spring and gutter support chairs for capping any parapet wall. The system shall be watertight, maintenance free, and not require exposed fasteners or sealant. Joints shall be butt type with concealed splice plates.

2. Performance characteristics:
   a. Coping sections shall expand and contract freely while mechanically locked in place on anchor cleats.
   b. Coping sections shall lock to anchor cleats by mechanical pressure from support chairs.
   c. All coping cover joints shall be underlayed with gutter/support chairs capable of draining water.
3. Metal: .050" aluminum for all sizes; 24 gauge galvanized steel with Kynar coating.
4. Coping cap: Length of 10'-0"; Refer to drawings for width.
5. Coping vertical 4.5" face and 4" back leg.
6. Internal splice plates: Shall be concealed with matching finish to maintain outside face continuity.
7. Coping Cleat: 20 gauge galvanized steel anchor cleat with 26 gauge stainless steel spring; normally 12" wide @ 5'-0" on center to be mechanically fastened as indicated and detailed.
8. Gutter/support chair: Metal Gutter Chair in color and finish to match coping cap.
9. Fasteners: Shall be stainless steel screw type with a minimum pull-out resistance of 240 # (109 kg) as supplied by the manufacturer per substrate application. No exposed fasteners shall be permitted.
10. Finishes: Shall be standard pre-coated Kynar-500 from manufacturer's color list.
    a. .

2.02 ROOF-EDGE SPECIALTIES

A. Roof-Edge Fascia: Manufactured, two-piece, roof-edge fascia consisting of snap-on metal fascia cover in section lengths not exceeding and a continuous metal receiver with integral drip-edge cleat to engage fascia cover. Provide matching corner units.
   1. Manufacturers: Subject to compliance with requirements, [provide products by the following] [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
   2. Basis-of-Design Product: Subject to compliance with requirements, provide [product indicated on Drawings] or comparable product by one of the following:
      a. Hickman Company, W. P.
      b. Metal-Fab Manufacturing, LLC.
      c. Perimeter Systems; a division of SAF.
   3. Formed Aluminum Sheet Fascia Covers: Aluminum sheet, thickness as required to meet performance requirements.
      a. Surface: Smooth, flat finish.
      b. Finish: Three-coat fluoropolymer.
      c. Color: As selected by Architect from manufacturer's full range.
   4. Some manufacturers do not offer first two options in "Corners" Subparagraph below; if required, verify availability with manufacturers.
   5. Corners: Factory mitered and continuously welded.

2.03 MATERIALS

A. Aluminum Sheet: ASTM B 209 , alloy as standard with manufacturer for finish required, with temper to suit forming operations and performance required.

B. Aluminum Extrusions: ASTM B 221 , alloy and temper recommended by manufacturer for type of use and finish indicated, finished as follows:

2.04 MISCELLANEOUS MATERIALS

A. Fasteners: Manufacturer's recommended fasteners, suitable for application and designed to meet performance requirements. Furnish the following unless otherwise indicated:
   1. Fasteners for Aluminum: Aluminum or Series 300 stainless steel.

B. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane polymer sealant of type, grade, class, and use classifications required by roofing-specialty manufacturer for each application.

2.05 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Coil-Coated Aluminum Sheet Finishes:
   1. High-Performance Organic Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
      a.
      b. Three-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

D. Aluminum Extrusion Finishes:
   1. High-Performance Organic Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
      a. Three-Coat Fluoropolymer: AAMA. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.

B. Examine walls, roof edges, and parapets for suitable conditions for roof specialties.

C. Verify that substrate is sound, dry, smooth, clean, sloped for drainage where applicable, and securely anchored.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 UNDERLAYMENT INSTALLATION

A. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches . Roll laps with roller. Cover underlayment within 14 days.
   1. Apply continuously under copings roof-edge specialties.
   2. Coordinate application of self-adhering sheet underlayment under roof specialties with requirements for continuity with adjacent air barrier materials.

3.03 INSTALLATION, GENERAL

A. General: Install roof specialties according to manufacturer's written instructions. Anchor roof specialties securely in place, with provisions for thermal and structural movement. Use fasteners, solder, protective coatings, separators, underlayments, sealants, and other miscellaneous items as required to complete roof-specialty systems.
   1. Install roof specialties level, plumb, true to line and elevation; with limited oil-canning and without warping, jogs in alignment, buckling, or tool marks.
   2. Provide uniform, neat seams with minimum exposure of solder and sealant.
   3. Install roof specialties to fit substrates and to result in weathertight performance. Verify shapes and dimensions of surfaces to be covered before manufacture.
   4. Torch cutting of roof specialties is not permitted.
   5. Do not use graphite pencils to mark metal surfaces.

B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.
   1. Coat concealed side of uncoated aluminum and stainless-steel roof specialties with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
   2. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof specialties for waterproof performance.

C. Expansion Provisions: Allow for thermal expansion of exposed roof specialties.
   1. Space movement joints at a maximum of 12 feet with no joints within 18 inches of corners or intersections unless otherwise indicated on Drawings.
   2. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures.

D. Fastener Sizes: Use fasteners of sizes that penetrate [wood blocking or sheathing not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws] [substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance] <Insert size requirement>.

E. Seal concealed joints with butyl sealant as required by roofing-specialty manufacturer.

F. Seal joints as required for weathertight construction. Place sealant to be completely concealed in joint. Do not install sealants at temperatures below 40 deg F.

3.04 COPING INSTALLATION

A. Install cleats, anchor plates, and other anchoring and attachment accessories and devices with concealed fasteners.

B. Anchor copings with manufacturer's required devices, fasteners, and fastener spacing to meet performance requirements.
   1. Interlock face and back leg drip edges of snap-on coping cap into cleated anchor plates anchored to substrate at manufacturer's required spacing that meets performance requirements.
   2. Interlock face-leg drip edge into continuous cleat anchored to substrate at manufacturer's required spacing that meets performance requirements. Anchor back leg of coping with screw fasteners and elastomeric washers at manufacturer's required spacing that meets performance requirements.

3.05 ROOF-EDGE SPECIALITIES INSTALLATION

A. Install cleats, cants, and other anchoring and attachment accessories and devices with concealed fasteners.

B. Anchor roof edgings with manufacturer's required devices, fasteners, and fastener spacing to meet performance requirements.

3.06 ROOF-EDGE DRAINAGE-SYSTEM INSTALLATION

A. General: Install components to produce a complete roof-edge drainage system according to manufacturer's written instructions. Coordinate installation of roof perimeter flashing with installation of roof-edge drainage system.

3.07 REGLET AND COUNTERFLASHING INSTALLATION

A. General: Coordinate installation of reglets and counterflashings with installation of base flashings.

B. Embedded Reglets: See [Section 03 30 00 "Cast-in-Place Concrete"] [and] [Section 04 20 00 "Unit Masonry"] for installation of reglets.

C. Surface-Mounted Reglets: Install reglets to receive flashings where flashing without embedded reglets is indicated on Drawings. Install at height so that inserted counterflashings overlap 4 inches

over top edge of base flashings.

3.08 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder and sealants.

C. Remove temporary protective coverings and strippable films as roof specialties are installed. On completion of installation, clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain roof specialties in a clean condition during construction.

D. Replace roof specialties that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 07 72 00
ROOF ACCESSORIES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Gravity ventilators.
   2. Pipe and duct support.
   3. Pipe portals.
   4. Preformed flashing sleeves.

B. Related Requirements:
   1. Section 05 50 00 "Metal Fabrications" for metal vertical ladders, ships' ladders, and stairs for access to roof hatches.
   2. Section 07 62 00 "Sheet Metal Flashing and Trim" for shop- and field-formed metal flashing, roof-drainage systems, roof expansion-joint covers, and miscellaneous sheet metal trim and accessories.
   3. Section 07 71 00 "Roof Specialties" for manufactured fasciae, copings, gravel stops, gutters and downspouts, and counterflashing.

1.02 COORDINATION

A. Coordinate layout and installation of roof accessories with roofing membrane and base flashing and interfacing and adjoining construction to provide a leakproof, weathertight, secure, and noncorrosive installation.

B. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of roof accessory.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For roof accessories.
   1. Include plans, elevations, keyed details, and attachments to other work. Indicate dimensions, loadings, and special conditions. Distinguish between plant- and field-assembled work.

1.04 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Roof plans, drawn to scale, and coordinating penetrations and roof-mounted items. Show the following:
   1. Size and location of roof accessories specified in this Section.
   2. Method of attaching roof accessories to roof or building structure.

3. Other roof-mounted items including mechanical and electrical equipment, ductwork, piping, and conduit.
4. Required clearances.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For roof accessories to include in operation and maintenance manuals.

1.06 WARRANTY

A. Special Warranty on Painted Finishes: Manufacturer's standard form in which manufacturer agrees to repair finishes or replace roof accessories that show evidence of deterioration of factory-applied finishes within specified warranty period.
1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:
   a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
   b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
   c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. General Performance: Roof accessories shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

B. Wind-Restraint Performance: As indicated on Drawings.

2.02 PREFORMED FLASHING SLEEVES

A. Exhaust Vent Flashing: Double-walled metal flashing sleeve or boot, insulation filled, with integral deck flange, 12 inches high, with removable metal hood and metal collar.

B. Vent Stack Flashing: Metal flashing sleeve, uninsulated, with integral deck flange.

2.03 METAL MATERIALS

A. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 coating designation.

B. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M, AZ50 coated.

C. Aluminum Sheet: ASTM B 209, manufacturer's standard alloy for finish required, with temper to suit forming operations and performance required.

D. Aluminum Extrusions and Tubes: ASTM B 221, manufacturer's standard alloy and temper for type of use, finished to match assembly where used; otherwise mill finished.

E. Stainless-Steel Sheet and Shapes: ASTM A 240/A 240M or ASTM A 666, Type 304.

F. Steel Shapes: ASTM A 36/A 36M, hot-dip galvanized according to ASTM A 123/A 123M unless otherwise indicated.

G. Steel Tube: ASTM A 500/A 500M, round tube.

H. Galvanized-Steel Tube: ASTM A 500/A 500M, round tube, hot-dip galvanized according to ASTM A 123/A 123M.

I. Steel Pipe: ASTM A 53/A 53M, galvanized.

2.04 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.

2.05 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.

B. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.

C. Verify dimensions of roof openings for roof accessories.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. General: Install roof accessories according to manufacturer's written instructions.
   1. Install roof accessories level; plumb; true to line and elevation; and without warping, jogs in

alignment, buckling, or tool marks.
2. Anchor roof accessories securely in place so they are capable of resisting indicated loads.
3. Use fasteners, separators, sealants, and other miscellaneous items as required to complete installation of roof accessories and fit them to substrates.
4. Install roof accessories to resist exposure to weather without failing, rattling, leaking, or loosening of fasteners and seals.

B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.

C. Coat concealed side of uncoated aluminum stainless-steel roof accessories with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
1. Underlayment: Where installing roof accessories directly on cementitious or wood substrates, install a course of underlayment and cover with manufacturer's recommended slip sheet.
2. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof accessories for waterproof performance.

D. Equipment Support Installation: Install equipment supports so top surfaces are level with each other.

E. Gravity Ventilator Installation: Verify that gravity ventilators operate properly and have unrestricted airflow. Clean, lubricate, and adjust operating mechanisms.

F. Pipe Support Installation: Comply with MSS SP-58 and MSS SP-89. Install supports and attachments as required to properly support piping. Arrange for grouping of parallel runs of horizontal piping, and support together.
1. Pipes of Various Sizes: Space supports for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.

G. Preformed Flashing-Sleeve and Flashing Pipe Portal Installation: Secure flashing sleeve to roof membrane according to flashing-sleeve manufacturer's written instructions; flash sleeve flange to surrounding roof membrane according to roof membrane manufacturer's instructions.

H. Seal joints with elastomeric or butyl sealant as required by roof accessory manufacturer.

3.03 REPAIR AND CLEANING

A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing according to ASTM A 780/A 780M.

B. Touch up factory-primed surfaces with compatible primer ready for field painting according to Section 09 91 13 "Exterior Painting."

C. Clean exposed surfaces according to manufacturer's written instructions.

D. Clean off excess sealants.

E. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 07 84 00
PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Penetrations in fire-resistance-rated walls.
   2. Penetrations in smoke barriers.
   3. Penetrations in fire barrier walls.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Product Schedule: For each penetration firestopping system. Include location and design designation of qualified testing and inspecting agency.
   1. Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping condition, submit illustration, with modifications marked, approved by penetration firestopping manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

1.03 INFORMATIONAL SUBMITTALS

A. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for penetration firestopping.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: A firm experienced in installing penetration firestopping similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its penetration firestopping products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.

B. Fire-Test-Response Characteristics: Penetration firestopping shall comply with the following requirements:
   1. Penetration firestopping tests are performed by a qualified testing agency acceptable to authorities having jurisdiction.
   2. Penetration firestopping is identical to those tested per testing standard referenced in "Penetration Firestopping" Article. Provide rated systems complying with the following requirements:
      a. Penetration firestopping products bear classification marking of qualified testing and

inspecting agency.

1.05 PROJECT CONDITIONS

A. Environmental Limitations: Do not install penetration firestopping when ambient or substrate temperatures are outside limits permitted by penetration firestopping manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.

B. Install and cure penetration firestopping per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

1.06 COORDINATION

A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping is installed according to specified requirements.

B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Grace Construction Products.
   2. Hilti, Inc.
   3. 3M Fire Protection Products.
   4. Tremco, Inc.; Tremco Fire Protection Systems Group.

2.02 PENETRATION FIRESTOPPING

A. Provide penetration firestopping that is produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.

B. Penetrations in Fire-Resistance-Rated Walls: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).
   1. Fire-resistance-rated walls include fire walls and smoke partitions.
   2. F-Rating: Not less than the fire-resistance rating of constructions penetrated.

C. Penetrations in Smoke Barriers: Provide penetration firestopping with ratings determined per UL 1479.

1. L-Rating: Not exceeding 5.0 cfm/sq. ft. of penetration opening at 0.30-inch wg at both ambient and elevated temperatures.

D. VOC Content: Penetration firestopping sealants and sealant primers shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
   1. Sealants: 250 g/L.
   2. Sealant Primers for Nonporous Substrates: 250 g/L.
   3. Sealant Primers for Porous Substrates: 775 g/L.

E. Low-Emitting Materials: Penetration firestopping sealants and sealant primers shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

F. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping manufacturer and approved by qualified testing and inspecting agency for firestopping indicated.
   1. Permanent forming/damming/backing materials, including the following:
      a. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
   2. Temporary forming materials.
   3. Substrate primers.
   4. Collars.
   5. Steel sleeves.

2.03 FILL MATERIALS

2.04 MIXING

A. For those products requiring mixing before application, comply with penetration firestopping manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Surface Cleaning: Clean out openings immediately before installing penetration firestopping to comply with manufacturer's written instructions and with the following requirements:
   1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping.
   2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping. Remove loose particles remaining from cleaning operation.
   3. Remove laitance and form-release agents from concrete.

B. Priming: Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. Masking Tape: Use masking tape to prevent penetration firestopping from contacting adjoining surfaces that will remain exposed on completion of the Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove stains. Remove tape as soon as possible without disturbing firestopping's seal with substrates.

3.03 INSTALLATION

A. General: Install penetration firestopping to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
   1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestopping.

C. Install fill materials for firestopping by proven techniques to produce the following results:
   1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
   2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
   3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.04 IDENTIFICATION

A. Identify penetration firestopping with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of firestopping edge so labels will be visible to anyone

seeking to remove penetrating items or firestopping. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
2. Contractor's name, address, and phone number.
3. Designation of applicable testing and inspecting agency.
4. Date of installation.
5. Manufacturer's name.
6. Installer's name.

3.05 CLEANING AND PROTECTION

A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping is without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping and install new materials to produce systems complying with specified requirements.

3.06 PENETRATION FIRESTOPPING SCHEDULE

A. Firestopping for Electrical Cables:
   1. Type of Fill Materials: As required to achieve rating.

B. Firestopping for Insulated Pipes:
   1. Type of Fill Materials: As required to achieve rating.

C. Firestopping for Miscellaneous Electrical Penetrants:
   1. Type of Fill Materials: As required to achieve rating.

D. Firestopping for Miscellaneous Mechanical Penetrants:
   1. Type of Fill Materials: As required to achieve rating.

END OF SECTION

SECTION 07 84 43
JOINT FIRESTOPPING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Joints in or between fire-resistance-rated constructions.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.03 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each joint firestopping system, for tests performed by a qualified testing agency.

1.04 CLOSEOUT SUBMITTALS

A. Installer Certificates: From Installer indicating that joint firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with UL's "Qualified Firestop Contractor Program Requirements."

1.06 PROJECT CONDITIONS

A. Environmental Limitations: Do not install joint firestopping systems when ambient or substrate temperatures are outside limits permitted by joint firestopping system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.

B. Install and cure joint firestopping systems per manufacturer's written instructions using natural means of ventilation or, where this is inadequate, forced-air circulation.

1.07 COORDINATION

A. Coordinate construction of joints to ensure that joint firestopping systems can be installed according to specified firestopping system design.

B. Coordinate sizing of joints to accommodate joint firestopping systems.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics:
   1. Perform joint firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
   2. Test per testing standards referenced in "Joint Firestopping Systems" Article. Provide rated systems complying with the following requirements:
      a. Joint firestopping systems shall bear classification marking of a qualified testing agency.
         1. UL in its "Fire Resistance Directory."
         2. Intertek Group in its "Directory of Listed Building Products."

2.02 JOINT FIRESTOPPING SYSTEMS

A. Joint Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which joint firestopping systems are installed. Joint firestopping systems shall accommodate building movements without impairing their ability to resist the passage of fire and hot gases.

B. Joints in or between Fire-Resistance-Rated Construction: Provide joint firestopping systems with ratings determined per ASTM E 1966 or UL 2079.
   1. Manufacturers: Subject to compliance with requirements, provide products by the following:
      a. 3M Fire Protection Products.
      b. Hilti, Inc..
      c. Tremco, Inc..
   2. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of the wall, floor, or roof in or between which it is installed.

C. Exposed Joint Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

D. Accessories: Provide components of fire-resistive joint systems, including primers and forming materials, that are needed to install elastomeric fill materials and to maintain ratings required. Use only components specified by joint firestopping system manufacturer and approved by the qualified testing agency for conditions indicated.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Surface Cleaning: Before installing fire-resistive joint systems, clean joints immediately to comply with fire-resistive joint system manufacturer's written instructions and the following requirements:
   1. Remove from surfaces of joint substrates foreign materials that could interfere with adhesion of elastomeric fill materials or compromise fire-resistive rating.
   2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with elastomeric fill materials. Remove loose particles remaining from cleaning operation.
   3. Remove laitance and form-release agents from concrete.

B. Prime substrates where recommended in writing by joint firestopping system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

3.03 INSTALLATION

A. General: Install fire-resistive joint systems to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install forming materials and other accessories of types required to support elastomeric fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
   1. After installing elastomeric fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of fire-resistive joint system.

C. Install elastomeric fill materials for fire-resistive joint systems by proven techniques to produce the following results:
   1. Elastomeric fill voids and cavities formed by joints and forming materials as required to achieve fire-resistance ratings indicated.
   2. Apply elastomeric fill materials so they contact and adhere to substrates formed by joints.
   3. For elastomeric fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.04 IDENTIFICATION

A. Joint Identification: Identify joint firestopping systems with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of joint edge so labels are visible to anyone seeking to remove or joint firestopping system. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
   1. The words "Warning - Joint Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
   2. Contractor's name, address, and phone number.
   3. Designation of applicable testing agency.

4. Date of installation.
5. Manufacturer's name.
6. Installer's name.

3.05 FIELD QUALITY CONTROL

A. Inspecting Agency: Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E 2393.

B. Where deficiencies are found or joint firestopping systems are damaged or removed due to testing, repair or replace joint firestopping systems so they comply with requirements.

C. Proceed with enclosing joint firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

3.06 CLEANING AND PROTECTION

A. Clean off excess elastomeric fill materials adjacent to joints as the Work progresses by methods and with cleaning materials that are approved in writing by joint firestopping system manufacturers and that do not damage materials in which joints occur.

B. Provide final protection and maintain conditions during and after installation that ensure joint firestopping systems are without damage or deterioration at time of Substantial Completion. If damage or deterioration occurs despite such protection, cut out and remove damaged or deteriorated fire-resistive joint systems immediately and install new materials to produce fire-resistive joint systems complying with specified requirements.

3.07 JOINT FIRESTOPPING SYSTEM SCHEDULE

A. Where UL-classified systems are indicated, they refer to system numbers in UL's "Fire Resistance Directory" under product Category XHBN or Category XHDG.

B. Where Intertek Group-listed systems are indicated, they refer to design numbers in Intertek Group's "Directory of Listed Building Products" under product category Expansion/Seismic Joints or Firestop Systems.

C. Perimeter Joint Firestopping System at Curtainwall: HI/BPF 120-10

END OF SECTION

SECTION 07 92 00
JOINT SEALANTS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes sealants for the following applications, including those specifically by reference to this Section:
   1. Exterior joints in the following vertical surfaces and nontraffic horizontal surfaces:
      a. Exterior wall sill sealer material at bottom of exterior metal stud tracks.
      b. Joints subject to movement at sheet metal and trim and exterior door thresholds.
      c. Joints between different materials.
      d. Perimeter joints between abutting materials and frames of doors and windows.
      e. Other Joints as indicated.
   2. Exterior joints in the following horizontal surfaces:
      a. Control, expansion, and isolation joints in cast-in-place concrete slabs.
      b. Joints between different materials listed above.
      c. Other joints as indicated.
   3. Interior Joints in the following vertical surfaces and horizontal nontraffic surfaces:
      a. Control and expansion joints on exposed interior surfaces of exterior walls.
      b. Perimeter joints of exterior openings where indicated.
      c. Tile control and expansion joints.
      d. Vertical control joints on exposed surfaces of interior unit masonry walls and partitions.
      e. Perimeter joints between interior wall surfaces and frames of interior doors, windows, and elevator entrances.
      f. Joints between Architectural woodwork and adjacent materials.
      g. Joints between plumbing fixtures and adjoining walls, floors, and counters.
      h. Other joints as indicated.
   4. Interior joints in the following horizontal traffic surfaces:
      a. Control and expansion joints in cast-in-place concrete slabs.
      b. Control and expansion joints in tile flooring.
      c. Other joints as indicated.
   5. Comply with 2012 IECC COMcheck:

1.02 RELATED SECTIONS:

A. Section 04 20 00 - "Unit Masonry" for masonry control and expansion joint fillers and gaskets.

B. Section 08 80 00 - "Glazing" for glazing sealants.

C. Section 09 29 00 - "Gypsum Boards" for sealing perimeter joints.

D. Section 09 30 00 - "Tiling" for sealing tile joints.

E. Section 09 51 23 - "Acoustical Tile Ceilings" for sealing edge moldings at perimeters with acoustical sealants.

1.03 PERFORMANCE REQUIREMENTS

A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.

B. Provide joint sealants for interior applications that establish and maintain airtight and water resistant continuous joint seals without staining or deteriorating joint substrates.

1.04 SUBMITTALS

A. Product Data: For each joint-sealant product indicated.

B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

C. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- wide joints formed between two 6-inch- long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

D. Product Certificates: For each kind of joint sealant and accessory, from manufacturer.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project. An experienced installer who has specialized in installing joint sealants similar in material, design, and extent to those indicated for this Project and whose work has resulted in joint-sealant installations with a record of successful in-service performance.

B. Source Limitations: Obtain each kind of joint sealant from single source from single manufacturer.

C. Comply with recommendations of the Sealant, Waterproofing, and Restoration Institute (SWRI).

D. Mockups: Before installing joint sealants, apply elastomeric sealants as follows to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution:
   1. Joints in mockups of assemblies specified in other Sections that are indicated to receive elastomeric joint sealants, which are specified by reference to this Section.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in the original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration date, pot life, curing time, and mixing instructions for multi-component materials.

B. Store and handle materials in compliance with manufacturer's written instructions to prevent their

deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.07 PROJECT CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:
   1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
   2. When joint substrates are wet.
   3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
   4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.08 WARRANTY

A. General Warranty: Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of Contract Documents.

B. Special Installer's Warranty: Manufacturer's standard form in which Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
   1. Warranty Period: Five years from date of Substantial Completion

C. Special Manufacturer's Warranty: Manufacturer's standard form in which joint-sealant manufacturer agrees to furnish joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.
   1. Warranty Period: Ten years from date of Substantial Completion.

D. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:
   1. Movement of the structure caused by structural settlement or errors attributable to design or construction resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
   2. Disintegration of joint substrates from natural causes exceeding design specifications.
   3. Mechanical damage caused by individuals, tools, or other outside agents.
   4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.01 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible

with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

B. Liquid-Applied Joint Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

C. Stain-Test-Response Characteristics: Where sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

D. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.02 ELASTOMERIC JOINT SEALANTS:

A. Elastomeric Sealant Standard: Comply with ASTM C920 and other requirements indicated for each liquid-applied chemically curing sealant in Elastomeric Joint Sealant Schedule at the endo of Part 3, including those referencing ASTM C 920 classifications for type, grade, class, & uses.

B. Additional Movement Capability: Where additional movement capability is specified in the Elastomeric Joint Sealant Schedule, provide products with the capability, when tested for adhesion and cohesion under maximum cyclic movement per ASTM C 719, to withstand the specified percentage change in the joint width existing at the time of installation and remain in compliance with other requirements of ASTM C 920 for uses indicated.

C. Suitability for Contact with Food: Where elastomeric sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.

2.03 LATEX JOINT SEALANTS

A. Latex Joint Sealant: Acrylic latex or siliconized acrylic latex, ASTM C 834.as indicated in Sovent Release Joint-Sealant Schedule at end of Part 3.

2.04 SOLVENT-RELEASE-CURING JOINT SEALANTS

A. Butyl-Rubber-Based Solvent-Release Joint Sealant Standard: Comply with ASTM C 1085 for each product of this description indicated in Solvent-Release Joint-Sealant Schedule at end of Part 3.

2.05 ACOUSTICAL JOINT SEALANTS

A. Acoustical Joint Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90. Product has flame-spread and smoke developed ratings of less than 25 per ASTM E 84. See Acoustical Joint Sealant Schedule.

2.06 JOINT SEALANT BACKING

A. General: Provide sealant backings of material that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin) Type O (open-cell material) Type B (bicellular material with a surface skin) or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

2.07 SILL SEALER

A. Exterior Metal Stud Tracks: Provide continuous sill seal foam gasket under all exterior metal stud tracks.

2.08 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
   1. Remove all foreign material from joint substrates that could interfere with adhesion of joint

sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.

2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
   a. Concrete.
   b. Masonry.
   c. Unglazed surfaces of ceramic tile.
   d. Exterior insulation and finish systems.
3. Remove laitance and form-release agents from concrete.
4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
   a. Metal.
   b. Glass.
   c. Porcelain enamel.
   d. Glazed surfaces of ceramic tile.

B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.03 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Seal and caulk all sources of air leakage in the building thermal envelope.

D. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of sealant backings.
2. Do not stretch, twist, puncture, or tear sealant backings.
3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
   1. Place sealants so they directly contact and fully wet joint substrates.
   2. Completely fill recesses in each joint configuration.
   3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
   1. Remove excess sealant from surfaces adjacent to joints.
   2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
   3. Retain one or more of three subparagraphs below to suit joint configurations required for Project. First subparagraph makes concave configuration the default requirement; second and third subparagraphs require that other configurations be indicated on Drawings. Revise if one of the latter two configurations is the default requirement.
   4. Provide concave joint profile per Figure 8A in ASTM C 1193, unless otherwise indicated.

G. Acoustical Sealant Installation: At sound-rated assemblies and elsewhere as indicated, seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations.

3.04 FIELD QUALITY CONTROL

A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:
   1. Seal at least 5 foot lengths of joints and cure properly
   2. Cut sealant and pull out according to method described in SWRI's "Sealants: The Professional's Guide"
   3. Select test joints representative of joints to be sealed by the product to be tested.
   4. Perform test for each type of sealant to be used on exterior.
   5. Do Test in presence of the Owner and technical representative of sealant manufacturer.
   6. Report acceptable results only.

B. Evaluation of Field-Adhesion Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.05 CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.06 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.07 ELASTOMERIC JOINT-SEALANT SCHEDULE

A. Medium-Modulus Neutral-Curing Silicone Sealant. Provide products complying with the following:
   1. Products: Available products include the following:
      a. 756 H.P.; Dow Corning.
      b. Silglaze II; GE Silicones.
      c. 895; Pecora Corporation.
   2. Type and Grade: S (single component) and NS (nonsag).
   3. Class: 25.
   4. Additional Movement Capability: 50 percent movement in extension and 50 percent movement in compression for a total of 100 percent movement.
   5. Uses Related to Exposure: NT (nontraffic) and T (traffic).
   6. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.

B. High-Modulus Neutral-Curing Silicone Sealant. Provide products complying with the following:
   1. Products: Available products include the following:
      a. 995; Dow Corning.
      b. Ultraglaze 4000; GE Silicones.
      c. Ultraglaze 4000AC; GE Silicones.
   2. Type and Grade: S (single component) and NS (nonsag).
   3. Class: 25.
   4. Additional Movement Capability: 50 percent movement in extension and 50 percent movement in compression for a total of 100 percent movement.
   5. Use Related to Exposure: NT (nontraffic).
   6. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.

C. Mildew-Resistant Silicone Sealant. Provide products formulated with fungicide that are intended for sealing interior ceramic tile joints and other nonporous substrates that are subject to in-service exposures of high humidity and temperature extremes, and that comply with the following:

1. Products: Available products include the following:
   a. 786 Mildew Resistant; Dow Corning.
   b. Sanitary 1700; GE Silicones.
   c. NuFlex 302; NUCO Industries, Inc.
   d. 898 Silicone Sanitary Sealant; Pecora Corporation.
   e. PSI-611; Polymeric Systems, Inc.
   f. Tremsil 600 White; Tremco.
2. Type and Grade: S (single component) and NS (nonsag).
3. Class: 25.
4. Use Related to Exposure: NT (nontraffic).
5. Uses Related to Joint Substrates: G, A, and, as applicable to joint substrates indicated, O.

D. Multicomponent Nonsag Urethane Sealant. Provide products complying with the following:
1. Products: Available products include the following:
   a. Vulkem 922; Mameco International.
   b. Dynatrol II; Pecora Corporation.
   c. Flexiprene 2000; Polymeric Systems, Inc.
   d. Sikaflex - 2c NS; Sika Corporation.
   e. DYmeric 511; Tremco.
2. Type and Grade: M (multicomponent) and NS (nonsag).
3. Class: 25.
4. Additional Movement Capability: 50 percent movement in extension and 50 percent in compression for a total of 100 percent movement.
5. Use Related to Exposure: NT (nontraffic).
6. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.

E. Single-Component Nonsag Urethane Sealant. Provide products complying with the following:
1. Products: Available products include the following:
   a. Vulkem 116; Mameco International.
   b. Vulkem 230; Mameco International.
   c. Sikaflex - 1a; Sika Corporation.
   d. NP 1; Sonneborn Building Products Div., ChemRex Inc.
2. Type and Grade: S (single component) and NS (nonsag).
3. Class: 12-1/2 and 25.
4. Uses Related to Exposure: T (traffic) and NT (nontraffic).
5. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.

3.08 SOLVENT-RELEASE JOINT-SEALANT SCHEDULE

A. Butyl-Rubber-Based Solvent-Release Sealant. Provide products complying with the following:
1. Products: Available products include the following:
   a. Bostik 300; Bostik Inc.
   b. PTI 707; H.B. Fuller Company.
   c. PTI 757; H.B. Fuller Company.
   d. NuFlex 232; NUCO Industries, Inc.
   e. BC-158; Pecora Corporation.
   f. PSI-301: Polymeric Systems, Inc.

g. Sonneborn Multi-Purpose Sealant; Sonneborn Building Products Div., ChemRex, Inc.
h. Tremco Butyl Sealant; Tremco.

3.09 LATEX JOINT-SEALANT SCHEDULE

A. Latex Sealant. Provide products complying with the following:
1. Products: Available products include the following:
2. Chem-Calk 600; Bostik Inc.
3. NuFlex 330; NUCO Industries, Inc.
4. LC 160 All Purpose Acrylic Caulk; Ohio Sealants, Inc.
5. AC-20; Pecora Corporation.
6. PSI-701; Polymeric Systems, Inc.
7. Sonolac; Sonneborn Building Products Div., ChemRex, Inc.
8. Tremflex 834; Tremco.

3.010 ACOUSTICAL JOINT-SEALANT SCHEDULE

A. Acoustical Sealant for Exposed and Concealed Joints. Provide products complying with the following:
1. Products: Available products include the following:
2. AC-20 FTR Acoustical and Insulation Sealant; Pecora Corporation.
3. SHEETROCK Acoustical Sealant; USG Corp., United States Gypsum Co.

END OF SECTION

SECTION 08 11 13
HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Standard hollow metal doors frames.
   2. Custom hollow metal.

B. Related Sections:
   1. Division 04 Section "Unit Masonry" for embedding anchors for hollow metal work into masonry construction.
   2. Division 08 Section "Sound Control Door Assemblies" for packaged, acoustical hollow metal door and frame assemblies with STC ratings of 35 or more.
   3. Division 08 Section "Door Hardware (Scheduled by Describing Products)" for door hardware for hollow metal doors.
   4. Division 09 Sections "Interior Painting" for field painting hollow metal doors and frames.
   5. Division 26 Sections for electrical connections including conduit and wiring for door controls and operators.

1.02 DEFINITIONS

A. Minimum Thickness: Minimum thickness of base metal without coatings.

B. Standard Hollow Metal Work: Hollow metal work fabricated according to ANSI/SDI A250.8.

C. Custom Hollow Metal Work: Hollow metal work fabricated according to ANSI/NAAMM-HMMA 861.

1.03 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, core descriptions, fire-resistance rating, and finishes.

B. Shop Drawings: Include the following:
   1. Elevations of each door design.
   2. Details of doors, including vertical and horizontal edge details and metal thicknesses.
   3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
   4. Locations of reinforcement and preparations for hardware.
   5. Details of each different wall opening condition.
   6. Details of anchorages, joints, field splices, and connections.
   7. Details of accessories.
   8. Details of moldings, removable stops, and glazing.
   9. Details of conduit and preparations for power, signal, and control systems.

C. Other Action Submittals:
   1. Schedule: Provide a schedule of hollow metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with door hardware schedule.

D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each type of hollow metal door and frame assembly.

1.04 QUALITY ASSURANCE

A. Source Limitations: Obtain hollow metal work from single source from single manufacturer.

B. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252.
   1. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.

C. Fire-Rated, Borrowed-Light Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled, by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9. Label each individual glazed lite.

D. Smoke-Control Door Assemblies: Comply with NFPA 105 or UL 1784.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow metal work palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
   1. Provide additional protection to prevent damage to finish of factory-finished units.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow metal work under cover at Project site. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch- high wood blocking. Do not store in a manner that traps excess humidity.
   1. Provide minimum 1/4-inch (6-mm) space between each stacked door to permit air circulation.

1.06 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.07 COORDINATION

A. Coordinate installation of anchorages for hollow metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Amweld Building Products, LLC.
   2. Curries Company; an Assa Abloy Group company.
   3. Kewanee Corporation (The).
   4. Mesker Door Inc.
   5. Steelcraft; an Ingersoll-Rand company.

2.02 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum metallic coating.

D. Frame Anchors: ASTM A 591/A 591M, Commercial Steel (CS), 40Z coating designation; mill phosphatized.
   1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.

E. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.

F. Powder-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow metal frames of type indicated.

G. Grout: ASTM C 476, except with a maximum slump of 4 inches, as measured according to ASTM C 143/C 143M.

H. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool with 6- to 12-lb/cu. ft. density; with maximum flame-spread and smoke-development indexes of 25 and 50, respectively; passing ASTM E 136 for

combustion characteristics.

I. Glazing: Comply with requirements in Division 08 Section "Glazing."

J. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.03 STANDARD HOLLOW METAL DOORS

A. General: Provide doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces unless otherwise indicated. Comply with ANSI/SDI A250.8.
   1. Design: As indicated.
   2. Core Construction: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core.
      a. Fire Door Core: As required to provide fire-protection and temperature-rise ratings indicated.
      c. Thermal-Rated (Insulated) Doors: Where indicated, provide doors fabricated with thermal-resistance value (R-value) of not less than 2.5 when tested according to ASTM C 1363.
         1. Locations: Exterior doors interior doors where indicated.

      Vertical Edges for Single-Acting Doors: Manufacturer's standard.
      d. Beveled Edge: 1/8 inch in 2 inches.
   3. Vertical Edges for Double-Acting Doors: Round vertical edges with 2-1/8-inch (54-mm) radius.
   4. Top and Bottom Edges: Closed with flush or inverted 0.042-inch (1.0-mm-) thick, end closures or channels of same material as face sheets.
   5. Tolerances: Comply with SDI 117, "Manufacturing Tolerances for Standard Steel Doors and Frames."

B. Exterior Doors: Face sheets fabricated from metallic-coated steel sheet. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:
   1. Level 2 and Physical Performance Level B (Heavy Duty), Model 1 (Full Flush).

C. Interior Doors: Face sheets fabricated from cold-rolled steel sheet unless metallic-coated sheet is indicated. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:
   1. Level 2 and Physical Performance Level B (Heavy Duty), Model 1 (Full Flush).

D. Fabricate concealed stiffeners and hardware reinforcement from either cold- or hot-rolled steel sheet.

2.04 STANDARD HOLLOW METAL FRAMES

A. General: Comply with ANSI/SDI A250.8 and with details indicated for type and profile.

B. Exterior Frames: Fabricated from metallic-coated steel sheet.
   1. Fabricate frames with mitered or coped corners.
   3. Fabricate frames as face welded unless otherwise indicated.
   4. Frames for Level 2 Steel Doors: 0.053-inch- thick steel sheet.

C. Interior Frames: Fabricated from cold-rolled steel sheet unless metallic-coated sheet is indicated.
   1. Fabricate frames with mitered or coped corners.
   3. Fabricate frames as face welded unless otherwise indicated.
   5. Frames for Level 1 Steel Doors: 0.042-inch- thick steel sheet.
   6. Frames for Level 2 Steel Doors: 0.053-inch- thick steel sheet.
   7. Frames for Level 3 Steel Doors: 0.053-inch- thick steel sheet.
   8. Frames for Level 4 Steel Doors: 0.067-inch- thick steel sheet.
   9. Frames for Wood Doors: thick steel sheet.
   10. Frames for Borrowed Lights: thick steel sheet.

D. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcement plates from same material as frames.

2.05 FRAME ANCHORS

A. Jamb Anchors:
   1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch (1.0 mm) thick, with corrugated or perforated straps not less than 2 inches (50 mm) wide by 10 inches (250 mm) long; or wire anchors not less than 0.177 inch (4.5 mm) thick.
   2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch (1.0 mm) thick.

B. Floor Anchors: Formed from same material as frames, not less than 0.042 inch thick, and as follows:
   1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.

2.06 STOPS AND MOLDINGS

A. Moldings for Glazed Lites in Doors: Minimum 0.032 inch thick, fabricated from same material as door face sheet in which they are installed.

B. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch high unless otherwise indicated.

C. Loose Stops for Glazed Lites in Frames: Minimum 0.032 inch thick, fabricated from same material as frames in which they are installed.

D. Terminated Stops: Where indicated on interior door frames, terminate stops 6 inches above finish floor with a 45 -degree angle cut, and close open end of stop with steel sheet closure. Cover opening in extension of frame with welded-steel filler plate, with welds ground smooth and flush with frame.

1. Provide terminated stops unless otherwise indicated.

2.07 LOUVERS

A. Provide louvers for interior doors, where indicated, that comply with SDI 111C, with blades or baffles formed of 0.020-inch- ((0.5-mm-)) thick, cold-rolled steel sheet set into 0.032-inch- (0.8-mm-) thick steel frame.
   1. Sightproof Louver: Stationary louvers constructed with inverted V-shaped or Y-shaped blades.

2.08 ACCESSORIES

A. Grout Guards: Formed from same material as frames, not less than 0.016 inch (0.4 mm) thick.

2.09 FABRICATION

A. Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.

B. Tolerances: Fabricate hollow metal work to tolerances indicated in SDI 117.

C. Hollow Metal Doors:
   1. Exterior Doors: Provide weep-hole openings in bottom of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
   2. Glazed Lites: Factory cut openings in doors.
   3. Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted.

D. Hollow Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
   1. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
   2. Sidelight Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
   3. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
   4. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
   5. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
   6. Jamb Anchors: Provide number and spacing of anchors as follows:
      a. Masonry Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:

1. Two anchors per jamb up to 60 inches (1524 mm) high.
2. Three anchors per jamb from 60 to 90 inches (1524 to 2286 mm) high.
3. Four anchors per jamb from 90 to 120 inches (2286 to 3048 mm) high.
4. Four anchors per jamb plus 1 additional anchor per jamb for each 24 inches (610 mm) or fraction thereof above 120 inches (3048 mm) high.

b. Stud-Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
1. Three anchors per jamb up to 60 inches (1524 mm) high.
2. Four anchors per jamb from 60 to 90 inches (1524 to 2286 mm) high.
3. Five anchors per jamb from 90 to 96 inches (2286 to 2438 mm) high.
4. Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches (610 mm) or fraction thereof above 96 inches (2438 mm) high.
5. Two anchors per head for frames above 42 inches (1066 mm) wide and mounted in metal-stud partitions.

7. Door Silencers: Except on weather-stripped doors, drill stops to receive door silencers as follows. Keep holes clear during construction.
a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

E. Fabricate concealed stiffeners, edge channels, and hardware reinforcement from either cold- or hot-rolled steel sheet.

F. Hardware Preparation: Factory prepare hollow metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Division 08 Section "Door Hardware."
1. Retain first option in first subparagraph below for standard hollow metal work. Retain second option for custom hollow metal work.
2. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
3. Reinforce doors and frames to receive nontemplated, mortised and surface-mounted door hardware.
4. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
5. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 Sections.

G. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.
1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow metal work.
2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
4. Provide loose stops and moldings on inside of hollow metal work.
5. Coordinate rabbet width between fixed and removable stops with type of glazing and type of installation indicated.

2.010 STEEL FINISHES

A. Prime Finish: Apply manufacturer's standard primer immediately after cleaning and pretreating.
   1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

2.011 Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.

C. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.

B. Prior to installation, adjust and securely brace welded hollow metal frames for squareness, alignment, twist, and plumbness to the following tolerances:
   1. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
   2. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
   3. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
   4. Plumbness: Plus or minus 1/16 inch, measured at jambs on a perpendicular line from head to floor.

C. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.03 INSTALLATION

A. General: Install hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.

B. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with ANSI/SDI A250.11 .
   1. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
      a. At fire-protection-rated openings, install frames according to NFPA 80.
      b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
      c. Install frames with removable glazing stops located on secure side of opening.
      d. Install door silencers in frames before grouting.
      e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
      f. Check plumbness, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
      g. Field apply bituminous coating to backs of frames that are filled with grout containing anti-freezing agents.
   2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.
      a. Floor anchors may be set with powder-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
   3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation behind frames.
   4. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.
   5. Concrete Walls: Solidly fill space between frames and concrete with grout. Take precautions, including bracing frames, to ensure that frames are not deformed or damaged by grout forces.
   6. Installation Tolerances: Adjust hollow metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
      a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
      b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
      c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
      d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.

C. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.
   1. Non-Fire-Rated Standard Steel Doors:
      a. Jambs and Head: 1/8 inch (3 mm) plus or minus 1/16 inch (1.6 mm).
      b. Between Edges of Pairs of Doors: 1/8 inch (3 mm) plus or minus 1/16 inch (1.6 mm).
      c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch (9.5 mm).

d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch (19 mm).

2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
3. Smoke-Control Doors: Install doors according to NFPA 105.

D. Glazing: Comply with installation requirements in Division 08 Section "Glazing" and with hollow metal manufacturer's written instructions.
   1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

3.04 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.

B. Remove grout and other bonding material from hollow metal work immediately after installation.

D. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

END OF SECTION

SECTION 08 31 13
ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes access doors and frames for walls and ceilings.

B. Related Requirements:
   1. Section 09 29 00 Gypsum Board for doors installed in gypsum board assemblies.
   2. Section 23 33 00 Air Duct Accessories for heating and air-conditioning duct access doors.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each type of access door and frame and for each finish specified, complete assembly minimum 6 by 6 inches in size.

C. Product Schedule: For access doors and frames

PART 2 - PRODUCTS

2.01 Manufacturers

A. Flush Access Doors with Exposed Flanges
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. Acudor Products, Inc.
      b. Babcock-Davis.
      c. Cendrex Inc.
      d. Elmdor/Stoneman Manufacturing Company; a division of Acorn Engineering Company.
      e. JL Industries, Inc.; a division of the Activar Construction Products Group.
      f. Karp Associates, Inc.
      g. Lane-Aire Manufacturing Corp.
      h. Larsens Manufacturing Company.
      i. Maxam Metal Products Limited.
      j. Metropolitan Door Industries Corp.
      k. MIFAB, Inc.
      l. Milcor; Commercial Products Group of Hart & Cooley, Inc.
      m. Nystrom, Inc.
      n. Williams Bros. Corporation of America (The).

2.02 PERFORMANCE REQUIREMENTS

A. Fire-Rated Access Doors and Frames: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection[and temperature-rise limit] ratings indicated, according to NFPA 252 or UL 10B.

2.03 ACCESS DOORS AND FRAMES

A. Flush Access Doors with Exposed Flanges (Non-Rated General Purpose Access Door)
   1. Description: Face of door flush with frame, with 1-inch exposed flange and concealed, removable, button hinge.
   2. Locations: Walls and Ceilings
   3. Door Sizes: 24”x24”
   4. Steel Sheet:
      a. Door Material: Nominal 0.062 inch (1.6 mm) 16 gauge. Fold on all four sides for structural rigidity.
         1. Optional Material: Nominal 0.075 inch (1.9 mm) 14 gauge
      b. Frame Material: Nominal 0.062 inch, 16 gauge. Provide 1/4-inch mounting holes and easy install tabs.
      c. Finish: Paintable White; powder-coat.
   5. Hinges: Concealed spring, button type, to allow for door removal.
   6. Latch and Lock: Cam latch, key operated
   7. Options: Flush continuous piano hinge.

B. Recessed Access Doors no flange with Concealed Flanges
   1. Description: Door face recessed 5/8 inch for gypsum board infill; with concealed flange and concealed hinge.
   2. Locations: Wall and ceiling at drywall locations
   3. Door Size: 12” x 12”
   4. Cold-Rolled Steel Sheet:
      a. Door Material: Nominal 0.062 inch , 16 gauge.
      b. Frame Material: Nominal 0.062 inch , 16 gauge. Provide 1/4-inch mounting holes.
      c. Finish: Paintable White; powder-coat.
   5. Latch and Lock: Cam latch, key operated
   6. Options: Gasketing.

C. Recessed Drywall [tile door] Access Doors <AP>
   1. Description: Tile Ready Access Door for walls. Tile Inlay:
   2. Door face Tile infill.
   3. Locations: At tiled plumbing Wall.
   4. Door Size: 12 x 24 to match wall tile
      a. Door Material: Nominal 0.075 inch (1.9 mm) 14 gauge
      b. Frame Material: Nominal 0.062 inch, 16 gauge. Provide 1/4-inch mounting holes and easy install tabs.
   5. Hinges: Cabinet
   6. Latch and Lock: Cam latch, key operated
   7. Options: Gasketing

2.04 FIRE-RATED ACCESS DOORS AND FRAMES

A. Fire-Rated, Flush (Model IT) Access Doors with Exposed Flanges:
   1. Description: Door face flush with frame with exposed flange, self-closing door, and continuous piano hinge.
   2. Locations: Wall and ceiling
   3. Door Size: <Insert door size>.
   4. Fire-Resistance Rating: as indicated on drawings
   5. Temperature-Rise Rating: 250 deg F at the end of 30 minutes.
   6. Cold-Rolled Steel Sheet:
      a. Door Material: Nominal 0.036 inch, 20 gauge.
      b. Frame Material: Nominal 0.062 inch, 16 gauge.
      c. Finish: Paintable white powder-coat;
   7. Latch and Lock: Self-latching door hardware, operated by key.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Comply with manufacturer's written instructions for installing access doors and frames.

3.03 ADJUSTING

A. Adjust doors and hardware, after installation, for proper operation.

END OF SECTION

SECTION 08 33 23
OVERHEAD COILING DOORS

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes the following types of manual and electric-motor-operated overhead coiling doors:
   1. Heavy-Duty Insulated Manually Operated Rolling Service Doors.
   2. Heavy-Duty Insulated Electrically Operated Rolling Service Door.

B. Related Sections include the following:
   1. Division 26 Sections for electrical service and connections for powered operators and accessories.

1.02 DEFINITIONS

A. Operation Cycle: One cycle of a door is complete when it is moved from the closed position to the fully open position and returned to the closed position.

1.03 REFERENCES

A. ANSI/DASMA 108 - American National Standards Institute Standard Method for Testing Sectional Garage Doors And Rolling Doors: Determination Of Structural Performance Under Uniform Static Air Pressure Difference.

B. NFRC 102 - Test Procedure for Measuring the Steady-State Thermal Transmittance of Fenestration Systems.

C. ASTM E 90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Element.

D. ASTM E 330 - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.

E. ASTM A 653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

F. ASTM A 666 - Standard Specification for Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.

G. ASTM A 924 - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.

H. ASTM B 221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

I. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

J. NEMA MG 1 - Motors and Generators.

1.04 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide overhead coiling doors capable of withstanding the effects of gravity loads and the following loads and stresses without evidencing permanent deformation of door components:
   1. Wind Load: Uniform pressure (velocity pressure) of 20 lbf/sq. ft., acting inward and outward in conformance with ASTM E 330
   2. Impact Test for Flying Debris: Comply with ASTM E 1996, tested according to ASTM E 1886.
      a. Level of Protection: Basic Protection.
      b. Wind Zone One: 90 mph, pressure test to 1/2 and 1-1/2 x design pressure (positive and negative).

B. Operation-Cycle Requirements: Provide overhead coiling door components and operators capable of operating for not less than 20,000 cycles and for 10 cycles per day.

1.05 SUBMITTALS

A. Product Data: For each type and size of overhead coiling door and accessory. Include the following:
   1. Summary of forces and loads on walls and jambs.

B. Shop Drawings: Shop Drawings: Include detailed plans, elevations, details of framing members, anchoring methods, required clearances, hardware, and accessories. Include relationship with adjacent construction.

C. Samples for Verification: Of each type of exposed finish specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.

D. Verification Samples: For each finish product specified, two samples, minimum size of 6 inches (150 mm) long, representing actual product, color and patterns.

E. Manufacturer's Certificates: Certify products meet or exceed specified requirements.

F. Operation and Maintenance Data: Submit lubrication requirements and frequency, and periodic adjustments required.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in performing Work of this section with a minimum of five years' experience in the fabrication and installation of security enclosures.

B. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for

both installation and maintenance of units required for this Project with a minimum of three years' experience.

C. Source Limitations: Obtain overhead coiling doors through one source from a single manufacturer.
   1. Obtain operators and controls from overhead coiling door manufacturer.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Protect materials from exposure to moisture. Do not deliver until after wet work is complete and dry.

C. Store materials in a dry, warm, ventilated weathertight location.

1.08 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.09 COORDINATION

A. Coordinate Work with other operations and installation of adjacent materials to avoid damage to installed materials.

1.010 WARRANTY

A. Warranty: Manufacturer's limited door and operator system, except the counterbalance spring and finish, to be free from defects in materials and workmanship for 3 years or 20,000 cycles, whichever occurs first.

B. Warranty: Manufacturer's limited door system warranty for 2 years for all parts and components.

C. PowderGuard Finish
   1. PowderGuard Premium Applied to curtain, guides, bottom bar, headplates: Manufacturer's limited Premium Finish warranty for 2 years.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Overhead Door Corp.
   2. Raynor.
   3. Clopay Building Products

B. Manual and Electrically Operated Service Doors: Overhead Door Company - Stormtite 625
   1. Thermal Resistance: R=7.7 minimum.
   2. Bottom Bar: Double-Angle
   3. Guides: Steel
   4. Curtain: 24-ga. galvanized steel
   5. Hood: 24-ga. galvanized steel
   6. Lock: Chain Keeper.
   7. Sizes: Refer to Door Schedule.

2.02 DOOR CURTAIN MATERIALS AND CONSTRUCTION

A. Door Curtains: Fabricate overhead coiling door curtain of interlocking roll formed slats, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:
   1. Steel Door Curtain Slats: Zinc-coated (galvanized), cold-rolled structural steel (SS) sheet; complying with ASTM A 653/A 653M, G90 (Z275) coating designation.
      a. Minimum Base-Metal (Uncoated) Thickness: 0.0209 inch.
      b. Profile F-265i on insulated, F-265, uninsulated.
      c. Flat profile type F-265i for doors up to 40 feet (12.19 m) wide.
      d. Front slat fabricated of: 24 gauge galvanized steel.
      e. Back slat fabricated of: 24 gauge galvanized steel.
      f. Slat cavity filled with CFC-free foamed-in-place, polyurethane insulation.
         1. R-Value: 7.7, U-Value: 0.13.
         2. Sound Rating: STC-21.
   2. Performance:
      a. Through Curtain Sound Rating: Sound Rating: STC-28 (STC-30+ with HZ noise generator) as per ASTM E 90.
      b. Installed System Sound Rating: STC-21 as per ASTM E 90.
      c. U-factor: 0.91 NFRC test report, maximum U-factor of no higher than 1.00.
      d. Air Infiltration: Meets ASHRAE 90.1 & IECC 2012/2015 C402.4.3 Air leakage <1.00 cfm/ft2.
   3. Inside Curtain Slat Face: To match material of outside metal curtain slat.

B. Endlocks and Windlocks for Service Doors: Malleable-iron castings galvanized after fabrication, secured to curtain slats with galvanized rivets or high-strength nylon. Provide locks on not less than alternate curtain slats for curtain alignment and resistance against lateral movement.

C. Bottom Bar for Service Doors: Consisting of 2 angles, each not less than 1-1/2 by 1-1/2 by 1/8 inch (38 by 38 by 3 mm) thick; galvanized, stainless-steel, or aluminum extrusions to suit type of curtain slats.

D. Guides: Three structural steel angles.

E. Brackets:
   1. Hot rolled steel to support counterbalance, curtain and hood.

F. Finish; Bottom Bar, Guides, Headplate and Brackets: Standard color.

G. Counterbalance: Helical torsion spring type housed in a steel tube or pipe barrel, supporting the curtain with deflection limited to 0.03 inch per foot of span. Counterbalance is adjustable by means of an adjusting tension wheel

H. Manual Operation: chain hoist.

I. Electric Motor Operation: : Overhead Door Company – RHX heavy-duty commercial operator.
   1. Provide UL listed electric operator, size as recommended by manufacturer to move door in either direction at not less than 2/3 foot nor more than 1 foot per second at 14'x 16' door only.
   2. Sensing Edge Protection:
      a. Pneumatic sensing edge.
      b. Electric sensing edge
   3. Operator Controls:
      a. Push-button and key operated control stations with open, close, and stop buttons.
   4. Special Operation:
      a. Photocell operation
   5. Motor Voltage: 3 HP, 480V/3-Phase.

J. Standard windload shall be 20 PSF.

K. Locking:
   1. Chain keeper locks for chain hoist operation.
   2. Interior slide bolt lock for electric operation with interlock switch.

L. Wall Mounting Condition:
   1. Face of Wall mounting

2.03 HOODS AND ACCESSORIES

A. Hood: Form to act as weatherseal and entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Provide closed ends for surface-mounted hoods and provide fascia for any portion of between-jamb mounting projecting beyond wall face. Provide intermediate support brackets as required to prevent sagging.

B. Integral Frame, Hood, and Fascia: Provide welded assemblies of the following sheet metal: Fabricate from minimum 0.064-inch- thick, hot-dip galvanized steel sheet with G90 zinc coating, complying with ASTM A 653/A 653M.

C. Weatherseals: Provide replaceable, adjustable, continuous, compressible weather-stripping gaskets fitted to bottom and top of exterior doors, unless otherwise indicated. At door head, use 1/8-inch-thick, replaceable, continuous sheet secured to inside of hood.
   1. Air Infiltration Package, IECC 2012/2015 listed; product to meet C402.4.3 2012 Air leakage <1.00 cfm/ft2.
      a. Air infiltration perimeter seal package includes: guide cover, guide cap, dual brush exterior guide seal, 4-inch finned lintel brush seal and vinyl bottom seal.
   2. Provide motor-operated doors with combination bottom weatherseal and sensor edge.

D. Fabricate locking device assembly with lock, spring-loaded dead bolt, operating handle, cam plate, and adjustable locking bar to engage through slots in tracks.
   1. Locking Bars: Single-jamb side operable from inside only.
   2. Cylinder locks; slide bolts

E. If door unit is power operated, provide safety interlock switch to disengage power supply when door is locked.

2.04 COUNTERBALANCING MECHANISM

A. General: Counterbalance doors by means of adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to door curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.

B. Counterbalance Barrel: Fabricate spring barrel of hot-formed, structural-quality, welded or seamless carbon-steel pipe, of sufficient diameter and wall thickness to support rolled-up curtain without distortion of slats and to limit barrel deflection to not more than 0.03 in./ft. of span under full load.

C. Provide spring balance of one or more oil-tempered, heat-treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Provide cast-steel barrel plugs to secure ends of springs to barrel and shaft.

D. Fabricate torsion rod for counterbalance shaft of cold-rolled steel, sized to hold fixed spring ends and carry torsional load.

E. Brackets: Provide mounting brackets of manufacturer's standard design, either cast iron or cold-rolled steel plate.

2.05 ELECTRIC DOOR OPERATORS

A. Comply with NFPA 70.

B. Disconnect Device: Provide hand-operated disconnect or mechanism for automatically engaging chain and sprocket operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount disconnect and operator, so they are accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.

C. Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency auxiliary operator.

D. Provide control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with NFPA 70 Class 2 control circuit, maximum 24-V, ac or dc.

E. Door-Operator Type: Top of Hood -mounted, jackshaft-type door operator unit consisting of electric motor, belt-reduction drive, and chain and sprocket secondary drive.

F. Electric Motors: Provide high-starting torque, reversible, continuous-duty, Class A insulated, electric motors complying with NEMA MG 1; with overload protection; sized to start, accelerate, and operate door in either direction from any position, at not less than 2/3 fps and not more than 1 fps, without exceeding nameplate ratings or service factor.
   1. Type: Polyphase, medium-induction type.
   2. Service Factor: According to NEMA MG 1, unless otherwise indicated.
   3. Coordinate wiring requirements and electrical characteristics of motors with building electrical system.
   4. Provide open drip proof-type motor, and controller with NEMA ICS 6, Type 1 enclosure.

G. Limit Switches: Provide adjustable switches, interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.

2.06 FINISHES, GENERAL

A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General: Install coiling doors and operating equipment complete with necessary hardware, jamb and head molding strips, anchors, inserts, hangers, and equipment supports.

3.02 ADJUSTING

A. Lubricate bearings and sliding parts; adjust doors to operate easily, free of warp, twist, or distortion and with weathertight fit around entire perimeter.

3.03 STARTUP SERVICES

A. Engage a factory-authorized service representative to perform startup service.

B. Complete installation and startup check according to manufacturer's written instructions.

C. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.04 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain overhead coiling doors. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION

SECTION 08 41 13
ALUMINUM STOREFRONT AND ENTRANCES

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Furnish and install aluminum architectural storefront system complete with hardware and related components as shown on drawings and specified in this section.

B. Glass
   1. Reference Section 08 81 00 for Glass and Glazing.

1.02 LABORATORY TESTING AND PERFORMANCE REQUIREMENTS

A. Test Units
   1. Air, water, and structural test unit size shall be a minimum of two lites high and three lites wide.
   2. Thermal test unit sizes shall be 80" (2032 mm) wide x 80" (2032 mm) high with one intermediate vertical mullion and two lites of glass.

B. Test Procedures and Performance
   1. Air Infiltration Test
      a. Test unit in accordance with ASTM E 283 at a static air pressure difference of 6.24 psf (299 Pa).
      b. Air infiltration shall not exceed .06 cfm/SF (.30 $l/s \cdot m^2$) of unit.
   2. Water Resistance Test
      a. Test unit in accordance with ASTM E 331.
      b. There shall be no uncontrolled water leakage at a static test pressure of 10.0 psf (478 Pa).
   3. Uniform Load Deflection Test
      a. Test in accordance with ASTM E 330.
      b. Deflection under design load shall not exceed L/175 of the clear span.
   4. Uniform Load Structural Test
      a. Test in accordance with ASTM E 330 at a pressure 1.5 times the design wind pressure in 1.05.B.3.b.
      b. At conclusion of the test, there shall be no glass breakage, permanent damage to fasteners, storefront parts, or any other damage that would cause the storefront to be defective.
   5. Condensation Resistance Test (CRF)
      a. Test unit in accordance with AAMA 1503.1.
      b. Condensation Resistance Factor (CRF) shall not be less than 56 (frame) when glazed with 70 center of glass U-Factor. (See chart at end of section).
   6. Thermal Transmittance Test (Conductive U-Factor)
      a. With ventilators closed and locked, test unit in accordance with NFRC 100-2010.
      b. Conductive thermal transmittance (U-Factor) shall not be more than 0.61 $BTU/hr \cdot ft^2 \cdot °F$ ($3.46 W/m^2 \cdot K$) when glazed with 0.47 center of glass U-Factor.

c. Project Wind Loads

7. The system shall be designed to withstand the following loads normal to the plane of the wall:
   a. As listed on Drawings

1.03 FIELD TESTING AND PERFORMANCE REQUIREMENTS

A. Test in accordance with AAMA 501.2 for spray test only or AAMA 503.92 for pressurized test.

1.04 QUALITY ASSURANCE

A. Provide test reports from AAMA accredited laboratories certifying the performance as specified in 1.05.

B. Test reports shall be accompanied by the storefront manufacturer's letter of certification stating that the tested storefront meets or exceeds the referenced criteria for the appropriate storefront type.

1.05 SUBMITTALS

A. Contractor shall submit shop drawings; finish samples, test reports, and warranties.
   1. Samples of materials as may be requested without cost to owner, i.e., metal, glass, fasteners, anchors, frame sections, mullion section, corner section, etc.

B. An NFRC Component Modeling Approach (CMA) generated label certificate shall be provided by the manufacturer. The label certificate shall be project specific and will contain the thermal performance ratings of the manufacturer's framing combined with the specified glass, and the glass spacer used in the fabrication of the glass, at NFRC standard test size as defined in table 4-3 in NFRC 100-2010.

1.06 WARRANTIES

A. Total Storefront Installation
   1. The responsible contractor shall assume full responsibility and warrant for one year the satisfactory performance of the total storefront installation. This includes the glass (including insulated units), glazing, anchorage and setting system, sealing, flashing, etc., as it relates to air, water and structural adequacy as called for in the specifications and approved shop drawings.
   2. Any deficiencies due to such elements not meeting the specifications shall be corrected by the responsible contractor at their expense during the warranty period.

B. Window Material and Workmanship
   1. Provide written guarantee against defects in material and workmanship for 5 years from the date of final shipment.

C. Glass
   1. Provide written warranty for insulated glass units that they will be free from obstruction of vision as a result of dust or film formation on the internal glass surfaces caused by failure of the hermetic seal due to defects in material and workmanship.
   2. Warranty period shall be for 10 (ten) years.

D. Finish
   1. Warranty period shall be for 5 years from the date of final shipment.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design Product:
   1. Exterior: EFCO Series 406 Thermal Flush-Glazed Screw Spline Storefront

B. Subject to Compliance with requirements, provide a comparable product by one of the following:
   1. Kawneer
   2. Oldcastle®

2.02 MATERIALS

A. Aluminum
   1. Extruded aluminum shall be 6063-T6 alloy and temper.

B. Glass
   1. Ship open for 1” Insulated glass with a center of glass U-Factor of .46 constructed as follows:
      a. Exterior lite – ¼” thick,Tinted, H.S. Temp glass,
         with a surface coating of Low E on the number 2 surface.
      b. Air space of ½” inch (or argon filled).
      c. Interior lite – ¼” thick, Clear, Tempered glass,
         with a surface coating on the number 3 surface.

C. Thermal Barrier
   1. All exterior aluminum shall be separated from interior aluminum by a rigid, structural thermal barrier. For purposes of this specification, a structural thermal barrier is defined as a system that shall transfer shear during bending and, therefore, promote composite action between the exterior and interior extrusions.
   2. Barrier material shall be poured-in-place, two-part polyurethane. A nonstructural thermal barrier is unacceptable.

2.03 FABRICATION

A. General
   1. All aluminum frame extrusions shall have a minimum wall thickness of .080" (2 mm).
   2. All exposed work shall be carefully matched to produce continuity of line and design with all joints. System design shall be such that raw edges will not be visible at joints.

B. Frame
   1. Depth of frame shall not be less than 6 1/2" (165 mm) at Exterior.
   2. Face dimension shall not be less than 2" (50 mm).
   3. Frame components shall be screw spline construction.

4. Door frame shall have shear blocked horizontals between the door jambs with screw spline sidelights.

C. Glazing
1. All units shall be “dry glazed" with gaskets on both exterior and interior of the glass.

2.04 HARDWARE

A. Provide hardware to ensure the opening, closing, locking, access control integration and product capability including, but not limited to, the following:
1. Closer: LCN 5030 concealed overhead/ single acting closer hydraulic and spring controlled.
2. Pulls: Kawneer CP-11.
3. Hinges: Top, Bottom & Intermediate Pivots.
4. Sweeps: Kawneer standard.
   a. Weatherstipping & Gasketing: Kawneer standard.
5. Threshold: Kawneer standard Butt Hung.
6. Exit Device: Kawneer Paneline EL Concealed Rod Exit Device
7. Threshold: Standard for offset pivot doors.

2.05 FINISH

A. Anodic
1. Finish all exposed areas of aluminum windows and components with electrolytically deposited color in accordance with Aluminum Association Designation AA-M10-C22-A41 Color shall be Clear.

PART 3 - EXECUTION

3.01 INSPECTION

A. Job Conditions
1. All openings shall be prepared by others to the proper size and shall be plumb, level and in the proper location and alignment as shown on the architect's drawings.
2. Provide for manufacturer representation to conduct pre-installation site meeting.

3.02 INSTALLATION

A. Use only skilled tradesmen with work done in accordance with approved shop drawings and specifications.

B. Storefront system shall be erected plumb and true, in proper alignment and relation to established lines and grades.

C. Entrance doors shall be securely anchored in place to a straight, plumb and level condition, without distortion. Weather stripping contact and hardware movement shall be checked and final adjustments made for proper operation and performance of units.

D. Furnish and apply sealing materials to provide a weather tight installation at all joints and intersections and at opening perimeters.

E. Sealing materials specified shall be used in strict accordance with the manufacturer‘s printed instructions, and shall be applied only by mechanics specially trained or experienced in their use. All surfaces must be clean and free of foreign matter before applying sealing materials. Sealing compounds shall be tooled to fill the joint and provide a smooth finished surface.

3.03 ANCHORAGE

A. Adequately anchor to maintain positions permanently when subjected to normal thermal movement, specified building movement, and specified wind loads.

3.04 PROTECTION AND CLEANING

A. The general contractor shall protect the aluminum materials and finish against damage from construction activities and harmful substances. The general contractor shall remove any protective coatings as directed by the architect, and shall clean the aluminum surfaces as recommended for the type of finish applied.

END OF SECTION

SECTION 08 71 11
DOOR HARDWARE

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Finish Hardware for door openings, except as otherwise specified herein.
   1. Door hardware for steel (hollow metal) doors
   2. Door hardware for wood doors
   3. Door hardware for other doors indicated
   4. Keyed cylinders as indicated

B. Related Sections:
   1. Division 6: Rough Carpentry
   2. Division 8: Aluminum Doors and Frames
   3. Division 8: Hollow Metal Doors and Frames
   4. Division 8: Wood Doors

C. References: Comply with applicable requirements of the following standards. Where these standards conflict with other specific requirements, the most restrictive shall govern.
   1. Builders Hardware Manufacturing Association (BHMA)
   2. NFPA 101 Life Safety Code
   3. NFPA 80 -Fire Doors and Windows
   4. ANSI-A156.xx- Various Performance Standards for Finish Hardware
   5. UL10C – Positive Pressure Fire Test of Door Assemblies
   6. ANSI-A117.1 – Accessible and Usable Buildings and Facilities
   7. DHI /ANSI A115.IG – Installation Guide for Doors and Hardware

D. Intent of Hardware Groups
   1. Should items of hardware not definitely specified be required for completion of the Work, furnish such items of type and quality comparable to adjacent hardware and appropriate for service required.
   2. Where items of hardware aren't definitely or correctly specified, are required for completion of the Work, a written statement of such omission, error, or other discrepancy to Architect, prior to date specified for receipt of bids for clarification by addendum; or, furnish such items in the type and quality established by this specification, and appropriate to the service intended.

1.02 SUBSTITUTIONS:

A. Refer to Division 1 for Product Substitution Procedures

1.03 SUBMITTALS:

A. Comply with Division 1.
B. Special Submittal Requirements: Coordinate submittals of this Section with related Sections to

ensure the "design intent" of the system/assembly is understood and can be reviewed together.

C. Product Data: Manufacturer's specifications and technical data including the following:
   1. Detailed specification of construction and fabrication.
   2. Manufacturer's installation instructions.
   3. Wiring diagrams for each electric product specified. Coordinate voltage with electrical before submitting.
   4. Submit 6 copies of catalog cuts with hardware schedule.

D. Shop Drawings - Hardware Schedule: Submit 6 complete reproducible copies of detailed hardware schedule in a vertical format.
   1. List groups and suffixes in proper sequence.
   2. Completely describe door and list architectural door number.
   3. Manufacturer, product name, and catalog number.
   4. Function, type, and style.
   5. Size and finish of each item.
   6. Mounting heights.
   7. Explanation of abbreviations and symbols used within schedule.
   8. Detailed wiring diagrams, specially developed for each opening, indicating all electric hardware, security equipment and access control equipment, and door and frame rough-ins required for specific opening.

E. Templates: Submit templates and "reviewed Hardware Schedule" to door and frame supplier and others as applicable to enable proper and accurate sizing and locations of cutouts and reinforcing.
   1. Templates, wiring diagrams and "reviewed Hardware Schedule" of electrical terms to electrical for coordination and verification of voltages and locations.

F. Samples: (If requested by the Architect)
   1. 1 sample of Lever and Rose/Escutcheon design, (pair).
   2. 3 samples of metal finishes

G. Contract Closeout Submittals: Comply with Division 1 including specific requirements indicated.
   1. Operating and maintenance manuals: Submit 3 sets containing the following.
      a. Complete information in care, maintenance, and adjustment, and data on repair and replacement parts, and information on preservation of finishes.
      b. Catalog pages for each product.
      c. Name, address, and phone number of local representative for each manufacturer.
      d. Parts list for each product.
   2. Copy of final hardware schedule, edited to reflect, "As installed".
   3. Copy of final keying schedule
   4. As installed “Wiring Diagrams” for each piece of hardware connected to power, both low voltage and 110 volts.
   5. One set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.

1.04 QUALITY ASSURANCE

A. Comply with Division 1.
   1. Statement of qualification for distributor and installers.
   2. Statement of compliance with regulatory requirements and single source responsibility.
   3. Distributor's Qualifications: Firm with 3 years experience in the distribution of commercial hardware.
   4. Installer's Qualifications: Firm with 3 years experienced in installation of similar hardware to that required for this Project, including specific requirements indicated.
   5. Regulatory Label Requirements: Provide testing agency label or stamp on hardware for labeled openings.
      a. Provide UL listed hardware for labeled and 20 minute openings in conformance with requirements for class of opening scheduled.
      b. Underwriters Laboratories requirements have precedence over this specification where conflict exists.
   6. Single Source Responsibility: Except where specified in hardware schedule, furnish products of only one manufacturer for each type of hardware.

B. Review Project for extent of finish hardware required to complete the Work. Where there is a conflict between these Specifications and the existing hardware, notify the Architect in writing and furnish hardware in compliance with the Specification unless otherwise directed in writing by the Architect.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Packing and Shipping: Comply with Division 1.
   1. Deliver products in original unopened packaging with legible manufacturer's identification.
   2. Package hardware to prevent damage during transit and storage.
   3. Mark hardware with door numbers to correspond with "approved hardware schedule".
   4. Deliver hardware to door and frame manufacturer upon request.

B. Storage and Protection: Comply with manufacturer's recommendations.

1.06 PROJECT CONDITIONS:

A. Coordinate hardware with other work. Furnish hardware items of proper design for use on doors and frames of the thickness, profile, swing, security and similar requirements indicated, as necessary for the proper installation and function, regardless of omissions or conflicts in the information on the Contract Documents.

B. Review Shop Drawings for doors and entrances to confirm that adequate provisions will be made for the proper installation of hardware.

1.07 WARRANTY:

A. Refer to Conditions of the Contract

B. Manufacturer's Warranty:
   1. Closers: Ten years
   2. Exit Devices: Three Years
   3. Locksets & Cylinders: Five years
   4. All other Hardware: Two years.

1.08 OWNER'S INSTRUCTION:

A. Instruct Owner's personnel in operation and maintenance of hardware units.

1.09 MAINTENANCE:

A. Extra Service Materials: Deliver to Owner extra materials from same production run as products installed. Package products with protective covering and identify with descriptive labels. Comply with Division 1 Closeout Submittals Section.
   1. Special Tools: Provide special wrenches and tools applicable to each different or special hardware component.
   2. Maintenance Tools: Provide maintenance tools and accessories supplied by hardware component manufacturer.
   3. Delivery, Storage and Protection: Comply with Owner's requirements for delivery, storage and protection of extra service materials.

B. Maintenance Service: Submit for Owner's consideration maintenance service agreement for electronic products installed.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

A. The following manufacturers are approved subject to compliance with requirements of the Contract Documents. Approval of manufacturers other than those listed shall be in accordance with Division 1.

2.02 MATERIALS:

A. Hinges:
   1. Template screw hole locations
   2. Minimum of 2 permanently lubricated non-detachable bearings
   3. Equip with easily seated, non-rising pins
   4. Sufficient size to allow 180-degree swing of door
   5. Furnish hinges with five knuckles and flush bearings
   6. Provide hinge type as listed in schedule.
   7. Furnish 3 hinges per leaf to 7 foot 6 inch height. Add one for each additional 30 inches in height or fraction thereof.
   8. Tested and approved by BHMA for all applicable ANSI Standards for type, size, function and finish.

9. UL10C listed for Fire

B. Mortise Type Locks and Latch sets:
   1. Tested and approved by BHMA for ANSI A156.13, Series 1000, Operational Grade 1, Extra-Heavy Duty, Security Grade 2 and be UL10C listed
   2. Fit ANSI A115.1 door preparation
   3. Functions and design as indicated in the hardware groups
   4. Two-piece, ¾" (19mm) throw, anti-friction latch bolt made of self-lubricating stainless steel
   5. Deadbolt functions shall have 1" (25mm) throw bolt made of hardened stainless steel
   6. Latch bolt and Deadbolt are to extend into the case a minimum of 3/8" (9.5mm) when fully extended
   7. Auxiliary deadlatch to be made of one piece stainless steel, permanently lubricated
   8. Provide sufficient curved strike lip to protect door trim
   9. Lever handles must be of forged or cast brass, bronze, or stainless steel construction and conform to ANSI A117.1. Levers that contain a hollow cavity are not acceptable
   10. Lock shall have self-aligning, thru-bolted trim
   11. Levers to operate a roller bearing spindle hub mechanism
   12. Mortise cylinders of locksets shall have a concealed internal set screw for securing the cylinder to the lockset. The internal set screw will be accessible only by removing the core, with the control key, from the cylinder body
   13. Spindle to be designed to prevent forced entry from attacking of lever
   14. Provide locksets with 7-pin removable and interchangeable core cylinders
   15. Each lever to have independent spring mechanism controlling it
   16. Core face must be the same finish as the lockset
       Manufacturer: Best 45H– NO SUBSTITUTION

C. Exit Devices shall be:
   1. Tested and approved by BHMA for ANSI 156.3, Grade 1
   2. Provide a deadlocking latch bolt
   3. Non-fire rated exit devices shall have cylinder dogging.
   4. Touchpad shall be "T" style
   5. Exposed components shall be of architectural metals and finishes.
   6. Lever design shall match lockset lever design
   7. Provide strikes as required by application.
   8. Fire exit devices to be listed for UL10C
   9. UL listed for Accident Hazard
   10. Shall consist of a cross bar or push pad, the actuating portion of which extends across, shall not be less than one half the width of the door leaf.
   11. Manufacturer: Von Duprin 99 Series – NO SUBSTITUTION

D. Door Closers shall be:
   1. Tested and approved by BHMA for ANSI 156.4, Grade 1
   2. UL10C certified
   3. Conform to ANSI 117.1
   4. Separate adjusting valves for closing and latching speed, and backcheck
   5. Provide adapter plates, shim spacers and blade stop spacers as required by frame and door conditions

6. Mount closers on non-public side of door, unless otherwise noted in specification
7. Closers shall be non-handed, non-sized and multi-sized.
8. Manufacturer: LCN 4040 XP – NO SUBSTITUTION

E. Door Stops: Provide a dome floor or wall stop for every opening as listed in the hardware sets.
1. Wall stop and floor stop shall be wrought bronze, brass or stainless steel.
2. Provide fastener suitable for wall construction.
3. Coordinate reinforcement of walls where wall stop is specified.
4. Provide dome stops where wall stops are not practical. Provide spacers or carpet riser for floor conditions encountered

F. Over Head Stops: Provide a Surface mounted or concealed overhead when a floor or wall stop cannot be used or when listed in the hardware set.
1. Concealed overhead stops shall be heavy duty bronze or stainless steel.
2. Surface overhead stops shall be heavy duty bronze or stainless steel.

G. Push Plates: Provide ANSI J301, .050 thickness, size as indicated in hardware set. Furnish oval-head countersunk screws to match finish.

H. Pulls with plates: Provide ANSI J301, .050 thickness Plates with ANSI J401 Pull as listed in hardware set. Provide proper fasteners for door construction.

I. Kickplates/Armor Plates: Provide ANSI J102, height as scheduled by width less 2 inches on single doors and 1 inch on pairs of doors. Furnish oval-head countersunk screws to match finish.

J. Mop plates: Provide ANSI J103, 6 inches high by width less 1 inch on single doors and 1 inch on pairs of doors. Furnish oval-head countersunk screws to match finish.

K. Door Bolts: Flush bolts for wood or metal doors.
1. Provide a set of Automatic bolts ANSI/BHMA 156.3 Type 25 for hollow metal label doors.
2. Provide a set of Automatic bolts ANSI/BHMA 156.3 Type 27 at wood label doors.
3. Manual flush bolts ANSI/BHMA 156.16 at openings where allowed local authority.
4. Provide Dust Proof Strike ANSI/BHMA 156.16 at doors with flush bolts.

L. Coordinator and Brackets: Provide a surface mounted coordinator when automatic bolts are used in the hardware set.
1. Coordinator shall comply with ANSI/BHMA A1156.3 Type 21A full width of the opening.
2. Provide mounting brackets for soffit applied hardware such as closer brackets, etc.
3. Provide hardware preparation (cutouts) for latches as necessary.

M. Magnetic Door Holders: Provide magnetic door holders with Tri-Voltage that can be wired 12VDC, 24V AC/DC or 120V AC
1. Wall mounted magnetic door holders shall be Recessed.
2. Armature shall be thru-bolted and can be provided with any projection required using optional armature extensions.

N. Seals: All seals shall be finished to match adjacent frame color. Seals shall be furnished as listed in

schedule. Material shall be UL listed for labeled openings.

O. Weatherstripping: Provide at head and jambs only those units where resilient or flexible seal strip is easily replaceable. Where bar-type weatherstrip is used with parallel arm mounted closers install weatherstrip first.
   1. Weatherstrip shall be resilient seal of Neoprene, Polyurethane, Vinyl or Silicone
   2. UL10C Positive Pressure rated seal set when required.

P. Door Bottoms/Sweeps: Surface mounted or concealed door bottom where listed in the hardware sets.
   1. Door seal shall be resilient seal of Neoprene, Polyurethane or Nylon Brush
   2. UL10C Positive Pressure rated seal set when required.

Q. Thresholds: Thresholds shall be aluminum beveled type with maximum height of ½" for conformance with ADA requirements. Furnish as specified and per details. Provide fasteners and screws suitable for floor conditions.

R. Key Control: Provide one wall mounted key cabinet complete with hooks, index and tags.

S. Silencers: Furnish silencers on all interior frames, 3 for single doors, 2 for pairs. Omit where any type of seals occur.

2.03 FINISH:

A. Designations used in Schedule of Finish Hardware - 3.5, and elsewhere to indicate hardware finishes are those listed in ANSI/BHMA A156.18 including coordination with traditional U.S. finishes shown by certain manufacturers for their products

B. Powder coat door closers to match other hardware, unless otherwise noted.

C. Aluminum items shall be finished to match predominant adjacent material. Seals to coordinate with frame color.

2.04 KEYS AND KEYING:

A. Provide keyed brass construction cores and keys during the construction period. Construction control and operating keys and core shall not be part of the Owner's permanent keying system or furnished in the same keyway (or key section) as the Owner's permanent keying system. Permanent cores and keys (prepared according to the accepted keying schedule) will be furnished by the Campus.

B. Cylinders, removable and interchangeable core system: Best Standard 7-pin.

C. The Owner, or the Owner's agent, will install permanent cores and return the construction cores to the Hardware Supplier. Construction cores and keys remain the property of the Hardware Supplier.

2.05 HARDWARE SETS

1. SET #01 - Door: 100

1	Mortise Cylinder	1E-74 PATD	626	BE
1	Construction Core	1CA CONSTRUCTION CORE BRASS		BE

NOTE: Balance of hardware devices to hang, secure, close and gasket by the Aluminum Door and Frame Supplier.

2. SET #02 – Overhead Doors: 107D, 107E, 107F, 107G, 107H, 107I, 107J, 108C, 108D, 108E, 113D

1	Cyl. or Padlock as required	Best Cyl or Padlock as Required	626	BE
1	Construction Core			
1	CA CONSTRUCTION CORE BRASS			BE

NOTE: Balance of overhead door hardware devices to hand, secure, close and gasket opening as supplied by overhead door supplier.

SET #03 - Doors: 101, 109, 110, 114 (45 MIN rated)

3	Hinges FBB179 4 1/2 X 4 1/2		US26D	ST
1	Lockset-Storeroom	45H-7D14H PATD	626	BE
1	Construction Core	1CA CONSTRUCTION CORE BRASS		BE
1	Wall Bumper	1270CV	626	TR
1	Coat Hook	3071-1	630	TR1
3	Door Silencers	1229A	GREY	TR

SET #04 - Doors: 107A, 108A, 108B, 109A, 110A, 113A, 115, 115A

3	Hinges FBB179 4 1/2 X 4 1/2		US26D	ST
1	Exit Device-Storeroom	2103 X 4903D 36" SNB (2)	630	PR
1	Rim Cylinder-Exit Trim	12E-72 PATD	626	BE
1	Construction Core	1CA CONSTRUCTION CORE BRASS		BE
1	Door Closer	CLD-4551 EDA P45HD-110 SN	689	SD
1	Kick Plate	K0050 10" x 34" B4E-HEAVY-KP CSK	630	TR
1	Wall Bumper	1270CV	626	TR
3	Door Silencers	1229A	GREY	TR

SET #04A - Doors: 103, 104 (45-min. rated)

3	Hinges	FBB179 4 1/2 X 4 1/2	US26D	ST	
1	Lockset-Storeroom	45H-7D14H PATD	626	BE	
1	Construction Core	1CA CONSTRUCTION CORE BRASS			BE
1	Door Closer	CLD-4551 EDA P45HD-110 SN	689	SD	
1	Kick Plate	K0050 10" x 34" B4E-HEAVY-KP CSK		630	TR
1	Wall Bumper	1270CV	626	TR	
3	Door Silencers	1229A GREY	TR		

3. SET #05 - Doors: 101A

3	Hinges	FBB191 4 1/2 X 4 1/2 NRP	US32D	ST	
1	Lockset-Storeroom w/Deadbolt	45H-7TD14H PATD	626	BE	
1	Construction Core	1CA CONSTRUCTION CORE BRASS			BE
1	Door Closer	CLD-4550 CS P45HD-110 SN	689	SD	
1	Perimeter Gasketing	5050 C-17 17'	NA		
1	Threshold	896 S 36"	AL	NA	
3	Door Silencers	1229A GREY	TR		

4. SET #06 - Doors: 105, 106 – 45 min. rated

3	Hinges	FBB179 4 1/2 X 4 1/2	US26D	ST	
1	Passage Set	45H-0N14H	626	BE	
1	Door Closer	CLD-4551 TCS SN	689	SD	
1	Mop Plate	KM050 6" x 35" B4E-HEAVY-KP CSK		630	TR
1	Kick Plate	K0050 10" x 34" B4E-HEAVY-KP CSK		630	TR
3	Door Silencers	1229A GREY	TR		

5. SET #07 - Doors: 107B, 108F, 112, 113B, 113C

3	Hinges	FBB191 4 1/2 X 4 1/2 NRP	US32D	ST	
1	Exit Device-Storeroom	2103 X 4903D 36" CD SNB (2)		630	PR
1	Rim Cylinder-Exit Trim	12E-72 PATD	626	BE	
1	Mortise Cylinder-Cyl Dogging	1E-74 PATD	626	BE	
2	Construction Core	1CA CONSTRUCTION CORE BRASS			BE
1	Door Closer	CLD-4550 CS P45HD-110 SN	689	SD	
1	Kick Plate	K0050 10" x 34" B4E-HEAVY-KP CSK		630	TR
1	Perimeter Gasketing	5050 C-17 17'	NA		
1	Threshold	896 S 36"	AL	NA	
3	Door Silencers	1229A GREY	TR		

6. SET #08 - Doors: 111A, 111B

3	Hinges	FBB179 4 1/2 X 4 1/2		US26D	ST	
1	Exit Device-Passage Set		FL 2114 X 4914D 36" SNB (2)		630	PR
1	Door Closer	CLD-4550 EDA		689	SD	
1	Kick Plate	K0050 10" x 34" B4E-HEAVY-KP CSK			630	TR
1	Wall Bumper	1270CV		626	TR	
1	Perimeter Gasketing	5050 C-17 17'		NA		
3	Door Silencers	1229A GREY		TR		

7. SET #09 - Door: 117

3	Hinges	FBB191 4 1/2 X 4 1/2 NRP		US32D	ST	
1	Exit Device-Storeroom	2103 X 4903D 36" SNB (2)			630	PR
1	Rim Cylinder-Exit Trim		12E-72 PATD	626	BE	
1	Construction Core	1CA CONSTRUCTION CORE BRASS			BE	
1	Door Closer	CLD-4550 CS P45HD-110 SN		689	SD	
1	Kick Plate	K0050 10" x 35" B4E-HEAVY-KP CSK			630	TR
1	Perimeter Gasketing	5050 C-17 17'		NA		
1	Drip Cap	16 A 40"		NA		
2	Door Sweep	101 VA 36"		NA		
1	Threshold	896 S 36"		AL	NA	
2	Door Silencers	1229A GREY		TR		

2.06 SCHEDULE OF FINISH HARDWARE:

1. Manufacturer List

	Code	Name
1.	BE	Best Access Systems
2.	NA	National Guard
3.	PR	Precision
4.	SD	Stanley Door Closers
5.	ST	Stanley
6.	TR	Trimco

2. Option List

	Code	Description
1.	CD	CYLINDER DOGGING
2.	FL	Fire Exit Hardware
3.	SN	Sex Nuts (Pkg. of 4)
4.	36"	36" Door Width
5.	CSK	COUNTER SINKING OF KICK and MOP PLATES
6.	SNB (2)	SEX BOLTS (2)
7.	P45HD-110	Spacer Block HD Arm on Rabbet
8.	B4E-HEAVY-KP	BEVELED 4 EDGES - KICK PLATES

3. Finish List
    1. Code Description
    2. AL Aluminum
    3. 626 Satin Chromium Plated
    4. 630 Satin Stainless Steel
    5. 689 Aluminum Painted
    6. GREY Grey
    7. US26D Chromium Plated, Dull
    8. US32D Stainless Steel, Dull

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verification of conditions: Examine doors, frames, related items and conditions under which Work is to be performed and identify conditions detrimental to proper and or timely completion.
    1. Do not proceed until unsatisfactory conditions have been corrected.

3.02 HARDWARE LOCATIONS:

A. Mount hardware units at heights indicated in the following publications except as specifically indicated or required to comply with the governing regulations.
    1. Recommended Locations for Builder's Hardware for Standard Steel Doors and Frames, by the Door and Hardware Institute (DHI).
    2. Recommended locations for Architectural Hardware for flush wood doors (DHI).
    3. WDMA Industry Standard I.S.-1A-04, Industry Standard for Architectural wood flush doors.

3.03 INSTALLATION:

A. Install each hardware item per manufacturer's instructions and recommendations. Do not install surface mounted items until finishes have been completed on the substrate. Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.

B. Conform to local governing agency security ordinance.

C. Install Conforming to ICC/ANSI A117.1 Accessible and Usable Building and Facilities.
    1. Adjust door closer sweep periods so that from the open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches from the latch, measured to the landing side of the door.

D. Installed hardware using the manufacturers fasteners provided. Drill and tap all screw holes located in metallic materials. Do not use "Riv-Nuts" or similar products.

3.04 FIELD QUALITY CONTROL AND FINAL ADJUSTMENT

A. Contractor/Installers, Field Services: After installation is complete, contractor shall inspect the

completed door openings on site to verify installation of hardware is complete and properly adjusted, in accordance with both the Contract Documents and final shop drawings.

1. Check and adjust closers to ensure proper operation.
2. Check latch set, lockset, and exit devices are properly installed and adjusted to ensure proper operation.
    a. Verify levers are free from binding.
    b. Ensure latch bolts and dead bolts are engaged into strike and hardware is functioning.

B. Report findings, in writing, to architect indicating that all hardware is installed and functioning properly. Include recommendations outlining corrective actions for improperly functioning hardware if required.

END OF SECTION

SECTION 08 80 00
GLAZING

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:
   1. Windows.
   2. Doors.
   3. Storefront framing.
   4. Interior borrowed lites.

1.02 RELATED SECTIONS:

A. Section 08 11 13 Hollow Metal Doors & Frames for glazing in viewlites.

B. Section 08 41 13 Aluminum Storefront & Entrances for glazing in storefront systems.

1.03 DEFINITIONS

A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.

B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.

C. Interspace: Space between lites of an insulating-glass unit.

1.04 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design glass, including comprehensive engineering analysis according to ASTM E 1300 by a qualified professional engineer, using the following design criteria:
   1. Design Wind Pressures: Determine design wind pressures applicable to Project according to ASCE/SEI 7, based on heights above grade indicated on Drawings.
      a. Wind Design Data: As indicated on Drawings.
      b. Basic Wind Speed: 120 mph.
      c. Importance Factor: 1.25.
      d. Exposure Category: B.
   2. Design Snow Loads: As indicated on Drawings.
   3. Vertical Glazing: For glass surfaces sloped 15 degrees or less from vertical, design glass to resist design wind pressure based on glass type factors for short-duration load.
   4. Sloped Glazing: For glass surfaces sloped more than 15 degrees from vertical, design glass to resist each of the following combinations of loads:
      a. Outward design wind pressure minus the weight of the glass. Base design on glass type factors for short-duration load.

b. Inward design wind pressure plus the weight of the glass plus half of the design snow load. Base design on glass type factors for short-duration load.
c. Half of the inward design wind pressure plus the weight of the glass plus the design snow load. Base design on glass type factors for long-duration load.

5. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 1 inch, whichever is less.
6. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.

B. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.

C. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
1. For monolithic-glass lites, properties are based on units with lites 6 mm thick.
2. For laminated-glass lites, properties are based on products of construction indicated.
3. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
4. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F (W/sq. m x K).
5. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
6. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

1.05 SUBMITTALS

A. Product Data: For each glass product and glazing material indicated.

B. LEED Submittals:
1. Product Data for Credit EQ 4.1: For glazing sealants used inside of the weatherproofing system, including printed statement of VOC content.

C. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches (300 mm) square.
1. Tinted glass.
2. Coated glass.
3. Fire-resistive glazing products.
4. Insulating glass.

D. Qualification Data: For installers.

E. Product Certificates: For glass and glazing products, from manufacturer.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications for Insulating-Glass Units with Sputter-Coated, Low-E Coatings: A qualified insulating-glass manufacturer who is approved and certified by coated-glass manufacturer.

B. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.

C. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.

D. Source Limitations for Glass: Obtain insulating glass from single source from single manufacturer for each glass type

E. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.

F. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
   1. GANA Publications: GANA's "Laminated Glazing Reference Manual" and GANA's "Glazing Manual."
   2. AAMA Publications: AAMA GDSG-1, "Glass Design for Sloped Glazing," and AAMA TIR-A7, "Sloped Glazing Guidelines."
   3. IGMA Publication for Sloped Glazing: IGMA TB-3001, "Guidelines for Sloped Glazing."
   4. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."

G. Fire-Protection-Rated Glazing Labeling: Permanently mark fire-protection-rated glazing with certification label of a testing agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, test standard, whether glazing is for use in fire doors or other openings, whether or not glazing passes hose-stream test, whether or not glazing has a temperature rise rating of 450 deg F, and the fire-resistance rating in minutes.

H. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.

I. Safety Glazing Labeling: Where safety glazing labeling is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction or the manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

J. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
   1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

B. Comply with insulating-glass manufacturer's written recommendations for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.08 PROJECT CONDITIONS

A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
   1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or below 40 deg F (4.4 deg C).

1.09 WARRANTY

A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer's standard form in which coated-glass manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.
   1. Warranty Period: 10 years from date of Substantial Completion.

B. Manufacturer's Special Warranty on Laminated Glass: Manufacturer's standard form in which laminated-glass manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.
   1. Warranty Period: 10 years from date of Substantial Completion.

C. Manufacturer's Special Warranty on Insulating Glass: Manufacturer's standard form in which insulating-glass manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.
   1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide product indicated in glass schedules or comparable product by one of the following:
   1. Gardner Glass, Inc.
   2. Guardian Industries Corp.; SunGuard.
   3. Pilkington North America.
   4. PPG Industries, Inc.

B. Source Limitations for Glass: Obtain from single source from single manufacturer for each glass type.
   1. Obtain tinted glass from single source from single manufacturer.
   2. Obtain reflective-coated glass from single source from single manufacturer.

2.02 GLASS PRODUCTS, GENERAL

A. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass lites in thicknesses as needed to comply with requirements indicated.
   1. Minimum Glass Thickness for Exterior Lites: Not less than 6.0 mm.
   2. Thickness of Tinted Glass: Provide same thickness for each tint color indicated throughout Project.

B. Strength: Where float glass is indicated, provide annealed float glass, Kind HS heat-treated float glass, or Kind FT heat-treated float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened glass is indicated, provide Kind HS heat-treated float glass or Kind FT heat-treated float glass as needed to comply with "Performance Requirements" Article. Where fully tempered glass is indicated, provide Kind FT heat-treated float glass.

C. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
   1. For monolithic-glass lites, properties are based on units with lites 6.0 mm thick.
   2. For laminated-glass lites, properties are based on products of construction indicated.
   3. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
   4. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F (W/sq. m x K).
   5. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
   6. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

2.03 FITTINGS AND HARDWARE

A. Operable Panel Hardware: Coordinate with additional requirements as specified in Section 08 71 00.

2.04 GLASS PRODUCTS

A. Glass: Flat glass meeting requirements of ASTM C1036, Type I – Transparent Flat Glass, Class2, Quality Q3, fully tempered in accordance with ASTM C1048, Kind FT, and as follows:
   1. Thickness: As indicated.
   2. Color: Clear
   3. Prepare glazing panels for indicated fittings and hardware before tempering.
   4. Polish edges that will be exposed in finished work to bright flat polish.
   5. Temper glass materials horizontally; visible tong marks or tong mark distortions are not permitted.

B. Aluminum Components: Conforming to ASTM B221 (ASTM B221M), Alloy 6603, T5 Temper.

C. Sealant: One part silicone sealant, conforming to ASTM C920, clear.

D. Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I (clear) unless otherwise indicated.

E. Heat-Treated Float Glass: ASTM C 1048; Type I; Quality-Q3; Class I (clear) unless otherwise indicated; of kind and condition indicated.
   1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
   2. For uncoated glass, comply with requirements for Condition A.
   3. For coated vision glass, comply with requirements for Condition C (other coated glass).

F. Ceramic-Coated Spandrel Glass: ASTM C 1048, Condition B, Type I, Quality-Q3, and complying with other requirements specified.
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. AGC Flat Glass North America.
   2. Glass: Clear float.
   3. Ceramic Coating Color: As selected by Architect from manufacturer's full range.

G. Silicone-Coated Spandrel Glass: ASTM C 1048, Condition C, Type I, Quality-Q3, and complying with other requirements specified.
   1. Products: Subject to compliance with requirements, provide the following:
      a. AGC Flat Glass North America.
   2. Glass: Clear float.
   3. Silicone Coating Color: As selected by Architect from manufacturer's full range.

2.05 INSULATING GLASS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Guardian Industries.
   2. PPG Industries, Inc
   3. Pilkington North America

B. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190, and complying with other requirements specified.
   1. Sealing System: Dual seal, with manufacturer's standard, primary and secondary.
   2. Spacer: Manufacturer's standard spacer material and construction.
   3. Desiccant: Molecular sieve or silica gel, or blend of both.

C. Glass: Comply with applicable requirements in "Glass Products" Article as indicated by designations in "Insulating-Glass Types" Article.

2.06 FIRE-PROTECTION-RATED GLAZING

A. Fire-Protection-Rated Glazing, General: Listed and labeled by a testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 252 for door assemblies and NFPA 257 for window assemblies.

B. Laminated Glass with Intumescent Interlayers: Laminated glass made from multiple plies of uncoated, clear float glass; with intumescent interlayers; complying with testing requirements in 16 CFR 1201 for Category II materials.
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. InterEdge, Inc., a subsidiary of AFG Industries, Inc.; Pyrobel.
      b. Pilkington Group Limited (distributed by Technical Glass Products); PyroStop.
      c. Vetrotech Saint-Gobain; SGG Contraflam N2

2.07 GLAZING GASKETS

A. Dense Compression Gaskets: Molded or extruded gaskets of profile and hardness required to maintain watertight seal, made from one of the following:
   1. Neoprene complying with ASTM C 864.
   2. EPDM complying with ASTM C 864.
   3. Silicone complying with ASTM C 1115.
   4. Thermoplastic polyolefin rubber complying with ASTM C 1115.

2.08 GLAZING SEALANTS

A. General:
   1. Compatibility: Provide glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
   2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
   3. VOC Content: For sealants used inside of the weatherproofing system, not more than 250 g/L when calculated according to 40 CFR 59, Subpart D.

4. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.

B. Glazing Sealants for Fire-Rated Glazing Products: Products that are approved by testing agencies that listed and labeled fire-resistant glazing products with which they are used for applications and fire-protection ratings indicated.

2.09 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

D. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

F. Perimeter Insulation for Fire-Resistive Glazing: Product that is approved by testing agency that listed and labeled fire-resistant glazing product with which it is used for application and fire-protection rating indicated.

2.010 FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

B. Grind smooth and polish exposed glass edges and corners.

2.011 MONOLITHIC-GLASS TYPES

A. Glass Type: Clear float glass.
   1. Thickness: 6.0 mm.
   2. Provide safety glazing labeling.

2.012 INSULATING-GLASS TYPES

A. Glass Type: Low-e-coated, tinted insulating glass equal to Solarban® 60

B. Basis of Design: IGU -Outdoor Lite: 6mm Starphire®, ½” Air, Indoor Lite: 6mm Solarban® 60 (3)

on Starphire®

1. Overall Unit Thickness: 1 inch.
2. Thickness of Each Glass Lite: 1/4 inch.
3. Outdoor Lite: Float glass.
4. Interspace Content: Argon.
5. Indoor Lite: Clear float glass.
6. Low-E Coating: Sputtered on second surface.
7. Visible Light Transmittance: 70 percent minimum.
8. U-Factor: .29 maximum.
9. Solar Heat Gain Coefficient: .39 maximum.

2.013 FIRE-PROTECTION-RATED GLAZING TYPES

A. Glass Type 20-minute fire-rated glazing with hose-stream test;

B. Glass Type 45-minute fire-rated glazing; laminated glass with intumescent interlayers.

C. Glass Type 90-minute fire-rated glazing with 450 deg F temperature rise limitation; laminated glass with intumescent interlayers.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:
   1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
   2. Presence and functioning of weep systems.
   3. Minimum required face and edge clearances.
   4. Effective sealing between joints of glass-framing members.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that will leave visible marks in the completed work.

3.03 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other

glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Adjust glazing channel dimensions as required by Project conditions during installation to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.

D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

G. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm).
   1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
   2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

J. Set glass lites with proper orientation so that coatings face exterior or interior as specified.

K. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.

L. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.04 TAPE GLAZING

A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with

or protrude slightly above sightline of stops.

B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

C. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Do not remove release paper from tape until right before each glazing unit is installed.

F. Apply heel bead of elastomeric sealant.

G. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

3.05 GASKET GLAZING (DRY)

A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

E. Install gaskets so they protrude past face of glazing stops.

3.06 SEALANT GLAZING (WET)

A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.07 CLEANING AND PROTECTION

A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.

C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.

D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.

E. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

END OF SECTION

SECTION 09 22 16
NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes non-load-bearing steel framing members for the following applications:
   1. Interior framing systems (e.g., supports for partition walls, framed soffits, furring, etc.).
   2. Interior suspension systems (e.g., supports for ceilings, suspended soffits, etc.).

B. Related Sections include the following:
   1. Division 07 Section " Joint Systems" for head-of-wall joint systems installed with non-load-bearing steel framing.
   2. Division 09 Section "Gypsum Board Shaft Wall Assemblies" for non-load-bearing metal shaft-wall framing, gypsum panels, and other components of shaft-wall assemblies.

1.02 SUBMITTALS

A. Product Data: For each type of product indicated.

1.03 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

PART 2 - PRODUCTS

2.01 NON-LOAD-BEARING STEEL FRAMING, GENERAL

A. Recycled Content of Steel Products: Provide products with average recycled content of steel products such that postconsumer recycled content plus one-half of pre-consumer recycled content is not less than 25 percent.

B. Framing Members, General: Comply with ASTM C 754 for conditions indicated.
   1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal, unless otherwise indicated.
   2. Protective Coating: ASTM A 653/A 653M, G40 (Z120) , hot-dip galvanized, unless otherwise indicated.

2.02 SUSPENSION SYSTEM COMPONENTS

A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625-inch- diameter wire, or double strand of 0.0475-inch- diameter wire.

B. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.162-inch diameter.

C. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.0538 inch and minimum 1/2-inch- wide flanges.
   1. Depth: As indicated on Drawings.

D. Furring Channels (Furring Members):
   1. Cold-Rolled Channels: 0.0538-inch (1.37-mm) bare-steel thickness, with minimum 1/2-inch- (12.7-mm-) wide flanges, 3/4 inch (19.1 mm) deep.
   2. Steel Studs: ASTM C 645.
      a. Minimum Base-Metal Thickness: 0.0179 inch (0.45 mm).
      b. Depth: As indicated on Drawings.
   3. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch deep.
      a. Minimum Base Metal Thickness: 0.0179 inch (0.45 mm).
   4. Resilient Furring Channels: 1/2-inch- (12.7-mm-) deep members designed to reduce sound transmission.
      a. Configuration: Hat shaped.

E. Grid Suspension System for Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.
   1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
   2. Products: Subject to compliance with requirements, provide one of the following:
      a. Armstrong World Industries, Inc.; Drywall Grid Systems.
      b. USG Corporation; Drywall Suspension System.

2.03 STEEL FRAMING FOR FRAMED ASSEMBLIES

A. Steel Studs and Runners: ASTM C 645.
   1. Minimum Base-Metal Thickness: 0.0312 inch (0.45 mm).
   2. Depth: As indicated on Drawings.

B. Slip-Type Head Joints: Where indicated, provide the following:

C. Single Long-Leg Runner System: ASTM C 645 top runner with 2-inch- deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top runner and with continuous bridging located within 12 inches of the top of studs to provide lateral bracing.

D. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
   1. Minimum Base-Metal Thickness: 0.0538 inch (0.45 mm).

E. Cold-Rolled Channel Bridging: 0.0538-inch (1.37-mm) bare-steel thickness, with minimum 1/2-

inch- (12.7-mm-) wide flanges.
1. Depth: 1-1/2 inches (38.1 mm).
2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches (38.1 by 38.1 mm), 0.068-inch- (1.73-mm-) thick, galvanized steel.

F. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
1. Minimum Base Metal Thickness: 0.0312 inch (0.45 mm).
2. Depth: As indicated on Drawings.

G. Resilient Furring Channels: 1/2-inch- (12.7-mm-) deep, steel sheet members designed to reduce sound transmission.
1. Configuration: Hat shaped.

H. Cold-Rolled Furring Channels: 0.0538-inch (1.37-mm) bare-steel thickness, with minimum 1/2-inch- (12.7-mm-) wide flanges.
1. Depth: 3/4 inch (19.1 mm).
2. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with minimum bare-steel thickness of 0.0312 inch (0.79 mm).
3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625-inch- (1.59-mm-) diameter wire, or double strand of 0.0475-inch- (1.21-mm-) diameter wire.

2.04 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards.
1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance.
1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.
1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

3.03 INSTALLATION, GENERAL

A. Installation Standard: ASTM C 754, except comply with framing sizes and spacing indicated.
   1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.

B. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

C. Install bracing at terminations in assemblies.

D. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.04 INSTALLING SUSPENSION SYSTEMS

A. Install suspension system components in sizes and spacings indicated on Drawings, but not less than those required by referenced installation standards for assembly types and other assembly components indicated.

B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.

C. Suspend hangers from building structure 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 suspension system.
      a. 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 locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
      a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.
   3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
   4. Do not attach hangers to steel roof deck.
   5. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
   6. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
   7. Do not connect or suspend steel framing from ducts, pipes, or conduit.

D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.

E. Seismic Bracing: Sway-brace suspension systems [with hangers used for support] see drawings for details.

F. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

G. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet (3 mm in 3.6 m) measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

3.05 INSTALLING FRAMED ASSEMBLIES

A. Install studs so flanges within framing system point in same direction.
   1. Space studs as follows:
      a. Single-Layer Application: 24 inches (610 mm) o.c., unless otherwise indicated.
      b. Multilayer Application: 24 inches (610 mm) o.c., unless otherwise indicated.
      c. Tile backing panels: 16 inches (406 mm) o.c., unless otherwise indicated.

B. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.
   1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
   2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
      a. Install two studs at each jamb, unless otherwise indicated.
      b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch (12.7-mm) clearance from jamb stud to allow for installation of control joint in finished assembly.
      c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
   3. Other Framed Openings: Frame openings other than door openings the same as required for door openings, unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
   4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
   5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
   6. Curved Partitions:
      a. Bend track to uniform curve and locate straight lengths so they are tangent to arcs.
      b. Begin and end each arc with a stud, and space intermediate studs equally along arcs. On straight lengths of not less than 2 studs at ends of arcs, place studs 6 inches (150 mm) o.c.

C. Direct Furring:
   1. Screw to wood framing.
   2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (610 mm) o.c.

D. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.

END OF SECTION

SECTION 09 29 00
GYPSUM BOARD

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes the following:
   1. Interior gypsum board.
   2. Tile backing panels.

B. Related Sections include the following:
   1. Section 06 10 53 – Miscellaneous Rough Carpentry for wood framing and furring that supports gypsum board.
   2. Section 06 16 00 – Sheathing for gypsum sheathing.
   3. Section 07 21 00 Thermal Insulation for insulation and vapor retarders installed in assemblies that incorporate gypsum board.
   4. Section 09 22 16 Non-Structural Metal Framing for non-structural framing and suspension systems that support gypsum board.
   5. Section 09 30 00 Tiling for cementitious backer units installed as substrates for ceramic tile.
   6. Section 09 91 23 Painting for primers applied to gypsum board surfaces.

1.02 SUBMITTALS

A. Product Data: For each type of product indicated.
   1. Trim Accessories: Full-size Sample in 12-inch- long length for each trim accessory indicated.

B. LEED Submittals:
   1. Product Data for Credit MR 4.1[and MR 4.2]: For products having recycled content, documentation indicating percentages by weight of postconsumer and pre-consumer recycled content.
   2. Product Data for Credit EQ 4.1: For adhesives used to laminate gypsum board panels to substrates, including printed statement of VOC content.

1.03 QUALITY ASSURANCE

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

1.04 STORAGE AND HANDLING

A. Store materials inside under cover and keep them dry and protected against damage from weather, condensation, direct sunlight, construction traffic, and other causes. Stack panels flat to prevent sagging.

1.05 PROJECT CONDITIONS

A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.

B. Do not install interior products until installation areas are enclosed and conditioned.

C. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.
   1. Indications that panels are wet, or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
   2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.01 INTERIOR GYPSUM BOARD

A. Size: Provide in maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

B. Regional Materials: Products shall be manufactured within 100 miles of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 100 miles of Project site.

C. General: Complying with ASTM C 36/C 36M or ASTM C 1396/C 1396M, as applicable to type of gypsum board indicated and whichever is more stringent.

   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. American Gypsum Co.
      b. Certain Teed Corporation.
      c. National Gypsum Company.
      d. USG Corporation.

D. Regular Type:
   1. Thickness: 5/8 inch.
   2. Long Edges: Tapered.

E. Type X:
   1. Thickness: 5/8 inch (15.9 mm).
   2. Long Edges: Tapered.

F. Moisture- and Mold-Resistant Type: With moisture- and mold-resistant core and surfaces.
   1. Core: 5/8 inch (15.9 mm), Type X.
   2. Long Edges: Tapered.

G. Impact Resistant Gypsum Board: ASTM C 1396/C 1396M gypsum board, tested according to ASTM C 1629/C 1629M.
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. CertainTeed Corporation.
      b. Georgia-Pacific Building Products.
      c. USG Corporation.
      d. National Gypsum
   2. Core: Fire-resistance rated gypsum core, with additives to enhance mold/mildew resistance, surface indentation resistance, impact resistance and moisture and mold resistance.
   3. Surface Abrasion: ASTM C 1629/C 1629M, meets or exceeds requirements.
   4. Soft body Impact Resistance: Classification Level 3 in accordance with ASTM C 1629.
   5. Hard body Impact Resistance: Classification Level 3 in accordance with ASTM C 1629.
   6. Indentation: ASTM C 1629/C 1629M, meets or exceeds requirements.
   7. Embedded Fiberglass mesh.
   8. Long edges: Tapered
   9. Environmental Requirements: Provide products that comply with testing and product requirements for low emitting materials.
   10. Overall thickness: 5/8 inch

2.02 EXTERIOR GYPSUM BOARD FOR CEILINGS AND SOFFITS

A. Exterior Gypsum Soffit Board: ASTM C 931/C 931M or ASTM C 1396/C 1396M, with manufacturer's standard edges.
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. American Gypsum Co.
      b. CertainTeed Corporation
      c. National Gypsum Company.
      d. USG Corporation.
   3. Core: As indicated.

B. Glass-Mat Gypsum Sheathing Board: ASTM C 1177/C 1177M.
   1. Product: Subject to compliance with requirements, provide "Dens-Glass Gold" by G-P Gypsum.
   2. Core: 5/8 inch (15.9 mm), Type X

2.03 TILE BACKING PANELS

A. Water-Resistant Gypsum Backing Board: ASTM C 630/C 630M or ASTM C 1396/C 1396M.
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. American Gypsum Co.
      b. CertainTeed Corporation
      c. National Gypsum Company.
      d. USG Corporation.
   3. Core: As indicated on Drawings.

2.04 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.
   1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized steel sheet.
   2. Shapes:
      a. Cornerbead.
      b. LC-Bead: J-shaped; exposed long flange receives joint compound.
      c. L-Bead: L-shaped; exposed long flange receives joint compound.
      d. Expansion (control) joint.

B. Interior Drywall Corner Protection: Drawing Designation WP2
   1. Basis of Design: CertainTeed NO-COAT®, Drywall Corner for reinforced corners
      a. Outside 90,
         1. High strength tapered copolymer core.
         2. Severe Impact Resistant will not dent
         3. Crisp sharp lines without ridges
         4. Surface Paper for applying paint and textures.

C. Exterior Trim: ASTM C 1047.
   1. Material: Hot-dip galvanized steel sheet, plastic, or rolled zinc.
   2. Shapes:
      a. Cornerbead.
      b. LC-Bead: J-shaped; exposed long flange receives joint compound.

D. Aluminum Trim: Extruded accessories of profiles and dimensions indicated.
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Fry Reglet Corp.
      b. Pittcon Industries.

3. Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B 221 (ASTM B 221M), Alloy 6063-T5.
4. Finish: Corrosion-resistant primer compatible with joint compound and finish materials specified.

2.05 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.

B. Joint Tape:
1. Interior Gypsum Wallboard: Paper.
2. Exterior Gypsum Soffit Board: Paper.
3. Tile Backing Panels: As recommended by panel manufacturer.

C. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.
1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.
   a. Use setting-type compound for installing paper-faced metal trim accessories.
3. Fill Coat: For second coat, use drying-type, all-purpose compound.
4. Finish Coat: For third coat, use drying-type, all-purpose compound.

D. Joint Compound for Exterior Applications:
1. Exterior Gypsum Soffit Board: Use setting-type taping compound and setting-type, sandable topping compound.

E. Joint Compound for Tile Backing Panels:
1. Water-Resistant Gypsum Backing Board: Use setting-type taping compound and setting-type, sandable topping compound.

2.06 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.

B. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.
2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

C. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.

D. Acoustical Sealant: As specified in Section 07 92 00 Joint Sealants.
   1. Provide sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. Thermal Insulation: As specified in Division 07 Section "Thermal Insulation."

F. If desired, delete last paragraph above and paragraph below and insert requirements for thermal insulation and vapor retarder.

G. Vapor Retarder: As specified in Division 07 Section "Thermal Insulation."

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames and framing, for compliance with requirements and other conditions affecting performance.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 APPLYING AND FINISHING PANELS, GENERAL

A. Comply with ASTM C 840.

B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.5 mm) of open space between panels. Do not force into place.

D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

E. Form control and expansion joints with space between edges of adjoining gypsum panels.

F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
   1. Unless 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. (0.7 sq. m) in area.

2. Fit gypsum panels around ducts, pipes, and conduits.
3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- (6.4- to 9.5-mm-) wide joints to install sealant.

G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) wide spaces at these locations, and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

I. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.

J. Install sound attenuation blankets before installing gypsum panels, unless blankets are readily installed after panels have been installed on one side.

3.03 APPLYING INTERIOR GYPSUM BOARD

A. Install interior gypsum board in the following locations:
1. Regular Type: Vertical surfaces, unless otherwise indicated.
2. Type X: Where required for fire-resistance-rated assembly.
3. Type C: Where required for specific fire-resistance-rated assembly indicated.
4. Moisture- and Mold-Resistant Type: As indicated on Drawings.

B. Single-Layer Application:
1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing, unless otherwise indicated.
2. On partitions/walls, apply gypsum panels vertically (parallel to framing), unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
   a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
   b. At stairwells and other high walls, install panels horizontally, unless otherwise indicated or required by fire-resistance-rated assembly.
3. On Z-furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

C. Multilayer Application:
1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints 1 framing member, 16 inches (400 mm)

minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.

2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
3. On Z-furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
4. Fastening Methods: Fasten base layers and face layers separately to supports with screws.

D. Curved Surfaces:
1. Install panels horizontally (perpendicular to supports) and unbroken, to extent possible, across curved surface plus 12-inch- (300-mm-) long straight sections at ends of curves and tangent to them.
2. For double-layer construction, fasten base layer to studs with screws 16 inches (400 mm) o.c. Center gypsum board face layer over joints in base layer, and fasten to studs with screws spaced 12 inches (300 mm) o.c.

3.04 APPLYING EXTERIOR GYPSUM PANELS FOR CEILINGS AND SOFFITS

A. Apply panels perpendicular to supports, with end joints staggered and located over supports.
1. Install with 1/4-inch (6.4-mm) open space where panels abut other construction or structural penetrations.
2. Fasten with corrosion-resistant screws.

3.05 APPLYING TILE BACKING PANELS

A. Water-Resistant Gypsum Backing Board: Install at showers, tubs, and where indicated. Install with 1/4-inch (6.4-mm) gap where panels abut other construction or penetrations.

B. Areas Not Subject to Wetting: Install regular-type gypsum wallboard panels to produce a flat surface except at showers, tubs, and other locations indicated to receive water-resistant panels.

C. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.06 INSTALLING TRIM ACCESSORIES

A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

B. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect for visual effect.

C. Interior Trim: Install in the following locations:

1. Cornerbead: Use at outside corners, unless otherwise indicated.
2. LC-Bead: Use at exposed panel edges.
3. L-Bead: Use where indicated.

D. Exterior Trim: Install in the following locations:
   1. Cornerbead: Use at outside corners.

E. LC-Bead: Use Aluminum Trim: Install in locations indicated on Drawings.

3.07 FINISHING GYPSUM BOARD

A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

B. Prefill open joints, rounded or beveled edges, and damaged surface areas.

C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.

D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
   1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
   2. Level 2: Panels that are substrate for tile.
   3. Level 4: At panel surfaces that will be exposed to view, unless otherwise indicated.
      a. Primer and its application to surfaces are specified in other Division 09 Sections.

3.08 PROTECTION

A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

B. Remove and replace panels that are wet, moisture damaged, and mold damaged.
   1. Indications that panels are wet, or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
   2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION

SECTION 09 30 00
TILING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Porcelain tile.
   2. Glazed wall tile.
   3. Stone thresholds.
   4. Crack isolation membrane.
   5. Tile backing panels.
   6. Metal edge strips.

B. Related Sections:
   1. Section 07 92 00 "Joint Sealants" for sealing of expansion, contraction, control, and isolation joints in tile surfaces.

1.02 DEFINITIONS

A. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.

B. ANSI A108 Series: ANSI A108.01, ANSI A108.02, ANSI A108.1A, ANSI A108.1B, ANSI A108.1C, ANSI A108.4, ANSI A108.5, ANSI A108.6, ANSI A108.8, ANSI A108.9, ANSI A108.10, ANSI A108.11, ANSI A108.12, ANSI A108.13, ANSI A108.14, ANSI A108.15, ANSI A108.16, and ANSI A108.17, which are contained in "American National Standard Specifications for Installation of Ceramic Tile."

C. Module Size: Actual tile size plus joint width indicated.

D. Face Size: Actual tile size, excluding spacer lugs.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show locations of each type of tile and tile pattern. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.

C. Samples for Verification:
   1. Full-size units of each type and composition of tile and for each color and finish required. For ceramic mosaic tile in color blend patterns, provide full sheets of each color blend.
   2. Assembled samples mounted on a rigid panel, with grouted joints, for each type and

composition of tile and for each color and finish required. Make samples at least 12 inches (300 mm) square, but not fewer than 4 tiles. Use grout of type and in color or colors approved for completed Work.

3. Full-size units of each type of trim and accessory for each color and finish required.
4. Stone thresholds in 6-inch (150-mm) lengths.
5. Metal edge strips in 6-inch (150-mm) lengths.

1.04 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.
2. Grout: Furnish quantity of grout equal to 3 percent of amount installed for each type, composition, and color indicated.

1.05 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer is a five-star member of the National Tile Contractors Association or a Trowel of Excellence member of the Tile Contractors Association of America.
2. Installer's supervisor for Project holds the International Masonry Institute's Foreman Certification.

B. Source Limitations for Tile: Obtain tile of each type and color or finish from one source or producer.

1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.

C. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from one manufacturer and each aggregate from one source or producer.

D. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single manufacturer for each product:

1. Stone thresholds.
2. Crack isolation membrane.
3. Joint sealants.
4. Cementitious backer units.
5. Metal edge strips

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.

B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.

C. Store aggregates where grading and other required characteristics can be maintained, and contamination can be avoided.

D. Store liquid materials in unopened containers and protected from freezing.

E. Handle tile that has temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.

1.07 PROJECT CONDITIONS

A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

PART 2 - PRODUCTS

2.01 PRODUCTS, GENERAL

A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.

1. Provide tile complying with Standard grade requirements unless otherwise indicated.

B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCA installation methods specified in tile installation schedules, and other requirements specified.

C. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.

D. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer unless otherwise indicated.
1. Where tile is indicated for installation in wet areas, do not use back- or edge-mounted tile assemblies unless tile manufacturer specifies in writing that this type of mounting is suitable for installation indicated and has a record of successful in-service performance.

E. Factory-Applied Temporary Protective Coating: Where indicated under tile type, protect exposed surfaces of tile against adherence of mortar and grout by precoating with continuous film of petroleum paraffin wax, applied hot. Do not coat unexposed tile surfaces.

2.02 TILE PRODUCTS

A. Porcelain Tile Type: Unglazed and Glazed Porcelain Tile.

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following and approved by the Architect:
   a. Anatolia
   b. American Olean, a division of Dal-Tile Corporation
   c. Crossville
2. Composition: As indicated on the Drawings.
3. Module Size: As indicated on the Drawings (25.4 by 25.4 mm) (25.4 by 50.8 mm) (50.8 by 50.8 mm).
4. Thickness: As indicated on the Drawings (6.35 mm).
5. Tile Color and Pattern: As indicated on the Drawings.
6. Grout Color: As selected by Architect from manufacturer's full range.
7. Dynamic Coefficient of Friction (DCOF AcuTest, ANSI A137.1): Not less than the following:
   a. Level Surfaces: 0.42
   b. Ramps: 0.8.
8. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as indicated on the Drawings, selected from manufacturer's standard shapes.
   a. Tapered Transition Tile: Shape designed to effect transition between thickness of tile floor and adjoining floor finishes of different thickness, tapered to provide reduction in thickness from 1/2 to 1/4-inch (12.7 to 6.35 mm) across nominal 4-inch (100-mm) dimension.

2.03 THRESHOLDS

A. General: Fabricate to sizes and profiles indicated or required to provide transition between adjacent floor finishes.
   1. Bevel edges at 1:2 slope, with lower edge of bevel aligned with or up to 1/16 inch above adjacent floor surface. Finish bevel to match top surface of threshold. Limit height of threshold to 1/2 inch or less above adjacent floor surface.

2.04 TILE BACKING PANEL

A. Cementitious Backer Units: ANSI A118.9 or ASTM C 1325, in maximum lengths available to minimize end-to-end butt joints.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. USG Corporation; DUROCK Cement Board.
   2. Thickness: As indicated.

B. Fiber-Cement Underlayment: ASTM C 1288, in maximum lengths available to minimize end-to-end butt joints.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. James Hardie; Hardiebacker 500.
   2. Thickness: As indicated.

2.05 CRACK ISOLATION MEMBRANE

A. General: Manufacturer's standard product that complies with ANSI A118.12 for standard

performance and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.

B. Polyethylene Sheet: Polyethylene faced on both sides with fleece webbing; 0.008-inch (0.203-mm) nominal thickness.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Schluter Systems L.P.; KERDI.

C. Corrugated Polyethylene: Corrugated polyethylene with dovetail-shaped corrugations and with anchoring webbing on the underside; 3/16-inch (4-mm) nominal thickness.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Schluter Systems L.P.; DITRA.

2.06 SETTING MATERIALS

A. Latex-Portland Cement Mortar (Thin Set): ANSI A118.4.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
      a. Ardex Americas
      b. Laticrete International, Inc.
      c. MAPEI Corporation.
   2. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.
   3. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.4.

2.07 GROUT MATERIALS

A. Water-cleanable Epoxy Grout: ANSI A118.3
   1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
      a. Laticrete International, Inc.
      b. MAPEI Corporation

B. Sand-Portland Cement Grout: ANSI A108.10, composed of white or gray cement and white or colored aggregate as required to produce color indicated.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
      a. Laticrete International, Inc.
      b. MAPEI Corporation.

2.08 MISCELLANEOUS MATERIALS

A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.

B. Metal Edge Strips: Angle or L-shape, height to match tile and setting-bed thickness, metallic or

combination of metal and PVC or neoprene base, designed specifically for flooring applications; stainless-steel, ASTM A 666, 300 Series exposed-edge material.

1. Metal Edge Strips: Angle or L-shaped, height to match tile and setting-bed thickness, metallic or combination of metal and PVC or neoprene base, designed specifically for flooring applications; stainless-steel, ASTM A 666, 300 Series exposed-edge material.
2. Basis-of Design Manufacturer: Subject to compliance with requirements, provide Schluter Systems L.P. DILEX-EHK and QUADEC profile or equivalent products by one of the following:
   a. Blanke Corporation
   b. Ceramic Tool Company, Inc
   c. Schluter Systems L.P.
3. Finish: Brushed stainless steel
4. Thickness: As required to finish tile installation.

C. Temporary Protective Coating: Product indicated below that is formulated to protect exposed surfaces of tile against adherence of mortar and grout; compatible with tile, mortar, and grout products; and easily removable after grouting is completed without damaging grout or tile.
   1. Petroleum paraffin wax, fully refined and odorless, containing at least 0.5 percent oil with a melting point of 120 to 140 deg F (49 to 60 deg C) per ASTM D 87.
   2. Grout release in form of manufacturer's standard proprietary liquid coating that is specially formulated and recommended for use as temporary protective coating for tile.

D. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

E. Grout Sealer: Manufacturer's standard product for sealing grout joints and that does not change color or appearance of grout.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. MAPEI Corporation; KER 003, Silicone Spray Sealer for Cementitious Tile Grout.
      b. Southern Grouts & Mortars, Inc.; Silicone Grout Sealer.

2.09 MIXING MORTARS AND GROUT

A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.

B. Add materials, water, and additives in accurate proportions.

C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.
   1. Verify that substrates for setting tile are firm, dry, clean, free of coatings that are incompatible with tile-setting materials including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
   2. Verify that concrete substrates for tile floors installed with thin-set mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.
      a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
      b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.
   3. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
   4. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with thin-set mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.

B. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot (1:50) toward drains.

C. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

D. Field-Applied Temporary Protective Coating: If indicated under tile type or needed to prevent grout from staining or adhering to exposed tile surfaces, precoat them with continuous film of temporary protective coating, taking care not to coat unexposed tile surfaces.

3.03 TILE INSTALLATION

A. Comply with TCNA's "Handbook for Ceramic Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 Series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.
   1. For the following installations, follow procedures in the ANSI A108 Series of tile installation

standards for providing 95 percent mortar coverage:
a. Tile floors in wet areas.
b. Tile floors composed of tiles 8 by 8 inches (200 by 200 mm) or larger.
c. Tile floors composed of rib-backed tiles.

B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

D. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.

E. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.
1. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so joints between sheets are not apparent in finished work.
2. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
3. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.

F. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:
1. Ceramic Mosaic Tile: 1/16 inch.
2. Quarry Tile: 1/4 inch.
3. Paver Tile: 1/4 inch.
4. Glazed Wall Tile: 1/16 inch.
5. Decorative Thin Wall Tile: 1/16 inch.

G. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.

H. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.
1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.
2. Prepare joints and apply sealants to comply with requirements in Section 07920 "Joint Sealants."

I. Stone Thresholds: Install stone thresholds in same type of setting bed as adjacent floor unless otherwise indicated.
1. Do not extend crack isolation membrane under thresholds set in latex-portland cement mortar. Fill joints between such thresholds and adjoining tile set on crack isolation membrane with

elastomeric sealant.

J. Metal Edge Strips: Install at locations indicated.

K. Grout Sealer: Apply grout sealer to cementitious grout joints in tile floors according to grout-sealer manufacturer's written instructions. As soon as grout sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

3.04 TILE BACKING PANEL INSTALLATION

A. Install cementitious backer units and fiber-cement underlayment and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated. Use latex-portland cement mortar for bonding material unless otherwise directed in manufacturer's written instructions.

3.05 CRACK ISOLATION MEMBRANE INSTALLATION

A. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness and bonded securely to substrate.

B. Do not install tile or setting materials over crack isolation membrane until membrane has cured.

3.06 CLEANING AND PROTECTING

A. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
   1. Remove latex-portland cement grout residue from tile as soon as possible.
   2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.
   3. Remove temporary protective coating by method recommended by coating manufacturer and that is acceptable to tile and grout manufacturer. Trap and remove coating to prevent drain clogging.

B. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.

C. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.

D. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

END OF SECTION

SECTION 09 51 23
ACOUSTICAL TILE CEILINGS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Acoustical tiles for ceilings.
   2. Concealed suspension systems.

B. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. LEED Submittals:
   1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating costs for each product having recycled content.

C. Product Data for Credit EQ 4.1: For adhesives and sealants, documentation including printed statement of VOC content.

D. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below.
   1. Acoustical Tile: Set of full-size Samples of each type, color, pattern, and texture.
   2. Concealed Suspension-System Members: 6-inch- (150-mm-) long Sample of each type.
   3. Exposed Moldings and Trim: Set of 6-inch- (150-mm-) long Samples of each type and color.

1.03 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
   1. Ceiling suspension-system members.
   2. Method of attaching hangers to building structure.
      a. Furnish layouts for cast-in-place anchors, clips, and other ceiling attachment devices whose installation is specified in other Sections.
      b. Size and location of initial access modules for acoustical tile.
      c. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
      d. Minimum Drawing Scale: 1/8 inch = 1 foot (1:96).

B. Product Test Reports: For each acoustical tile ceiling, for tests performed by manufacturer and

witnessed by a qualified testing agency.

1.04 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to the National Voluntary Laboratory Accreditation Program (NVLAP) for testing indicated.

a.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical tiles, suspension-system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical tiles, permit them to reach room temperature and a stabilized moisture content.

C. Handle acoustical tiles carefully to avoid chipping edges or damaging units in any way.

1.06 FIELD CONDITIONS

A. Environmental Limitations: Do not install acoustical tile ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical tile ceiling installation.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Acoustical ceiling shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   1. Flame-Spread Index: Comply with ASTM E 1264 for Class B materials.
   2. Smoke-Developed Index: 75 or less.

2.02 ACOUSTICAL TILES, GENERAL

A. Source Limitations:
   1. Acoustical Ceiling Tile: Obtain each type from single source from single manufacturer.

2. Suspension System: Obtain each type from single source from single manufacturer.

B. Source Limitations: Obtain each type of acoustical ceiling tile and supporting suspension system from single source from single manufacturer.

C. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 5 percent.

D. Acoustical Tile Standard: Provide manufacturer's standard tiles of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances unless otherwise indicated.
   1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches (400 mm) away from test surface according to ASTM E 795.

E. Acoustical Tile Colors and Patterns: Match appearance characteristics indicated for each product type.

2.03 ACOUSTICAL TILE <CG1>

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

B. Basis-of-Design Product: Subject to compliance with requirements, provide Armstrong, Optima Open Plan, Tegular #3355 or comparable product by one of the following:
   1. Armstrong World Industries, Inc.
   2. CertainTeed Corp.
   3. USG Interiors, LLC

C. Classification: Provide tiles complying with ASTM E 1264 for type, form, and pattern as follows:
   1. Type and Form: Type: XII, Form: 2,
   2. Pattern: E.

D. Color: White.

E. LR: Not less than 0.90.

F. NRC: Not less than Insert 0.95.

G. CAC: 26

H. AC: 200.

I. Edge/Joint Detail: Square Tegular.

J. Thickness: 1 inch.

K. Modular Size: 24 x 24.

L. Broad Spectrum Antimicrobial Fungicide and Bactericide Treatment: Provide acoustical tiles treated with manufacturer's standard antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D 3273 and evaluated according to ASTM D 3274 or ASTM G 21.

2.04 METAL SUSPENSION SYSTEMS, GENERAL

A. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 5percent.

B. Metal Suspension-System Standard: Provide manufacturer's standard metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635/C 635M.

C. Attachment Devices: Size for five times the design load indicated in ASTM C 635/C 635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.

D. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:
1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.

E. Hanger Rods: Mild steel, zinc coated or protected with rust-inhibitive paint.

F. Seismic Struts: Manufacturer's standard compression struts designed to accommodate lateral forces.

G. Seismic Clips: Manufacturer's standard seismic clips designed and spaced to secure acoustical tiles in-place.

2.05 METAL SUSPENSION SYSTEM

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. Armstrong World Industries, Inc.
2. USG Interiors, Inc.; Subsidiary of USG Corporation.

2.06 METAL EDGE MOLDINGS AND TRIM

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. Armstrong World Industries, Inc.

2. CertainTeed Corp.
3. Fry Reglet Corporation.
4. USG Interiors, Inc.; Subsidiary of USG Corporation.

C. Extruded-Aluminum Edge Moldings and Trim: Where indicated, provide manufacturer's extruded-aluminum edge moldings and trim of profile indicated or referenced by manufacturer's designations, including splice plates, corner pieces, and attachment and other clips and complying with seismic design requirements and the following:
   1. Aluminum Alloy: Alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated and with not less than the strength and durability properties of aluminum extrusions complying with ASTM B 221 (ASTM B 221M) for Alloy and Temper 6063-T5.
   2. Baked-Enamel or Powder-Coat Finish: Minimum dry film thickness of 1.5 mils (0.04 mm). Comply with ASTM C 635/C 635M and coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

2.07 ACOUSTICAL SEALANT

A. Products: Subject to compliance with requirements, provide one of the following:
   1. Acoustical Sealant for Exposed and Concealed Joints:
      a. Pecora Corporation; AC-20 FTR Acoustical and Insulation Sealant.
      b. USG Corporation; SHEETROCK Acoustical Sealant.
         1. Acoustical Sealant for Concealed Joints:
      c. Pecora Corporation; AIS-919.
      d. Tremco, Inc.; Tremco Acoustical Sealant.

B. Acoustical Sealant: Manufacturer's standard sealant complying with ASTM C 834 and effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
   1. Exposed and Concealed Joints: Nonsag, paintable, nonstaining latex sealant.
   2. Concealed Joints: Nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber sealant.
   3. Acoustical sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing and substrates to which acoustical tile ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine acoustical tiles before installation. Reject acoustical tiles that are wet, moisture damaged,

or mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Measure each ceiling area and establish layout of acoustical tiles to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width tiles at borders and comply with layout shown on reflected ceiling plans.

3.03 INSTALLATION OF SUSPENDED ACOUSTICAL TILE CEILINGS

A. General: Install acoustical panel ceilings to comply with ASTM C 636/C 636M and seismic design requirements indicated, according to manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."

B. Suspend ceiling hangers from building's 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 structure or of ceiling suspension system.
   2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
   3. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
   4. Do not attach hangers to steel deck tabs.
   5. Do not attach hangers to steel roof deck. Attach hangers to structural members.
   6. Space hangers not more than 48 inches (1200 mm) o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches (200 mm) from ends of each member.
   7. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.

C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or post-installed anchors.

D. Install edge moldings and trim of type indicated at perimeter of acoustical tile ceiling area and where necessary to conceal edges of acoustical tiles.
   1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
   2. Screw attach moldings to substrate at intervals not more than 16 inches (400 mm) o.c. and not more than 3 inches (75 mm) from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet (3.2 mm in 3.6 m). Miter corners accurately and connect securely.
   3. Do not use exposed fasteners, including pop rivets, on moldings and trim.

E. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

F. Arrange directionally patterned acoustical tiles as follows:
   1. As indicated on reflected ceiling plans.
   2. Install tiles with pattern running in one direction parallel to [long] [short] axis of space.
   3. Install tiles in a basket-weave pattern.

G. Install acoustical tiles in coordination with suspension system and exposed moldings and trim. Place splines or suspension-system flanges into kerfed edges so tile-to-tile joints are closed by double lap of material.
   1. Fit adjoining tile to form flush, tight joints. Scribe and cut tile for accurate fit at borders and around penetrations through tile.
   2. Hold tile field in compression by inserting leaf-type, spring-steel spacers between tile and moldings, spaced 12 inches (305 mm) o.c.

3.04 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
   1. Compliance of seismic design.

B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections and prepare test reports.

C. Perform the following tests and inspections of completed installations of acoustical tile ceiling hangers and anchors and fasteners in successive stages and when installation of ceiling suspension systems on each floor has reached 20 percent completion but no tiles have been installed. Do not proceed with installations of acoustical tile ceiling hangers for the next area until test results for previously completed installations of acoustical tile ceiling hangers show compliance with requirements.
   1. Within each test area, testing agency will select one of every 10 power-actuated fasteners and postinstalled anchors used to attach hangers to concrete and will test them for 200 lbf of tension; it will also select one of every two postinstalled anchors used to attach bracing wires to concrete and will test them for 440 lbf of tension.
   2. When testing discovers fasteners and anchors that do not comply with requirements, testing agency will test those anchors not previously tested until 20 pass consecutively and then will resume initial testing frequency.

D. Acoustical tile ceiling hangers and anchors and fasteners will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

3.05 CLEANING

A. Clean exposed surfaces of acoustical tile ceilings, including trim and edge moldings. Comply with

manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace tiles and other ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION

SECTION 09 61 00
CONCRETE FLOOR FINISH

PART 1 - GENERAL

1.01 SCOPE

A. This contractor shall furnish all labor and materials and perform all work required for the preparation and polishing of existing concrete floors.

1.02 RELATED SECTIONS

A. Section 07 92 00 – Joint Sealants: For sealants in concrete floor surfaces.

B. Section 09 91 00 – Painting: Painting of floor borders.

1.03 REFERENCES

A. American Concrete Institute (ACI)
   1. ACI 302.1R – Guide for Concrete Floor and Slab Construction.

B. ASTM International
   1. ASTM C309 – Standard Specification for Liquid Membrane Forming Compounds for Curing Concrete.
   2. ASTM C171 – Standard Specification for Sheet Materials for Curing Concrete.
   3. ASTM C779 – Standard Test Method for Abrasion Resistance of Horizontal Concrete Surfaces.
   4. ASTM C805 – Standard Test Method for Rebound Number of Hardened Concrete.
   5. ASTM E 1155 – Standard Test Method for Determining Floor Flatness and Levelness Using the F number system.

C. Reunion Internationale des Laboratories D'Essais et de Recherches sur les Materiaux et les Constructions (RILEM).
   1. RILEM Test Method 11.4 Standard Measurement of Reduction of Moisture Penetration through Horizontal Concrete Surfaces.

1.04 PERFORMANCE REQUIREMENTS

A. Provide polished flooring that has been selected, manufactured and installed to achieve the following:
   1. Abrasion Resistance: ASTM C779, Up to 400% increase in abrasion resistance
   2. Reflectivity: Increase of 35% as determined by gloss meter
   3. Waterproof Properties: RILEM Test Method 11.4, 70% or greater reduction in absorption
   4. Impact Strength: ASTM C805, Up to 21% increased impact strength

5. Must meet or exceed ADA/OSHA suggested 0.5 standard value for the Static Co-efficient of Friction

1.05 PRE-INSTALLATION MEETINGS

A. Conduct pre-installation conference at project site prior to the start of work.

1.06 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Closeout Submittal:
   1. Warranty: Submit warranty documents specified.
   2. Maintenance Data: For polished concrete finishing to include in maintenance manuals. Also include the following.
      a. Manufacturer's instructions on maintenance renewal of applied treatments.
      b. Protocols and product specifications for joint filling, crack repair and/or surface repair.

1.07 QUALITY ASSURANCE

A. Manufacturers Qualifications:
   1. Manufacturer has a minimum of 5 years' experience in manufacturing components similar to or exceeding requirements of project.
   2. Manufacturer must be able to provide technically trained field representative during construction and approving application method.

B. Installer Qualifications
   1. Installer experienced in performing work of this section who has specialized in installation work similar to that required for this project.
   2. Installer trained and having current certification for Specified Concrete Polishing System.

C. Mock-Ups
   1. Mock-up size: 10'x10' floor area at job site, at location as directed under conditions similar to those which will exist during actual placement. Divide mock-up area into 4 equal zones, allowing for sequential attempts to determine amount of aggregate exposure, and color (if required) and shine selection.
   2. Mock-up will be used to judge workmanship, concrete substrate preparation, operation of equipment, material application, color selection and shine level.
   3. Allow 24 hours for inspection of mock-up before proceeding with work.
   4. When accepted, mock-up will demonstrate minimum standard of quality required for this project.
      a. Level of cut: Class B– Salt/Pepper Finish.
      b. Level of shine: Level 1 – Low Gloss; up to 400 grit polish, a gloss reading of 10-20.

D. Sequence with Other Work: Comply with Manufacturer's written recommendations for sequencing construction operations.

E. Environmental Limitations: Do not install work until ambient temperature and humidity conditions are maintained at levels indicated in reference standards

1.08 DELIVERY, STORAGE & HANDLING

A. Comply with manufacturer's ordering instructions and lead time requirements to avoid construction delays.

B. Deliver materials in manufacturer's original packaging with identification labels and seals intact.

C. Storage and Protection:
   1. Store materials protected from exposure to harmful weather conditions and at temperature conditions recommended by manufacturer.
   2. Protection of Concrete Slab.
      a. Protect from petroleum stains during construction.
      b. Diaper all hydraulic lifts and power equipment.
      c. Restrict vehicular parking, drop cloths will be placed under vehicles parked on slab.
      d. No pipe cutting machinery will be used on interior floor slab.
      e. Steel will not be placed on interior floor slab to avoid rust staining.
      f. No acids or acidic detergents will come into contact with slab.

1.09 WARRANTY

A. Provide 10-year minimum manufacturer's material warranty.

PART 2 - PRODUCTS

2.01 GENERAL

A. Ensure concrete finishing components and materials are from single source, from single manufacturer. Acceptable Manufactures:
   1. Curecrete Distribution, Inc - "RetroPlate" Systems; Springville, UT.
   2. Prosoco - "Consolideck", Lawrence, KS.
   3. Laticrete - "L&M FGS Permashine", Bethany, CT.

2.02 POLISHED CONCRETE FINISHING PRODUCTS

A. Products/Systems:
   1. Hardener, Sealer, Densifier: RetroPlate 99 – penetrating, water based, odorless liquid, VOC compliant, environmentally safe chemical, will leave no film on surface
   2. Joint Filler: CreteFill Pro 85, Semi-rigid, 2 component, self-leveling, 100%solids, rapid curing, polyuria control joint and crack filler with an 85 Shore-A hardness.
   3. Oil Repellent Sealer: RetroPel
   4. Cleaning Solution: CreteClean Plus
   5. Stain Protector: RetroGuard.
   6. Finish:

a. Level of cut: Class B– Salt/Pepper Finish.
b. Level of shine: Level 1 – Low Gloss; up to 400 grit polish, a gloss reading of 10-20.

PART 3 - EXECUTION

3.01 MANUFACTURERS INSTRUCTIONS

A. Comply with manufacturer's written data, including product technical bulletins, product catalog installation instructions, product carton installations and Spec-Data sheets.

3.02 EXAMINATION

A. Site Verification of Conditions.
   1. Verify that concrete substrate conditions, which have been previously installed, are acceptable for product installation in accordance with manufacturer's instructions prior to installation of finishing materials.
   2. Verify floor is free of curing membrane, bond-breaker, and concrete laitance.

3.03 PREPARATION

A. Prep existing floors:
   1. Remove all existing paint, rust and stains. Refer to Environmental Specification for Lead-based and Lead-Containing paint for proper removal. Treat oil sports with emulsifier and oil absorber materials and scrub with a high pH detergent.
   2. Grind smooth all raised and previously patched areas.
   3. Patch and repair all concrete cracks and surface failures.
   4. Remove all existing floor mounted screws and brackets. Patch and repair all holes.

B. Ensure surfaces are clean and free of dirt and other foreign matter harmful to performance of Concrete finishing materials.

C. Examine surface to determine soundness of concrete for polishing.

3.04 INSTALLATION

A. Floor Surface Polishing and Treatment.
   1. Provide polished concrete floor treatment in entirety of slab indicated by drawings. Provide Consistent finish in all contiguous areas.
   2. Apply floor finish prior to installation of new walls, equipment, fixtures and accessories.
   3. Diamond polish concrete floor surfaces with proper grinding equipment, recommended by Polishing system representative.
      a. Comply with manufacturer's recommended polishing grits for each sequence to achieve desired finish level. Level of shine shall match that of approved mock-up.
      b. Expose aggregate in concrete surface only as determined by approved mock-up.
      c. All concrete surfaces shall be as uniform in appearance as possible.
   4. Apply RetroPlate 99, Hardener, Densifier as follows:

a. Apply RetroPlate 99 at 200 sq. ft. per gallon, according to manufacturer's directions.
b. Apply RetroGuard according to manufacturer's directions.
    1. Remove defects and re-polish defective areas
    2. Finish edges of floor finish adjoining other materials in a clean and sharp manner

5. Coordinate polish and treatment of floors with Painting Contractor for installation of painted accent room borders.

3.05 FINAL CLEANING

A. Mechanically scrub treated floors for seven days with soft to medium pads using approved Cleaning solution (Crete Clean Plus).

B. Upon completion, general contractor must remove surplus and excess materials, rubbish, tools and equipment.

3.06 PROTECTION

A. Protect installed product (Polished floors) from damage during construction

END OF SECTION

SECTION 09 65 13
RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Resilient base.
   2. Resilient molding accessories.

B. Related Sections:
   1. Section 09 65 19 “Resilient Tile Flooring."

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples for Verification: For each type of product indicated, in manufacturer's standard-size Samples but not less than 12 inches long, of each resilient product color, texture, and pattern required.

C. Product Schedule: For resilient products. Use same designations indicated on Drawings.

1.03 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Furnish not less than 10 linear feet (3 linear m) for every 500 linear feet (150 linear m) or fraction thereof, of each type, color, pattern, and size of resilient product installed.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F.

1.05 PROJECT CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive resilient products during the following time periods:
   1. 48 hours before installation.
   2. During installation.
   3. 48 hours after installation.

B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.

C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.01 RESILIENT BASE: RB1 & RB2.

A. Resilient Base Standard: ASTM F 1861.

1. Material Requirement: See Drawings.
2. Manufacturing Method: See Drawings.
3. Style: See Drawings.

B. Minimum Thickness: See Drawings.

C. Height: See Drawings.

D. Lengths: Cut lengths 48 inches (1219 mm) long or coils in manufacturer's standard length.

E. Finish: See Drawings.

F. Colors and Patterns: See Drawings.

2.02 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.
1. Adhesives shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24) [except that adhesive for rubber stair treads shall have a VOC content of 60 g/L or less].

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Verify that finishes of substrates comply with tolerances and other requirements specified in other

Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.

C. Do not install resilient products until they are same temperature as the space where they are to be installed.
   1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.

D. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.03 RESILIENT BASE INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient base.

B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

C. Install resilient base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.

D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

E. Do not stretch resilient base during installation.

F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.

G. Preformed Corners: Install preformed corners before installing straight pieces.

H. Job-Formed Corners:
   1. Outside Corners: Use straight pieces of maximum lengths possible. Form without producing discoloration (whitening) at bends.
   2. Inside Corners: Use straight pieces of maximum lengths possible.

3.04 RESILIENT ACCESSORY INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient accessories.

B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of [carpet] [resilient floor covering] that would otherwise be exposed.

3.05 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protection of resilient products.

B. Perform the following operations immediately after completing resilient product installation:
   1. Remove adhesive and other blemishes from exposed surfaces.
   2. Damp-mop surfaces to remove marks and soil.

C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Cover resilient products until Substantial Completion.

END OF SECTION

SECTION 09 65 19
RESILIENT TILE FLOORING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Resilient tile floor.

B. Related Sections:
   1. Section 09 65 13 "Resilient Wall Base and Accessories" for resilient base, reducer strips, and other accessories installed with resilient floor coverings.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For each type of floor tile. Include floor tile layouts, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.
   1. Show details of special patterns.

C. Samples for Verification: Full-size units of each color and pattern of floor tile required.
   1. For heat-welding bead, manufacturer's standard-size Samples, but not less than 9 inches long, of each color required.

D. Product Schedule: For floor tile. Use same designations indicated on Drawings.

1.03 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of floor tile to include in maintenance manuals.

1.04 MATERIALS MAINTENANCE SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Floor Tile: Furnish 1 box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C). Store floor tiles on flat surfaces.

1.06 PROJECT CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive floor tile during the following time periods:
   1. 48 hours before installation.
   2. During installation.
   3. 48 hours after installation.

B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).

C. Close spaces to traffic during floor tile installation.

D. Close spaces to traffic for 48 hours after floor tile installation.

E. Install floor tile after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. FloorScore Compliance: Resilient tile flooring shall comply with requirements of FloorScore Standard.

2.02 SOLID VINYL FLOOR TILE

A. Products: Subject to compliance with requirements, provide one of the following: See drawings.

B. Tile Standard: ASTM F 1700.
   1. Class: III Printed Vinyl Plank.

C. Thickness: 4.5 mm.

D. Size: See drawings.

E. Colors and Patterns: See drawings

2.03 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by manufacturer to suit floor tile and substrate conditions indicated.
   1. Adhesives shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
      a. VCT and Asphalt Tile Adhesives: Not more than 50 g/L.
      b. Rubber Floor Adhesives: Not more than 60 g/L.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor tile.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

B. Concrete Substrates: Prepare according to ASTM F 710.
   1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
   2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
   3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
   4. Moisture Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.

C. Access Flooring Panels: Remove protective film of oil or other coating using method recommended by access flooring manufacturer.

D. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.

E. Do not install floor tiles until they are same temperature as space where they are to be installed.
   1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.

F. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.03 FLOOR TILE INSTALLATION

A. Comply with manufacturer's written instructions for installing floor tile.

B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.
   1. Lay tiles in pattern indicated.

C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.
   1. Lay tiles in pattern of colors and sizes indicated.

D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.

E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent, nonstaining marking device.

G. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in finished floor areas. Maintain overall continuity of color and pattern between pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.

H. Adhere floor tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

I. Comply with manufacturer's written instructions for cleaning and protection of floor tile.

J. Perform the following operations immediately after completing floor tile installation:
   1. Remove adhesive and other blemishes from exposed surfaces.
   2. Sweep and vacuum surfaces thoroughly.
   3. Damp-mop surfaces to remove marks and soil.

K. Protect floor tile products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

L. Floor Polish: Remove soil, visible adhesive, and surface blemishes from floor tile surfaces before applying liquid floor polish.

M. Cover floor tile until Substantial Completion.

END OF SECTION

SECTION 09 68 13
TILE CARPETING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. This contractor shall furnish all labor and materials and perform all work required for the walk-off entrance carpet tile.

1.02 RELATED SECTIONS

A. Section 09 65 00 - Resilient Flooring: Resilient base installed with carpet tile.

1.03 PERFORMANCE REQUIREMENTS

A. Carpet shall be impervious to, and is not damaged by water.

B. The stain-resistant properties must be permanent and cannot be removed by commercial cleanings or abrasive wear. Test data as follows:
   1. Red dye 40 must be released by water only, after exposure to 150,000+ cycles in a tetrapod walker and after sample is allowed to soak in 10:1 solution of ammonia and water.
   2. Carpet must pass AATC 175 stain resistance with rating of 8 or better when modified by running 200 cycles of abrasion employing a 'Taber Abraser" (1,000-gram load/H-18 wheel prior to staining).
   3. Topical stain resistant treatments will not be acceptable. Stain resistant properties must be inherent.

C. Antimicrobial Treatment: Treat carpet fibers with a surface-durable, non-leaching, antimicrobial carpet treatment which:
   1. Exhibits electrostatic and covalent bonding capability.
   2. Provides a minimum level of 90% bacterial reduction (test AATC-100).
   3. Provides a maximum level of 20% substrate fungal growth (test AATC-30).
   4. Continues to exhibit antimicrobial activity for the carpet manufacturer's guaranteed life of carpet.

D. Test Requirements:
   1. Flame/Smoke-Resistant Standards: Provide carpet complying with ratings as indicated for the following:
   2. Floor Radiant Panel Test –ASTM E-648-78 and/or NFPA 253 Carpet shall have a minimum critical radiant flux of forty-five hundredths (0.45) watts per square centimeter (cm2).
   3. Methenamine Tablet Test DOC-FF-1-70 and/or ASTM 0-2859-76. Carpet shall meet the “Standards for the Surface Flammability of Carpets”.
   4. Smoke Density Test - NFPA 258 and/or ASTM E 662-83. Carpet shall have a specific optical density (DM) of four hundred fifty (450) or less (flaming).

5. For material to be installed on floor - Class B (flame spread rating of 26 to 75 as determined by ASTM-E84).

E. Fade Resistance:
   1. Lightfastness - AATCC 16E-1982-Dark color: Gray scale rating of 4 or better after 180 standard fading hours, as compared to AATCC Gray Scale for evaluation of change in color.
   2. Ozone and Gas - AATCC 129-1298 - Rating 3 or better per color AATCC transference scale.

F. Static Resistance/Electrostatic Propensity: Carpet construction to provide minimum of 3.0 KV resistance for 20% R.H. at 70 degrees F. (21 degrees C), AATCC 134.

1.04 SUBMITTALS

A. Samples: Submit manufacturers standard color pallet of the specified carpet for color selections by the Architect/Owner. The name of the manufacturer and the specifications for the product shall be included.
   1. Maintenance Manual: Submit manual of carpet manufacturer's recommendations for the care, cleaning and maintenance of carpeting.
   2. Certificate of Compliance: Submit certified test report that carpet meets the tuft bind, static control, edge ravel, secondary backing delamination and flammability properties.
   3. Material Safety Data Sheets (MSDS) on all adhesive to be used.
   4. Seaming diagram for planned installation.

1.05 QUALITY ASSURANCE

A. Manufacturer: Carpet manufacturer shall have at least five (5) years of production experience with carpet similar to the type specified herein.
   1. Installer: Installer to have had at least five (5) years experience and be an authorized Installer by the manufacturer.
   2. Testing and Inspection: The Owner may, at his discretion, engage the services of a testing laboratory to ensure that all materials and workmanship are in accordance with the specifications.

B. Moisture Test:
   1. Contractor to perform “Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in-situ Probes” to determine moisture and/ or humidity in concrete floor slabs per prior to installing finish material.
   2. Contractor to provide and install moisture mitigation product as determined by tile manufacturer prior to installing flooring.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver carpet to the Owner's site in original protective wrapping with registration numbers and tags attached.

1.07 GUARANTEES AND WARRANTIES

A. The contractor shall guarantee all work against defects in workmanship for a period of three (3) years.

B. Manufacturer shall guarantee the following:
   1. No Edge Ravel – No Sealer required to guarantee no edge ravel at edge or seams under normal use for life of carpet (wet or dry).
   2. No delamination – Guaranteed for Life (wet or dry).
   3. 20 lb. Tuft bind – Guaranteed for Life (wet or dry).
   4. Carpet installed glued directly to floor requires use of no chair pads. Backing guaranteed not to delaminate for life of carpet.
   5. Carpet impervious to water. Must meet British Spill Test Method "E".
   6. Asbestos: Warrant that no asbestos-containing materials were used in any product in this section.
   7. All guarantees must be non-prorated and include labor, materials and freight for replacement carpet.
   8. Life of carpet shall be interpreted that manufacturer shall warrant all performance features specified for as long as the carpet is installed in the original installation and maintained in accordance with manufacturer's approved procedures.

1.08 MAINTENANCE MATERIAL

A. Maintenance Manual: Submit manual of carpet manufacturer's recommendations for the care, cleaning and maintenance of carpeting.
   1. Submit one-hundred (100) percent of total yardage of carpet as an extra stock for CPT-1.
   2. Place in room designated by Owner, in orderly manner. This must not be 'scrap strips' but shall be full width roll goods.

PART 2 - PRODUCTS

2.01 MANUFACTURER:

A. Acceptable Manufacturer:
   1. Interface, 1503 Orhcard Hill Road; LaGrange, GA 30240.
   2. Contact Christi Hitch at (901) 219-5476.

2.02 PRODUCTS:

A. Refer to Drawings or carpet tile type, color and location.

2.03 ACCESSORIES

A. Sub-Floor Filler: White premix latex; type as recommended by carpet manufacturer.
   1. Carpet Gripper: Type recommended by carpet manufacturer to suit application, with attachment devices.
   2. Edge Strips: Metal edge type, anodized finish, color as selected.
   3. Adhesive: Premium Quality (quick release type) compatible with cushion material and recommended by cushion manufacturer.

PART 3 - EXECUTION

3.01 SUBSTRATE PREPARATION

A. Comply with carpet manufacturer's written recommendations on how to prepare the substrate on which the carpet will be installed.
   1. Level substrate to not less than 1/4 inch in 10 feet in all directions. This shall be non-cumulative. Sand or grind ridges, spikes, protrusions, rough areas, and bumps. Patch and fill cracks and depressions. No imperfections shall telegraph through the installed carpet, neither visually nor by touch.
   2. Remove any existing substrate coatings such as curing compounds, soap, wax, oil, rubber or silicone.
   3. Clean substrate of loose dust, construction debris, or other material. Examine substrate for presence of moisture.

B. Moisture mitigation: Install MoistureGard 2.0 or equal for moisture levels surpassing acceptable levels indicated by Moisture Test.

3.02 CARPET INSTALLATION

A. General:
   1. Comply with manufacturer's instruction and recommendations and approved seaming drawings for seam locations and direction of carpet. Maintain uniformity of carpet direction and lay of pile. At doors, center seams under doors; do not place seams in traffic direction at doorways.
   2. Extend carpet under open-bottomed obstructions and under removable flanges and furnishings and into alcoves and closets of each space.
   3. Provide cutouts where required, and bind edges properly where not concealed by protective edge guards or overlapping flanges.
   4. Install carpet edge guard where edge of carpet is exposed; anchor guards to substrate.

B. Carpet shall be glued down with waterproof adhesive per manufacturer's recommendations, without folds or wrinkles. Attachment shall be secure with all temporary nails removed. All seams

shall be flat and shall be as invisible as possible. All work shall be done by experienced craftsman, in order to obtain the best Installation.

C. Carpet shall be installed wall to wall, using continuous lengths and as broad widths as possible. Install carpet only when the floor temperature is 65 degrees F minimum and will remain at 65 degrees minimum for 48 hours after the installation. Take the reading from a thermometer placed directly on the floor.

3.03 CONDUCT OF WORK

A. Work once started shall be diligently carried out toward completion. All work shall be done in a workmanship-like manner in accordance with standard practices and in accordance with manufacturer's recommendations.

3.04 CLEAN-UP

A. Upon completions of the installation, the Installer shall:
   1. Remove all waste and excess material, tools, and equipment.
   2. Remove soiled spots or excessive adhesive.
   3. Remove loose pieces of face yard with shape scissors.
   4. Vacuum the carpet. Use an upright, beater-bar type vacuum cleaner. Obtain Architect's satisfaction with results.

3.05 PROTECTION

A. Provide protective methods and materials needed to ensure that carpeting will be without deterioration or damage at time of Substantial Completion.

3.06 FINAL INSPECTION

A. Completion shall be subject to a joint final inspection by the Owner and the contractor or their representative.

END OF SECTION

SECTION 09 91 23
PAINTING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Section includes surface preparation and the application of paint systems on interior substrates.

B. Includes furnishing and application of painting materials to surfaces, including:
   1. Surface preparation of surfaces to be painted.
   2. Touching up of prime coats and other preparation necessary prior to finish painting.
   3. Painting, staining and otherwise finishing of new surfaces as indicated/scheduled on the Drawings and specified in this and other Sections of this Project Manual.

C. Surfaces to be Painted: Except where natural finish of material is specifically noted as a surface not to be painted, paint exposed surfaces whether or not colors or materials are designated in "schedules". Where items or surfaces are not specifically mentioned, paint the same as similar adjacent materials or areas. If color or finish is not designated, Architect will select these colors from standard colors or finishes available.

1.02 RELATED SECTIONS

A. Section 04 20 00 - Unit Masonry: Painting of exposed concrete block walls.

B. Section 07 92 00 - Sealants and Caulking: Coordination of sealant and caulking installation with application of paint.

C. Section 08 11 13 - Hollow Metal Doors and Frames: Surface preparation and painting of hollow metal doors and frames.

D. Section 09 21 16 - Gypsum Board Assemblies: Surface preparation and painting of gypsum wallboard systems.

E. Division 22 - Mechanical: Painting of mechanical equipment exposed to view and exposed to weather.

F. Division 26 - Electrical: Painting of electrical equipment exposed to view and exposed to the weather.

1.03 DEFINITIONS

A. "Paint" as used herein means all coating systems materials including primers, emulsions, enamels, stains, sealers and fillers, and other applied materials whether used as prime, intermediate or finish coats.

B. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.

C. Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.

D. Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.

E. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.

F. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.

G. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.

H. Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

B. Samples for Verification: For each type of paint system and in each color and gloss of topcoat.
1. Submit Samples on rigid backing, 8 inches square.
2. Step coats on Samples to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

C. Product List: For each product indicated, include the following:
1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
2. Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.
3. VOC content.

1.05 QUALITY ASSURANCE

A. Single Source Responsibility: Provide primers and other undercoat paint produced by same manufacturer as finish coats. Use only thinners approved by paint manufacturer, and use only within recommended limits.

B. Coordination of Work: Review other Sections of these specifications in which prime paints are to be provided to ensure compatibility of total coatings systems for various substrates. Upon request from other trades, furnish information or characteristics of finish materials provided for use, to ensure compatible prime coats are used.

C. Acceptable Surfaces: The paint contractor and General Contractor shall be solely responsible for determining that the wall is ready and suitable to be painted.

D. Acceptance of Paint Application: Each coat of paint must be reviewed and accepted by the Architect before the succeeding coat of paint can be applied. Any coat of paint applied without this review will not be considered as painted.

1.06 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Paint: 5 percent, but not less than 1 gal. of each material and color applied.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
   1. Maintain containers in clean condition, free of foreign materials and residue.
   2. Remove rags and waste from storage areas daily.

   Environmental Requirements: Comply with manufacturer's recommendations as to environmental conditions under which coatings and coating systems can be applied. Do not apply finish in areas where dust is being generated.

1.08 FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.

B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

C. Inspection of Surfaces: The painting contractor shall be responsible for inspecting the work of others prior to the application of any paint or finishing material. If any surface to be finished cannot be put in proper condition for finishing by customary cleaning, sanding, and puttying operations, the painting contractor shall immediately notify the General Contractor in writing or assume responsibility for and rectify any unsatisfactory finish resulting.

D. Protection: All materials used on the job shall be stored in a single place designated by the Contractor. Such storage place shall be kept neat and clean. All damage to the storage area and its surroundings shall be repaired. Any soiled or used rags, waste and trash must be removed from the building every night, and every precaution taken to avoid the danger of fire.

E. Protect surfaces and objects inside and outside the building, as well as the grounds, lawns, shrubbery, and adjacent properties against damage. The painting contractor shall hold himself responsible for damage to adjacent furnishings.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products as indicated on the Drawings and/or by one of the following:
   1. Sherwin-Williams Company
   2. Farrell Calhoun
   3. PPG Architectural Coatings: PPG Paints
   4. Benjamin Moore & Co.

A. All paint and primer applied in the field shall be the products of a single manufacturer. For the purpose of clarification, only the products of one manufacturer have been listed herein.

B. Paint: The VOC concentrations of the product shall not exceed those listed below. The calculation of VOC shall exclude water and tinting color added at the point of sale. VOCs need to be confirmed by using the products MSDS sheets.

Exterior Coatings:

Coating Type	VOC weight in grams/liter of product minus water
Non-flat	50
Flat	50
Primer, Sealer, Undercoat	100
Stain, Exterior	100
Low Solids*	120
Waterproofing: Concrete/Masonry	100
Industrial	100
Floor	50

* Low Solids In g/L (grams per liter), not less water

C. Primers: Where the manufacturer specifies products, the VOC limits follow the rules set forth above. These coatings are intended for on-site application to exterior surfaces of residential, commercial, institutional or industrial buildings.

D. Extra Stock: Supply an extra 2% of total quantity of each paint used with a minimum of three (3) gallons of each paint. Furnish in manufacturer's unopened, labeled containers for Owner's use.

2.02 PAINTING SCHEDULE

A. Exterior Painting Schedule:
   1. Exposed Exterior Concrete Masonry Units:
      a. Basis of design Product: Thoroseal. If not currently available, provide products with essentially the same characteristics and properties.
      b. Apply one coat of THORO(R) Block Filler to smooth the surface of the block to help eliminate pinholes that would allow water to penetrate the waterproof coating.
      c. Apply two coats of THOROCOAT(R) waterproof coating.
      d. Comply with manufacturer's written preparation and application instructions.

2. Exterior Doors and Frames:
    a. Prepare and paint the doors and door frames to match the color of the masonry walls.
    b. Follow Company Standard SZ269S for priming and finishing.

3. Galvanized Metal, Including Weather Exposed HVAC and Electrical Equipment:
    a. First coat: Farrell-Calhoun #697 100% Acrylic Interior/Exterior Bonding Primer, DFT mils: 1.7.
    b. Omit first coat on items where compatible factory primer has been applied.
    c. Second and third coats: Farrell-Calhoun #8000 Line Waterborne 100% Acrylic DTM Enamel, DTF mils: 1.7 mils per coat.

4. Ferrous Metals, Including Weather Exposed HVAC and Electrical Equipment:
    a. First coat: Farrell-Calhoun #5-56 100% Acrylic All Purpose Metal Primer, DFT mils: 1.8 Omit first coat on items where compatible factory primer has been applied.
    b. Second and third coats: Farrell-Calhoun #8000 Line Waterborne 100% Acrylic DTM Enamel, DTF mils: 1.7 mils per coat.

5. Copper/Aluminum, Including Weather Exposed HVAC and Electrical Equipment:
    a. First coat: Farrell-Calhoun #5-56 100% Acrylic All Purpose Metal Primer, DFT mils: 1.8
    b. Second and third coats: Farrell-Calhoun #8000 Line Waterborne 100% Acrylic DTM Enamel, DTF mils: 1.7 mils per coat.

6. Weather Exposed Ferrous Piping:
    a. First coat: Farrell-Calhoun #1022 Tuff-Boy Rust-Stop White Primer, DFT mils: 2.0.
    b. Second and Third coats: Farrell-Calhoun #1000 Tuff-Boy Interior/Exterior Chrome Finish Aluminum, DTF mils: 1.4 per coat.

B. Interior Painting Schedule:
1. Concrete Floor Sealer:
    a. Kemiko Clear-A-Thane which is a waterborne, low VOC single component acrylic sealer (available in gloss and satin). Clean concrete floor and prepare to receive water before coating.
2. Galvanized Metal:
    a. First coat: Farrell-Calhoun #697 100% Acrylic Interior/Exterior Bonding Primer, DFT mils: 1.7. Omit first coat on items where compatible factory primer has been applied.
    b. Second and third coats: Farrell-Calhoun #8000 Line Waterborne 100% Acrylic DTM Enamel, DTF mils: 1.7 mils per coat.
3. Ferrous Metals - Enamel Finish:
    a. First coat: Farrell-Calhoun #5-56 100% Acrylic All Purpose Metal Primer, DFT mils: 1.8 Omit first coat on items where compatible factory primer has been applied.
    b. Second and third coats: Farrell-Calhoun #8000 Line Waterborne 100% Acrylic DTM Enamel, DTF mils: 1.7 mils per coat.
4. Ferrous Metals – Epoxy Finish:
    a. First coat: Devoe High Performance Coatings Tru-Glaze-WB 4030 Waterborne Epoxy Primer, DFT mils: 9-11.
    b. Second and third coats: Devoe High Performance Coatings Tru-Glaze 4418 Waterborne

Acrylic Epoxy Coating, DFT mils: 2.0-2.5 per coat.

5. Dry-Fall:
   a. One Coat: Farrell-Calhoun #1022 Tuff-Boy Rust Stop White Primer
   b. Two Coats: Farrell-Calhoun #8995 Tuff-Boy DTM 100% Acrylic Waterborne Semi-Gloss Dry Fall

PART 3 - EXECUTION

3.01 COOPERATION WITH OTHER TRADES

A. This work shall be scheduled and coordinated with other trades and shall not proceed until other work and job conditions are as required to achieve satisfactory results.

3.02 GENERAL REQUIREMENTS

A. Before starting any work, surfaces to receive paint finishes shall be examined carefully for defects which cannot be corrected by the procedures specified herein and which might prevent satisfactory painting results. Work shall not proceed until such damages are corrected.

B. Secure approval of color samples before applying any paint or finish. All priming coats and undercoats shall be tinted to the approximate shade of the final coat.

C. Start of painting shall be construed as acceptance of the surfaces to receive paint or other finish.

D. Maintain temperature in building at constant 65□F, or above, and provide adequate ventilation for escape of moisture from building in order to prevent mildew, damage to other work and improper drying of paint. Once painting has commenced, provide constant temperature of 65□F, or above, and prevent wide variation in temperature which might result in condensation on freshly painted surfaces.

E. Surfaces to receive work described in this section shall be smooth, even, sound, thoroughly clean and dry and free of defects which would adversely affect application of this work. Surfaces which do not meet the tolerances or quality requirements imposed within the specifications governing substrate construction, shall be repaired or replaced prior to initiating this work.

F. All materials shall be mixed, thinned, modified, and applied only as specified by the manufacturer's direction on the container.

G. Application shall be sufficiently heavy to achieve pleasingly uniform color and lucid effect; matching approved sample.

H. All coats shall be thoroughly dry before applying succeeding coats.

I. Inspection of Coats: Notify the Architect for inspection between coats at least 24 hours in advance. The number of coats specified are intended to provide full coverage. Satisfactory coverage subject to the approval of the Architect. Additional coat or coats will be required by the Architect if these

coats do not give sufficient coverage. Final coat shall match approved sample panel.

J. Prior to the application of any paint, all surfaces shall be cleaned and inspected. Remove all dust and dirt and patch nail holes and dimples with vinyl paste spackling compound. Spackling compound will be brought flush with the adjoining surfaces and touch sanded to produce a smooth even surface.

K. All wood to be painted will be touched up with shellac at knots and pitch streaks.

L. Wood receiving the Spar Varnish finish shall be ribbed with steel wool to remove the high gloss finish to a low luster finish to be approved by Architect.

M. Metal surfaces shall first be washed with a mineral spirit to remove any dirt or grease before applying materials. Where rust or scale is present, it shall be wire brushed, or sandpapered clean before painting. Shop coats of paint that become marred shall be cleaned and touched up with a similar primer. Galvanized metal surfaces shall be chemically treated with a compound designed for this purpose in accordance with manufacturer's directions for use before applying the first coat of paint. All metals exposed to view not prefinished shall be painted unless noted otherwise.

N. The priming coat on all surfaces shall be tinted to the appropriate shade of the final coat and touched up before applying the second and third coats to provide an even finish. The Contractor will secure color schedules before priming. All coats shall be thoroughly dry before applying succeeding coats.

O. Paste wood filler, applied on open grain wood, when "Set" shall be wiped across the grain to secure a clean finish. All woodwork to be finished with enamel shall be sanded smooth and surface cleaned before proceeding with the application of the first coat. Enamel applied to wood shall be sanded between coats with a fine sandpaper to produce an even, smooth finish. All interior wood trim shall be back-primed before installation.

P. The tops, bottoms and edges of all doors shall be finished to match the surface of the doors after the hardware has been attached. Any door found unfinished upon completion of the work shall be taken down and finished.

Q. All work, where a coat of material has been applied, must be thoroughly dry, and inspected and approved by the Architect before the application of the succeeding specified coats, otherwise no credit for the coat applied will be given, and the Contractor automatically assumes the responsibility to re-coat the work in question, The Contractor shall notify the Architect when a given area is ready to be inspected.

R. Interior and cabinets and all other surfaces shall be finished the same as nearest or adjoining surfaces unless otherwise shown on the Drawings or color schedule.

S. No material will be applied over a damp surface. Exterior work shall not be performed during dusty, rainy or frosty weather. A temperature of 70 degrees Fahrenheit of more shall be maintained when enamel is being applied and 50 degrees Fahrenheit or more during interior painting. Exterior painting will be performed when the air temperature is 50 degrees Fahrenheit or higher and in

drying weather.

T. Access doors or panels, electrical panelboard covers, ducts and raceways in finished areas shall be painted the same color as adjacent surfaces except where color coding is specified.

U. Paint all exposed piping including piping in mechanical rooms the color as directed by the Mechanical Engineer and/or as specified in Division 15 – Mechanical.

V. Paint unfinished exposed surfaces of plumbing fixtures two coats paint as specified for interior woodwork. Hardware and accessories, fixtures and similar items placed prior to painting shall be removed or protected during painting and then replaced on completion of painting.

W. All work shall be complete. When color, stain, dirt or undercoats show through the final coat of paint the work shall be covered by additional coats until the paint is uniform in color and appearance and coverage is complete to the satisfaction of the Architect.

X. Supports for baseboard radiation shall be field painted as directed by the Architect.

Y. Paint all exposed surfaces of exterior mechanical equipment, two coats of exterior paint as specified in the painting schedule for exterior ferrous metals.

Z. The Contractor shall not only protect the painting work at all times, but shall also protect all adjacent work and materials by suitable coverings or other methods during progress of the work. Upon completion of the painting all paint spots shall be removed as outlined in the General Conditions. All rubbish and accumulated materials of any nature shall be removed from the job site leaving work in a clean, orderly and acceptable condition.

3.03 PREPARATION OF SURFACES

A. General:
1. Surfaces shall be clean, dry and adequately protected from dampness.
2. Surfaces shall be smooth, even and true to plane.
3. Surface shall be free of any foreign material which will adversely affect adhesion or appearance of applied coating.
4. Remove all loose, spalling paint from previously painted surfaces utilizing wire brushes, pressure washing or mechanical means, as required to provide a smooth and sound substrate for the application of new paint.
5. Mildew shall be removed and neutralized by scrubbing affected areas thoroughly with a solution made by adding two ounces of Tri-Sodium Phosphate and eight ounces of Sodium Hypochloride (Clorox) to one gallon warm water. Use a scouring powder if necessary to remove mildew spores. Rinse with clear water and allow to dry before painting.

B. Preparation of Ferrous Metal Surfaces:
1. Remove rust, mill scale and defective paint down to sound surface or bare metal, using scraper, sandpaper, or wire brush as necessary. Grind if necessary to remove shoulders at edge of sound paint to prevent flaws from photographing through finish coats.
2. Remove dirt and grease with mineral spirits and wipe dry with clean cloths.

3. Touch-up all bare metal and damaged shop coats with specified rust-inhibitive primer.
4. Necessary touching up of shop primer shall be done on ferrous metal surfaces of all items installed adjacent to concrete prior to any openings between metal surface and adjacent surfaces being filled in or caulked.

C. Preparation of Galvanized Metal Surfaces:
1. Remove dirt and grease with mineral spirits and wipe dry with clean cloths.
2. All galvanized steel surfaces shall be pre-treated with proprietary acid-bound resinous or crystalline zinc phosphate preparations used according to the manufacturer's directions prior to painting.

D. Preparation of Copper Surfaces:
1. Buff or polish surfaces to bright color.
2. Remove dirt and grease from surface with a mild phosphoric acid. Wipe dry with clean cloths.
3. Apply finish while surface is clean and bright.

E. Preparation of surfaces to receive Dry-Fall paint application:
1. The surface to be painted should be dry and free of any dirt, grease, mildew, oil, rust, or other foreign contaminants.
2. Hand Tool Cleaning per SSPC-SP2.
3. Rusted Steel: Commercial Blast per SSPC-SP6. For iron and steel in areas exposed to chemicals or moisture including condensation, prime with an appropriate primer. Remove all oil and grease from surface by Solvent Cleaning per SSPC-SP1.
4. Do not use hydrocarbon solvents for cleaning as they will leave behind an oily residue.

3.04 APPLICATION

A. General:
1. Protection of Adjacent Surfaces and Mixed Items:
   a. The Contractor not only shall protect his work at all times, but shall also protect all adjacent work and materials by drop cloth, covering or other methods during progress of his work.
   b. Remove and protect hardware, accessories, device plates, lighting fixtures, factory finished work, and similar items, or provide ample in-place protection. Upon completion of each space, carefully replace all removed items. This work shall be done only by skilled mechanics.
   c. Remove electrical panel box covers and doors before painting wall. Paint separately and reinstall after paint is dry.
2. The undercoats of paint and enamel shall be of approximate shade of the final coat. All metal surfaces calling for enamel or varnished finish shall first have priming coat well sanded, and shall be sanded between coats with fine sandpaper or steel wool that will produce an even, smooth finish. Each coat shall be perfectly dry before applying succeeding coats.
3. Do not apply initial coating until moisture content of surface is within limitations recommended by paint manufacturer. Test with moisture meter. Exterior surfaces shall not be painted in damp, frosty, or cold weather. Latex paints shall not be applied when surface or air temperature is below 50°F.
4. Surfaces shall be finished the same as nearest or adjoining surfaces unless otherwise shown.

5. Exposed access doors or panels, exposed electric panelboard covers, exposed pipes, ducts and raceways shall be painted the same color as adjacent surfaces. All piping exposed in finished areas shall be painted as required for interior ferrous metal. Where galvanized pipe occurs, prime galvanized surface as specified.
6. Hardware and accessories, fixtures and similar items placed prior to painting shall be removed or protected during painting, replaced on completion of painting.
7. Remove silencers from metal door frames prior to painting. Afterwards, replace silencers.
8. The tops, bottoms and edges of all doors to be painted shall be finished to match the surface of the doors after the hardware has been attached. Any door found unpainted upon the completion of the painting work shall be taken down and painted.
9. All weather exposed HVAC and electrical equipment shall be painted.

3.05 CLEANUP

A. During progress of the work, keep areas free form any unnecessary accumulation of tools, equipment and surplus materials and debris.

B. At completion of work, the painting contractor shall remove from the premises all surplus painting materials and all debris created by him; he shall remove all spatters and leave his part of the work in a clean and finished condition.

END OF SECTION

SECTION 10 14 00
INTERIOR SIGNAGE

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes
   1. Room and door signs.

1.02 SUBMITTALS

A. See Section 01 31 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Manufacturer's printed product literature for each type of sign type, font, foreground and background colors, locations, and overall dimensions of each sign.

C. Signage Schedule: Provide enough information to completely define each sign for fabrication, including all copy, sign and letter sizes, fonts, and colors.

D. Signage Drawings: Provide drawings showing locations and mounting methods.

E. Selection Samples: Two sets of color chips of actual material, font, and method of attachment.

F. Manufacturer's Instructions: Printed installation instructions for each product.

1.03 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

B. Installer Qualifications: Company specializing in installing the products specified in this section with minimum 5 years of documented experience.

C. Regulatory Requirements: Sign types to comply with ADAAG requirements.

D. It shall be the responsibility of the successful bidder to meet any and all local, state, and federal code requirements in fabricating and installing signs.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Package signs as required to prevent damage before installation.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Room and Door Signs: Obtain room and door signs from one source and a single manufacturer. Provide manufacturer's warranty against defects in materials or workmanship for a minimum 5 years.

B. Available Manufacturers: Subject to compliance with requirements.
   1. Sign Matters, Inc. 901-861-3001 – 369 Distribution Pkwy, Collierville, TN 38017

2.02 SIGNAGE TYPES

A. Accessibility Compliance: All signs are required to comply with ADAAG and ANSI/ICC A117.1 and applicable building codes, unless otherwise indicated; in the event of conflicting requirements, comply with the most comprehensive and specific requirements.

B. Provide signage install for every door and room, whether it has a door or not, except for corridors, lobbies, and similar open areas.

C. All Signage Types: Unless otherwise indicated:
   1. Sign Materials: Non-Glare Acrylic
      a. Character Font: Helvetica Neue Lt 77 Condensed
      b. Character Case: Upper case only.
      c. Character Color: Oyster Vinyl / Ash Tactile
      d. Pictograms: Pictogram field height shall be 6" minimum.
      e. Copy shall be 5/8" minimum
      f. All signs to have braille.

D. Room and Door Signs:
   1. Contractor supplied Room Signs from Architect's Vendor Sign Matters, Inc.
      a. All signs must provide "tactile" signage, with raised 1/32", raised copy and Grade II braille. Pictograms: Pictogram field height shall be 6" minimum.
         1. Identify the room names and numbers as shown on drawings, unless otherwise noted by the architect.
   2. Sign Type 1: Interior Rooms w/ paper insert
      a. Size: 6"h x 6"w
      b. Insert Size: 2 5/8"h x 10"w
      c. Insert Color: White Cardstock with Black copy
   3. Sign Type 2: Exterior Sign
      a. Size: 4"h x 6"w
   4. Sign Type 3: Restroom Sign
      a. Size: 8"h x 6"w
   5. Sign Type 4: Interior Directional Signage
      a. Size: 6"h x 6"w
   6. Sign Type 5: Interior Rooms w/ Room names

a. Size: 6”h x 4”w

7. Sign Type 6: Exterior Signs – Life Safety

2.03 ROOM AND DOOR SIGNS

A. Mounting: All signs hardware shall be finished and architectural in appearance and suitable for the mounting surface.

B. Signs on glass to have back plate that matches the material and color of the background of the sign front.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that substrate surfaces are ready to receive the work.

3.02 INSTALLATION

A. Install in accordance with all federal, state and local laws, codes, ordinances, and regulations related to signs, including ADAAG- Americans with Disabilities Act Accessibility Guidelines, 2010 Standards, as issued by the Department of Justice.

END OF SECTION

SECTION 10 21 13
TOILET COMPARTMENTS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Solid plastic toilet compartments, Moisture Resistant Substrate:
      a. Floor mounted overhead-braced toilet compartments.
      b. Urinal privacy screens.

1.02 RELATED SECTIONS

A. Section 05 50 00 - Metal Fabrications.

B. Section 06 10 53 - Rough Carpentry.

C. Section 10 28 00 – Toilet and Bath Accessories

1.03 SUBMITTALS

A. Submit under provisions of Section 01 30 00 - Administrative Requirements.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.

C. USGBC LEED Submittals:
   1. Credits MR4.1 and MR4.2 - Recycled Content; submit manufacturer's calculation of value of recycled content for specified products, calculated in accordance with USGBC LEED certification requirements.

D. Shop Drawings: Submit manufacturer's shop drawings for each product specified, including the following:
   1. Plans, elevations, details of construction and attachment to adjacent construction.
   2. Show anchorage locations and accessory items.
   3. Verify dimensions with field measurements prior to final production of toilet compartments and doors

E. Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) square representing actual product, color, and patterns.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Minimum 10- year experience manufacturing similar products.

B. Installer Qualifications: Minimum 2- year experience installing similar products.

C. Single Source Requirements: To the greatest extent possible provide products from a single manufacturer.

D. Accessibility Requirements: Comply with requirements applicable in the jurisdiction of the project, including but not limited to ADA and ICC/ANSI A117.1 requirement as applicable.

1.05 PRE-INSTALLATION MEETINGS

A. Convene minimum two weeks prior to starting work of this section.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store products in manufacturer's unopened packaging bearing the brand name and manufacturer's identification until ready for installation.

B. Handling: Handle materials to avoid damage.

1.07 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.

1.08 SEQUENCING

A. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

1.09 WARRANTY

A. Manufacturer's Warranty: Manufacturer's standard 25-year limited warranty for panels, doors, and stiles against breakage, corrosion, delamination, and defects in factory workmanship. Manufacturer's standard 1-year guarantee against defects in material and workmanship for stainless steel door hardware and mounting brackets.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design Product: Subject to compliance with requirements provide, Hiny Hiders Partitions

as manufactured by Scranton Products or comparable product by one of the following:
1. Bobrick Washroom Equipment, Inc
2. Bradley Corporation, Mills Partitions

B. Substitutions: The Architect will consider products of comparable manufacturers as a substitution, pending the Contractor's submission of adequate documentation of the substitution in accordance with procedures in Division 1 of the Project Manual. Documentation shall include a list of five similar projects of equivalent size where products have been installed for a minimum of two years, and manufacturer's certification that products are fabricated in the United States.

2.02 SOLID PLASTIC TOILET COMPARTMENTS

A. Solid Plastic Toilet Partitions: TA10
   1. Style: Floor mounted overhead-braced toilet compartments
   2. Design Type:
      a. Standard Height.
         1. Door/Panel Height: 55 inches (147 cm).
         2. Floor Clearance: 12 inches
   3. Doors, Panels, and Pilasters: 1 inch (25 mm) thick with all edges rounded to a radius.
   4. Mount doors and dividing panels based on height of specified system.
   5. Mounting Configuration:
      a. Floor-mounted, overhead-braced with satin finish, extruded anodized aluminum headrails, 0.065 inch (1.65 mm) thick with anti-grip profile.
         1. Stile Maximum Height: 83 inches (211 cm).

B. Solid Plastic Urinal Screens:
   1. Mounting Configuration:
      a. Floor Mounted.
         1. Screen Height: 48 inches (122 cm) with 12 inches (30 cm) floor clearance.

C. Door, Panel, and Pilaster Construction - Materials: 1 inch (25mm) thick with all edges rounded to a radius. Mount doors and dividing panels based on height of specified system.

D. Edges: Standard

E. Color:
   1. As indicated on Drawings.

F. Fire Resistance:
   1. National Fire Protection Association/International Building Code Interior Wall and Ceiling Finish: Class C
      a. Flame Spread Index (ASTM E 84): 76-200 for panels and stiles.
      b. Smoke Developed Index (ASTM E 84): 0-450 for panels and stiles.

G. Pilaster Shoes: 3 inches (76 mm) high type 304, 20-gauge stainless steel. Secured to pilasters with a stainless steel tamper resistant Torx head sex bolt.

H. Headrail: Heavy-duty extruded 6463-T5 alloy aluminum with anti-grip design. Finish to be clear anodized. Fastened to headrail brackets with stainless steel tamper resistant Torx head sex bolt and fastened at the top of the pilaster with stainless steel tamper resistant Torx head screws.
   1. Headrail Brackets: 20-gauge stainless steel with satin finish. Secured to the wall with stainless steel tamper resistant Torx head screws.

I. Wall Brackets: Stainless Steel Brackets: Stainless steel type 304.
   1. Brackets are fastened to pilasters with stainless steel tamper resistant Torx head screws and fastened to the panels with stainless steel tamper resistant Torx head sex bolts.
   2. Bracket Type: Stirrup double ear aluminum.
   3. Bracket Type: Continuous 54 inches (1372 mm) stainless steel.

J. Anchors: Expansion shields and threaded rods at floor connections as applicable. Threaded rods secured to supports above ceiling as applicable. Supports above ceiling furnished and installed as Work of Section 05 50 00 - Metal Fabrications.

K. Hardware:
   1. Compliance: Operating force of less than 5 lb (2.25 kg).
   2. Materials: 18-8, Type 304, heavy-gauge stainless steel with satin finish.
   3. Doorstops: Prevents inswinging doors from swinging out beyond stile; on outswing doors, doorstop prevents door from swinging in beyond stile.
   4. Fastening: Hardware is secured to door and stile with pin-in-head Torx stainless steel machine screws. Hinges, latch and optional door stops secured to door with pin-in-head Torx stainless steel machine screws into factory-installed, threaded brass inserts. Fasteners for hinges, latch and optional door stops secured directly into core not acceptable.
      a. Threaded Brass Inserts: Factory-installed; withstand direct pull force exceeding 1500 lb (680 kg) per insert.
   5. Clothes Hooks: Projecting no more than 1-1/8 inch (29 mm) from face of door.One supplied per door.
   6. Door Strike/Keeper: Heavy-duty extruded aluminum 6436-T5 alloy with a bright dip anodized finish. Secured to pilasters with stainless steel tamper resistant Torx head sex bolts. Bumper shall be made of extruded black vinyl. Style: 54 inches (1372 mm) aluminum.
      a. Style: 54 inches (1372 mm) aluminum.
   7. Aluminum Slide Bolt Latch and Housing: Heavy-duty extruded 6463-T5 alloy aluminum. Latch and housing to have a bright dip anodized finish. Slide bolt and button to have a black anodized finish.
   8. Locking: Door locked from inside by sliding door latch into keeper.
   9. Hinge Type: Continuous Aluminum Hinge
      a. Standard.
         1. Balanced, with field-adjustable cam to permit door to be fully closed or partially open when compartment is unoccupied.
   10. Mounting Brackets:
      a. Stirrup Brackets: Stainless Steel Double Ear, Secure stiles-to-walls and panels to walls.
   11. Equip outswing handicapped doors with second door pull and door stop.

PART 3 - PRODUCTS

3.01 PREPARATION

A. Prepare substrates including but not limited to blocking and supports in walls and ceilings at points of attachment using methods recommended by the manufacturer for achieving the best result for the substrates under the project conditions.
   1. Inspect areas scheduled to receive compartments for correct dimensions, plumbness of walls, and soundness of surfaces that would affect installation of mounting brackets.
   2. Verify spacing of plumbing fixtures to assure compatibility with installation of compartments.

B. If preparation is the responsibility of another installer, notify Architect in writing of deviations from manufacturer's recommended installation tolerances and conditions.

C. Do not proceed with installation until substrates have been properly prepared with blocking and supports in walls and ceilings at points of attachment and deviations from manufacturer's recommended tolerances are corrected. Commencement of installation constitutes acceptance of conditions.

3.02 INSTALLATION

A. Install products in strict compliance with manufacturer's written instructions and recommendations, including the following:
   1. Verify blocking and supports in walls and ceilings has been installed properly at points of attachment.
   2. Verify location does not interfere with door swings or use of fixtures.
   3. Use fasteners and anchors suitable for substrate and project conditions
   4. Install units rigid, straight, plumb, and level.
   5. Conceal evidence of drilling, cutting, and fitting to room finish.
   6. Test for proper operation.

3.03 ADJUSTING, CLEANING AND PROTECTION

A. Adjust hardware for proper operation after installation. Set hinge came on in-swinging doors to hold doors open when unlatched. Set hinge cam on out-swinging doors to hold unlatched doors in closed position.

B. Touch-up, repair or replace damaged products.

C. Clean exposed surfaces of compartments, hardware, and fittings.

END OF SECTION

SECTION 10 28 00
TOILET AND BATH ACCESSORIES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Public-use washroom accessories.
   2. Custodial accessories.

B. Related Sections:
   1. Section 09 30 00 "Tiling" for ceramic toilet and bath accessories.

1.02 SUBMITTALS

A. Product Data: For each type of product indicated. Include the following:
   1. Construction details and dimensions.
   2. Anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
   3. Material and finish descriptions.
   4. Features that will be included for Project.
   5. Manufacturer's warranty.

B. Samples: Full size, for each accessory item to verify design, operation, and finish requirements.
   1. Approved full-size Samples will be returned and may be used in the Work.

C. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.
   1. Identify locations using room designations indicated.
   2. Identify products using designations indicated.

D. Maintenance Data: For toilet and bath accessories to include in maintenance manuals.

1.03 QUALITY ASSURANCE

A. Source Limitations: For products listed together in the same Part 2 articles, obtain products from single source from single manufacturer.

1.04 COORDINATION

A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.

B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying

the Work.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Stainless Steel: ASTM A 666, Type 304, 0.031-inch (0.8-mm) minimum nominal thickness unless otherwise indicated.

B. Brass: ASTM B 19, flat products; ASTM B 16/B 16M, rods, shapes, forgings, and flat products with finished edges; or ASTM B 30, castings.

C. Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold rolled, commercial steel), 0.036-inch (0.9-mm) minimum nominal thickness.

D. Galvanized-Steel Sheet: ASTM A 653/A 653M, with G60 (Z180) hot-dip zinc coating.

E. Galvanized-Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.

F. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.

G. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).

H. ABS Plastic: Acrylonitrile-butadiene-styrene resin formulation.

2.02 PUBLIC-USE WASHROOM ACCESSORIES

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   1. VonDrehle
   2. Bobrick Washroom Equipment, Inc.
   3. Bradley Corporation.
   4. Georgia Pacific.

B. Toilet Paper (Roll) Dispenser (Locations Indicated on plans): TA2
   1. Basis-of-Design Product: VonDrehle #AE42V JRT Dispenser
   2. Description: Single Jumbo Roll Tissue Dispenser.
   3. Mounting: Partition/ surface mounted.
   4. Operation: Noncontrolled delivery.
   5. Capacity: Designed for 9-inch diameter tissue rolls.
   6. Material and Finish: Polycarbonate Smoke Cover with Polystyrene Black Base.

C. Paper Towel (Roll) Dispenser: TA5
   1. Basis-of-Design Product: Von Drehle #2245 Hands-Free Electronic Dispenser.
   2. Description: Electronic 9-inch Roll Towel Dispenser.
   3. Mounting: Surface mounted.

4. Minimum Capacity: 8-inch- wide, 800-foot- long roll.
5. Material and Finish: Smoke ABS plastic cover with Black ABS Plastic Base.
6. Operation: Hands Free, Battery operated. Fully Programmable to Control Usage.

D. Liquid-Soap Dispenser;
1. O.S.C.I.

E. Grab Bar: TA1
1. Basis-of-Design Product: Bobrick B-6806 Series
2. Mounting: Flanges with concealed fasteners.
3. Material: Stainless steel, 0.05 inch (1.3 mm) thick.
   a. Finish: 304 Stainless steel, No. 4 finish (satin) on ends and slip-resistant texture in grip area.
4. Outside Diameter: 1-1/2 inches.
5. Configuration and Length: As indicated on Drawings.

F. Sanitary-Napkin Disposal Unit: TA8
1. Basis-of-Design Product: Bobrick, B-354.
2. Mounting: Partition mounted, dual access.
3. Door or Cover: Self-closing, disposal-opening cover and hinged face panel with tumbler lockset.
4. Receptacle: Removable.
5. Material and Finish: Stainless steel, No. 4 finish (satin).

G. Sanitary-Napkin Disposal Unit: TA8
1. Basis-of-Design Product: Bobrick, B-353.
2. Mounting: Recessed.
3. Door or Cover: Self-closing, disposal-opening cover and hinged face panel with tumbler lockset.
4. Receptacle: Removable.
5. Material and Finish: Stainless steel, No. 4 finish (satin).

H. Robe Hook: TA3
1. Basis-of-Design Product: Bobrick, B-6727.
2. Mounting: Surface mounted with concealed mounting bracket.
3. Material and Finish: Stainless steel, No. 4 finish (satin).

I. Mirror: TA4 & TA11
1. Basis-of-Design Product: Bobrick, B-290.
2. Description: Mirror with stainless steel welded angle frame
3. Mounting: Surface mounted with snap locking.
4. Material and Finish: 304 Stainless steel, No. 4 finish (satin).
5. Size: See drawings

2.03 CUSTODIAL ACCESSORIES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering

products that may be incorporated into the work include, but are not limited to, the following:

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   1. Bobrick Washroom Equipment, Inc.
   2. Bradley Corporation.

C. Mop and Broom Holder: TA9
   1. Basis-of-Design Product: Bobrick, B-239x34.
   2. Description: Unit with shelf, hooks, holders, and rod suspended beneath shelf.
   3. Length: 34 Inches.
   4. Hooks: Four.
   5. Mop/Broom Holders: Three, spring-loaded, rubber hat, cam type.
   6. Material and Finish: Stainless steel, No. 4 finish (satin).
      a. Shelf: Not less than nominal 0.05-inch- (1.3-mm-) thick stainless steel.
      b. Rod: Approximately 1/4-inch- (6-mm-) diameter stainless steel.

2.04 FABRICATION

A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.

B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

B. Grab Bars: Install to withstand a downward load of at least 250 lbf, when tested according to ASTM F 446.

3.02 ADJUSTING AND CLEANING

A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.

B. Remove temporary labels and protective coatings.

C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

END OF SECTION

SECTION 10 44 13
FIRE EXTINGUISHER CABINETS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Semi-recessed fire extinguisher cabinets in gypsum board wall assemblies.
   2. Surface or column mounted fire extinguisher brackets.

B. Related Requirements:
   1. Section 05 50 00 "Metal Fabrications" for masonry shelf angles and connections.
   2. Section 09 29 00 "Gypsum Board" for interior non-load-bearing, metal-stud-framed, shaft-wall assemblies.
   3. Section 09 22 16 "Non-Structural Metal framing" for interior non-load-bearing, metal-stud framing and ceiling-suspension assemblies.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire protection cabinets.
   1. Fire Protection Cabinets: Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.

B. Shop Drawings: For fire protection cabinets. Include plans, elevations, sections, details, and attachments to other work.

1.03 COORDINATION

A. Coordinate size of fire protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.

B. Coordinate size of fire protection cabinets to ensure that type and capacity of fire hoses, hose valves, and hose racks indicated are accommodated.

C. Coordinate sizes and locations of fire protection cabinets with wall depths.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Stainless-Steel Sheet: ASTM A 666, Type 304.

B. Transparent Acrylic Sheet: ASTM D 4802, Category A-1 (cell-cast sheet), 3 mm thick, with Finish 1 (smooth or polished).

2.02 FIRE EXTINGSUISHER CABINET: <FEC-2>

A. Cabinet Type: Suitable for fire extinguisher.
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. J. L. Industries, Inc., a division of Activar Construction Products Group; Architectural Series.
      b. Larsen's Manufacturing Company; Architectural Series.

B. Cabinet Material: Cold rolled steel sheet.

C. Semi-recessed Cabinet: Cabinet box partially recessed in walls of sufficient depth to suit style of trim indicated; with one-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend). Provide where walls are of insufficient depth for recessed cabinets but are of sufficient depth to accommodate semi-recessed cabinet installation.
   1. Square Trim: 1-1/2-inch backbend depth.

D. Cabinet Trim Material: Stainless Steel.

E. Door Material: Stainless Steel.

F. Door Style: Full Panel Glazing with SAF-T-LOK

G. Door Glazing: Clear Acrylic.

H. Door Hardware: Standard

I. Accessories:
   1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
   2. Break-Glass Strike: Manufacturer's standard metal strike, complete with chain and mounting clip, secured to cabinet.
   3. Door Lock: Cam lock that allows door to be opened during emergency by pulling sharply on door handle.
   4. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated.
      a. Identify fire extinguisher in fire protection cabinet with the words "FIRE EXTINGUISHER."
         1. Location: Applied to location indicated on Drawings.
         2. Application Process: Pressure-sensitive vinyl letters.
         3. Lettering Color: Black.
         4. Orientation: Vertical.

2.03 FABRICATION

A. Fire Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.
   1. Weld joints and grind smooth.
   2. Provide factory-drilled mounting holes.
   3. Prepare doors and frames to receive locks.
   4. Install door locks at factory.

B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles selected.

2.04 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces of fire protection cabinets from damage by applying a strippable, temporary protective covering before shipping.

C. Finish fire protection cabinets after assembly.

D. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.05 STEEL FINISHES

A. Surface Preparation: Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning".

2.06 STAINLESS-STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
   1. Run grain of directional finishes with long dimension of each piece.
   2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
   3. Directional Satin Finish: No. 4.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine roughing-in for hose valves and cabinets to verify actual locations of piping connections

before cabinet installation.

B. Examine walls and partitions for suitable framing depth and blocking where semi-recessed recessed and semi-recessed cabinets will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Prepare recesses for semi-recessed fire protection cabinets as required by type and size of cabinet and trim style.

3.03 INSTALLATION

A. General: Install fire protection cabinets in locations and at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction.
   1. Fire Protection Cabinets: 54 inches above finished floor to top of cabinet.

B. Fire Protection Cabinets: Fasten cabinets to structure, square and plumb.
   1. Unless otherwise indicated, provide recessed fire protection cabinets. If wall thickness is not adequate for recessed cabinets, provide semi-recessed fire protection cabinets.
   2. Provide inside latch and lock for break-glass panels.
   3. Fasten mounting brackets to inside surface of fire protection cabinets, square and plumb.

C. Identification: Apply vinyl lettering at locations indicated.

3.04 ADJUSTING AND CLEANING

A. Remove temporary protective coverings and strippable films, if any, as fire protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.

B. Adjust fire protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

C. On completion of fire protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.

D. Touch up marred finishes or replace fire protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire protection cabinet and mounting bracket manufacturers.

E. Replace fire protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 10 44 16
FIRE EXTINGUISHERS

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.

B. Related Sections:
   1. Division 10 Section "Fire Extinguisher Cabinets."

1.02 SUBMITTALS

A. Product Data: For each type of product indicated. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher and mounting brackets.

B. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

1.03 QUALITY ASSURANCE

A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."

B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.
   1. Provide fire extinguishers approved, listed, and labeled by FMG.

1.04 COORDINATION

A. Coordinate type and capacity of fire extinguishers with fire protection cabinets to ensure fit and function.

1.05 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Failure of hydrostatic test according to NFPA 10.
      b. Faulty operation of valves or release levers.
   2. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS: FEC-1

A. Fire Extinguishers: Type, size, and capacity for each mounting bracket indicated.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   2. Basis-of-Design Product: Subject to compliance with requirements, provide or comparable product by one of the following:
      a. J. L. Industries, Inc.; a division of Activar Construction Products Group.
      b. Larsen's Manufacturing Company.
      c. Guardian Fire Equipment, Inc.

B. Multipurpose Dry-Chemical Type: UL-rated nominal capacity, with monoammonium phosphate-based dry chemical in manufacturer's standard enameled container.

C. Fire Extinguishers: Type 2-A; 20-B. Verify required types with State Fire Marshal prior to submittals.

2.02 MOUNTING BRACKETS

A. Mounting Brackets: Manufacturer's standard steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or red baked-enamel finish.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide or comparable product by one of the following:
      a. J. L. Industries, Inc.; a division of Activar Construction Products Group.
      b. Larsen's Manufacturing Company
      c. Guardian Fire Equipment, Inc.

B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.
   1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.
      a. If more than one orientation is required, indicate location of each on Drawings.
      b. Orientation: Vertical.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine fire extinguishers for proper charging and tagging.
   1. Remove and replace damaged, defective, or undercharged fire extinguishers.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. General: Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.
   1. Mounting Brackets: 42” above finished floor to top of fire extinguisher.

B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

END OF SECTION

SECTION 10 50 20
CANOPIES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Building supported, pre-engineered metal canopies including fascia channels, decking, tension rods, and attachment hardware.

1.02 REFERENCES

A. Aluminum Association (AA)DAF 45 - Designation System for Aluminum Finishes.

B. American Architectural Manufacturers Association (AAMA)
   1. 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Architectural Extrusions and Panels.

C. American Society of Civil Engineers (ASCE) 7 - Minimum Design Loads for Buildings and Other Structures.

D. ASTM International (ASTM)
   1. B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
   2. B429 - Standard Specification for Aluminum-Alloy Extruded Pipe and Tube.

1.03 SYSTEM DESCRIPTION

A. Design Requirements: Design canopy system to withstand:
   1. Standards for wind pressure, snow load, and drifting snow load in accordance with current adopted form of the Uniform Construction code or accepted requirements of local municipality.

1.04 SUBMITTALS

A. Submittals for Review:
   1. Shop Drawings: Indicate system components, dimensions, attachments, and accessories.
   2. Samples:
      a. 3 x 3-inch coating samples in specified color.
      b. 6-inch long fascia extrusion sample showing profile and finish.
      c. 6-inch decking samples showing profile and finish.

B. (LEED Project Submittals)
   1. Product Data for Credit MR 4: documentation indicating percentages by weight of post-consumer and pre consumer recycled content. Include statement indicating cost for each product having recycled content.

2. Product Data for Credit MR 5: Indicate location of product manufacturer, distance from manufacturer to project site, and mill test report for origination of materials.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Minimum 5 years experience in installation of manufactured products.

B. Manufacturers Qualifications: Minimum of 5 years in manufacturing required.

PART 2 - PRODUCTS

2.01 MANUFACTURER

A. Basis of Design Product:
   Mapes Canopies
   1. Cantilever Canopy by Mapes Canopies with Hangers
      a. Decking shall consist of 3" extruded flat soffit .078 decking
      b. Deflection rating L/180
      c. Intermediate framing members shall be extruded aluminum, alloy 6063-T6,
      d. Fascia .125” extruded 8" C-Channel style.
      e. Cantilever supported brackets shall be standard finish.
      f. Concealed drainage. Water shall drain from covered surfaces into intermediate trough and be directed to Downspout from Rear Gutter.
   2. Post supported Super Lumideck by Mapes Canopies
      a. Decking, beams, posts and fascia shall be extruded aluminum, alloy 6063-T6,
      b. Support columns and gutter beams shall be designed such that the columns will be notched to create a “saddle” that will receive and secure the gutter beams.
      c. Post and beams shall be mechanically assembled utilizing 3/16” fasteners with a minimum shear stress of 350 lb. Pre-welded or factory-welded connections are not acceptable.
      d. Decking shall be designed with interlocking extruded aluminum members with mechanical fasteners field applied to provide structural integrity for the completed assembly

2.02 MATERIALS

A. Aluminum Extrusions:
   1. ASTM B221& ASTM B429 6061-T6 alloy and temper.

B. Hardware:
   1. All fasteners shall be stainless steel or hot dip galvanized for corrosion resistance.

2.03 COMPONENTS

A. Framing:
   1. Type: Extruded aluminum “C” channel fascia with internal gutter.
   2. Size: 8”x 0.125”

B. Canopy Supports: 2 1/2” x 2 1/2” x 0.125 inch square tube supports attached to 6” x 12” plate.

C. Roof Panels: 3” x 12” x .003 Interlocking, Extruded Aluminum Flat soffit decking (as selected from manufacturer’s decking options)

D. Attachment: 1” diameter steel hanger rod finished to match canopy.

E. Fascia Profiles: 8” Deep

F. Other Components: other components as indicated or as required for system attachment and performance.

2.04 ACCESSORIES

A. Anchors and Fasteners: Stainless steel or hot dip galvanized and corrosion resistant

2.05 FABRICATION

A. Fabricate canopy system in accordance with approved Shop Drawings.

B. All canopies to be mechanically assembled with a minimum shear stress strength of 350lbs. Pre-welding is not acceptable.

C. Drainage system to be concealed type. Covered surfaces direct water to field drilled drain, to be coordinated at site.

2.06 FINISHES

A. Finish type shall be 2-Coat Kynar Finish.

PART 3 - EXECUTION

3.01 FIELD DIMENSIONS

A. Field verify dimensions of supporting structure at site of installation prior to fabrication.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions and approved Shop Drawings.

B. Install components plumb and level, in proper plane, free from warp and twist.

C. Anchor system to building components; provide adequate clearance formovement caused by thermal expansion and contraction and wind loads.

D. Coordinate installation of canopy light fixtures.

3.03 ADJUSTING

A. Touch up minor scratches and abrasions on finished surfaces to match original finish.

END OF SECTION

SECTION 12 24 13
ROLLER WINDOW SHADES

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes roller shades and motorized shade operators.

B. Related Sections include the following:
   1. Section 06 10 00: Rough Carpentry
   2. Section 08 52 00: Aluminum Windows

1.02 SUBMITTALS

A. Product Data: For each type of product indicated. Include styles, material descriptions, construction details, dimensions of individual components and profiles, features, finishes, and operating instructions.

B. Samples for Initial Selection: For each colored component of each type of shade indicated.
   1. Include similar Samples of accessories involving color selection.

C. Window Treatment Schedule: For roller shades. Use same designations indicated on Drawings.

D. Maintenance Data: For roller shades to include in maintenance manuals. Include the following:
   1. Methods for maintaining roller shades and finishes.
   2. Precautions about cleaning materials and methods that could be detrimental to fabrics, finishes, and performance.
   3. Operating hardware.
   4. Motorized shade operator.

1.03 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

B. Source Limitations: Obtain roller shades through one source from a single manufacturer.

C. Product Standard: Provide roller shades complying with WCMA A 100.1.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver shades in factory packages, marked with manufacturer and product name, fire-test-response characteristics, and location of installation using same designations indicated on Drawings and in a window treatment schedule.

1.05 PROJECT CONDITIONS

A. Environmental Limitations: Do not install roller shades until construction and wet and dirty finish work in spaces, including painting, is complete and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operable glazed units' operation hardware throughout the entire operating range. Notify Architect of discrepancies. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 - PRODUCTS

2.01 ROLLER SHADES

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

B. Products: Subject to compliance with requirements, provide one of the following:
1. Timber Blind Metro Shade
2. MechoShade Systems, Inc.
3. Draper Inc. Clutch XD FlexShades

C. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product:

D. Fabrics: Inherently anti-static, flame retardent, fade and stain resistant, light filtering, room darkening & black out fabrics providing 0% - 15% openness factors. Fabric weights to range between 6.00 oz/sq. yd. – 20.70 oz/sq. yd containing fiberglass, PVC, polyester, acrylic, vinyl laminates, cotton & vinyl coatings. Finish selected by architect from Manufacturer's available colors.

E. Rollers: Electrogalvanized or epoxy primed steel or extruded-aluminum tube of diameter and wall thickness required to support and fit internal components of operating system and the weight and width of shade band material without sagging; designed to be easily removable from support brackets; with manufacturer's standard method for attaching shade material. Provide capacity for one roller shade band(s) per roller, unless otherwise indicated on Drawings.

F. Direction of Roll: Regular, from back of roller, and reverse, from front of roller, as indicated on Drawings for double-roller shades.

G. Hembar: Extruded aluminum flat bar, heat sealed and completely enclosed into a 1-1/2" pocket. Thicker fabrics may required external hembar.

H. Mounting Brackets: Galvanized or zinc-plated steel.

I. Fascia: L-shaped, formed-steel sheet or extruded aluminum; long edges returned or rolled; continuous panel concealing front and bottom of shade roller, brackets, and operating hardware and operators; length as indicated on Drawings; removable design for access. Unless ceiling is below window head.

J. Top/Back Cover: L-shaped; material and finish to match fascia; combining with fascia and end caps to form a six-sided headbox enclosure sized to fit shade roller and operating hardware inside. Bottom Bar: Steel or extruded aluminum, with plastic or metal capped ends. Provide concealed, by pocket of shade material, internal-type bottom bar with concealed weight bar as required for smooth, properly balanced shade operation.

K. Audiovisual Light-Blocking Shades: Designed for eliminating all visible light gaps when shades are fully closed; fabricated from blackout shade band material with fascia and bottom bar extended and formed for light-tight joints among shade components and between shade components and adjacent construction.
   1. Side Channels, Sill Channel or Angle, and Perimeter Seals: Manufacturer's standard design, including sill light seal attached to bottom bar, for eliminating light gaps when shades are closed.
   2. Shade Band Retention System: Manufacturer's standard design for guiding shade band material through range of travel and holding shade band flat with edges of material within side channels.

L. Mounting: As indicated on Drawings, mounting permitting easy removal and replacement without damaging roller shade or adjacent surfaces and finishes.

M. Manufacturer's standard for fixing shade in place, keeping shade band material taut, and reducing light gaps when shades are closed.

N. Shade Operation: Manual; with continuous-loop bead-chain, clutch, and cord tensioner and bracket lift operator.
   1. Pull: Manufacturer's standard hand-grip engaged pull and pole, in length required to make operation convenient from floor level, with hook for engaging ring.
   2. Position of Clutch Operator: Left side of roller, as determined by hand of user facing shade from inside, unless otherwise indicated on Drawings.
   3. Clutch: Capacity to lift size and weight of shade; sized to fit roller or provide adaptor.
   4. Lift-Assist Mechanism: Manufacturer's standard spring assist for balancing roller shade weight and lifting heavy roller shades.
   5. Loop Length: As indicated on Drawings.
   6. Bead Chain: Stainless steel.
   7. Cord Tensioner Mounting: As indicated on Drawings.
   8. Operating Function: Stop and hold shade at any position in ascending or descending travel.

2.02 ROLLER SHADE FABRICATION

A. Product Description: Roller shade consisting of a roller, a means of supporting the roller, a flexible sheet or band of material carried by the roller, a means of attaching the material to the roller, a

bottom bar, and an operating mechanism that lifts and lowers the shade.

B. Concealed Components: Noncorrodible or corrosion-resistant-coated materials.
   1. Lifting Mechanism: With permanently lubricated moving parts.

C. Unit Sizes: Obtain units fabricated in sizes to fill window and other openings as follows, measured at 74 deg F:
   1. Shade Units Installed between (Inside) Jambs: Edge of shade not more than 1/4 inch from face of jamb. Length equal to head to sill dimension of opening in which each shade is installed.

D. Installation Brackets: Designed for easy removal and reinstallation of shade, for supporting roller, and operating hardware and for hardware position and shade mounting method indicated.

E. Installation Fasteners: No fewer than two fasteners per bracket, fabricated from metal noncorrosive to shade hardware and adjoining construction; type designed for securing to supporting substrate; and supporting shades and accessories under conditions of normal use.

F. Color-Coated Finish: For metal components exposed to view, apply manufacturer's standard baked finish complying with manufacturer's written instructions for surface preparation including pretreatment, application, baking, and minimum dry film thickness.

G. Colors of Metal and Plastic Components Exposed to View: As selected by Architect from manufacturer's full range, unless otherwise indicated.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, accurate locations of connections to building electrical system, and other conditions affecting performance.
   1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 ROLLER SHADE INSTALLATION

A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions and located so shade band is not closer than 2 inches to interior face of glass. Allow clearances for window operation hardware.

B. Connections: Connect motorized operators to building electrical system.

3.03 ADJUSTING

A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

3.04 CLEANING AND PROTECTION

A. Clean roller shade surfaces after installation, according to manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that roller shades are without damage or deterioration at time of Substantial Completion.

C. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

3.05 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain roller shades. Refer to Division 01 Section Demonstration and Training."

END OF SECTION

SECTION 21 05 00

COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes the following:
   1. Piping materials and installation instructions common to most piping systems.
   2. Sleeves.
   3. Escutcheons.
   4. Supports and anchorages.

1.02 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.03 SUBMITTALS

A. Welding certificates.

1.04 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
   1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
   2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for Fire-Suppression Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

PART 2 - PRODUCTS

2.01 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 21 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.02 JOINING MATERIALS

A. Refer to individual Division 21 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

E. Brazing Filler Metals: AWS A5.8, BCuP Series or BAg1, unless otherwise indicated.

F. Welding Filler Metals: Comply with AWS D10.12.

G. Solvent Cements for Joining CPVC Plastic Piping: ASTM F 493.

2.03 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
   1. Underdeck Clamp: Clamping ring with set screws.

2.04 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Cast-Brass Type: With set screw.
   1. Finish: Polished chrome-plated

D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
   1. Finish: Polished chrome-plated

PART 3 - EXECUTION

3.01 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping per NFPA 13 and according to the following requirements and Division 21 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Select system components with pressure rating equal to or greater than system operating pressure.

K. Install escutcheons for penetrations of walls, ceilings, and floors.

L. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

M. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
   1. Install steel pipe for sleeves smaller than 6 inches in diameter.
   2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
   3. 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.

N. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
   1. 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.

O. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Section 07 84 00 - Firestopping for materials.

P. Verify final equipment locations for roughing-in.

Q. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

R. All piping penetrations of floors, walls, partitions, etc. shall be caulked / sealed full perimeter regardless of whether or not the partition wall is fire rated.

3.02 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 21 Sections specifying piping systems. Comply with NFPA 13.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

E. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

F. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.03 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor fire-suppression materials and equipment.

B. Field Welding: Comply with AWS D1.1.

3.04 PRESSURE TEST

A. The results of all piping system pressure tests shall be submitted to the construction manager for record purposes.

3.05 PROTECTION OF WORK

A. The contractor must take appropriate precautions during construction to prevent dust and debris from entering water systems by covering equipment and open-ended pipes as the installation progresses.

END OF SECTION

SECTION 21 05 48

VIBRATION AND SEISMIC CONTROLS FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes the following:
   1. Restraining braces.

1.02 DEFINITIONS

A. SBC: Standard Building Code.

B. ICC-ES: ICC-Evaluation Service.

1.03 SUBMITTALS

A. Product Data: For each product indicated.

B. Delegated-Design Submittal: For vibration isolation and seismic-restraint calculations and details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

C. Welding certificates.

D. Qualification Data: For professional engineer.

1.04 QUALITY ASSURANCE

A. Comply with seismic-restraint requirements in the Standard Building Code and NFPA 13 unless requirements in this Section are more stringent.

B. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

C. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall be acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 - PRODUCTS

2.01 SEISMIC-RESTRAINT DEVICES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Amber/Booth Company, Inc.
   2. Cooper B-Line, Inc.; a division of Cooper Industries.
   3. Hilti, Inc.
   4. Kinetics Noise Control.
   5. Mason Industries.

B. Channel Support System: shop or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building

structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.

C. Hanger Rod Stiffener: Reinforcing steel angle clamped.

D. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.

E. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

F. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.

PART 3 - EXECUTION

3.01 VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Equipment Restraints:
   1. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
   2. Install seismic-restraint devices using methods approved by an evaluation service, an agency acceptable to authorities having jurisdiction and providing required submittals for component.

B. Piping Restraints:
   1. Comply with requirements in MSS SP-127 and NFPA 13.
   2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
   3. Brace a change of direction longer than 12 feet.

C. Install seismic-restraint devices using methods approved by an evaluation service, an agency acceptable to authorities having jurisdiction, and providing required submittals for component.

D. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

E. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

F. Drilled-in Anchors:
   1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
   2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
   3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
   4. Set anchors to manufacturer's recommended torque, using a torque wrench.
   5. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.02 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Division 21 Section "Water-Based Fire-Suppression Systems" for piping flexible connections.

END OF SECTION

SECTION 21 10 00

WATER BASED FIRE PROTECTION SPRINKLER SYSTEM

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Design and install a wet-pipe sprinkler system for the entire building as indicated on the drawings.

1.02 REFERENCES

A. NFPA 13 - Installation of Sprinkler Systems.

B. NFPA 24 - Private Fire Service and Their Appurtenances.

1.03 SYSTEM DESCRIPTION

A. System to provide ordinary hazard, group 2 coverage for storage rooms, janitor's closet, mechanical rooms, electrical rooms, and Diesel Tech Lab. System to provide light hazard coverage for rest of building.

B. Interface system with building control system including fire and smoke alarm system.

C. Provide system to NFPA 13 occupancy requirements.

D. Hydraulically calculate system for density as required by NFPA 13, fire marshal, and owner's insurance underwriter.

E. Provide underground water main service compliant with requirement of NFPA 24.

F. Connect to water main as indicated on site fire protection drawings.

G. Provide seismic restraints for sprinkler piping per NFPA 13 and SBC.
Refer to Section 21 05 48.

H. Identification of sprinkler piping.

1.04 QUALITY ASSURANCE

A. Design and installation to conform to NFPA 13 and NFPA 24.

B. Equipment and Components: Bear UL and FM label or marking.

C. Design sprinkler system under direction of Professional Engineer experienced in design of wet pipe sprinkler systems.

D. Specialist Firm: Company specializing in sprinkler systems with 5 documented years' experience.

E. Maintain one copy of each document on site.

1.05 REGULATORY REQUIREMENTS

A. Hydraulic Calculations, Product Data, Shop Drawings: Bear stamp of approval of authority having jurisdiction, Local and State Fire Marshal, and Owner's fire insurance underwriter.

1.06 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 01 33 00.

B. Indicate hydraulic calculations, detailed pipe layout, hangers and supports, components and accessories.

C. Submit shop drawings, product data, and hydraulic calculations to authority having jurisdiction,

Local and State Fire Marshal, and Owner's insurance underwriter for approval. Submit proof of approval to Architect/Engineer. Shop drawings must be signed by a responsible managing employee and submitted by a registered fire protection contractor.

1.07 PROJECT RECORD DOCUMENTS

A. Submit documents under provisions of Section 01 78 21.

1.08 OPERATION AND MAINTENANCE DATA

A. Submit manufacturer's operation and maintenance data under provisions of Section 01 78 21.

B. Include written maintenance data on components of system, servicing requirements, and record drawings.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect, and handle products to site under provisions of Section 01 10 00.

B. Deliver and store valves in shipping containers, with labeling in place.

C. Provide temporary protective coating on cast iron and steel valves.

D. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

1.10 EXTRA STOCK

A. Provide extra sprinkler heads under provisions of NFPA 13 and Section 01 77 70.

B. Provide suitable wrenches for each head type.

C. Provide metal storage cabinet in sprinkler riser room.

D. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

PART 2 - PRODUCTS

2.01 PIPING MATERIALS

A. Above Ground Inside Building Piping: Steel, as permitted by NFPA 13.

B. Under Ground Outside Building: Ductile iron 200 psi with mechanical joints or AWWA C-900 plastic as allowed by NFPA 24.

C. Sprinkler System Piping Above Grade: Steel pipe and fittings as permitted by NFPA 14.

2.02 PIPING SPECIALTIES

A. Sprinkler alarm valve.

B. Water motor alarm.

C. Flow detector switches.

D. Tamper switches for valves.

2.03 SPRINKLER HEADS FOR WET PIPE SYSTEM

A. Suspended Ceiling Type: Provide polished chrome semi-recessed sprinkler heads as indicated on drawings.

B. Exposed Area Type: Standard upright, with brass finish.

C. Provide wire guard in mechanical rooms, electrical rooms, storage rooms, and janitor's closets.

D. Sprinkler heads shall be quick response type.

E. Provide sprinkler heads with a temperature rating of 93°C in electrical rooms.

2.04 PIPE MARKERS

A. Color: Conform to ASME A13.1.

B. Plastic Pipe Markers: Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification or fluid being conveyed.

C. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

D. Underground Plastic Pipe Markers: Bright colored continuously printed plastic ribbon type, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service.

PART 3 - EXECUTION

3.01 INSTALLATION - PIPE

A. Install piping in accordance with NFPA 13 for sprinkler systems and NFPA 24 for underground systems.

B. Do not penetrate building structure members unless indicated.

C. Provide sleeves when penetrating floors and walls.

D. Seal pipe and sleeve penetration to achieve fire resistance equivalent to fire separation required.

E. Contractor shall provide seismic restraints for sprinkler piping per NFPA 13 and SBC. Provide flexible couplings at flexure points per NFPA 13 and maintain clearances around piping penetrations through walls and partitions per NPFA 13.

F. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.

G. Install piping to allow for expansion and contraction without stressing pipe or joints.

H. Provide concrete thrust blocks and restraints as required by NFPA 24.

3.02 INSTALLATION - VALVES

A. Install valves with stems upright or horizontal, not inverted.

B. Provide gate valves with tamper switches for shut-off or isolating service.

C. Provide drain valves at main shut-off valves, low points of piping and apparatus.

D. Place pipe runs to minimize obstruction to other work.

E. Place piping in concealed spaces above finished ceilings.

F. Where heads occur in ceiling tiles, center heads in tiles, (both directions). Exact location of all heads shall be approved by the Architect prior to beginning any work.

G. Apply strippable tape or paper cover to ensure concealed sprinkler head cover plates do not receive field paint finish.

H. All system gauges and valves must be accessible for inspection and maintenance per NFPA 13.

3.03 INSTALLATION - COORDINATION

A. Coordinate all electrical requirements of the sprinkler system with general and electrical contractors prior to beginning work.

B. Coordinate all space requirements for sprinkler system equipment, including risers, valves, drains, pumps, etc., with the general contractor prior to beginning work.

C. Coordinate all site utility requirements to meet NFPA 13 and the local code requirements of the authority having jurisdiction, prior to beginning work, such that a properly functioning sprinkler system is provided.

3.04 CLEANING

A. Flush entire piping system for foreign matter.

3.05 SYSTEM TESTS

A. Hydrostatically test entire system in accordance with NFPA 13, NFPA 24, and local authority requirements.

B. Test shall be witnessed by authority having jurisdiction, Owner's insurance underwriter and Architect.

C. Provide owner with notarized certificate of material and testing.

END OF SECTION

SECTION 22 05 00

COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes the following:
   1. Piping materials and installation instructions common to most piping systems.
   2. Dielectric fittings.
   3. Mechanical sleeve seals.
   4. Sleeves.
   5. Escutcheons.
   6. Grout.
   7. Supports and anchorages.
   8. Identification.

1.02 DEFINITIONS

A. Finished Spaces: Spaces other than plumbing and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and plumbing equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.03 SUBMITTALS

A. Welding certificates.

1.04 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
   1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
   2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.05 MAINTENANCE LOG

A. The contractor shall maintain an appropriate maintenance log, where applicable, of all interim maintenance tasks performed on all equipment started-up and/or operated during construction so that the manufacturer's warranties are not voided prior to the equipment being turned over to the owner. Maintenance logs shall be submitted to the owner as a part of the project close-out documentation when the building is released to the owner.

PART 2 - PRODUCTS

2.01 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.02 JOINING MATERIALS

A. Refer to individual Division 22 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

E. Brazing Filler Metals: AWS A5.8, BCuP Series or BAg1, unless otherwise indicated.

F. Welding Filler Metals: Comply with AWS D10.12.

G. Solvent Cements for Joining Plastic Piping:
   1. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

2.03 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig a minimum working pressure at 180 deg F.

D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig or minimum working pressure as required to suit system pressures.

E. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

F. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

2.04 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

B. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

C. Pressure Plates: Stainless steel, Include two for each sealing element.

D. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.05 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

2.06 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Cast-Brass Type: With set screw.
1. Finish: Polished chrome-plated
2. Finish: Polished chrome-plated

2.07 IDENTIFICATION TAGS AND MARKERS FOR PLUMBING

A. Color: Unless specified otherwise, conform with ANSI/ASME A13.1.

B. Plastic Nameplates: Laminated three-layer plastic with 3/4" tall engraved black letters on light contrasting background color.

C. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inch diameter.

D. Plastic Pipe Markers: Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and fluid being conveyed.

E. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings indicating service and direction of flow (if applicable).

F. Underground Plastic Pipe Markers: Bright colored continuously printed plastic ribbon tape of not less than 6 inch wide by 4 mil thick, manufactured for direct burial service.

G. Identify the following piping systems:
1. Domestic Cold Water.
2. Domestic Hot Water.
3. Domestic Hot Water Return.
4. Sanitary Waste and Vent.
5. A/C Condensate.
6. Storm Drainage.
7. Emergency Storm Drainage.
8. Compressed Air.

PART 3 - EXECUTION

3.01 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Install escutcheons for penetrations of walls, ceilings, and floors.

M. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

N. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
   1. Install steel pipe for sleeves smaller than 6 inches in diameter.
   2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
   3. 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.

O. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
   1. 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.

P. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Section 07 84 00 - Firestopping for materials.

Q. Verify final equipment locations for roughing-in.

R. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements. Provide clearances to equipment as required in manufacturer's literature.

S. All piping penetrations of floors, wall, partitions, etc. shall be caulked / sealed full perimeter - regardless of whether or not the wall / partitions is fire rated.

3.02 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
   1. Comply with ASTM F 402, for safe-handling practice of cleaners, primers, and solvent cements.
   2. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
   3. PVC Nonpressure Piping: Join according to ASTM D 2855.

J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

3.03 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2" and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2" and larger, adjacent to flanged valves and at final connection to each piece of equipment.
3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.04 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

3.05 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.

C. Field Welding: Comply with AWS D1.1.

3.06 GROUTING

A. Mix and install grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Cure placed grout.

3.07 PLUMBING IDENTIFICATION DEVICES

A. Plastic Nameplates: Install with corrosive-resistant mechanical fasteners or adhesive.

B. Plastic Tags: Install with corrosive-resistant chain.

C. Plastic Pipe Markers: Install in accordance with manufacturer's instructions.

D. Plastic Tape Pipe Markers: Install complete around pipe in accordance with manufacturer's instructions.

E. Underground Plastic Pipe Markers: Install 6 to 8 inches below finished grade, directly above buried pipe.

F. Equipment: water heaters, pumps etc. and associated starters with engraved nameplates. Match the record drawings.

G. Valves: Identify valves in main and branch piping with tags.

H. Piping: Identify piping, concealed or exposed, with plastic pipe markers. Omit only in areas where piping is run exposed to view in finished spaces as determined by the architect. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 10 feet on straight runs including risers and drops, adjacent to each valve and "T", at each side of penetration of structure or enclosure, and at each obstruction.

3.08 PROTECTION OF WORK

A. The contractor must take appropriate precautions during construction to prevent dust and debris from entering water systems by covering equipment and open-ended pipes as the installation progresses.

3.09 PRESSURE TEST

A. The results of all piping system pressure test shall be submitted to the construction manager for record purposes.

END OF SECTION

SECTION 22 05 29

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Pipe, duct, and equipment hangers, supports, and associated anchors.

B. Equipment bases and supports.

C. Sleeves and seals.

D. Flashing and sealing equipment and pipe stacks.

E. Place hanger and support inserts and sleeves.

F. Through-penetration firestopping.

1.02 RELATED WORK

A. Section 22 07 00 - Plumbing Insulation.

B. Section 22 11 16 - Domestic Water Piping.

C. Section 22 11 19 - Domestic Water Piping Specialties.

D. Section 22 13 16 - Sanitary Waste and Vent Piping.

1.03 REFERENCES

A. ANSI/ASME B31.1 - Power Piping.

B. U.L. Fire Resistant Directory. Through Penetration Fire Stop Systems for walls, floors, and partitions.

1.04 SUBMITTALS

A. Reference Section 01 33 00 - Shop Drawings, Product Data, Samples.

B. Submit shop drawings and product data.

C. Indicate hanger and support framing and attachment methods.

D. Indicate U.L. system number for all Penetration Systems thru fire rated walls or partitions.

PART 2 - PRODUCTS

2.01 PIPE HANGERS AND SUPPORTS

A. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Carbon steel, adjustable swivel, split ring.

B. Hangers for Pipe Sizes 2 to 4 inches and Cold Pipe Sizes 6 inches and over: Carbon steel, adjustable, clevis.

C. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.

D. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.

E. Wall Support for Pipe Sizes 4 Inches and Over: Welded steel bracket and wrought steel clamp.

F. Vertical Support: Steel riser clamp.

G. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

H. Floor Support for Pipe Sizes to 4 inches: Cast iron adjustable pipe saddle, locknut nipple, floor flange, and concrete pier or steel support. Grinnell Figure 264 or equal.

I. Floor Support for Pipe Sizes 6 Inches and Over: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support. Grinnell Figure 274 or equal.

J. Shield for Insulated Piping 2-1/2 Inches and Smaller: Finish insulation with vapor barrier mastic. Provide 14 gage galvanized steel shield over insulation in 180 degree segments, minimum 12 inches long at pipe support. Grinnell Figure 167 or equal. Provide shields for all piping, including piping supported or roller hangers.

K. Shields for Insulated Piping 3 Inches and Larger: Provide foamglass insulation section, 18 inch minimum length, shield thickness same as insulation thickness. Provide 14 gage galvanized sheet shield over insulation in 180 degree segments, minimum 18 inches long at pipe support.

L. Shields for Vertical Copper Pipe Risers: Sheet lead.

2.02 HANGER RODS

A. Steel Hanger Rods: Threaded both ends, threaded one end, or continuous threaded.

2.03 INSERTS

A. Inserts: Malleable iron case of (galvanized) steel and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.04 SLEEVES

A. Sleeves for Pipes Through Non-fire Rated Floors: Form with 18 gage galvanized steel.

B. Sleeves for Pipes Through Non-Fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Form with schedule 40 steel pipe.

C. Sleeves for Pipes Through Fire Rated and Fire Resistive Floors and Walls, and Fireproofing: Schedule 40 steel with U.L. listed fire barrier caulk per the requirements of the U.L. Fire Resistance Directory Fire Stop System.

D. Stuffing or Fire Stopping Insulation: As required by the applicable U.L. System for Through Penetration Fire Stop System.

E. Caulk: Per applicable U.L. Through Penetration Fire Stop Systems.

F. Wrap for insulated piping penetrations of rated walls and floors: Elastomeric intumescent wrap strip per U.L. Fire Resistance Directory - through Penetration Fire Stop Systems.

2.05 FABRICATION

A. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.

B. Design hangers without disengagement of supported pipe.

C. Provide copper plated hangers and supports for un-insulated copper piping.

2.06 FINISH

A. Prime coat all steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are included.

B. Provide one (1) prime coat and one (1) finish coat of paint on all exterior or interior exposed steel hangers and supports.

2.07 THROUGH-PENETRATION FIRESTOPPING OF FIRE-RATED CONSTRUCTION

A. Systems or devices listed in the U.L. Resistance Directory under categories XHCR and XHEZ shall be used to protect all mechanical piping or conduit (temperature controls) penetrations of fire rated construction, the system used shall conform to the construction type, penetrant type, annular space requirements and fire rating involved in each separate instance. Systems or devices must be asbestos-free.

B. The systems withstand the passage of cold smoke either as an inherent property of the system, or by the use of a separate product included as a part of the U.L. system or device, and designed to perform this function.

C. Acceptable manufacturers and products shall be those listed in the U.L. Fire Resistance Directory for the U.L. System involved.

D. Fill, void or cavity materials: As classified under category XHHW in the U.L. Fire Resistance Directory.

E. Forming materials: As classified under category XHKU in the U.L. Fire Resistance Directory.

PART 3 - EXECUTION

3.01 INSERTS

A. Where concrete slabs form finished ceiling, provide inserts to be flush.

3.02 PIPE HANGERS AND SUPPORTS

A. Support horizontal piping as follows:

PIPE SIZE	MAX.HANGER SPACING	HANGER DIAMETER
1/2 to 1-1/4 inch	6'-6"	3/8"
1-1/2 to 2 inch	10'-0"	3/8"
2-1/2 to 3 inches	10'-0"	1/2"
4 to 6 inch	10'-0"	5/8"
C.I. Bell and Spigot (or No-Hub) and at all joints	5'-0"	5/8"
PVC	4'-0"	3/8"

B. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.

C. Place a hanger within **12 inches of each horizontal elbow.**

D. Use hangers with 1-1/2 inch minimum vertical adjustment.

E. Support horizontal cast iron pipe adjacent to each hub, with 5 feet maximum spacing between hangers.

F. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.

G. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.

H. Support riser piping independently of connected horizontal piping.

I. Size supports large enough to allow for insulation covering. Insulation for all piping shall be continuous at all supports.

3.03 EQUIPMENT BASES AND SUPPORTS

A. Provide housekeeping pads for all floor mounted equipment. Pads shall be minimum 6" tall and shall be reinforced as called for on the structural drawings. Pads shall be 6" larger than the equipment on all sides. Chamfer edges.

B. Provide templates, anchor bolts, and accessories for mounting and anchoring equipment.

C. Construct support of steel members or steel pipe and fittings. Brace and fasten with flanges bolted to structure.

D. Provide rigid anchors for pipes after vibration isolation components are installed.

E. Grout pump bases per the pump manufacturer's recommendations.

F. Provide seismic anchors for all mechanical equipment and associated supports.

3.04 FLASHING

A. Provide flexible flashing and metal counterflashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.

B. Flash vent and soil pipes projecting 8 inches minimum above finished roof surface with lead worked one inch minimum into pipe, 8 inches minimum clear on sides with 36 x 36 inches sheet size. For pipes through outside walls, turn flanges back into wall and caulk, metal counterflash and seal. EPDM Roof: Flash per roof manufacturer's recommendation.

C. Flash floor drains in floors with topping over finished areas with lead, 10 inches clear on sides with minimum 36 x 36 inch sheet size. Fasten flashing to drain clamp device.

D. Seal Floor and mop sink drains watertight to adjacent materials.

E. Provide acoustical lead flashing around ducts and pipes penetrating equipment rooms, installed in accordance with manufacturer's instructions for sound control.

3.05 SLEEVES

A. Set sleeves in position in formwork. Provide reinforcing around sleeves.

3.06 SEISMIC BRACING

A. Provide seismic restraints in accordance with the requirements of the 1999 Standard Building Code for the following:
   1. All natural gas piping.
   2. All other piping in Mechanical Equipment Rooms 1-1/4" diameter and larger, all piping (other than gas) outside Mechanical Equipment Rooms 2-1/2" diameter and larger and all conduits 2-1/2" diameter and larger.

      Exception: Piping suspended by individual hangers 12 inches or less in length, as measured from the top of the pipe to the bottom of the support where the hanger is attached, need not be braced.

B. Where possible, hangers and supports for pipes shall not exceed a length of 12 inches.

C. Coordinate bracing methods with vibration isolation systems. Use cable restraints, in accordance with S.M.A.C.N.A. Restraint Manual, to prevent short circuiting vibration isolation devices.

D. Anchor and secure all devices, equipment, tanks, panels, etc. to resist seismic forces.

E. Submittal Data Requirements

1. The manufacturer of vibration isolation and seismic restraints shall provide submittals for products as follows:
   a. Descriptive Data:
      1) Catalog cuts or data sheets on vibration isolators and specific restraints detailing compliance with the specification.
      2) Detailed schedules of flexible and rigidly mounted equipment, showing vibration isolators and seismic restraints by referencing numbered descriptive drawings.
   b. Shop Drawings:
      1) Submit fabrication details for equipment bases including dimensions, structural member sizes and support point locations.
      2) Provide all details of suspension and support for ceiling hung equipment.
      3) Where walls, floors, slabs or supplementary steel work are used for seismic restraint locations, details of acceptable attachment methods for ducts, conduit and pipe must be included and approved before the condition is accepted for installation. Restraint manufacturers' submittals must include spacing, static loads and seismic loads at all attachment and support points.
      4) Provide specific details of seismic restraints and anchors; include number, size and locations for each piece of equipment.
   c. Seismic Certification and Analysis:
      1) Seismic restraint calculations must be provided for all connections of equipment to the structure. Calculations must be stamped by a registered professional engineer with at least five years of seismic design experience, licensed in the state of the job location.
      2) All restraining devices shall have a preapproval number from California OSHPD or some other recognized government agency showing maximum restraint ratings. Preapprovals based on independent testing are preferred to preapprovals based on calculations. Where preapproved devices are not available, submittals based on independent testing are preferred. Calculations (including the combining of tensile and shear loadings) to support seismic restraint designs must be stamped by a registered professional engineer with at least five years of seismic design experience and licensed in the state of the job location. Testing and calculations must include both shear and tensile loads as well as one test or analysis at 45° to the weakest mode.
      3) Analysis must indicate calculated dead loads, static seismic loads and capacity of materials utilized for connections to equipment and structure. Analysis must detail anchoring methods, bolt diameter, embedment and/or welded length. All seismic restraint devices shall be designed to accept, without failure, the code required seismic forces acting through the equipment center of gravity. Overturning moments may exceed forces at ground level.

END OF SECTION

SECTION 22 07 00
PLUMBING INSULATION

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Piping Insulation.

B. Jackets and accessories.

1.02 RELATED WORK

A. Section 22 05 29 - Hangers and Supports for Plumbing Piping and Equipment.

B. Section 22 11 16 - Domestic Water Piping.

C. Section 22 13 16 - Sanitary Waste and Vent Piping.

1.03 REFERENCES

A. ANSI/ASTM C195 - Mineral Fiber Thermal Insulation Cement.

B. ANSI/ASTM C547 - Mineral Fiber Preformed Pipe Insulation.

C. ASTM C449 - Mineral Fiber Hydraulic-setting Thermal Insulating and Finishing Cement.

D. ASTM E84 - Surface Burning Characteristics of Building Materials.

1.04 QUALITY ASSURANCE

A. Applicator: Company specializing in piping insulation application with documented experience.

B. Materials: Flame spread/fuel contributed/smoke developed rating of 25/30/50 in accordance with ASTM E84.

C. Systems: Insulation systems at penetrations of fire rated construction shall be as required by the U.L. Fire Resistance Directory.

1.05 SUBMITTALS

A. Submit product data.

B. Include brochure and description list of materials and thickness for each service and locations.

C. Submit manufacturer's installation data.

PART 2 - PRODUCTS

2.01 INSULATION

A. Type A: Glass fiber insulation; ANSI/ASTM C547; 'K" value of 0.24 at 75 degrees F; noncombustible as manufactured by Owens-Corning.

B. Type B: Tubular closed cell insulation; "K" value of 0.255 at 75 degrees F. equal to Halstead.
   1. Joint Sealant: Contact cement by manufacturer.
   2. Exterior Sealant: Synthetic resin protective paint.
   3. Pre-slit insulation is not acceptable.

2.02 JACKETS AND FITTINGS

A. Kraft reinforced all service jacketing (ASJ) shall be standard on all piping.

B. Aluminum jacketing with aluminum fittings for elbows, etc. as called for.

C. All aluminum jacketing shall be 0.016" thick smooth. Corrugated aluminum jackets are not acceptable.

2.03 ACCESSORIES

A. Insulation Bands: 3/4 inch wide; stainless steel or 0.007 inch thick.

B. Insulating Cement: ANSI/ASTM C195; hydraulic setting mineral wool.

C. Finishing Cement: ASTM C449.

D. Fibrous Glass Cloth: Untreated; 9 oz/sq yd weight.

E. Adhesives: As directed by manufacturer.

PART 3 - EXECUTION

3.01 PREPARATION

A. Install materials after piping has been tested and approved.

3.02 INSTALLATION

A. Install materials in accordance with manufacturer's instructions.

B. Insulation with vapor barrier through supports and penetrations shall be continuous.

C. In exposed piping, locate insulation and cover seams in least visible locations.

D. On insulated piping with vapor barrier, insulate fittings, valves, unions, flanges, strainers, flexible connections, and expansion joints.

E. On insulated hot water piping: neatly bevel and seal at unions, valves and flow controllers. Seal with manufacturers approved finishing material.

F. Neatly cutout and seal insulation at all cleanouts in drain piping. Seal to maintain insulation system vapor barrier.

G. Provide an insert, (See Supports Section 22 05 29) of same thickness and contour as adjoining insulation, between support shield and piping, but under the finish jacket, on piping 2 inches diameter or larger, to prevent insulation from sagging at support points. Inserts shall be foamglass or other heavy density insulating material suitable for the planned temperature range. Factory fabricated inserts may be used.

H. Neatly finish insulation at supports, protrusions, and interruptions.

I. Insulation for all cold water piping shall have vapor barrier jackets, factory-applied. Insulate cold water and make-up water fittings, joints and valves with pre-molded insulation of like material and thickness as adjacent pipe, and finish with glass cloth and vapor barrier adhesive. All insulation at pipe fittings shall be factory pre-molded type.

J. Domestic hot water piping fittings and joints shall be insulated with material and thickess as adjacent piping and finished with PVC covers. Neatly bevel and seal hot water pipe insulation at pumps, unions, valves, etc.

K. Jackets:

1. Indoor, Concealed Applications: Insulated pipes conveying fluids ***above*** ambient temperature shall have standard all service jackets, with or without vapor barrier, factory-applied or field-applied. **Insulate fittings and joints with factory pre-molded insulation of like material and thickness as adjoining pipe, and finish with glass cloth**

and adhesive. No exceptions. Neatly bevel and seal insulation at valves. PVC fitting covers may be used over pre-molded fitting insulation. PVC elbow covers with fiberglass insulation stuffing **shall not** be used.

2. Indoor, Concealed Applications: Insulated pipes conveying fluids ***below*** ambient temperature shall have vapor barrier jackets, factory-applied. **Insulate fittings, joints, and valves with factory pre-molded insulation of like material and thickness as adjacent pipe, and finish with glass cloth and vapor barrier adhesive.** PVC jackets are **not** acceptable.
3. Indoor, Exposed Applications: For pipe exposed in mechanical equipment rooms or in finished spaces, insulate as for concealed applications and provide aluminum jacket for all piping, valves, and fittings.
4. Provide 0.016" smooth aluminum jacket for all type "A" pipe insulation located outside the building and all piping in the mechanical rooms within 6'- 0" of the floor.
5. All exterior exposed portions of closed cell foam (Type "B") insulation shall be protected with minimum 2 coats weatherproof synthetic resin sealant.
6. Insulation with vapor barrier jacket shall not be installed using staples unless same is protected by mastic being applied over staples.

3.03 SCHEDULE

INSULATION PIPING	TYPE	PIPE SIZE	THICKNESS INCH
Domestic Hot Water Supply and Return	A	All	1”
Domestic Cold Water	A	All	½”
Condensate Drains	A	All	½”
Storm Drain Piping and Roof Drain Bodies	A	All	½”

Note: Insulation types, thicknesses, density, etc. at penetrations of fire rated construction shall be as required by the U.L. Fire Resistance Directory.

END OF SECTION

SECTION 22 11 16
DOMESTIC WATER PIPING

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Pipe and pipe fittings.

B. Valves.

C. Domestic water piping system.

1.02 RELATED WORK

A. Section 31 22 00 - Structure excavation, backfill and finished grading.

B. Section 09 90 00 - Painting.

C. Section 22 05 00 - Common Work Results for Plumbing.

D. Section 22 05 29 - Hangers and Supports for Plumbing Piping and Equipment.

E. Section 22 07 00 - Plumbing Insulation.

F. Section 22 11 19 - Domestic Water Piping Specialties.

G. Section 22 40 00 - Plumbing Fixtures.

1.03 REFERENCES

A. ANSI/ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings - DWV.

B. ANSI/ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV.

C. ANSI/ASME Sec. 9 - Welding and Brazing Qualifications.

D. ANSI/ASTM B32 - Solder Metal.

E. ANSI/ASTM D2466 - Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.

F. ANSI/AWS D1.1 - Structural Welding Code.

G. ASTM B88 - Seamless Copper Water Tube.

1.04 QUALITY ASSURANCE

A. Valves: Manufacturer's name and pressure rating marked on valve body.

B. Welding Materials and Procedures: Conform to ASME Code and applicable state labor regulations.

C. Welders Certification: In accordance with ANSI/ASME Sec. 9, and ANSI/AWS D1.1.

1.05 SUBMITTALS

A. Submit product data under provisions of Section 01 33 00.

B. Include data on pipe materials, pipe fittings, valves and accessories.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Section 01 10 00.

B. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

C. Provide temporary protective coating on cast iron and steel valves.

D. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

E. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

PART 2 - PRODUCTS

2.01 WATER PIPING, BURIED WITHIN 5'-0" OF BUILDING

A. Copper Tubing: ASTM B88, Type K, hard drawn.
   1. Fittings: ANSI/ASME B16.23, cast brass, or ANSI/ASME B16.29, wrought copper.
   2. Joints: ANSI/ASTM B32.

2.02 WATER PIPING, ABOVE GRADE

A. Copper Tubing: ASTM B88, Type L, hard drawn.
   1. Fittings: ANSI/ASME B16.23, cast brass, or ANSI/ASME B16.29, wrought copper.
   2. Joints: ANSI/ASTM B32, solder, Grade 95TA.

2.03 FLANGES, UNIONS, AND COUPLINGS

A. Pipe Size 2 Inches and Under:
   1. Ferrous pipe: 150 psig malleable iron threaded unions.
   2. Copper tube and pipe: 150 psig bronze unions with soldered joints.

B. Pipe Size Over 2 Inches:
   1. Ferrous pipe: 150 psig forged steel slip-on flanges; 1/16 inch thick preformed neoprene gaskets.
   2. Copper tube and pipe: 150 psig slip-on bronze flanges; 1/16 inch thick preformed neoprene gaskets.

C. Grooved and Shouldered Pipe End Couplings:
   1. Housing: Malleable Iron clamps to engage and lock, designed to permit some angular deflection, contraction, and expansion; steel bolts, nuts, and washers; galvanized for galvanized pipe.
   2. Sealing gasket: "C" shape composition sealing gasket.

D. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.04 BALL VALVES

A. 2 Inch and Under:

   Equal to Watts LFB-6080 1/4" thru 2", Watts #G-4000-FDA 2-1/2" and larger.

B. 2-1/2 Inch Thru 10 Inch:

   Equal to Watts Series G-4000-FDA meeting ASTM A126 Class B-A351-A6-A439 and AISI 304.

C. Valves shall have stainless steel ball, full port, and extended handle.

D. Propress ball valves shall have press ends equipped with sealing element made of EPDM. Inspect valve to assure sealing element is in place.

2.05 GATE VALVES

A. 2-1/2 Inch and Larger:

   Equal to Watts 408-OSY-RN, ASTM A126, Class B; MSS-SP70, Federal Spec.WW-V58 Class 1.

2.06 SWING CHECK VALVES

A. Manufacturers:
   1. Watts LFCV or approved equal, 90° or 45°, FDA approved rated at 200 PSI WOG.

B. Up to and including 2 Inches: Bronze swing disc, solder or screwed ends.

C. Over 2 Inches: Iron body, bronze trim, swing disc, renewable disc and seat, flanged ends.

2.07 RELIEF VALVES

A. Manufacturers:
   1. Watts LF100XL or approved equal.

B. Bronze body, teflon seat, steel stem and springs, automatic, direct pressure actuated, capacities AGA and ASME certified and labeled.

2.08 STRAINERS

A. Watts or equal FDA approved "Y" Type, rated 200 PSI WOG.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify excavations under provisions of Section 31 22 00.

B. Verify that excavations are to required grade, dry, and not over-excavated.

C. Verify the copper tubing and fittings are free of defects, sand holes, or cracks.

D. Verify the sealing elements in Propress fittings are properly in place and free from damage. For Propress fittings 2-1/2" and larger, installer should insure that the stainless steel grip ring is in place.

3.02 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe. Copper tubing shall be cut with a wheeled tubing cutter.

B. Remove scale and dirt, on inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.03 INSTALLATION

A. Provide non-conducting dielectric connections wherever jointing dissimilar metals and where pipe extends into grade.

B. Route piping in orderly manner and maintain gradient.

C. Install piping to conserve building space and not interfere with use of space.

D. Group piping whenever practical at common elevations.

E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

F. Provide clearance for installation of insulation and access to valves and fittings.

G. Provide access where valves and fittings are not exposed. Coordinate size and location of access doors with Section 08 31 00.

H. Slope water piping and arrange to drain at low points.

I. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

J. Prepare pipe, fittings, supports, and accessories not prefinished, ready for finish painting. Refer to Section 22 05 00.

K. Establish invert elevations, slopes for drainage to 1/8 inch per foot minimum unless otherwise noted. Maintain gradients.

L. Install in accordance with manufacturer's instructions.

M. Establish elevations of buried piping outside the building to ensure not less than one foot of cover.

N. Provide support for utility meters in accordance with requirements of utility companies.

O. Excavate in accordance with Section 31 22 00 for work of this section.

P. Backfill in accordance with Section 31 22 00 for work of this section.

Q. Install valves with stems upright or horizontal, not inverted.

3.04 APPLICATION

A. Install unions downstream of valves and at equipment or apparatus connections.

B. Install brass male adapters each side of valves in copper piped system. Sweat solder adapters to pipe.

C. Install gate or ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.

D. Install ball valves for throttling, bypass, or manual flow control services.

E. Provide spring loaded check valves on discharge of water pumps.

F. Use grooved mechanical couplings and fasteners only in accessible locations.

G. All valves, supplies and pipe accessories installed in the domestic water system shall be certified by the manufacturer to meet lead-free requirements.

3.05 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

A. Prior to starting work, verify system is complete, flushed and clean.

B. Ensure PH of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).

C. Inject disinfectant, free chlorine in liquid, powder, tablet or gas form, throughout system to obtain 50 to 80 mg/L residual.

D. Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15 percent of outlets.

E. Maintain disinfectant in system for 24 hours.

F. If final disinfectant residual tests less than 25 mg/L, repeat treatment.

G. Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.

H. Take samples no sooner than 24 hours after flushing, from 10 percent of outlets and from water entry, and analyze in accordance with AWWA C601.

I. Provide documentation from local health department denoting approval of potable water system prior to owner occupying building. No Exceptions!

END OF SECTION

SECTION 22 11 19
DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Water hammer arrestors.

B. Hose bibbs.

C. Hydrants.

D. Backflow preventers.

1.02 RELATED WORK

A. Section 22 11 16 - Domestic Water Piping.

1.03 REFERENCES

A. ANSI A112.26.1 - Water Hammer Arresters.

B. PDI WH-201 - Water Hammer Arresters.

C. ANSI / ASSE 1011 - Hose Connection Vacuum Breakers.

D. ANSI / ASSE 1019 - Wall Hydrants, Frost Proof Automatic Draining Anti-Backflow Types.

1.04 QUALITY ASSURANCE

A. Manufacturer: For each product specified, provide components by same manufacturer throughout.

1.05 SUBMITTALS

A. Submit under provisions of Section 01 33 00.

B. Shop Drawings: Indicate dimensions, weights, and placement of openings and holes.

C. Product Data: Provide component sizes, rough-in requirements, service sizes, and finishes.

D. Manufacturer's Installation Instructions: Indicate assembly and support requirements.

1.06 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Section 01 78 21.

B. Record actual locations of equipment, backflow preventers, and concealed valves.

1.07 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Section 01 78 21.

B. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Section 01 10 00.

B. Accept specialties on site in original factory packaging. Inspect for damage.

PART 2 - PRODUCTS

2.01 WATER HAMMER ARRESTORS

A. Manufacturers:
   1. Watts LF15M2 Series, or equal.
   2. Provide water hammer arrestors on all equipment served by quick action solenoid valves.

B. ASSE 1010 and ANSI A112.26.1; sized in accordance with PDI WH-201.

2.02 HOSE BIBBS/HYDRANTS

A. ANSI/ASSE 1019; non-freeze, removable key, and vacuum breaker; as indicated on the drawing.

B. Approved manufacturers: Zurn, Watts, and Woodford.

C. All hose bibbs shall be certified as lead-free by the manufacturer.

2.03 REDUCED PRESSURE BACKFLOW PREVENTERS

A. Manufacturers: Watts, Zurn, Wilkins.
   1. Watts Series 957, 919 or approved equal with bronze strainer and quarter turn ball valves, FDA approved, ASSE No. 1013, AWWA C511-92, CSA B64.5, UL Classified File No. EX3185, IAPMO PS 31, SBCCI.
   2. The assembly shall consist of a pressure differential relief valve located in a zone between two positive seating check valves. Backsiphonage protection shall include provision to admit air directly into the reduced pressure zone via a separate channel from the water discharge channel, or directly into the supply pipe via a separate vent. The assembly shall include two tightly closing shutoff valves before and after the assembly, test cocks and a protective strainer upstream of the No. 1 shutoff valve.
   3. All backflow preventers shall be certified by a cross connection control device tester.

PART 3 - EXECUTION

3.01 INSTALLATION AND APPLICATIONS

A. Install specialties in accordance with manufacturer's instructions to permit intended performance. Where applicable, consult the manufacturer's technical representative for assistance and review of installation for appropriate function.

B. Install water hammer arrestors complete with accessible isolation valve on hot and cold water piping as recommended by Wade "Sizing and Placement Data". Provide access doors in accordance with Section 08 31 00.

END OF SECTION

SECTION 22 13 16

SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Pipe and pipe fittings.

B. Valves.

C. Sanitary sewer piping system.

1.02 RELATED WORK

A. Section 22 05 29 - Hangers and Supports for Plumbing Piping and Equipment.

B. Section 22 13 19 - Sanitary Waste Piping Specialties.

1.03 REFERENCES

A. ANSI/ASME B16.3 - Malleable Iron Threaded Fittings Class 150 NS 300.

B. ANSI/ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings - DWV.

C. ANSI/ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV.

D. ANSI/ASME Section 9 - Welding and Brazing Qualifications.

E. ANSI/ASTM B32 - Solder Metal

F. ANSI/AWS D1.1 - Structural Welding Code.

G. ASTM A53 - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.

H. ASTM A74 - Cast Iron Soil Pipe and Fittings.

I. ASTM A120 - Pipe, Steel, Black and Hot-Dipped Zinc Coated Galvanized), Welded and Seamless, for Ordinary Uses.

J. ASTM A234 - Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.

K. ASTM B306 - Copper Drainage Tube (DWV).

L. ASTM C564 - Rubber Gaskets for Cast Iron Soil Pipe and Fittings.

M. AWS A5.8 - Brazing Filler Metal.

N. AWWA C601 - Standard Methods for the Examination of Water and Waste Water.

O. CISPI 301 - Cast Iron Soil Pipe and Fittings for Hubless Cast Iron Sanitary Systems.

1.04 QUALITY ASSURANCE

A. Welding Materials and Procedures: Conform to ASME Code and applicable state labor regulations.

B. Welders Certification: In accordance with ANSI/ASME Sec. 9, and ANSI/AWS D1.1.

1.05 SUBMITTALS

A. Include data on pipe materials, pipe fittings, valves and accessories.

1.06 DELIVERY, STORAGE, AND HANDING

A. Deliver, store, protect and handle products to site under provisions of Section 01 10 00.

B. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

C. Provide temporary protective coating on cast iron and steel valves.

D. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

E. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

PART 2 - PRODUCTS

2.01 SANITARY SEWER PIPING, BURIED WITHIN 5'- 0" OF BUILDING

A. PVC Pipe: ASTM D2665, D1785, Schedule 40.
   1. Fittings: PVC.
   2. Joints: ASTM D2885, solvent weld with ASTM D2564 solvent cement.

2.02 SANITARY PIPING, ABOVE GRADE

A. PVC Pipe: ASTM D2665, D1785, Schedule 40.
   1. Fittings: PVC.
   2. Joints: ASTM D2885, solvent weld with ASTM D2564 solvent cement.
   3. Do not install PVC in return air plenums.

2.03 EQUIPMENT DRAINS AND OVERFLOWS (CONDENSATE)

A. Copper Tubing: Seamless copper drainage tube (DWV), Minimum 1 1/4" size.
   1. Fittings: ANSI/ASME B16.23 Cast brass, or ANSI/ASME B16.29 solder wrought copper with wye and brass cleanout plug at all changes in direction.
   2. Joints: soldered joints, using lead-free solder complying with ASTM B32.
   3. Traps: Factory fabricated, deep seal type, mechanical joint.

B. PVC Pipe:ASTM D2665, C1785, Schedule 40.
   1. Fittings: PVC.
   2. Joints: ASTM D2885, solvent weld with ASTM D2564 solvent cement.
   3. Traps: Deep seal type.
   4. Do not install PVC in return air plenums.

PART 3 - EXECUTION

3.01 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe. Remove scale and dirt, on inside and outside, before assembly.

3.02 INSTALLATION

A. Provide non-conducting dielectric connections wherever jointing dissimilar metals and where pipe extends into grade.

B. Route piping in orderly manner and maintain gradient.

C. Install piping to conserve building space and not interfere with use of space.

D. Group piping whenever practical at common elevations.

E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

F. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

G. Establish invert elevations, slopes for drainage to 1/8 inch per foot minimum. Maintain gradients.

H. Install bell and spigot pipe with bell end upstream.

I. Group piping whenever practical at common elevations.

J. Prepare pipe, fittings, supports, and accessories not prefinished, ready for finish painting. Refer to Section 22 05 00.

K. Install in accordance with manufacturer's instructions.

L. Establish elevations of buried piping outside the building to ensure not less than one foot of cover.

M. Excavate in accordance with Section 31 22 00 for work of this section.

N. Backfill in accordance with Section 31 22 00 for work of this section.

3.03 SERVICE CONNECTIONS

A. Connect to existing sanitary sewer services. Before commencing work check invert elevations required for sewer connections, confirm inverts and ensure that these can be properly connected with slope for drainage and cover to avoid freezing.

B. Field verify exact size, depth and location of all utilities prior to construction.

END OF SECTION

SECTION 22 13 19

SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Floor drains

B. Cleanouts.

C. Fixture carriers.

1.02 PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION

A. Section 01 10 00 - Summary of Work: Owner furnished equipment.

1.03 RELATED WORK

A. Section 22 05 29 - Hangers and Supports for Plumbing Piping and Equipment.

B. Section 22 11 16 - Domestic Water Piping.

C. Section 22 40 00 - Plumbing Fixtures.

1.04 REFERENCES

A. ANSI/A112.21.1 - Floor Drains.

1.05 SUBMITTALS

A. Submit under provisions of Section 01 33 00.

B. Shop Drawings: Indicate dimensions, weights, and placement of openings and holes.

C. Product Data: Provide component sizes, rough-in requirements, service sizes, and finishes.

D. Manufacturer's Installation Instructions: Indicate assembly and support requirements.

1.06 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Section 01 78 21.

B. Record actual locations of equipment, cleanouts, backflow preventers and concealed valves.

1.07 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Section 01 78 21.

B. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Section 01 10 00.

B. Accept specialties on site in original factory packaging. Inspect for damage.

PART 2 - PRODUCTS

2.01 FLOOR DRAINS

A. ANSI A112.21.1; Model type and manufactured as indicated on drawings.

B. Approved manufacturers: Zurn, Watts, Wade.

2.02 CLEANOUTS

A. Clean-outs shall be provided in waste and drainage lines where indicated on drawings and/or required by Plumbing Code. Cleanouts shall be sized same as for pipe in which installed, except no clean-out need be larger than 4" in diameter.

B. Where installed in exposed cast iron pipe, cleanouts shall consist of raised-head cast brass plug with caulking ferrule.

C. Cleanouts in walls shall consist of raised head, cast brass plug with stainless steel cover.

D. Where installed in floors, cleanouts shall consist of cast iron ferrule, brass plug, adjustable cast iron housing and nickel brass serrated cover and matching flange for flush mounting. Cleanouts in carpeted areas shall be provided with carpet marker. Outside cleanouts shall be set in a 12" x 12" x 6" thick concrete pad, top of pad shall be flush with finish grade.

E. Approved manufacturers: Zurn, Watts, Wade.

2.03 FIXTURE CARRIERS

A. Wall lavatory concealed arm carrier shall be "Zurn" Z1231 lavatory support with concealed arms, complete with Dura-coated rectangular steel uprights with welded feet, cast iron adjustable headers, concealed arms, steel sleeves, alignment truss, and mounting fasteners.

B. Water cooler support system shall be "Zurn" Z1225 with top and bottom plates, complete with dura-coated rectangular steel uprights with welded feet, adjustable support, plates and mounting fasteners.

C. Urinal support system shall be "Zurn" Z1225 with top and bottom plates, complete with dura-coated rectangular steel uprights with welded feet, adjustable support, plates and mounting fasteners.

D. Watts support systems and fixture carriers are an approved substitution.

E. The contractor shall coordinate all carriers and supports and dimensions with the applicable fixture manufacturer to be installed during installation.

PART 3 - EXECUTION

3.01 PREPARATION

A. Coordinate cutting and forming of floor construction to receive drains to required invert elevations.

3.02 INSTALLATION AND APPLICATIONS

A. Install specialties in accordance with manufacturer's instructions to permit intended performance.

B. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Ensure clearance at cleanout for rodding of drainage system.

C. Encase exterior cleanouts in 2 foot square x 4" thick concrete pad flush with grade, with 1/4 inch clearance between cleanout and pad.

D. Provide two-way cleanouts at exterior sanitary sewer.

END OF SECTION

SECTION 22 15 13
GENERAL SERVICES COMPRESSED AIR PIPING

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Compressed Air System.

1.02 REFERENCES

A. FS PPP-T-66 - Tape, Packaging, Vinyl Plastic Film.

B. FS TT-P-645 - Primer, Paint, Zinc Chromate, Alkyd Type.

C. MIL-STD-101 - Color Code for Pipelines and for Compressed Gas Cylinders.

D. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, and Manufacture.

E. MSS SP-69 - Pipe Hangers and Supports - Selection and Application.

1.03 SUBMITTALS

A. Submit under provisions of Section 013300.

B. Product Data: Provide manufacturers literature and illustrations for all components indicating size, dimensions and configuration.

C. Independent Testing Agency Reports: Indicate systems are complete, and pressure and cross connections tests performed. Document tests.

D. Manufacturer's Installation Instruction: Indicate requirements for equipment and systems.

1.04 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Section 017839.

B. Accurately record actual locations of piping, valving, and outlets.

1.05 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Section 017823.

B. Operation Data: include installation instructions, assembly views, lubrication instructions, and assembly views.

C. Maintenance Data: Include maintenance and inspection data, replacement part numbers and availability, and service depot location and telephone.

1.06 QUALITY ASSURANCE

A. Perform Work in accordance with NFPA 99.

B. Maintain one copy of each document on site.

1.07 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing the work of this Section with minimum 3 years documented experience.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Section 016000.

B. Accept material on site in factory containers and packing. Inspect for damage.

C. Protect from damage and contamination by maintaining factory packaging and caps in place until installation.

1.09 SCHEDULING

A. Schedule work under the provisions of Section 013100.

B. Schedule work to ensure equipment is installed and systems tested and certified prior to substantial completion.

1.10 WARRANTY

A. Provide five year warranty under provisions of Section 016000.

PART 2 - PRODUCTS

2.01 PIPE AND FITTINGS

A. Steel Pipe: ASTM A53 or A120, Schedule 40 Black. Fittings: ANSI / ASME B16.3, malleable iron, or ASTM A234, forged steel welding type. Joints: Screwed for low pressure pipe two inches and under; ANSI / AWS D1.1, welded, for pipe over two inches.

2.02 PIPING

A. Hangers and Supports: MSS SP-58 with types as required by MSS SP-69.

B. Piping Identification: FS PPP-T-66, pressure sensitive adhesive tape and decals, color and labelling to conform with MIL-STD-101.

2.03 OUTLETS

A. Outlets: Quick disconnect outlets.

B. Written approval of quick disconnect outlets shall be received from owner prior to beginning construction.

2.04 VALVES

A. Ball Valves: FS WW-V-35, brass or bronze body, double-seal ball valves with replaceable neoprene or TFE seat and stem seals, for minimum 300 psi working pressure, flange or union mounting, labeled for intended service.

2.05 PIPING

A. Hangers and Supports: MSS SP-58 with types as required by MSS SP-69.

B. Piping Identification: FS PPP-T-66, pressure sensitive adhesive tape and decals, color and labelling to conform with MIL-STD-101.

2.06 ACCESSORIES

A. Pressure Gages: ANSI B40.1, white dials and black lettering with restrictor, manufactured and labeled expressly for intended service and UL labeled.

B. Flexible Connectors: Corrugated flexible, single ply, seamless or seam-welded tubing of stainless steel or bronze or reinforced TFE bellows or hose.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions and NFPA 99.

B. Pre-Installation Cleaning: Disassemble positive pressure gas systems pipe, fittings, valves, and components, except those supplied cleaned and prepared for intended service, and thoroughly wash in hot solution of sodium carbonate or trisodium phosphate mixed one pound to 3 gallons of water. After washing, rinse with water, dry and cap until installation.

C. Effect changes in size with reducing fittings. Make changes in direction of required turns or offsets with fittings or tubing shaped by bending tools. Bends shall be free of flattening, buckling or thinning of tube wall.

D. Cut pipe and tubing accurately and install without springing or forcing.

E. Grade piping down in direction of flow.

F. Provide pipe sleeves where pipes and tubing pass through walls, floors, roofs, and partitions. Finish flush at both ends. Extend 2 inches above finished floors. Pack space between pipe or tubing and sleeve, and caulk.

G. Identify piping in accordance with MIL-STD 101, with tape and decals to FS PPP-T-66. Provide piping identification code and schematic. Refer to Section 220500. Labeling shall appear on pipe at intervals of not more than 20 feet and at least once in each room and each story traversed by pipe line.

H. Support gas piping with hangers suitable for size of pipe, spaced:
   1. 1/2 inch pipe or tubing: 72 inches.
   2. 3/4 inch or one inch pipe or tubing: 96 inches.
   3. 1-1/4 inches or larger (horizontal): 120 inches.
   4. 1-1/4 inches or larger (vertical): Every floor level.

I. Provide blowdown drip legs at all low points in the system.

J. Coordinate all outlet locations and mounting heights with owner and equipment manufacturers prior to beginning installation.

K. Install moisture drip leg with ball valve and spill to exterior finished grade. Slope all piping to moisture drip leg.

3.02 PIPING SYSTEMS CLEANING AND PRESSURE TESTING

A. After erection of pipe and tubing but prior to installation of service outlet valves, blow systems clear of free moisture and foreign matter.

B. Install service outlet valves, subject system to test pressure of 150 psig with nitrogen or dry compressed air. Check with soapy water. Provide 24-hour standing pressure test.

END OF SECTION

SECTION 22 34 00
FUEL-FIRED DOMESTIC WATER HEATERS

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes the following fuel-fired water heaters:
   1. Commercial, power direct-vent, storage, gas water heaters.

1.02 RELATED SECTIONS

A. Section 22 05 00 – Common Work Results for Plumbing.

B. Section 22 05 29 – Hangers and Supports for Plumbing Piping and Equipment.

C. Section 22 07 00 – Plumbing Insulation.

D. Section 22 11 16 – Domestic Water Piping.

1.03 REFERENCES

A. ANSI/ASHRAE 90A - Energy Conservation in New Building Design.

B. ASME Section VIIID - Pressure Vessels; Boiler and Pressure Vessel Codes.

C. ANSI/NFPA 30 - Flammable and Combustible Liquids Code.

D. ANSI/NFPA 54 - National Fuel Gas Code.

E. ANSI/NFPA 70 - National Electrical Code.

F. ANSI/UL 1453 - Electric Booster and Commercial Storage Tank Water Heaters.

1.04 SUBMITTALS

A. Product Data: For each type and size of water heater indicated. Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Operation and maintenance data.

D. Warranty.

1.05 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. ASME Compliance: Where ASME-code construction is indicated, fabricate and label commercial water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

C. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9" for all components that will be in contact with potable water.

D. Perform work in accordance with State and local standards.

E. Provide pumps with manufacturer's name, model number, and rating/capacity identified.

F. Ensure products and installation of specified products are in conformance with recommendations and requirements of the following organizations:
   1. American Gas Association (AGA).

2. National Sanitation Foundation (NSF).
3. American Society of Mechanical Engineers (ASME).
4. National Board of Boiler and Pressure Vessel Inspectors (NBBPVI).
5. National Electrical Manufacturer's Association (NEMA).
6. Underwriters Laboratories (UL).

G. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, operate within 25 percent of midpoint of published maximum efficiency curve.

1.06 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of fuel-fired water heaters that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Structural failures including storage tank and supports.
      b. Faulty operation of controls.
      c. Deterioration of metals, metal finishes, and other materials beyond normal use.
   2. Warranty Period(s): From date of Substantial Completion:
      a. Commercial, Gas Water Heaters: Three years.

1.07 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data under provisions of Section 017823.

B. Include operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Section 016000.

B. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
   2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 COMMERCIAL, GAS WATER HEATERS

A. Commercial, Atmospheric, Storage, Gas Water Heaters: Comply with ANSI Z21.10.3/CSA 4.3.
   1. Manufacturers:
      a. Lochinvar.
      b. A.O. Smith.
      c. State Industries, Inc.
      d. Owner shall approve final selection to standardize maintenance and service across multiple sites.

2. Storage-Tank Construction: ASME-code steel with 150-psig [1035-kPa] working-pressure rating.
    a. Tappings: Factory fabricated of materials compatible with tank. Attach tappings to tank before testing.
        1. NPS 2 (DN 50) and Smaller: Threaded ends according to ASME B1.20.1.
        2. NPS 2-1/2 (DN 65) and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges, and according to ASME B16.24 for copper and copper-alloy flanges.
    b. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
3. Factory-Installed, Storage-Tank Appurtenances:
    a. Anode Rod: Replaceable magnesium.
    b. Dip Tube: Provide unless cold-water inlet is near bottom of tank.
    c. Drain Valve: Corrosion-resistant metal complying with ASSE 1005.
    d. Insulation: Comply with ASHRAE/IESNA 90.1. Surround entire storage tank except connections and controls.
    e. Jacket: Steel with enameled finish.
    f. Burner: For use with atmospheric water heaters and for natural-gas fuel.
    g. Automatic Ignition: ANSI Z21.20, electric, automatic, gas-ignition system.
    h. Temperature Control: Adjustable thermostat.
    i. Safety Controls: Automatic, high-temperature-limit and low-water cutoff devices or systems.
    j. Combination Temperature and Pressure Relief Valves: ANSI Z21.22/CSA 4.4. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select one relief valve with sensing element that extends into storage tank.
4. Special Requirements: NSF 5 construction.
5. Draft Hood: Draft diverter; complying with ANSI Z21.12.
6. Automatic Damper: ANSI Z21.66, electrically operated automatic-vent-damper device with size matching draft hood.
7. Energy Management System Interface: Normally closed dry contacts for enabling and disabling water heater.

2.03 WATER HEATER ACCESSORIES

A. Gas Shutoff Valves: ANSI Z21.15/CGA 9.1, manually operated. Furnish for installation in piping.

B. Gas Pressure Regulators: ANSI Z21.18, appliance type. Include pressure rating, capacity, and pressure differential required between gas supply and water heater.

C. Gas Automatic Valves: ANSI Z21.21, appliance, electrically operated, on-off automatic valve.

D. Water Heater Mounting Brackets: Water heater manufacturer's factory-fabricated steel bracket for wall mounting and capable of supporting water heater and water.

E. Drain Pans: Corrosion-resistant metal with raised edge. Provide dimensions not less than base of water heater and include drain outlet not less than NPS 3/4 (DN 20).

F. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1 or ASHRAE 90.2.

2.04 CIRCULATION PUMP

A. Approved Manufacturers: Grundfos.

B. As scheduled on drawings, suitable for 125 working pressure with:
   1. Mechanical shaft seal.
   2. 115 V, single phase motor with thermal overload protection.
   3. Flexible shaft coupling.

C. Provide Honeywell L4006 series aquastat set to stop pump motor when return line water temperature is 115°F and to start pump when return water temperatures drops to 105°F.

PART 3 - EXECUTION

3.01 WATER HEATER INSTALLATION

A. Install commercial water heaters on concrete bases.
   1. Exception: Omit concrete bases for commercial water heaters if installation on stand, bracket, suspended platform, or direct on floor is indicated.
   2. Concrete base construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."

B. Install water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.

C. Install gas water heaters according to NFPA 54.
   1. Install gas shutoff valves on gas supplies to gas water heaters without shutoff valves.
   2. Install gas pressure regulators on gas supplies to gas water heaters without gas pressure regulators if gas pressure regulators are required to reduce gas pressure at burner.
   3. Install automatic gas valves on gas supplies to gas water heaters, if required for operation of safety control.

D. Install combination temperature and pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial, water-heater, relief-valve outlet, with drain piping same as domestic water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

E. Install water heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for water heaters that do not have tank drains. Refer to Division 22 Section "Domestic Water Piping Specialties" for hose-end drain valves.

F. Install thermometer on outlet piping of water heaters. Refer to Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers.

G. Install piping-type heat traps on inlet and outlet piping of water heater storage tanks without integral or fitting-type heat traps.

H. Fill water heaters with water.

I. Provide dielectric unions at each piping connection to water heaters.

J. HVAC Contractor shall provide combination air and flue gas vents through roof as required.

K. Install condensate drains in downward pitch to floor drains. Provide condensate neutralization kit.

L. Spill relief drains directly over floor drain.

M. Install piping adjacent to water heaters to allow service and maintenance. Arrange piping for easy removal of water heaters.

N. Refer to manufacturer's installation instructions and provide clearances as directed by manufacturer.

3.02 CONNECTIONS

A. Install piping adjacent to water heaters to allow service and maintenance. Arrange piping for easy removal of water heaters.

B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.03 FIELD QUALITY CONTROL

A. Engage a factory-authorized service representative to inspect installation, including connections.

B. Perform the following field tests and inspections:
   1. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
   2. Operational Test: After electrical circuitry has been energized, confirm proper operation.
   3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Remove and replace water heaters that do not pass tests and inspections and retest as specified above.

3.04 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain commercial water heaters. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION

SECTION 22 40 00
PLUMBING FIXTURES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Plumbing fixtures.

1.02 RELATED WORK

A. Section 06 41 00 - Architectural Casework.

B. Section 07 90 05 - Joint Sealers.

C. Section 10 28 00 - Toilet and Bath Accessories.

D. Section 22 05 29 - Hangers and Supports for Plumbing Piping and Equipment.

E. Section 22 11 16 - Domestic Water Piping.

F. Section 22 11 19 - Domestic Water Piping Specialties.

G. Section 22 13 16 - Sanitary Waste and Vent Piping.

H. Section 22 13 19 - Sanitary Waste Piping Specialties.

I. Section 22 34 00 - Fuel Fired Domestic Water Heaters.

1.03 REFERENCES

A. ANSI/ASME A112.6.1 - Supports for Off-the-Floor Plumbing Fixtures for Public use.

B. ANSI/ASME A112.18.1 - Finished and Rough Brass Plumbing Fixture Fittings.

C. ANSI/ASME A112.19.1 - Enameled Cast Iron Plumbing Fixtures.

D. ANSI/ASME A112.19.2 - Vitreous China Plumbing Fixtures.

E. ANSI/ASME A112.19.4 - Porcelain Enameled Formed Steel Plumbing Fixtures.

F. ANSI/ASME A112.19.5 - Trim for Water-Closet Bowls, Tanks, and Urinals.

G. ANSI/ARI 1010 - Drinking Fountains and Self-Contained Mechanically Refrigerated Drinking Water Coolers.

1.04 QUALITY ASSURANCE

A. Fixtures: By same manufacturer for each product specified throughout.

B. Trim: By same manufacturer for each product specified throughout.

1.05 SUBMITTALS

A. Submit product data under provisions of Section 01 33 00.

B. Product Data: Provide catalog illustrations of fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.

1.06 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data under provisions of Section 01 78 21.

B. Maintenance Data: Include fixture trim exploded view and replacement parts lists.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Section 01 10 00.

B. Accept fixtures on site in factory packaging. Inspect for damage.

C. Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.

1.08 FIELD MEASUREMENTS

A. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.

B. Confirm that millwork is constructed with adequate provision for the installation of countertop lavatories and sinks.

1.09 WARRANTY

A. Provide five year manufacturer's warranty under provisions of Section 01 77 70.

B. Warranty: Include coverage of electric water cooler compressor.

PART 2 - PRODUCTS

2.01 PLUMBING FIXTURES

A. Plumbing fixtures shall be equal to type and manufacturer scheduled on the drawings.

B. Approved manufacturers:
   1. Water closets, urinals, lavatories, and service sinks: Kohler, American Standard and Zurn.
   2. Drinking fountains: Halsey-Taylor, Oasis and Elkay.
   3. Faucets: Kohler, American Standard, Delta, Chicago, Elkay, Zurn, Sloan.
   4. Flush Valves: Zurn, Sloan, American Standard.
   5. Sinks: Elkay, Just.
   6. Mop Sinks: Stern Williams, Fiat, Florestone.
   7. Traps and Supplies: Kohler, Zurn, McGuire, T&S Brass.

C. All faucets, flush valves and accessories shall be certified as lead-free by the manufacturer.

PART 3 - EXECUTION

3.01 INSPECTION

A. Review millwork shop drawings. Confirm location and size of fixtures and openings **before** rough-in and installation.

B. Verify adjacent construction is ready to receive rough-in work of this Section.

3.02 EXAMINATION

A. Verify that walls and floor finishes are prepared and ready for installation of fixtures.

B. Verify that electric power is available and of the correct characteristics.

3.03 PREPARATION

A. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.

3.04 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install each fixture with mechanical joint trap, easily removable for servicing and cleaning.

C. Provide chrome plated rigid supplies to fixtures with stops, reducers, and escutcheons.

D. Install components level and plumb.

E. Install and secure fixtures in place with wall supports, wall carriers, and bolts as indicated.

F. Seal fixtures to wall and floor surfaces with sealant as specified in Section 07 90 05, color to match fixture.

G. Cover all floor drains during construction to prevent construction debris from entering the plumbing system.

H. Cap all plumbing waste outlets during construction until fixtures are installed.

I. Mount fixtures to heights as indicated on the drawings.

J. Brass nipples shall be used for wall hung urinal waste outlets. "No Substitute".

K. Solidly attach water closets to floor with lag screws. Lead flashing is not intended to hold fixture in place.

3.05 INTERFACE WITH OTHER PRODUCTS

A. Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.

3.06 ADJUSTING

A. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

3.07 CLEANING

A. At completion clean plumbing fixtures and equipment.

3.08 PROTECTION OF FINISHED WORK

A. Protect all finished work. Replace all damaged fixtures.

3.09 FIXTURE HEIGHTS

A. Fixtures shall be mounted at heights as indicated on the architectural drawings.

3.10 FIXTURE TRAPS

A. P-traps serving public plumbing fixtures shall meet ASME / ASNI A112.18.1M or IAPMO / UPC requirements. P-traps shall be cast brass construction with adjustable rotation on tube outlet, slip-point inlet, and cleanout plug. The inlet and outlet shall be 1-1/2" O.D.

B. Offset drains serving public plumbing fixture shall meet ASME / ANSI A112.18.1M or IAPMO / UPC requirements. The drain is intended for lavatory installations shall be brass construction with grid drain, 6" offset, and 1-1/4" connection.

END OF SECTION

SECTION 23 05 00

COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.01 WORK INCLUDED

A. This Section includes the following:
   1. Piping materials and installation instructions common to most piping systems.
   2. Dielectric fittings.
   3. Mechanical sleeve seals.
   4. Sleeves.
   5. Escutcheons.
   6. Supports and anchorages.
   7. Equipment installation requirements common to equipment sections.
   8. Concrete bases.
   9. Sealing of Duct and Pipe Penetrations.
   10. Mechanical Identification.
   11. Coordination with Building Commissioning

1.02 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.03 SUBMITTALS

A. Welding certificates.

1.04 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

C. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."

D. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

E. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting

electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.05 COORDINATION

A. For purposes of clearness and legibility, drawings are essentially diagrammatic, and, although size and location of equipment are drawn to scale wherever possible, the contractor shall make use of all data in all of the contract documents and shall verify this information at the building site. **THE DESIGN DRAWINGS ARE NOT INTENDED AS SHOP DRAWINGS AND THE CONTRACTOR SHALL VERIFY ALL SPACE REQUIREMENTS AND CLEARANCES FOR THE INSTALLATION OF THE MECHANICAL WORK WITH THE WORK OF ALL OTHER TRADES PRIOR TO BEGINNING ANY DUCT OR PIPE FABRICATION OR INSTALLATION.** Failure to properly coordinate all work prior to installation shall result in the contractor correcting all misplaced work at no cost to the Owner.

B. The drawings indicate required size and points of termination of pipes and ducts, and suggest proper routes of pipe to conform to structure, avoid obstructions and preserve clearances. However, it is not intended that drawings indicate all necessary offsets. Install piping and ducts in such a manner as to conform to structure, avoid obstructions, preserve headroom and keep openings and passageways clear without further instruction or cost to the Owner.

C. Shop drawings shall be furnished indicating all changes to meet space requirements, code requirements, and as necessary to resolve all space conflicts.

D. It is intended that all apparatus be located symmetrical with architectural elements, and shall be installed at exact height and locations as shown on the architectural drawings.

E. The Contractor shall fully inform himself regarding any and all peculiarities and limitations of the space available for the installation of all work and materials furnished and installed under the Contract. He shall exercise due and particular caution to determine that all parts of his work are made quickly and easily accessible.

F. In doing all work under this Contract, the Contractor shall carefully protect all existing lines which are to be maintained temporarily in service or which are not to be changed from any damage or discoloration, and shall make good, at his own expense, any damage done to such lines.

G. In performing the work under this Contract, it is possible that the contractor may encounter unknown underground utility lines. Such line may be lines which have or will be abandoned, inactive lines which it may be desired to preserve for future use, or active lines which must be preserved and either relocated or replaced.

H. Should the Contractor encounter any such unknown lines, he shall at once notify the Architect, who will determine whether they have been or may be abandoned or shall be preserved. The Engineer shall determine the character of the lines and, in the case of lines to be preserved, how best to care for them.

I. If the lines are found to have been or may be abandoned, the Contractor shall remove same to the extent necessary as directed by the Architect.

J. If it is found desirable or necessary to preserve the lines, they shall be capped off, relocated or otherwise cared for as directed by the Architect. In general, they shall be done by the trade having jurisdiction, but all contractors shall fully cooperate in such work.

K. All pavements, sidewalks damaged incident to construction work under this Contract shall be replaced by the Contractor as soon as possible in a manner satisfactory to the Architect, Owner, and governing authority, if applicable.

L. All manufactured articles, materials, and equipment shall be applied, installed, connected, erected, used, cleaned and conditioned, as directed by the manufacturers, unless herein specified to the contrary. Should there by a discrepancy between the installation shown on the drawings and/or specified and the manufacturers' directions and/or recommendations, this must be brought to the Architect's attention, and the procedure settled before proceeding with the work.

M. Contractor shall review each major unit of work to inspect the substrate to receive the work and conditions under which the work is to be performed. The installer shall report all unsatisfactory conditions in writing to the Architect. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the installer.

N. Where installations include manufactured products, comply with the manufacturer's applicable instructions and recommendations for installation, to the extent that these instructions and recommendations are more explicit or more stringent than requirements indicated in the contract documents.

O. Inspect each item of materials or equipment immediately prior to installation. Reject damaged and defective items.

P. Provide attachment and connection devices and methods for securing work. Secure work true to line and level, and within recognized industry tolerances. Allow for expansion and building movement. Provide uniform joint width in exposed work. Arrange joints in exposed work to obtain the best visual effect. Refer questionable visual effect choices to the Architect for final decision.

Q. Recheck measurements and dimensions of the work, as an integral step of starting each installation.

R. Install each unit of work during weather conditions and project status which will ensure the best possible results in coordination with the entire work. Isolate each unit of work from incompatible work as necessary to prevent deterioration. Take the necessary precautions to protect all installed work from ongoing construction and the work of other trades.

S. Coordinate enclosure of the work with required inspections and tests, so as to minimize the necessity of uncovering the work for that purpose.

T. Mounting Heights: Where mounting heights are not indicated, mount individual units of work at industry recognized standard mounting heights for the particular application indicated. Refer questionable mounting height choices to the Architect for final decision.

U. During handling and installation of work at the project site, clean and protect work in progress and adjoining work at the basis of continuous maintenance. Apply protective covering on installed work where it is required to ensure freedom from damage or deterioration at time of substantial completion.

V. Clean and perform maintenance on installed work as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

1.06 MAINTENANCE LOG

A. The contractor shall maintain an appropriate maintenance log, where applicable, of all interim maintenance tasks performed on all equipment started-up and/or operated during construction so that the manufacturer's warranties are not voided prior to the equipment being turned over to the owner. Maintenance logs shall be submitted to the owner as a part of the project close-out documentation when the building is released to the owner.

1.07 COMMISSIONING COORDINATION

A. The contractor shall be responsible for demonstrating their systems have been installed properly and are functioning in accordance with the design intent of the project documents. Refer to Sections 01 91 13 COMMISSIONING, 01 91 23 PERFORMANCE TESTING IDENTIFICATION FORM, 01 91 26 PERFORMANCE TESTING PROCEDURE FORM AND 01 91 29 FUNCTIONAL PERFORMANCE TEST CERTIFICATE in order to be apprised of, and to become familiar with their respective roles and responsibilities throughout the commissioning process.

PART 2 - PRODUCTS

2.01 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 23 piping sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.02 JOINING MATERIALS

A. Refer to individual Division 23 piping sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

E. Brazing Filler Metals: AWS A5.8, BCuP Series or BAg1, unless otherwise indicated.

F. Welding Filler Metals: Comply with AWS D10.12.

2.03 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.

D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.

E. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

F. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

2.04 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

2.05 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Cast-Brass Type: With set screw.
   1. Finish: Polished chrome-plated.

2.06 IDENTIFICATION TAGS AND MARKERS FOR MECHANICAL

A. Color: Unless specified otherwise, conform with ANSI/ASME A13.1.

B. Plastic Nameplates: Laminated three-layer plastic with 3/4" tall engraved black letters on light contrasting background color.

C. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inch diameter.

D. Plastic Pipe Markers: Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and fluid being conveyed.

E. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings indicating service and direction of flow (if applicable).

F. Underground Plastic Pipe Markers: Bright colored continuously printed plastic ribbon tape of not less than 6 inch wide by 4 mil thick, manufactured for direct burial service.

PART 3 - EXECUTION

3.01 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing. Where large ceiling cavity space exist, locate all valves and specialties within 18 inches of the ceiling access opening.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation. Size hangers for continuous insulation covering unless otherwise indicated.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Install escutcheons for penetrations of walls and ceilings where exposed to view in all finished spaces.

M. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, concrete floor, roof slabs and where necessary to comply with U.L. at rated wall penetrations.

N. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
   1. Install steel pipe for sleeves smaller than 8 inches in diameter.
   2. Install cast-iron "wall pipes" for sleeves 8 inches and larger in diameter.
   3. 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.

O. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
   1. 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.

P. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials. Also refer to Section 23 05 29.

Q. Verify final equipment locations for roughing-in.

R. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.02 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
   1. Comply with ASTM F 402, for safe-handling practice of cleaners, primers, and solvent cements.
   2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
   3. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
   4. PVC Nonpressure Piping: Join according to ASTM D 2855.

J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
   1. Plain-End Pipe and Fittings: Use butt fusion.
   2. Plain-End Pipe and Socket Fittings: Use socket fusion.

M. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.03 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:
   1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
   2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
   3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dis-similar metals.
   4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

5. Provide flanged pipe sections at pipe run outs to large equipment to permit piping to be easily dismantled for equipment removal.

3.04 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

B. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

C. Install equipment to allow right of way for piping installed at required slope.

D. Install all equipment per manufacturer's recommendations.

E. Do not locate rooftop mounted equipment to be closer to the edge of the roof than ten feet unless suitable parapet or protective guards are in place as required by the Mechanical Code. Verify all dimensions and clearances prior to final placement of equipment.

F. Ensure sufficient access for service and removal is provided for all mechanical equipment located in attic spaces. Ensure access openings are large enough to permit removal of equipment for replacement.

G. Do not locate HVAC fresh air intakes to be closer than 10 feet to any exhaust fan, exhaust fan discharge cap, flue vent, gas pressure regulator vent or sanitary VTR (coordinate with plumbing contractor). Pipe individual equipment natural gas pressure regulator vents (where applicable) to be minimum 10 feet away or a minimum of two feet higher than OA intake.

3.05 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to meet seismic requirements. All concrete bases for equipment shall be properly anchored to the building floor slab.

1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Install anchor bolts according to anchor-bolt manufacturer's written instructions. Seismic anchor bolts shall be used unless otherwise indicated.

3.06 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 Section "Metal Fabrications" for structural steel.

B. This contractor shall furnish and install all miscellaneous support members necessary for the proper support of all ductwork, equipment and piping. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment. Secure to the building structure.

C. Field Welding: Comply with AWS D1.1.

3.07 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor HVAC materials and equipment.

B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

D. Do not install combustible materials in return air plenums.

3.08 SEALING OF PENETRATIONS

A. All pipe and duct penetrations of walls, floors and partitions shall be sealed full perimeter to be completely "smoke tight" ; regardless of whether or not the wall, floor or partition is rated. Pipe penetrations of fire rated construction shall be sealed as specified in Section 23 05 29.

3.09 MECHANICAL IDENTIFICATION DEVICES

A. Plastic Nameplates: Install with corrosive-resistant mechanical fasteners or adhesive.

B. Plastic Tags: Install with corrosive-resistant chain.

C. Stencil Painting (Ductwork only): Apply in accordance with Section 09 90 00.

D. Plastic Pipe Markers: Install in accordance with manufacturer's instructions.

E. Plastic Tape Pipe Markers: Install complete around pipe in accordance with manufacturer's instructions.

F. Underground Plastic Pipe Markers: Install 6 to 8 inches below finished grade, directly above buried pipe.

G. Equipment: fans, air handlers, packaged units, make-up air units, condensing units, unit heaters, etc. and associated starters with engraved nameplates. Match the record drawings.

H. Controls: Identify control panels and major control components outside panels with engraved nameplates.

I. Piping: Identify piping, concealed or exposed, with plastic pipe markers. Omit only in areas where piping is run exposed to view in finished spaces as determined by the architect. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 10 feet on straight runs including risers and drops, adjacent to each valve and "T", at each side of penetration of structure or enclosure, and at each obstruction.

J. Ductwork: Identify ductwork with plastic markers or stencil painting with minimum 1" tall letters. Identify air handling unit, or fan served as well as service (supply, return, exhaust, outside air, etc). Omit on exposed ductwork in finished spaces.

K. Identify all duct access panels with stencil lettering per NFPA 90A.

L. Identify all HVAC motor starters with engraved tags.

END OF SECTION

SECTION 23 05 10

INDOOR AIR QUALITY MANAGEMENT PLAN

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. The contractor shall be responsible for providing and maintaining very high air quality for the duration of construction and upon Substantial Completion when the project is turned over to the owner.

1.02 REFERENCE STANDARDS

A. Sheet Metal and Air Conditioning Contractors National Association (SMACNA) IAQ Guidelines for Occupied Buildings under Construction, 2nd Edition 207, ANSI/SMACNA 008-2008 (Chapter 3).

B. Sheet metal and air conditioning Contractors' National Association, Inc., Duct cleanliness for new construction guidelines; SMACNA 2000. See SMACNA website for electronic copy (www.smacna.org).

1.03 SUBMITTALS

A. Indoor air quality plan documentation: Submit the following in accordance with SECTION 01 33 00 – SUBMITTALS:
   1. Submit for approval twenty (20) digital photographs of construction indoor air quality management measures such as protection of duct and on-site stored or installed absorptive materials.
   2. Submit cut sheet(s) of filtration media used during construction and installed immediately prior to occupancy with Minimum Efficiency Reporting Value MERV values highlighted.

1.04 PROJECT CONDITIONS

A. No smoking will be permitted in indoor Project site locations.

B. Protection:
   1. The General Contractor shall be responsible for protecting the Work from moisture, in order to prevent growth of fungus, bacteria and other biological contaminants.
   2. Install weatherproof enclosures to protect the work from exterior sources of moisture.
   3. Store construction materials in clean, dry area to prevent porous materials such as gypsum board, insulation, ceiling tile, wood and similar products from becoming wet.
   4. Moisture Stains: Materials with evidence of moisture damage, including stains, are not acceptable, including both stored and installed materials; immediately remove from site and properly dispose. Take special care to prevent accumulation of moisture on installed materials and within packaging during delivery, storage, and handling to prevent development of molds and mildew on packaging and on products.
      a. Immediately remove from site and properly dispose of materials showing signs of mold and signs of mildew, including materials with moisture stains.
      b. Replace moldy materials with new, undamaged materials.
   5. In the case that an unanticipated event permits the entry of water into new construction, the General Contractor shall perform procedures to dry out construction within 24 hours. Restoration drying techniques shall be employed to achieve and maintain conditions that will not support biological growth. Consider the use of desiccant drying, which is a very

effective way to prevent mold growth and accelerate drying of wet materials, including concrete.

a. Identify wet materials and remediate in accordance with the following publication: United States Environmental Protection Agency, 2001, "Mold Remediation in Schools and Commercial Buildings". See www.epa.gov/mold/mold_remediation.html or www.epa.gov/mold/images/moldremediation.pdf.
b. Construction that is not adequately dried out, or which shows evidence of biological growth, shall be removed immediately from the construction area and disposed of legally.
c. Where construction has been in contact with contaminated water, subsequent cleaning and decontamination shall be supervised by a qualified company as approved by the Owner

6. Duct Protection:
   a. Seal ducts during transportation, delivery, and construction to prevent accumulation of construction dust and construction debris inside ducts.
   b. Store ductwork in clean, dry conditions and keep ductwork sealed while it is stored.
   c. Wipe down internal surfaces of ductwork immediately prior to installation to remove dust.
   d. Seal open ends uncompleted ductwork and overnight for work in progress.
   e. During installation, protect ductwork waiting to be installed with surface wrapping, etc.

PART 2 - PRODUCTS

2.01 AIR INFILTRATION MEDIA

A. Minimum Efficiency Reporting Value (MERV) as determined by ASHRAE 52.2-1999:
   1. MERV-13 for filtration media installed at the end of construction.

PART 3 - EXECUTION

3.01 FIELD QUALITY CONTROL

A. Dust Protection: Protect HVAC supply and return openings from dust infiltration during dust producing activities (i.e. drywall installation and finishing.)

B. During construction, meet or exceed all of the following minimum requirements:
   1. Mold protection: Building materials, especially those like wood, porous insulation, paper, and fabric, should be kept dry to prevent the growth of mold and bacteria. Cover these materials with plastic to prevent rain damage, and if resting on the ground, use spacers to allow air to circulate between the ground and the materials. Water damaged materials should be dried within 24 hours. Due to the possibility of mold and bacteria growth, materials that are dam or wet for more than 72 hours may need to be discarded. Immediately remove materials showing signs of mold and mildew, including any with moisture stains, from the site and properly dispose of them. Replace moldy materials with new, undamaged materials.
   2. If *permanently installed* air handlers are used during construction, filtration media with a Minimum Efficiency Reporting Value (MERV) of 8 shall be used at each return air grille. (The procedure for determining MERV ratings is contained in ASHRAE 52.2-1999.) Replace all filtration media immediately prior to occupancy.

3. Filters: Replace all filtration media immediately prior to occupancy. Filtration media shall have a Minimum Efficiency Reporting Value (MERV) of 13 as determined by ASHRAE 52.2-1999.

3.02 CLEANING

A. Final Cleaning Environmental Issues:

1. Clean interior and exterior surfaces exposed to view; remove temporary labels, stains, and foreign substances.
2. Replace all air filters (i.e., pre and final filters) just prior to Substantial Completion.

3.03 PROTECTION

A. Environmental Issues:

1. Protect interior materials from water intrusion or penetration; where interior products not intended for wet applications are exposed to moisture, immediately remove from site and dispose of properly.
2. Protect installed products using methods that do not support growth of molds and mildews.
   a. Immediately remove from site materials with mold and materials with mildew.

END OF SECTION

SECTION 23 05 13

COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

B. Motor Controllers.

1.02 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
   1. Motor controllers.
   2. Torque, speed, and horsepower requirements of the load.
   3. Ratings and characteristics of supply circuit and required control sequence.
   4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.01 GENERAL MOTOR REQUIREMENTS

A. Comply with requirements in this Section except when stricter requirements are specified in HVAC equipment schedules or Sections.

B. Comply with NEMA MG 1 unless otherwise indicated.

2.02 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.

B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.03 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: Energy efficient, as defined in NEMA MG 1.

C. Service Factor: 1.15.

D. Multispeed Motors: Variable torque.
   1. For motors with 2:1 speed ratio, consequent pole, single winding.
   2. For motors with other than 2:1 speed ratio, separate winding for each speed.

E. Rotor: Random-wound, squirrel cage.

F. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

G. Temperature Rise: Match insulation rating.

H. Insulation: Class F.

2.04 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

A. Motors Used with Reduced-Voltage and Multi-speed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
   1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
   2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
   3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
   4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

2.05 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
   1. Permanent-split capacitor.
   2. Split phase.
   3. Capacitor start, inductor run.
   4. Capacitor start, capacitor run.

B. Multi-speed Motors: Variable-torque, permanent-split-capacitor type.

C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

D. Motors 1/20 HP and Smaller: Shaded-pole type.

E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

2.06 MOTOR CONTROLLERS

A. It shall be the responsibility of this section to furnish all required starters and motor controllers for all mechanical devices. Starters shall be equipped with all accessory inputs necessary to accomplish the specified sequence of operations.

B. Starters shall be mounted and wired by Division 26.

C. Starters shall be weatherproof where required.

D. Manual Controllers
   1. Manual Motor Controller: NEMA ICS 2,
      AC general-purpose Class A manually operated, full-voltage controller for overload element, red pilot light, auxiliary contact, and push button operator.
   2. Fractional Horsepower Manual Controller:
      NEMA ICS 2, AC general-purpose Class A manually operated, full-voltage controller for fractional horsepower induction motors, with thermal overload unit, pilot light, and toggle operator.

E. Magnetic Controllers

1. Magnetic starters shall be NEMA 2 or NEMA 4 (combination non-fused for 3-phase motors) type with auxiliary contacts as required to match the specified sequence of control. Starters shall be Furnas, Allen and Bradley or Cutler Hammer- no other substitutes.
2. Starters shall have solid state overload protection.
3. Auxiliary contacts shall be normally open or normally closed as required for proper control. Provide integral control transformers when required, with fused primary and secondary. Refer to the sequence of operations for all systems and provide auxiliary contacts at starters as necessary. (Including Fire Alarm System Interlock - Coordinate with Division 28).

PART 3 - EXECUTION

(Not Applicable)

END OF SECTION

SECTION 23 05 29

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Pipe, duct, and equipment hangers, supports, and associated anchors.

B. Equipment bases and supports.

C. Sleeves and seals.

D. Flashing and sealing equipment and pipe stacks.

E. Place hanger and support inserts and sleeves.

F. Through-penetration firestopping.

G. Roof Curbs.

H. Supports for Miscellaneous Roof Mounted Equipment.

I. Penetration Curbs.

1.02 REFERENCES

A. ANSI/ASME B31.1 - Power Piping.

B. U.L. Fire Resistant Directory. Through Penetration Fire Stop Systems for walls, floors, and partitions.

C. Sheetmetal and Air Conditioning Contractor's National Association (SMACNA) - HVAC Duct Construction Standards.

1.03 SUBMITTALS

A. Submit shop drawings and product data.

B. Indicate hanger and support framing and attachment methods.

C. Indicate U.L. system number for all Penetration Systems thru fire rated walls or partitions.

PART 2 - PRODUCTS

2.01 PIPE HANGERS AND SUPPORTS

A. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Carbon steel, adjustable swivel, split ring.

B. Hangers for Pipe Sizes 2 inches and over: Carbon steel, adjustable, clevis. Size clevis for continuous insulation covering for insulated pipes. Refer to 23 07 00.

C. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.

D. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.

E. Vertical Support: Steel riser clamp.

F. Un-insulated Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

G. Shield for Insulated Piping 1 inch and Smaller: 18 gage galvanized steel shield over insulation in 180 degree segments, minimum 12 inches long at pipe support.

H. Shields for Vertical Copper Pipe Risers: Sheet lead.

I. Floor or Grade Support: Cast iron adjustable pipe saddle with steel support. Floor flange bolted to floor for interior applications, concrete pier for exterior applications.

2.02 HANGER RODS

A. Steel Hanger Rods: Threaded both ends, threaded one end, or continuous threaded.

2.03 INSERTS

A. Inserts: Malleable iron case of (galvanized) steel and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.04 SLEEVES

A. Sleeves for Pipes Through Non-fire Rated Floors: Form with 18 gage galvanized steel.

B. Sleeves for Pipes Through Non-Fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Form with schedule 40 steel pipe.

C. Sleeves for Pipes Through Fire Rated and Fire Resistive Floors and Walls, and Fireproofing:

Schedule 40 steel with U.L. listed fire barrier caulk per the requirements of the U.L. Fire Resistance Directory Fire Stop System.

D. Sleeves for Round Ductwork: Form with galvanized steel.

E. Sleeves for Rectangular Ductwork: Form with galvanized steel.

F. Stuffing or Fire Stopping Insulation: As required by the applicable U.L. System for Through Penetration Fire Stop System.

G. Caulk: Per applicable U.L. Through Penetration Fire Stop Systems.

H. Wrap for insulated piping penetrations of rated walls and floors: Elastomeric intumescent wrap strip per U.L. Fire Resistance Directory - through Penetration Fire Stop Systems.

2.05 FABRICATION

A. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.

B. Design hangers without disengagement of supported pipe.

C. Provide copper plated hangers and supports for un-insulated copper piping.

2.06 FINISH

A. Prime coat all steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are included.

B. Provide one (1) prime coat and one (1) finish coat of paint on all exterior or interior exposed steel hangers and supports.

2.07 DUCT SUPPORTS

A. Ductwork supports, spacing, etc. shall be as directed by SMACNA and the International Mechanical Code.

B. Furnish and install all supplemental steel supports necessary for the proper support of all ductwork throughout the building. Coordinate with the building structure as required. Submit details of all proposed support systems for ductwork where exposed to view for review and approval prior to beginning and fabrication or installation.

C. All supports for exposed ducts shall be painted. Finished color as directed by the Architect.

2.08 THROUGH-PENETRATION FIRESTOPPING OF FIRE-RATED CONSTRUCTION

A. Systems or devices listed in the U.L. Resistance Directory under categories XHCR and XHEZ shall be used to protect all mechanical piping or conduit (temperature controls) penetrations of fire rated construction, the system used shall conform to the construction type, penetrant type, annular space requirements and fire rating involved in each separate instance. Systems or devices must be asbestos-free.

B. The systems withstand the passage of cold smoke either as an inherent property of the system, or by the use of a separate product included as a part of the U.L. system or device, and designed to perform this function.

C. Acceptable manufacturers and products shall be those listed in the U.L. Fire Resistance Directory for the U.L. System involved.

D. Fill, void or cavity materials: As classified under category XHHW in the U.L. Fire Resistance Directory.

E. Forming materials: As classified under category XHKU in the U.L. Fire Resistance Directory.

2.09 ROOF CURBS (EXCEPT SPRING CURBS)

A. Except where noted to be installed on spring isolation curbs, all rooftop equipment shall be installed on full perimeter roof mounting curbs sized to match the equipment to be installed per the manufacturer's recommendations. Curbs shall be constructed of **minimum 14 Ga.** Galvanized steel with wood nailer and rigid insulation. Minimum height from the finished roof surface to the top of the curb after installation shall be 12 inches - Coordinate with the height of the tapered roof insulation as shown on the drawings. Adjust curb heights (provide taller curbs) as required to ensure all units are at least 12" above the finished roof surface after installation. **All roof decking and insulation shall be continuous under the packaged rooftop units except for the duct openings.**

B. Provide curb-type equipment support rails for the support of all miscellaneous roof mounted equipment as noted on the plans. Thybar model TEMS or equivalent. Attach to the roof decking or structure per the mfgr's recommendations.

C. Fabrication: Welded 14 gage galvanized steel shell and base, mitered 3 inch cant, or variable step to match roof insulation, 1-1/2 inch thick insulation, and factory installed wood nailer.

D. Top of curbs shall be level, see plans for roof slopes and ridges and / or field verify slopes prior to ordering curbs. Field "shimming" of flat curbs for RTU's to match roof slope shall not be permitted.

2.10 SEISMIC SPRING CURBS WITH ACOUSTICAL TREATMENTS

A. Where noted on the plans and schedules, units shall be mounted on full perimeter spring isolation curb with acoustical treatments in lieu of manufacturer's standard roof curb. **All roof decking and insulation shall be continuous under the unit except for the duct openings**. The lower member shall consist of a rectangular steel tube containing adjustable and removable steel springs that support the upper floating section. The upper frame must provide continuous support for the equipment and must be captive so as to resiliently resist wind and seismic forces. All directional neoprene snubber bushings shall be a minimum of 1/4" thick. Steel springs shall rest on 1/4" neoprene acoustical pads and have a minimum deflection of 1-1/2". **Spring deflection and sizing shall be per the manufacturer's recommendations based on actual project conditions, unit weights, building structure, etc.** Hardware must be cadmium plated or galvanized and the springs plated or provided with an approved rust-resistant finish.

B. Weather proofing shall be provided by a continuous flexible aluminum seal jointed at the corners by EPDM bellows. The aluminum seal must be nailed over and provide counterflashing to the curb's waterproofing. Provision shall be made for access ports with waterproof covers at the spring location and 2" insulation on the sides of the lower curb.

C. The floating member of the roof curb shall have perimeter angle and cross members to support two layers of 5/8" waterproof sheetrock laid on with staggered joints. Sheetrock must surround ducts to provide a continuous sound break. This acoustical barrier shall be caulked to minimize sound transmission. Where the mechanical arrangement makes attachment to the floating member unfeasible, the barrier shall be attached at the highest practical elevation of the fixed curb with provision for 1" thick closed cell neoprene flexible seals around the ductwork. A four inch layer of 1.5 density fiberglass shall cover the entire solid roof surface under the unit. Ductwork shall be lined with sound absorbant material. Complete instructions shall be provided by the spring isolation curb manufacturer.

D. Curbs shall be pitched to match the roof slope and provide a level mounting platform for the units. Minimum curb height - from finished surface of the roof shall be 12 inches.

E. Curbs shall be MASON Industries, Inc. Type RSCA or equivalent.

2.11 MISCELLANEOUS MECHANICAL EQUIPMENT SUPPORTS / PENETRATIONS

A. All miscellaneous roof mounted equipment shall be installed on curb-type equipment support rails. Thycurb Model TEMs-1 or equivalent. Rails shall be minimum 12" tall and spacing shall be as required to provide proper level mounting for the equipment - coordinate with equipment manufacturer. Properly anchor equipment to support rails.

B. All piping penetrations of the roof shall be made using weatherproof pipe penetration curbs. Thycurb model TC-1 with removable TP-2 piping cover or equivalent. Seal full perimeter all piping penetrations to be weatherproof. Cut and patch existing roof as required.

PART 3 - EXECUTION

3.01 PIPE HANGERS AND SUPPORTS

A. Support horizontal piping as follows:

PIPE SIZE	MAX. HANGER SPACING	HANGER DIAMETER
1/2 to 1-1/4 inch	6'-6"	3/8"
1-1/2 to 2 inch	10'-0"	3/8"
2-1/2 to 3 inches	10'-0"	1/2"
4 to 6 inch	10'-0"	5/8"

B. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.

C. Place a hanger within **12 inches of each horizontal elbow.**

D. Use hangers with 1-1/2 inch minimum vertical adjustment.

E. Support riser piping independently of connected horizontal piping.

F. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.

3.02 EQUIPMENT BASES AND SUPPORTS

A. Provide templates, anchor bolts, and accessories for mounting and anchoring equipment.

B. Furnish and install all required supplemental supports for equipment, piping, ductwork, etc.

Construct supports of steel members or steel pipe and fittings. Brace and fasten with flanges bolted to structure.

C. Provide rigid anchors for pipes after vibration isolation components are installed.

D. Provide seismic anchors for all mechanical equipment and associated supports.

E. Install all roof mounted HVAC air conditioning units, fans, make-up air units, etc. on full perimeter insulated seismic roof curbs and/or seismic spring isolation curbs as noted. **All roof decking and insulation shall be continuous under the packaged rooftop units except for the duct openings.**

3.03 FLASHING AND SEALING OF PENETRATIONS

A. Provide flexible flashing and metal counterflashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.

B. Seal full perimeter **all** duct and pipe penetrations of walls, floors and partitions - whether or not the wall or floor is rated. Seal all exterior wall penetrations full perimeter to be completely weatherproof.

C. Seal all penetrations of smoke walls full perimeter to be completely smoke tight

3.04 SLEEVES

A. Set sleeves in position in formwork. Provide reinforcing around sleeves.

END OF SECTION

SECTION 23 05 48

SEISMIC BRACING FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 WORK INCLUDED

A. This Section includes the following:
   1. Restraining braces, cables and anchors for HVAC Equipment and Piping.
   2. Gas Piping Plan for Local Code Review and Approval
   3. Manufacturer's field observation of seismic component installation with letter of acceptance to local code authority.

1.02 PERFORMANCE REQUIREMENTS

A. Wind-Restraint Loading:
   1. Minimum 10 lb/sq. ft. multiplied by the maximum area of the HVAC component projected on a vertical plane that is normal to the wind direction, and 45 degrees either side of normal.

B. Seismic-Restraint Loading:
   1. As defined by local code and the authority having jurisdiction.
   2. Assigned Seismic Use Group or Building Category as Defined in the Building Code.

1.03 SUBMITTALS

A. Submittal Data Requirements
   1. The manufacturer of vibration isolation and seismic restraints shall provide submittals for products as follows:
      a. Descriptive Data:
         1) Catalog cuts or data sheets on vibration isolators and specific restraints detailing compliance with the specification.
         2) Detailed schedules of flexible and rigidly mounted equipment, showing vibration isolators and seismic restraints by referencing numbered descriptive drawings.
      b. Shop Drawings:
         1) Submit fabrication details for equipment bases including dimensions, structural member sizes and support point locations.
         2) Provide all details of suspension and support for ceiling hung equipment.
         3) Where walls, floors, slabs or supplementary steel work are used for seismic restraint locations, details of acceptable attachment methods for ducts, conduit and pipe must be included and approved before the condition is accepted for installation. Restraint manufacturers' submittals must include spacing, static loads and seismic loads at all attachment and support points.
         4) Provide specific details of seismic restraints and anchors; include number, size and locations for each piece of equipment.
         5) Provide a **gas piping plan** showing the locations of all required transverse and longitudinal restraints for **all new natural gas piping on this project**. Gas piping plan shall be prepared by the seismic bracing system manufacturer and must be sealed by an Engineer licensed in Tennessee. Submit to the office of local code enforcement with a copy to the architect and engineer.
      c. Seismic Certification and Analysis:

1) Seismic restraint calculations must be provided for all connections of equipment to the structure. Calculations must be stamped by a registered professional engineer with at least five years of seismic design experience, licensed in the state of the job location.
2) All restraining devices shall have a preapproval number from California OSHPD or some other recognized government agency showing maximum restraint ratings. Preapprovals based on independent testing are preferred to preapprovals based on calculations. Where preapproved devices are not available, submittals based on independent testing are preferred. Calculations (including the combining of tensile and shear loadings) to support seismic restraint designs must be stamped by a registered professional engineer with at least five years of seismic design experience and licensed in the state of the job location. Testing and calculations must include both shear and tensile loads as well as one test or analysis at 45° to the weakest mode.
3) Analysis must indicate calculated dead loads, static seismic loads and capacity of materials utilized for connections to equipment and structure. Analysis must detail anchoring methods, bolt diameter, embedment and/or welded length. All seismic restraint devices shall be designed to accept, without failure, the code required seismic forces acting through the equipment center of gravity. Overturning moments may exceed forces at ground level.

d. Field Services:
1) The seismic bracing manufacturer's representative shall visit the site and observe the installation of the seismic bracing components. Manufacturer's representative shall submit a letter to the office of local code enforcement assuring the proper installation of the seismic bracing components. Letter shall be submitted to local code enforcement prior to the first mechanical inspection and each subsequent inspection per local code requirements.

1.04 QUALITY ASSURANCE

A. Comply with seismic-restraint requirements in the International Building Code unless requirements in this Section are more stringent.

B. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

C. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If pre-approved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 - PRODUCTS

2.01 SEISMIC-RESTRAINT DEVICES

A. Provide seismic restraints in accordance with the requirements of the International Building Code for the following:
1. **All** natural gas piping. The 12" support rule does not apply to natural gas (high hazard) piping

2. All other piping in Mechanical Equipment Rooms 1-1/4" diameter and larger, all piping (other than gas) outside Mechanical Equipment Rooms 2-1/2" diameter and larger and all conduits 2-1/2" diameter and larger.
   Exception: Piping (other than gas) suspended by individual hangers 12 inches or less in length, (except gas piping) as measured from the top of the pipe to the bottom of the support where the hanger is attached, need not be braced.
3. All ducts with cross-sectional area 6 square foot or larger.
   Exception: No bracing is required if the duct is suspended by hangers 12 inches or less in length, as measured from the top of the duct to the bottom of the support where the hanger is attached. Hangers must be positively attached to the duct within 2 inches of the top of the duct with a minimum of two #10 sheetmetal screws.
4. All Mechanical equipment

B. Restraints for ductwork and piping (where required) shall be in accordance with the S.M.A.C.N.A. Seismic Restraint Manual as applicable for each portion of the work.

C. Where possible, hangers and supports for ducts and pipes shall not exceed a length of 12 inches.

D. Coordinate bracing methods with vibration isolation systems. Use cable restraints, in accordance with S.M.A.C.N.A. Restraint Manual, to prevent short circuiting vibration isolation devices.

E. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products and associated engineering and field observation services that may be incorporated into the work include:
   1. Mason Industries
   2. Kinetics Noise Control.
   3. Hilti, Inc.

F. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.

G. Restraint Cables: ASTM A 603 galvanized steel cables with end connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.

H. Hanger Rod Stiffener: Reinforcing steel angle clamped] to hanger rod.

I. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

J. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.

PART 3 - EXECUTION

3.01 APPLICATIONS

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application.

B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.02 SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Equipment Restraints:
   1. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
   2. Install seismic-restraint devices using methods approved by the seismic bracing component manufacturer and the authority having jurisdiction.

B. Piping Restraints:
   1. Comply with requirements in MSS SP-127.
   2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
   3. Brace a change of direction longer than 12 feet.

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install seismic-restraint devices using methods approved by the seismic bracing component manufacturer and the authority having jurisdiction.

E. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

F. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

G. Drilled-in Anchors:
   1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid pre-stressed tendons, electrical and telecommunications conduit, and gas lines.
   2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
   3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
   4. Set anchors to manufacturer's recommended torque, using a torque wrench.

3.03 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment.

3.04 FIELD QUALITY CONTROL

A. Manufacturer's representative for all seismic components shall review installation and verify systems are installed in accordance with the manufacturer's recommendation. Submit a review letter for local code enforcement.

3.05 ADJUSTING

A. Adjust isolators after piping system is at operating weight.

B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

C. Adjust active height of spring isolators.

D. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION

SECTION 23 05 93

TESTING, ADJUSTING AND BALANCING FOR HVAC

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Testing, adjustment, and balancing of air systems.

B. Measurement of final operating condition of HVAC systems.

1.02 REFERENCES

A. AABC - National Standards for Field Measurement and Instrumentation, Total System Balance.

B. ASHRAE - 1984 Systems Handbook: Chapter 37, Testing, Adjusting and Balancing.

C. NEBB - Procedural Standards for Testing, Balancing and Adjusting of Environmental Systems.

1.03 SUBMITTALS

A. Submit name of adjusting and balancing agency for approval within 30 days after award of Contract.

B. Prior to commencing work, submit draft reports indicating adjusting, balancing, and equipment data required.

C. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Architect/Engineer and for inclusion in operating and maintenance manuals.

D. Provide reports in soft cover, letter size, 3-ring binder manuals, complete with index page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.

E. Include detailed procedures, agenda, sample report forms.

1.04 QUALIFICATIONS

A. Independent contractor, **certified by AABC or NEBB** with minimum five years documented experience.

1.05 REPORT FORMS

A. Submit reports on AABC National Standards for Total System Balance.

B. Forms shall include the following information:

1. Title Page:
    a. Company name
    b. Company address
    c. Company telephone number
    d. Project name
    e. Project location
    f. Project Architect
    g. Project Engineer
    h. Project Contractor
    i. Project altitude
2. Instrument List:
    a. Instrument

b. Manufacturer
c. Model
d. Serial number
e. Range
f. Calibration date

3. Air Moving Equipment:
   a. Location
   b. Manufacturer
   c. Model
   d. Air flow, specified and actual
   e. Return air flow, specified and actual
   f. Outside air flow, specified and actual
   g. Total static pressure (total external), specified and actual
   h. Inlet pressure
   i. Discharge pressure
   j. Fan RPM
4. Fan Data:
   a. 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
5. Electric Motors:
   a. Manufacturer
   b. HP/BHP
   c. Phase, voltage, amperage; nameplate, actual, no load.
   d. RPM
   e. Service factor
   f. Starter size, rating, heater elements
6. Air Distribution Test Sheet:
   a. Air terminal number
   b. Room number/location
   c. Terminal type
   d. Terminal size
   e. Area factor
   f. Design velocity
   g. Design air flow
   h. Test (final) velocity
   i. Test (final) air flow
   j. Percent of design air flow
7. Return Air/Outside Air Data:
   a. Identification/location
   b. Design air flow
   c. Actual air flow

d. Design return air flow
e. Actual return air flow
f. Design outside air flow
g. Actual outside air flow
h. Return air temperature
i. Outside air temperature
j. Required mixed air temperature
k. Actual mixed air temperature
l. Design outside/return air ratio
m. Actual outside/return air ratio

8. Cooling Coil Test Data:
   a. Identification / Service
   b. Outside Air Temp - Summer (DB / WB)
   c. Return Air Temp - Summer (DB / WB)
   d. Cooling Coil Entering Air Temp - Summer (DB / WB)
   e. Cooling Coil Discharge Air Temp – Summer (DB / WB)
   f. Sensible Capacity (design versus actual)
   g. Total Capacity (design versus actual)
9. Heat Exchanger Test Data:
   a. Unit Manufacturer and Model No.
   b. Airflow (CFM)
   c. Outside Air Temp
   d. Return Air Temp
   e. Entering Air Temp
   f. Discharge Air Temp
   g. BTU/H Capacity (design versus actual)

1.06 QUALITY ASSURANCE

A. Agency shall be company specializing in the adjusting and balancing of systems specified in this Section with minimum five years documented experience. Perform Work under supervision of AABC or NEBB Certified Test and Balance Engineer.

B. Total system balance shall be performed in accordance with AABC National Standards for Field Measurement and Instrumentation, Total System Balance, ASHRAE - Systems Handbook.

1.07 SEQUENCING AND SCHEDULING

A. Sequence work to commence after completion of systems and schedule completion of work before Substantial Completion of Project.

PART 2 - PRODUCTS

A. This part is not used.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Before commencing work, verify that systems are complete and operable. Ensure the following:
   1. Equipment is operable and in a safe and normal condition.
   2. Temperature control systems are installed complete and operable.
   3. Proper thermal overload protection is in place for electrical equipment.

4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
5. Duct systems are clean of debris.
6. Correct fan rotation.
7. Fire and volume dampers are in place and open.
8. Coil fins have been cleaned and combed.
9. Access doors are closed and duct end caps are in place.
10. Air outlets are installed and connected.
11. Duct system leakage has been minimized. (All ducts are sealed)

B. Report any defects or deficiencies noted during performance of services to Architect/Engineer.

C. Promptly report abnormal conditions in mechanical systems or conditions which prevent system balance.

D. If, for design reasons, system cannot be properly balanced, report as soon as observed.

E. Beginning of work means acceptance of existing conditions.

3.02 PREPARATION

A. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Architect/Engineer to facilitate spot checks during testing.

B. Provide additional balancing devices as required.

3.03 INSTALLATION TOLERANCES

A. Adjust air handling systems to plus or minus 10 percent for supply return and exhaust systems from figures indicated.

3.04 ADJUSTING

A. Adjust work as necessary for final balance

B. Recorded data shall represent actually measured, or observed condition.

C. Permanently mark settings of dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

D. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.

E. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

F. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Owner.

G. Check and adjust systems approximately six months after final acceptance and submit report.

3.05 AIR SYSTEM PROCEDURE

A. Adjust air handling and distribution systems to provide required or design supply, return and exhaust air quantities at site altitude.

B. Measure air quantities at air inlets and outlets.

C. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.

D. Use volume control devices to regulate air quantities only to extent that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.

E. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.

F. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.

END OF SECTION

SECTION 23 07 00
HVAC INSULATION

PART 1 - GENERAL

1.01 REFERENCES

A. ANSI / ASTM C547 - Mineral Fiber Pre-Formed Pipe Insulation.

B. ANSI/ASTM C553 - Mineral Fiber Blanket and Felt Insulation.

C. ANSI/ASTM C612 - Mineral Fiber Block and Board Thermal Insulation.

D. ASTM E84 - Surface Burning Characteristics of Building Materials.

E. NFPA 255 - Surface Burning Characteristics of Building Materials.

F. UL 723 - Surface Burning Characteristics of Building Materials.

G. UL - Through Pipe Penetration Directory.

1.02 QUALITY ASSURANCE

A. Applicator: Company specializing in ductwork insulation application.

B. Materials: UL listed; flame spread/fuel contributed/smoke developed rating of 25 / 30 / 50 respectively in accordance with ASTM E84.

C. Insulation systems at pipe penetrations of fire rated construction shall be as required by UL - No exceptions. The requirements of UL shall supersede this section where pipes penetrate rated walls or floors.

1.03 SUBMITTALS

A. Include product description, list of materials and thickness for each service, and locations.

B. Submit manufacturer's installation instructions under provisions of Section 01 30 00.

1.04 DUCT SIZING

A. Duct sizes shown on the drawings are inside sheetmetal dimensions unless noted otherwise. Allowance has been made for internal liner where applicable.

PART 2 - PRODUCTS

2.01 DUCT INSULATION MATERIALS

A. Acceptable Manufacturer: Owens Corning Fiberglass Corporation.

B. Type "A" flexible glass fiber wrap, ANSI/ASTM C612, commercial grade "K" value of 0.29 at 75 degrees F minimum 0.75 pcf density; 0.002 inch foil scrim facing.

C. Type "B": Flexible glass fiber liner; ANSI/ASTM C553; 'k' value of 0.26 at 75 degrees F; 1.5 lb/cu ft minimum density; coated air side for maximum 4,000 ft/min air velocity.

D. Type “C”: Elastomeric External Insulation with 4-ply white Laminate Cover for exterior exposed ducts on the outside of the building. Flexible elastomeric duct wrap sheet insulation with exterior laminate weatherproof, UV resistant **white** covering having zero permeability.

E. Type “D”: Rigid glass fiber duct board, ASTM C411 rigid duct board insulation produced using glass fibers bonded with thermosetting resin with fire resistant foil-scrim-kraft vapor barrier outer jacketing. 2” thickness having minimum R-value of 8.7.

F. Adhesives: Waterproof fire-retardant type.

G. Lagging Adhesive: Fire resistive to ASTM E84.

H. Mechanical Liner Pins: Spot welded to duct with integral head or press-on head.

2.02 PIPE INSULATION

A. Type A: Glass fiber insulation: ANSI / ASTM C547; 'k' value of 0.24 at 75 degrees F; noncombustible as manufactured by Owens-Corning. All service kraft paper vapor barrier jacket.

B. Type B: Flexible closed cell insulation; "K" valve of 0.255 at 75 degrees F equal to Halstead or Armaflex. Tubular (for piping) or sheet type (for pump bodies, tanks, etc.)
   1. Joint Sealant: Closed cell elastomeric tape, 1/8" x 2" wide.
   2. Exterior Weatherproof Protective Sealant: Synthetic resin protective paint per mfgr.
   3. Pre-slit insulation is not acceptable.

2.03 PIPE INSULATION ACCESSORIES

A. Insulation Bands: 3/4 inch wide, stainless steel of 0.007 inch thick.

B. Insulating Cement: ANSI / ASTMC195; hydraulic setting mineral wool.

C. Finishing Cement: ASTM C449.

D. Fibrous Glass Cloth: Untreated; 9 oz / sq yd weight.

E. Weatherproof protective jacketing

PART 3 - EXECUTION

3.01 PREPARATION

A. Install materials after ductwork and piping have been tested and approved. Do not install insulation over heat traced piping until heat trace has been tested and approved.

B. Clean surfaces for adhesives.

3.02 DUCT INSULATION INSTALLATION

A. Install materials in accordance with manufacturer's instructions.

B. Butt and tape all duct wrap joints and seams per the manufacturer's installation instructions.

C. Where ducts are exposed to view, field paint insulation jacket – color per the architect

D. Do not install external insulation until all duct joints have been sealed.

E. Do not insulate exhaust air ducts

3.03 DUCT INSULATION SCHEDULE

INSULATION DUCTWORK	TYPE	THICKNESS	FINISH
Concealed Rectangular Supply, Return and Outside Air Ducts	A	3" (R10.2)	FSK
Rectangular Supply and Return where Exposed to View	A	3" (R10.2)	FSK (Field Painted)
Concealed Round Supply, Return and Outside Air Ducts	A	3" (R10.2)	FSK

3.04 PROTECTION OF WORK - DUCT INSULATION

A. Protect duct insulation at all times from damage and dust accumulation, before and after installation.

B. Protect stored insulation at the site with protective covers and elevated off the floor. Duct insulation shall not be allowed to get wet and any insulation that does get wet shall be discarded and not installed. Wet insulation shall not be permitted to "dry out" after getting wet. Any insulation allowed to get wet shall be un-acceptable for installation.

C. Protect open ends of ductwork and register openings in ductwork with covers to prevent construction dust build-up on the inside of the duct.

3.05 PIPING INSULATION INSTALLATION

A. Install materials in accordance with manufacturer's instructions.

B. Continue insulation with vapor barrier through all supports, penetrations, etc. except as noted.

C. In exposed piping, locate insulation and cover seams in least visible locations.

D. Neatly cutout and seal insulation at all cleanouts in drain piping. Seal to maintain insulation system vapor barrier.

E. Provide an insert, not less than 6 inches long, of same thickness and contour as adjoining insulation, between support shield and piping, but under the finish jacket, on piping 2 inches diameter or larger, to prevent insulation from sagging at support points. Inserts shall be cork or other heavy density insulating material suitable for the planned temperature range. Factory fabricated inserts may be used.

F. Neatly finish insulation at supports, protrusions, and interruptions.

G. Jackets:

1. Indoor, Concealed Applications: Insulated pipes conveying fluids ***above*** ambient temperature shall have standard all service jackets, with or without vapor barrier, factory-applied or field-applied. Insulate fittings and joints with factory pre-molded insulation of like material and thickness as adjoining pipe, and finish with glass cloth and adhesive. No exceptions. Neatly bevel and seal insulation where interrupted for valves, unions, strainers, etc. PVC fitting covers may be used over pre-molded fitting insulation. PVC elbow covers with fiberglass insulation stuffing shall not be used. No mitered elbows.
2. Indoor, Concealed Applications: Insulated pipes conveying fluids ***below*** ambient temperature (refrigerant and condensate drain pipes) shall have vapor barrier jackets, factory-applied. Insulate fittings, joints, and valves with **factory pre-molded insulation of like material and thickness as adjacent pipe, and finish with glass cloth and vapor barrier adhesive. PVC fitting covers and/or mitered insulation at fittings are not acceptable.**
3. Indoor, Exposed Applications: For pipe exposed in mechanical equipment rooms or in finished spaces, insulate as for concealed applications.
4. Provide 0.016" smooth weatherproof aluminum jacket for all type "A" pipe insulation located outside the building (pipe and fittings).
5. Type "B" closed cell type insulation shall be tubular and slipped over the pipe as the pipe sections are assembled. Firmly butt and seal insulation joints with mastic sealant per the insulation manufacturer's recommendations. Pre-slit insulation shall not be used.

3.06 SCHEDULE

PIPING	TYPE	PIPE SIZE	INSULATION THICKNESS INCH
Condensate Drains	A or B	All	1”
Refrigerant Piping	B	All	¾”

END OF SECTION

SECTION 23 08 00

MECHANICAL & CONTROL SYSTEMS COMMISSIONING

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. The Functional Performance Testing of the Mechanical Systems is essential to the operation and performance of the equipment and the completion of the project. Complete all inspections and tests prior to substantial completion of the Work.

PART 2 – PRODUCTS

2.01 TEST INSTRUMENTATION

A. The following are suggested testing instruments that could be used but similar types of instruments are acceptable. If the Designer determines that additional instruments are required, provide at no additional charge.

B. Recommended Instruments for Testing Purposes
   1. Shortridge Instruments: Air Data – Multimeter ADM – 860, 870 or 880
   2. EXTECH Instruments: Digital Psychrometer + InfraRed Thermometer RH401
   3. ThermoWorks: MTC Mini Handheld Thermocouple

PART 3 – EXECUTION

3.01 The Functional Performance Testing Procedures, approved by the Designer, will be used to document the inspection and testing of the equipment and systems. Provide all necessary manpower and have the appropriate subcontractor and/or manufacturer's representative present during the testing and demonstrate, to the Designers satisfaction, the full operation of all mechanical and control equipment and systems. Coordinate the schedule of the testing so that the Designer and Owner can be present.

A. Prior to starting the final testing of the systems, ensure that all equipment and systems were initially started-up and initialized as prescribed by the manufacturers instruction or by the manufacturer's representative and that the contractor has perform a complete operational test of all mechanical equipment and systems to ensure proper operation.

B. Review the Designer's inspection reports and correct all deficiencies.

C. Review the Test and Balance Report and correct all deficiencies.

D. Demonstrate the accuracy of 20% of the air readings; and, if more than 10% are incorrect by +/- 10% continue to check 50% of the report readings. If more than 10% of the additional readings are incorrect, have Test & Balance subcontractor recheck all readings.

E. Test and Balance readings that are verified will be recorded on the Terminal Box Point Calibration Check Sheet (see Division 23 group 08 specifications). The Designer may utilize the Test and Balance instruments furnished by the Test and Balance Contractor or provide their own instruments. All instruments utilized must have been calibrated within the past 12 months.

F. Demonstrate that all specified control equipment, software and system graphics are loaded into the operating system.

G. Check all control system control panels for cleanliness, neatness and that they are installed as specified.

H. Check the accuracy of all points and recorded readings on the Sensor Point Calibration Check Sheet (see Division 23 group 08 specifications).

I. In the event that the equipment, systems and/or sequences have been modified prior to the inspection and testing, document the modifications and correct the Performance Testing Procedures Form so that the system verification can continue.

J. Demonstrate the proper operation of the mechanical equipment and systems using the Performance Testing Identification Form and Performance Testing Procedures Forms approved by the Designer (see Division 01 group 91 specifications). During the testing, record on the forms the system response and point values to the operation. Record deficiencies corrected and retested.

K. Upon completion of the performance testing procedures, the Installer, General Contractor and Designers representatives, who observed the testing, will sign the Functional Performance Test Certification form (see Division 01 group 91 specifications) and attach deficiency list.
   1. Mechanical Systems
   2. Control System
   3. Domestic Hot Water System

L. Provide testing instruments, at no charge or the Designer may elect to provide their own instruments.

END OF SECTION

SECTION 23 05 00

SENSOR POINT CALIBRATION CHECK SHEET

Owner's Project Number:	166/ 000 04 2013 Y1	Page	of
Institution or Campus:	TCAT Crump, TN	Date:	
Building:		Tests run by:	
Installer:			

System/Unit Identifier:

Location:

List all sensors associated with this system or unit and verify the calibration, set point and location.

Sensor Description	Location Satisfactory (Y/N)	BAS Reading		Field Measurement Value	Action Required
		Set Point	Value		

NOTES:

SECTION 23 09 00
DDC BUILDING AUTOMATION SYSTEM

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Products Furnished but Not Installed Under This Section
B. Products Installed but Not Furnished Under This Section
C. related sections
D. Description
E. Approved Building Automation System Manufacturers
F. Quality Assurance
G. System Performance
H. Submittals
I. Warranty
J. System Maintenance
K. Remote Monitoring
L. Ownership of Proprietary Material
M. Building Level Utility (Electricity and Natural Gas) Metering/Monitoring

1.02 DESCRIPTION

A. The Building Automation System shall be an extension of and shall integrate with the existing Trane BAS currently in use at the T-CAT Bartlett satellite campus..

B. The Building Automation System shall be as indicated on the drawings and described in these specifications. System must be fully integrated and coordinated with mechanical equipment DDC controllers furnished and installed in the equipment manufacturer's factory as specified in those sections. The intent of the BAS is to integrate all NEW mechanical equipment into one system for global monitoring, control, and alarming associated with the building. It is the BAS manufacturer's responsibility to provide all the design, engineering, and field coordination required to ensure all equipment sequence of operations are met as specified and the designated BAS operators have the capability of managing the building mechanical system to ensure occupant comfort while maintaining energy efficiency.

C. The BAS shall meet both BACnet and Lontalk communication standards to ensure the system maintains "interoperability" to avoid proprietary arrangements that will make it difficult for the Owner t[o c]onsider other BAS manufacturers in future projects. The controllers listed under the scope of work shall be Siemens BACnet MSTP only at the B-ASC or B-AAC level and BACnet IP and BACnet MSTP at the B-BC level.

D. Controls provided by equipment manufactures shall be provided with BACnet MS/TP or BACnet IP interface. Controllers must allow for bi-directional data communication and all points needed to control equipment shall be made available to BAS contractor.

E. Direct Digital Control (DDC) technology shall be used to provide the functions necessary for control of mechanical systems and terminal devices on this project.

F. The BAS shall accommodate simultaneous multiple user operation. Access to the control system data should be limited only by operator password. Multiple users shall have access to all valid system data. An operator shall be able to log onto any workstation on the control system and have access to all appropriate data.

G. System software shall be based on a server/thin client architecture, designed around the open standards of web technology. The control system server shall be accessed using a Web browser over the control system network, the owner's local area network, and (at the owner's discretion) over the Internet. The intent of the thin-client architecture is to provide operators complete access to the control system via a Web browser. No special software other than a web browser shall be required to access graphics, point displays, and trends, configure trends, configure points and controllers, or to download programming into the controllers.

H. The mechanical systems shall be provided with factory mounted DDC controls that will permit each system to operate in a stand-alone fashion. As such, in the event of a BAS network communication failure, or the loss of an individual controller, the other DDC controllers shall continue to independently operate and communicate to the BAS. Field mounted controllers shall not be accepted on these systems.

I. Communication between DDC controllers and all workstation(s) shall be over a high-speed network. All nodes on this network shall be peers. The operator shall not have to know the controller identifier or location to view or control a point (object). Application Specific Controllers shall be constantly scanned by the Building Controllers to update point information and alarm information globally.

J. The BAS manufacturer shall provide all hardware and software necessary to implement the functions and sequence of operations specified.

K. For each applicable energy source below, provide utility meters or supplemental sub-meters integrated with the BAS to monitor and record building level energy use including current and historical energy demand and consumption for each fuel type as well as total energy consumption:
   1. Grid Provided Electricity
   2. Natural Gas

1.02 APPROVED BAS MANUFACTURERS

A. Manufacturers:
   1. Trane

1.03 QUALITY ASSURANCE

A. BAS Manufacturer Qualifications
   1. The BAS manufacturer must provide 24 hours/day, 7 days/week response in the event of a customer warranty or service call.
   2. The BAS Manufacturer shall have factory trained and certified personnel providing all engineering, service, startup, and commissioning field labor for the project from their local office location, including certification from VRF manufacture. BAS manufacturer shall be able to provide training certifications for all local office personnel upon request.
   3. The BAS shall be provided by a single manufacturer and this manufacturer's equipment must consist of operator workstation software, Web-based hardware/software, Open Standard Protocol hardware/software, Custom application Programming Language, Graphical Programming Language, Building Controllers, Custom Application Controllers, and Application Specific Controllers.

B. Codes and Standards: Meet requirements of all applicable standards and codes, except when more detailed or stringent requirements are indicated by the Contract Documents, including requirements of this Section.

1. Underwriters Laboratories: Products shall be UL-916-PAZX listed.
2. National Electrical Code – NFPA 70.
3. Federal Communications Commission – Part J.
4. ASHRAE/ANSI 135-2004 (BACnet) - (System Level Devices) - Building Controllers and PC Operator Workstations communicating on an Ethernet/IP protocol shall permit interoperability with other various building system manufacturers that are BACnet approved systems. (Unit level Devices) Custom Application Controllers and Application Specific Controllers shall utilize BACnet MS/TP communications.

C. All products used in this installation shall be currently manufactured, and shall have been applied to a minimum of three previous projects. This installation shall not be used as a test site for any new products unless explicitly approved by the Owner's representative in writing prior to bid date. Spare parts shall be available for at least 5 years after completion of this contract.

1.04 SYSTEM PERFORMANCE

A. Performance Standards. The BAS system shall conform to the following:
1. Graphic Display. The system shall display a graphic with a minimum of 20 dynamic points. All current data shall be displayed within 20 seconds of the operator's request.
2. Graphic Refresh. The system shall update all dynamic points with current data within 30 seconds.
3. Object Command. The maximum time between the command of a binary object by the operator and the reaction by the device shall be 10 seconds. Analog objects shall start to adjust within 10 seconds.
4. Object Scan. All changes of state and change of analog values shall be transmitted over the high-speed network such that any data used or displayed at a controller or workstation will be current within the prior 60 seconds.
5. Alarm Response Time. The maximum time from when an object goes into alarm to when it is annunciated at the workstation shall not exceed 30 seconds.
6. Program Execution Frequency. Custom and standard applications shall be capable of running as often as once every 5 seconds. The Contractor shall be responsible for selecting execution times consistent with the mechanical process under control.
7. Programmable Controllers shall be able to execute DDC PID control loops at a selectable frequency from at least once every 5 seconds. The controller shall scan and update the process value and output generated by this calculation at this same frequency.
8. Multiple Alarm Annunciations. All workstations on the network shall receive alarms within 5 seconds of each other.
9. Reporting Accuracy. Table 1 lists minimum acceptable reporting accuracies for all values reported by the specified system.

Table I – Reporting Accuracy

Measured Variable	Reported Accuracy
Space temperature	±1°F
Ducted air	±2°F
Outside air	±2°F
Water temperature	±1°F
Delta-T	±0.25°F

Relative humidity ±5% RH

Water flow ±5% of full scale

Air flow (terminal) ±10% of reading *Note 1

Air flow (measuring stations) ±5% of reading

Air pressure (ducts) ±25 Pa [±0.1 "W.G.]

Air pressure (space) ±3 Pa [±0.01 "W.G.]

Water pressure ±2% of full scale *Note 2

Electrical Power 5% of reading *Note 3

Carbon Monoxide (CO) ± 50 PPM

Carbon Dioxide (CO2) ± 50 PPM

Note 1: (10%-100% of scale) (cannot read accurately below 10%)

Note 2: for both absolute and differential pressure

Note 3: * not including utility supplied meters

1.05 SUBMITTALS

A. BAS manufacturer shall provide shop drawings and manufacturers' standard specification data sheets on all hardware and software being provided for this project. Submittals shall include a written sequence of operation for all systems and equipment. No work may begin on any segment of this project until the Engineer and Owner have reviewed submittals for conformity with the plan and specifications. Five (5) copies are required. All shop drawings shall be provided to the Owner electronically as .dwg or .dxf file formats once they have been approved and as-built drawings have been completed.

B. Provide the Engineer and Owner, any additional information or data which is deemed necessary to determine compliance with the specifications or which is deemed valuable in documenting and understanding the system to be installed.

C. Project Record Documents: Upon completion of installation, submit three (3) copies of record (as-built) documents. The documents shall be submitted for approval prior to final completion and include:
   1. Project Record Drawings - These shall be as-built versions of the submittal shop drawings. One set of electronic media including CAD .dwg or .dxf drawing files shall also be provided.
   2. Testing and Commissioning Reports and Checklists signed off by trained factory (equipment manufacturers) and field (BAS) commissioning personnel.
   3. Operating and Maintenance (O & M) Manuals - These shall be as-built versions of the submittal product data. In addition to the information required for the submittals, Operating & Maintenance manual shall include:
      a. Names, address and 24-hour/7-day per week telephone numbers of Contractor personnel managing and installing equipment, along with service personnel responsible for supporting the ongoing warranty and services of the control system.
      b. Procedures for operating the BAS including logging on/off, alarm management, generation of reports, trends, overrides of computer control, modification of setpoints, and other interactive system requirements.

c. Description of the programming language including syntax, statement descriptions, algorithms, calculations, point database creation and modification, program creation and modification, and operator use of the editor.
d. Explanation of how to design and install new points, new DDC controllers, and other BAS hardware.
e. Preventative Maintenance and calibration procedures; hardware troubleshooting; and hardware repair and/or replacement procedures.
f. Documentation of all software program logic created for Custom Programmable Controllers including the overall point database. Provide one set of magnetic media containing files of the software and point database.
g. One set of electronic media containing files of all operator color graphic screens for the project.
h. A list of recommended spare parts including pricing, manufacturer, supplier, and part numbers.
i. Documentation, installation, and maintenance information for all third party hardware/ software products provided including personal computers, printers, hubs, sensors, valves, etc.
j. Original issue media for all software provided, including operating systems, programming language, operator workstation software, and graphics software.
k. Licenses, Guarantee, and Warranty documents for all equipment and systems.
l. Recommended preventive maintenance procedures for all system components including a schedule of tasks (inspection, cleaning, calibration, etc.) and task descriptions.

D. Training Manuals: The BAS manufacturer shall provide a course outline and copies of training manuals at least two weeks prior to the start of any corporate training class to be attended by the Owner.

1.06 WARRANTY

A. Warrant all work as follows:
1. BAS system labor and materials shall be warranted free from defects for a period of twelve (12) months after final completion acceptance by the Owner. BAS failures during the warranty period shall be adjusted, repaired, or replaced at no charge to the Owner. The BAS manufacturer shall respond to the Owner's request for warranty service within 24 hours of the initiated call and will occur during normal business hours (8AM-5PM).
2. At the end of the final start-up/testing, if equipment and systems are operating satisfactorily to the Owner and Engineer, the Owner shall sign certificates certifying that the BAS is operational, and has been tested and accepted in accordance with the terms of this specification. The date of Owner's acceptance shall be the start of the warranty period.
3. Operator workstation software, project specific software, graphics, database, and firmware updates shall be provided to the Owner at no charge during the warranty period. Written authorization by the Owner must be granted prior to the installation of these updates.
4. The BAS manufacturer shall provide a web-accessible Users Network for the proposed System and give the Owner free access to question/answer forum, graphics library, user tips, upgrades, and training schedules for a one year period of time correlating with the warranty period.

1.07 SYSTEM MAINTENANCE

A. Perform Building Automation System preventative maintenance and support for a period of 1 year (beginning the date of substantial completion).
   1. Make a minimum of 2 complete Building Automation System inspections, in addition to normal warranty requirements. Inspections to include:
      a. System Review – Review the BAS to correct programming errors, failed points, points in alarm, and points that have been overridden manually.
      b. Seasonal Control Loop Tuning – Control loops are reviewed to reflect changing seasonal conditions and / or facility heating and cooling loads
      c. Sequence of operation verification – Systems all verified to be operating as designed and in automatic operation. Scheduling and setpoints are reviewed and modified.
      d. Database back-up
      e. Operator coaching
   2. Technician shall review critical alarm log and advise owner of additional services that may be required.
   3. Technician shall provide a written report to owner after each inspection.

B. Do not assign or transfer maintenance service to agent or subcontractor without prior written consent of owner.

1.08 OWNERSHIP OF PROPRIETARY MATERIAL

A. All project developed hardware and software shall become the property of the Owner. This includes but is not limited to:

B. Operator Graphic files

C. As-built hardware design drawings

D. Operating & Maintenance Manuals

E. BAS System software database

F. Controller application programming databases

G. Application Specific Controller configuration files

H. Advanced Application Controller configuration and programming files

I. Required Licensed software

1.09 COMMISSIONING COORDINATION

A. The contractor shall be responsible for demonstrating their systems have been installed properly and are functioning in accordance with the design intent of the project documents. Refer to Sections 01 91 13 COMMISSIONING, 01 91 23 PERFORMANCE TESTING IDENTIFICATION FORM, 01 91 26 PERFORMANCE TESTING PROCEDURE FORM AND 01 91 29 FUNCTIONAL PERFORMANCE TEST CERTIFICATE in order to be apprised of, and to become familiar with their respective roles and responsibilities throughout the commissioning process.

PART 2 - PRODUCTS

2.01 SECTION INCLUDES

A. General Description

B. Architecture/Communication

C. Operator Interface

D. Application and Control Software

E. System Controllers

F. Equipment Controllers

G. Auxiliary Control Devices

2.02 GENERAL DESCRIPTION

A. All products used in this installation shall be new, currently under manufacture, and shall be applied in similar installations for a minimum of 1 year. The installation shall not be used as a test site for any new products unless explicitly approved by the Owner's representative in writing. Spare parts shall be available for at least 5 years after completion of this contract.

2.03 ARCHITECTURE/COMMUNICATION

A. This project shall be comprised of a high speed Ethernet network utilizing BACnet/IP communications between System Controllers and Workstations. Communications between System Controllers and sub-networks of Custom Application Controllers and/or Application Specific Controllers shall utilize BACnet MSTP (RS485) communications.

1. Each System Controller shall perform communications to a network of Custom Application and Application Specific Controllers using BACnet/MSTP (RS485) as prescribed by the BACnet standard.
    a. Each System Controller shall function as a BACnet Router to each unit controller providing a unique BACnet Device ID for all controllers within the system.
2. Custom Application (Equipment) and Application Specific (Zone) Controllers shall meet the following communication requirements
    a. Communicate to Building Controller via BACnet MS/TP
    b. To ensure integration to the installed system and additions the Controller must be BTL Testing Lab listed for the following: Advance Applications Controller (B-AAC) or BACnet Application Specific Controllers (B-ASC).
    c. To allow maximum communications speed and co-existence with other controllers the Controller shall support at a minimum the following BACnet MS/TP master baud rate: 9600, 19200, 38400, 76800.
    d. In case of communications failure stand-alone operation shall use default values or last values for remote sensors read over the network such as outdoor air temperature.
    e. In the event of communication failure the Controller shall operate independently until communication is reestablished.
3. The Owner will provide all communication media, connectors, repeaters, network switches, and routers necessary for the high speed Ethernet network. An active Ethernet port will be provided adjacent to each System Controller and operator interface (PC) for connection to this high speed Ethernet network.
4. All values within the system (i.e. schedules, datalogs, points, software variables, custom program variables) shall be readable and controllable (where appropriate) by any System Controller or BACnet Workstation on the communications network via BACnet

2.04 OPERATOR INTERFACE

A. Building Automation System shall be implemented as a new BAS. Operator interface shall be accessible via a new owner BAS operator interface. The operator interface shall reside on the Enterprise wide network, which is same high-speed communications network as the System

Controllers. The Enterprise wide network will be provided by the owner and supports the Internet Protocol (IP).

B. Operator Interface
   1. The operator interface shall be accessible via a web browser.
   2. The operator interface shall support the following Internet web browsers:
      a. Internet Explorer 8.0+
      b. Firefox 4.0+
      c. Chrome 10.0+
   3. The operator interface shall support the following mobile web browsers:
      a. iOS (iPad/iPhone) V4.0+
      b. Android (Tablet) V4.0+
      c. Android (Phone) V2.3+
   4. System Security
      a. Each operator shall be required to login to the system with a user name and password in order to view, edit, add, or delete data.
      b. User Profiles shall restrict the user to only the objects, applications, and system functions as assigned by the system administrator.
      c. Each operator shall be allowed to change their user password
      d. The System Administrator shall be able to manage the security for all other users
      e. The system shall include pre-defined "roles" that allow a system administrator to quickly assign permissions to a user.
      f. User logon/logoff attempts shall be recorded.
      g. The system shall protect itself from unauthorized use by automatically logging off following the last keystroke. The delay time shall be user definable.
      h. All system security data shall be stored in an encrypted format.
   5. Database
      a. Database Save. A system operator with the proper password clearance shall be able to archive the database on the designated operator interface PC.
      b. Database Restore. The system operator shall also be able to clear a panel database and manually initiate a download of a specified database to any panel in the system.
   6. On-Line Help and Training
      a. Provide a context sensitive, on line help system to assist the operator in operation and configuration of the system.
      b. On-line help shall be available for all system functions and shall provide the relevant data for each particular screen.
   7. System Diagnostics
      a. The system shall automatically monitor the operation of all network connections, building management panels, and controllers.
      b. The failure of any device shall be annunciated to the operators.
   8. Equipment & Application Pages
      a. The operator interface shall include standard pages for all equipment and applications. These pages shall allow an operator to obtain information relevant to the operation of the equipment and/or application, including:
         1) Animated Equipment Graphics for each major piece of equipment and floor plan in the System. This includes:

a) ALL mechanical equipment that is controlled via the BAS. These graphics shall show all points dynamically as specified in the points list.
b) Animation capabilities shall include the ability to show a sequence of images reflecting the position of analog outputs, such as valve or damper positions. Graphics shall be capable of launching other web pages.

2) Alarms relevant to the equipment or application without requiring a user to navigate to an alarm page and perform a filter.
3) Historical Data (As defined in Automatic Trend Log section below) for the equipment or application without requiring a user to navigate to a data log page and perform a filter.

9. System Graphics. Operator interface shall be graphically based and shall include at least one graphic per piece of equipment or occupied zone, graphics for each chilled water and hot water system, Floorplan graphics, and graphics that summarize conditions on each floor of each building included in this contract. Floorplan graphics shall be created to represent the building layout and provide system equipment locations on the associated graphics.
   a. Functionality. Graphics shall allow operator to monitor system status, to view a summary of the most important data for each controlled zone or piece of equipment, to use point and-click navigation between zones or equipment, and to edit set points and other specified parameters.
   b. Graphic imagery – graphics shall use 3D images for all standard and custom graphics. The only allowable exceptions will be photo images, maps, schematic drawings, and selected floor plans.
   c. Animation. Graphics shall be able to animate by displaying different Image lies for changed object status.
   d. Alarm Indication. Indicate areas or equipment in an alarm condition using color or other visual indicator.
   e. Format. Graphics shall be saved in an industry-standard format such as BMP, JPEG, PNG, or GIF. Web-based system graphics shall be viewable on browsers compatible with World Wide Web Consortium browser standards. Web graphic format shall require no plug-in (such as HTML and JavaScript) or shall only require widely available no-cost plug-ins (such as Active-X and Macromedia Flash).
10. Custom Graphics
   a. The operator interface shall be capable of displaying custom graphics in order to convey the status of the facility to its operators.
   b. Graphical Navigation. The operator interface shall provide dynamic color graphics of building areas, systems and equipment.
   c. Graphical Data Visualization. The operator interface shall support dynamic points including analog and binary values, dynamic text, static text, and animation files.
   d. Custom background images. Custom background images shall be created with the use of commonly available graphics packages such as Adobe Photoshop. The graphics generation package shall create and modify graphics that are saved in industry standard formats such as GIF and JPEG.
11. Dashboard-style Graphics
   a. Graphics in the form of dashboards that provide "at-a-glance" views of operation shall be provided for controlled systems and subsystems.

1) Dashboards shall be provided in addition to standard operator interface screens that can be used for advanced-level diagnostics and system configuration.
2) Dashboards must allow, without any clicks, an operator to determine if the system depicted is operating as designed or if investigation is required.
3) Dashboards shall be customizable.
4) Dashboards shall reside in and be provided by enterprise, or system level devices that are part of the automation system.

b. Application dashboards shall provide a summary of the application conditions.
1) Application dashboards shall utilize [gauges, charts, bars, status points] or other similar "at a glance" representations to depict critical operating conditions as defined by user.
2) Application dashboards must depict the impact of system optimization strategies deployed.

12. Graphics Library. Furnish a library of standard HVAC equipment such as chillers, air handlers, terminals, fan coils, unit ventilators, rooftop units, and VAV boxes, in 3-dimensional graphic depictions. The library shall be furnished in a file format compatible with the graphics generation package program.
13. Manual Control and Override.
a. Point Control. Provide a method for a user to view, override, and edit if applicable, the status of any object and property in the system. The point status shall be available by menu, on graphics or through custom programs.
b. Temporary Overrides. The user shall be able to perform a temporary override wherever an override is allowed, automatically removing the override after a specified period of time.
c. Override Owners. The system shall convey to the user the owner of each override for all priorities that an override exists.
d. Provide a specific icon to show timed override or operator override, when a point, unit controller or application has been overridden manually.
14. Engineering Units
a. Allow for selection of the desired engineering units (i.e. Inch pound or SI) in the system.
b. Unit selection shall be able to be customized by locality to select the desired units for each measurement.
c. Engineering units on this project shall be IP.
15. Scheduling. A user shall be able to perform the following tasks utilizing the operator interface:
a. Create a new schedule, defining the default values, events and membership.
b. Create exceptions to a schedule for any given day.
c. Apply an exception that spans a single day or multiple days.
d. View a schedule by day, week and month.
e. Exception schedules and holidays shall be shown clearly on the calendar.
f. Modify the schedule events, members and exceptions.
g. Global Scheduling Support
1) Assign attributes for individual schedules in order to facilitate quick selection of similar schedules across multiple buildings.
2) The system shall allow ability to make changes to weekly schedules of all schedules in the system through single edit action.

3) Ability to apply an exception to any or all of the schedules in a system through a single edit action.
4) Allow user to specify different events for each day of the week when applying exceptions to schedules.
5) Allow user to enact an emergency schedule for any or all of the schedules in the system though a single click action.

16. Trend Logs
    a. Trend Logs Definition.
        1) The operator interface shall allow a user with the appropriate security permissions to define a trend log for any data in the system.
        2) The operator interface shall allow a user to define any trend log options as described in the Application and Control Software section.
    b. Trend Log Viewer.
        1) The operator interface shall allow Trend Log data to be viewed and printed.
        2) The operator interface shall allow a user to view trend log data in text-based (time –stamp/value).
        3) The operator shall be able to view the data collected by a trend log in a graphical chart in the operator interface.
        4) Trend log viewing capabilities shall include the ability to show a minimum of 5 points on a chart.
        5) Each data point trend line shall be displayed as a unique color.
        6) The operator shall be able to specify the duration of historical data to view by scrolling and zooming.
        7) The system shall provide a graphical trace display of the associated time stamp and value for any selected point along the x-axis.
    c. Export Trend Logs.
        1) The operator interface shall allow a user to export trend log data in CSV or PDF format for use by other industry standard word processing and spreadsheet packages.
17. Alarm/Event Notification
    a. An operator shall be notified of new alarms/events as they occur while navigating through any part of the system via an alarm icon.
    b. Alarm/Event Log. The operator shall be able to view all logged system alarms/events from any operator interface.
        1) The operator shall be able to sort and filter alarms from events. Alarms shall be sorted in a minimum of 4 categories based on severity.
        2) Alarm/event messages shall use full language, easily recognized descriptors.
        3) An operator with the proper security level may acknowledge and clear alarms/events.
        4) All alarms/events that have not been cleared by the operator shall be stored by the building controller.
        5) The alarm/event log shall include a comment field for each alarm/event that allows a user to add specific comments associated with any alarm.
    c. Alarm Processing.
        1) The operator shall be able to configure any object in the system to generate an alarm when transitioning in and out of a normal state.

2) The operator shall be able to configure the alarm limits, warning limits, states, and reactions for each object in the system.

18. Reports and Logs.
    a. The operator interface shall provide a reporting package that allows the operator to select reports.
    b. The operator interface shall provide the ability to schedule reports to run at specified intervals of time.
    c. The operator interface shall allow a user to export reports and logs from the building controller in a format that is readily accessible by other standard software applications including spreadsheets and word processing. Acceptable formats include:
        1) CSV, HTML, XML, PDF
    d. Reports and logs shall be readily printed to the system printer.
    e. Provide a means to list and access the last 10 reports viewed by the user.
    f. The following standard reports shall be available without requiring a user to manually configure the report:
        1) All Points in Alarm Report: Provide an on demand report showing all current alarms.
        2) All Points in Override Report: Provide an on demand report showing all overrides in effect.
        3) Commissioning Report: Provide a one-time report that lists all equipment with the unit configuration and present operation.
        4) Points report: Provide a report that lists the current value of all points
19. Air System. An operator shall be able to view and control (where applicable) the following parameters via the operator interface:
    a. Unit Status
    b. Unit Occupancy Status (Occupied, Un-occupied, Manual Over-ride)
    c. Space Temperature and Relative Humidity Setpoints
    d. Space Temperature
    e. Space Relative Humidity
    f. Space CO2 Level (Where Applicable - See Sequence)

2.05 APPLICATION AND CONTROL SOFTWARE

A. Furnish the following applications software for building and energy management. All software applications shall reside and run in the system controllers. Editing of applications shall occur at the operator interface.

1. Scheduling. Provide the capability to schedule each object or group of objects in the system. Each of these schedules shall include the capability for start, stop, optimal start, optimal stop, and night economizer actions. Each schedule may consist of up to [10] events. When a group of objects are scheduled together, provide the capability to define advances and delays for each member. Each schedule shall consist of the following:
    a. Weekly Schedule. Provide separate schedules for each day of the week.
    b. Exception Schedules. Provide the ability for the operator to designate any day of the year as an exception schedule. This exception schedule shall override the standard schedule for that day. Exception schedules may be defined up to a year in advance. Once an exception schedule is executed it will be discarded and replaced by the standard schedule for that day of the week.

c. Holiday Schedules. Provide the capability for the operator to define up to 99 special or holiday schedules. These schedules may be placed on the scheduling calendar and will be repeated each year. The operator shall be able to define the length of each holiday period.

d. Optimal Start. The scheduling application outlined above shall support an optimal start algorithm. This shall calculate the thermal characteristics of a zone and start the equipment prior to occupancy to achieve the desired space temperature at the specified occupancy time. The algorithm shall calculate separate sets of heating and cooling rates for zones that have been unoccupied for less then and greater than 24 hours. Provide the ability to modify the start algorithm based on outdoor air temperature. Provide an early start limit in minutes to prevent the system from starting before an operator determined time limit.

2. Trend Log Application
   a. Trend log data shall be sampled and stored on the System Controller panel and shall capable of being archived to a BACnet Workstation for longer term storage.
      1) Trend logs shall include interval, start-time, and stop-time.
      2) Trend log intervals shall be configurable as frequently as 1 minute and as infrequently as 1 year.
   b. Automated Trend Logs.
      1) The system controller shall automatically create trend logs for defined key measurements for each controlled HVAC device and HVAC application.
      2) The automatic trend logs shall monitor these parameters for a minimum of 7 days at 15 minute intervals. The automatic trend logs shall be user adjustable.
3. Alarm/Event Log
   a. Any object in the system shall be configurable to generate an alarm when transitioning in and out of a normal or fault state.
   b. Any object in the system shall allow the alarm limits, warning limits, states, and reactions to be configured for each object in the system.
   c. An alarm/event shall be capable of triggering any of the following actions:
      1) Route the alarm/event to one or more alarm log
         a) The alarm message shall include the name of the alarm location, the device that generated the alarm, and the alarm message itself.
      2) Route an e-mail message to an operator(s)
      3) Log a data point(s) for a period of time
      4) Run a custom control program
4. Point Control. User shall have the option to set the update interval, minimum on/off time, event notification, custom programming on change of events.
5. Timed Override. A standard application shall be utilized to enable/disable temperature control when a user selects on/cancel at the zone sensor, operator interface, or the local operator display. The amount of time that the override takes precedence will be selectable from the operator interface.
6. Anti-Short Cycling. All binary output points shall be protected from short cycling.

2.06 SYSTEM CONTROLLERS

A. There shall be one or more independent, standalone microprocessor based System Controllers to manage the global strategies described in Application and Control Software section.

1. The System Controller shall have sufficient memory to support its operating system, database, and programming requirements.
2. The controller shall provide a USB communications port for connection to a PC
3. The operating system of the Controller shall manage the input and output communications signals to allow distributed controllers to share real and virtual point information and allow central monitoring and alarms.
4. All System Controllers shall have a real time clock.
5. Data shall be shared between networked System Controllers.
6. The System Controller shall continually check the status of its processor and memory circuits. If an abnormal operation is detected, the controller shall:
    a. Assume a predetermined failure mode.
    b. Generate an alarm notification.
    c. Create a retrievable file of the state of all applicable memory locations at the time of the failure.
    d. Automatically reset the System Controller to return to a normal operating mode.
7. Environment. Controller hardware shall be suitable for the anticipated ambient conditions. Controller used in conditioned ambient shall be mounted in an enclosure, and shall be rated for operation at -40 F to 122 F.
8. Clock Synchronization.
    a. All System Controllers shall be able to synchronize with a NTP server for automatic time synchronization.
    b. All System Controllers shall be able to accept a BACnet time synchronization command for automatic time synchronization.
    c. All System Controllers shall automatically adjust for daylight savings time if applicable.
9. Serviceability
    a. Provide diagnostic LEDs for power, communications, and processor.
    b. The System Controller shall have a display on the main board that indicates the current operating mode of the controller.
    c. All wiring connections shall be made to field removable, modular terminal connectors.
    d. The System controller shall utilize standard DIN mounting methods for installation and replacement.
10. Memory. The System Controller shall maintain all BIOS and programming information indefinitely without power to the System controller
11. Immunity to power and noise. Controller shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shut-down below 80% nominal voltage
12. BACnet Test Labs (BTL) Listing. Each System Controller shall be listed as a Building Controller (B-BC) by the BACnet Test Labs.

2.07 EQUIPMENT CONTROLLERS

A. Advanced Application Controllers (AAC) shall be microprocessor-based DDC controllers which through hardware or firmware design control specified equipment. They are user programmable and are used to control equipment or applications of medium and high complexity. Examples are controllers for Air Handlers, Boiler Plants, Etc.
    1. For ease of troubleshooting, the Controller shall support data trend logging
        a. 25,000 samples minimum

b. Trends shall be capable of being collected at a minimum sample rate of once every second
c. Trends shall be capable of being scheduled or triggered.

2. To meet the sequence of operation for each application, the Controller shall use library programs provided by the controller manufacturer that are either factory loaded or downloaded with service tool to the Controller.
3. Environment. Controller hardware shall be suitable for the anticipated ambient conditions.
   a. Storage conditions:
      1) Temperature: -67°F to 203°F
      2) Humidity: Between 5% to 100% RH (non-condensing)
   b. Operating conditions:
      1) Temperature: -40°F to 158°F
      2) 'Humidity: Between 5% to 100% RH (non-condensing)
   c. Controllers used indoors shall be mounted in a NEMA 1 enclosure at a minimum
   d. Controllers used outdoors and/or in wet ambient shall be mounted within NEMA 4 type waterproof enclosures, and shall be rated for operation at -40 F to 158 F.
4. Input/Output: The Controller shall have on board or through expansion module all I/O capable of performing all functionality needed for the application. Controls provided by the equipment manufacture must supply the required I/O for the equipment. In addition other controls must meet the following requirements:
   a. Shall support flexibility in valve type, the controllers shall be capable of supporting the following valve control types 0-10VDC, 0-5VDC, 4-20mA, 24VAC - 2 position.
   b. Shall support flexibility in sensor type, the Controller shall be of reading sensor input ranges of 0 to10V, 0 to 20mA, 50ms or longer pulses, 200 to 20Kohm and RTD input.
   c. Shall support flexibility in sensor type, all Analog Outputs shall have the additional capability of being programmed to operate as Universal Inputs or Pulse Width Modulation Outputs.
   d. Shall support flexibility in sensor type, the Controller and/or expansion modules shall support dry and wetted (24VAC) binary inputs.
   e. The controller support pulse accumulator for connecting devices like energy meters.
   f. In order to support a wide range of devices, the Controller's binary output shall be able to drive at least 10VA each.
   g. Any I/O that is unused by functionality needed for the equipment shall be available to be used by custom program on the Controller and by any other controller on the network.
   h. The Controller shall provide 24VAC and 24VDC power terminals sensors and other devices required.
   i. The Controller shall provide a dedicated static pressure input.
5. Input/Output Expandability – The Controller shall provide the following functionality in order to meet current and future application needs:
   a. For the application flexibility, the Controller shall be capable of expanding to a total of at least 100 hardware I/O terminations.
   b. Expansion I/O can be mounted up to 200m from control
   c. Expansion I/O can be added in as small as 4 point increments.

d. To keep BACnet MS/TP network traffic to a minimum, expansion I/O must communicate via an internal controller communication bus (point expansion via the BACnet MS/TP network is not allowed)

6. Serviceability – The Controller shall provide the following in order to improve serviceability of the Controller.
   a. Diagnostic LEDs for power/normal operation/status, BACnet communications, sensor bus communications, and binary outputs. All wiring connections shall be clearly labeled and made to be field removable.
   b. Binary and analog inputs and outputs shall use removable connectors or be connected to terminal strip external to the control box
   c. Software service tool connection through all of the following methods: direct cable connection to the Controller, connection through another controller on BACnet link and through the Controller's zone sensor.
   d. For configuration, programming, and testing of controller programs must, for safety purposes, be able to be accomplished with the power off to the equipment and the controller.
   e. The Controller software tool service port shall utilize standard of-the-shelf USB printer cable.
   f. Capabilities to temporarily override the BACnet point values with built-in time expiration in the Controller.
   g. To aid in service replacement, the Controller shall easily attached to standard DIN rail mounting.
   h. For future expansion, the Controller shall be capable of adding sequence of operation programming utilizing service tools software with a graphical programming interface (editing or programming in line code is not permissible).
   i. To aid in service replacement, the Controller shall allow for setting its BACnet address must be rotary switches that correspond to a numerical value for the address to allow the setting of the address without the need of a service tool or the control being powered (DIP switch methodologies are not allowed).
   j. Controller data shall persist through a power failure.
7. Software Retention: All Controller operating parameters, setpoints, BIOS, and sequence of operation code must be stored in non-volatile memory in order to maintain such information for months without power.
8. Transformer for the Controller must be rated at minimum of 115% of ASC power consumption, and shall be fused or current limiting type. 24 VAC, +/- 15% nominal, 50-60 Hz, 24 VA plus binary output loads for a maximum of 12 VA for each binary output.
9. Controller must meet the following Agency Compliance:
   a. UL916 PAZX, Open Energy Management Equipment
   b. UL94-5V, Flammability
   c. FCC Part 15, Subpart B, Class B Limit
   d. BACnet Testing Laboratory (BTL) Listed
   e. cUL Marked for international compliance
   f. CE Marked for international compliance

B. Application Specific Controllers (ASC) shall be microprocessor-based DDC controllers which through hardware or firmware design control specified equipment. They are not user

programmable, but are customized for operation within the confines of the equipment they are designed to serve.

1. Application Specific Controller are only allowed when both the following
    a. The equipment is compressor based or boiler based and
    b. The controller is provided by the equipment manufacturer and warrantied as part of the equipment.

C. Zone Controllers are controllers that operate equipment that control the space temperature of single zone.
    1. Software
        a. To meet the sequence of operation for each zone control, the controller shall use programs developed and tested by the controller manufacturer that are either factory loaded or downloaded with service tool to the controller.
        b. Stand-Alone Operation: Each piece of equipment specified in section A shall be controlled by a single controller and provide stand-alone control in the event of communication failure. In case of communications failure stand-alone operation shall use default values or last values for remote sensors read over the network such as outdoor air temperature.
        c. For controlling ancillary devices and for flexibility to change to sequence of operation in the future, the controller shall be capable running custom programs written in a graphical programming language.
    2. Environment Controller hardware shall be suitable for the anticipated ambient conditions.
        a. Storage: -55 to 203 ºF and 5 to 95% Rh, non-condensing.
        b. Operating: -40 to 158 ºF and 5 to 95% Rh, non-condensing.
        c. Controllers used indoors shall be mounted in a NEMA 1 enclosure at a minimum
        d. Controllers used outdoors and/or in wet ambient shall be mounted within NEMA 4 type waterproof enclosures, and shall be rated for operation at -40 F to 158 F.
    3. Input/Output:
        a. For flexibility in selection and replacement of valves, the controllers shall be capable of supporting all of the following valve control types 0-10VDC, 0-5VDC, 4-20mA, 24VAC floating point, 24VAC - 2 position (Normally Open or Normally Closed).
        b. For flexibility in selection and replacement of sensors, the controllers shall be capable of reading sensor input ranges of 0 to10V, 0 to 20mA, pulse counts, and 200 to 20Kohm.
        c. For flexibility in selection and replacement of binary sensors, the controller shall support dry and wetted (24VAC) binary inputs.
        d. For flexibility in selection and replacement devices, the controller's shall have binary output which are able to drive at least 12VA each.
        e. For flexibility in selection and replacement of motors, the controller shall be capable of outputting 24VAC (binary output), DC voltage (0 to 10VDC minimum range) and PWM (in the 80 to 100 Hz range).
        f. For future needs, any I/O that is unused by functionality of equipment control shall be available to be used by custom program on the controller and by another controller on the network.
        g. For future expansion and flexibility, the controller shall have either on board or through expansion, 50 hardware input/output points. Expansion points must communicate with the controller via an internal communications bus. Expansion

points must be capable of being mounted up to 200 meters from the controller. Expansion points that require the BACnet network for communication with the controller are not allowed.

4. Serviceability – The controller shall provide the following in order to improve serviceability of the controller.
   a. Diagnostic LEDs shall indicate correct operation or failures/faults for all of the following: power, sensors, BACnet communications, and I/O communications bus.
   b. All binary output shall have LED's indicating the output state.
   c. All wiring connections shall removable without the use of a tool.
   d. Software service tool connection through all of the following methods: direct cable connection to the controller, connection through another controller on BACnet link and through the controller's zone sensor.
   e. For safety purposes, the controller shall be capable of being powered by a portable computer for the purposes of configuration, programming, and testing programs so that this work can be accomplished with the power off to the equipment.
   f. Capabilities to temporarily override of BACnet point values with built-in time expiration in the controller.
   g. BACnet Mack Address shall be set using decimal (0-9) based rotary switches.
   h. Configuration change shall not be made in a programming environment, but rather by a configuration page utilizing dropdown list, check boxes, and numeric boxes.
   i. BACnet trending objects resident on controller
      1) Minimum of 20,000 trending points total on controller
      2) Shall be capable of trending all BACnet points used by controller
      3) Shall be capable of 1 second sample rates on all points
5. Software Retention: All Zone Controller operating parameters, setpoints, BIOS, and sequence of operation code must be stored in non-volatile memory in order to maintain such information for months without power.
6. Transformer for the controller must be rated at minimum of 115% of ASC power consumption, and shall be fused or current limiting type. 24 VAC, +/- 15% nominal, 50-60 Hz, 24 VA plus binary output loads, for a maximum of 12 VA for each binary output.
7. Agency Approval: The controller shall have meet the Agency Compliance:
   a. UL916 PAZX, Open Energy Management Equipment
   b. UL94-5V, Flammability
   c. FCC Part 15, Subpart B, Class B Limit

2.08 AUXILIARY CONTROL DEVICES

A. Motorized dampers, unless otherwise specified elsewhere, shall be as follows:
   1. Damper frames shall be 16 gauge galvanized sheet metal or 1/8" extruded aluminum with reinforced corner bracing.
   2. Damper blades shall not exceed 8" in width or 48" in length. Blades are to be suitable for medium velocity performance (2,000 fpm). Blades shall be not less than 16 gauge.
   3. Damper shaft bearings shall be as recommended by manufacturer for application.
   4. All blade edges and top and bottom of the frame shall be provided with compressible seals. Side seals shall be compressible stainless steel. The blade seals shall provide for a maximum leakage rate of 10 CFM per square foot at 2.5" w.c. differential pressure.
   5. All leakage testing and pressure ratings will be based on AMCA Publication 500.

6. Individual damper sections shall not be larger than 48" x 60". Provide a minimum of one damper actuator per section.

B. Control dampers shall be parallel or opposed blade types as scheduled on drawings.

C. Electric damper/valve actuators.
   1. The actuator shall have electronic overload or digital rotation sensing circuitry to prevent damage to the actuator throughout the rotation of the actuator.
   2. Where shown, for power-failure/safety applications, an internal mechanical, spring return mechanism shall be built into the actuator housing.
   3. All rotary spring return actuators shall be capable of both clockwise or counter clockwise spring return operation. Linear actuators shall spring return to the retracted position.
   4. Proportional actuators shall accept a 0-10 VDC or 0-20 ma control signal and provide a 2-10 VDC or 4-20 ma operating range.
   5. All non-spring return actuators shall have an external manual gear release to allow manual positioning of the damper when the actuator is not powered. Spring return actuators with more than 60 in-lb. torque capacity shall have a manual crank for this purpose.
   6. Actuators shall be provided with a conduit fitting and a minimum 1m electrical cable and shall be pre-wired to eliminate the necessity of opening the actuator housing to make electrical connections.
   7. Actuators shall be Underwriters Laboratories Standard 873 listed.
   8. Actuators shall be designed for a minimum of 60,000 full stroke cycles at the actuator's rated torque.

D. Control Valves
   1. Control valves shall be two-way or three-way type for two-position or modulating service as scheduled or shown.
   2. Close-off (differential) Pressure Rating: Valve actuator and trim shall be furnished to provide the following minimum close-off pressure ratings:
      a. Water Valves:
         1) Two-way: 150% of total system (pump) head.
         2) Three-way: 300% of pressure differential between ports A and B at design flow or 100% of total system (pump) head.
      b. Steam Valves: 150% of operating (inlet) pressure.

E. Binary Temperature Devices
   1. Low-Voltage Space Thermostats shall be 24 V, bimetal-operated, mercury-switch type, with either adjustable or fixed anticipation heater, concealed setpoint adjustment, 55°F-85°F setpoint range, 2°F maximum differential, and vented cover.
   2. Line-Voltage Space Thermostats shall be bimetal-actuated, open-contact type or bellows actuated, enclosed, snap-switch type or equivalent solid-state type, with heat anticipator, UL listing for electrical rating, concealed setpoint adjustment, 55°F-85°F setpoint range, 2°F maximum differential, and vented cover.
   3. Low-Limit airstream thermostats shall be UL listed, vapor pressure type. Element shall be at least 20 ft long. Element shall sense temperature in each 1 ft section and shall respond to lowest sensed temperature. Low-limit thermostat shall be manual reset only.

F. Temperature Sensors
   1. Temperature sensors shall be Resistance Temperature Device (RTD) or Thermistor.

2. Duct sensors shall be rigid or averaging as shown. Averaging sensors shall be a minimum of 5 feet in length.
3. Immersion sensors shall be provided with a separable stainless steel well. Pressure rating of well is to be consistent with the system pressure in which it is to be installed.
4. Space sensors shall be equipped with set-point adjustment, override switch, display, and/or communication port as shown on the drawings.
5. Provide matched temperature sensors for differential temperature measurement. Differential accuracy shall be within 0.2 F.
6. The space temperature, setpoint, and override confirmation will be annunciated by a digital display for each zone sensor. The setpoint will be selectable utilizing buttons.
7. For systems with hot gas re-heat, room temperature sensors shall also include relative humidity sensing and setpoints in a single space sensor.

G. Humidity Sensors
1. Duct and room sensors shall have a sensing range of 20% to 80% with accuracy of ±5% R.H.
2. Duct sensors shall be provided with a sampling chamber.
3. Outdoor air humidity sensors shall have a sensing range of 20% to 95% R.H. It shall be suitable for ambient conditions of -40 F to 170 F.
4. Humidity sensor's drift shall not exceed 1% of full scale per year.

H. Static Pressure Sensors
1. Sensor shall have linear output signal. Zero and span shall be field-adjustable.
2. Sensor sensing elements shall withstand continuous operating conditions plus or minus 50% greater than calibrated span without damage.
3. Water pressure sensor shall have stainless steel diaphragm construction, proof pressure of 150 psi minimum. Sensor shall be complete with 4-20 ma output, required mounting brackets, and block and bleed valves. Mount in location accessible for service.
4. Water differential pressure sensor shall have stainless steel diaphragm construction, proof pressure of 150 psi minimum. Over-range limit (DP) and maximum static pressure shall be 3,000 psi. Transmitter shall be complete with 4-20 ma output, required mounting brackets, and five-valve manifold. Mount in a location accessible for service.

I. Low Limit Thermostats
1. Safety low limit thermostats shall be vapor pressure type with an element 20 ft minimum length. Element shall respond to the lowest temperature sensed by any one foot section.
2. Low limit shall be manual reset only.

J. Carbon Dioxide (CO2) Sensors
1. Carbon Dioxide sensors shall measure CO2 in PPM in a range of 0-2000 ppm. Accuracy shall be +/- 3% of reading with stability within 5% over 5 years. Sensors shall be duct or space mounted as indicated in the sequence of operation.

K. Flow Switches
1. Flow-proving switches shall be either paddle or differential pressure type, as shown.
2. Paddle type switches (water service only) shall be UL listed, SPDT snap-acting with pilot duty rating (125 VA minimum). Adjustable sensitivity with NEMA 1 Type enclosure unless otherwise specified:

3. Differential pressure type switches (air or water service) shall be UL listed, SPDT snapacting, pilot duty rated (125 VA minimum), NEMA 1 Type enclosure, with scale range and differential suitable for intended application, or as specified.
4. Current sensing relays may be used for flow sensing or terminal devices.

L. Relays
1. Control relays shall be UL listed plug-in type with dust cover. Contact rating, configuration, and coil voltage suitable for application.
2. Time delay relays shall be UL listed solid-state plug-in type with adjustable time delay. Delay shall be adjustable plus or minus 200% (minimum) from set-point shown on plans. Contact rating, configuration, and coil voltage suitable for application. Provide NEMA 1 Type enclosure when not installed in local control panel.

M. Transformers and Power Supplies
1. Control transformers shall be UL listed, Class 2 current-limiting type, or shall be furnished with over-current protection in both primary and secondary circuits for Class 2 service.
2. Unit output shall match the required output current and voltage requirements. Current output shall allow for a 50% safety factor. Output ripple shall be 3.0 mV maximum Peakto-Peak. Regulation shall be 0.10% line and load combined, with 50 microsecond response time for 50% load changes. Unit shall have built-in over-voltage protection.
3. Unit shall operate between 0 C and 50 C.
4. Unit shall be UL recognized.

N. Current Switches
1. Current-operated switches shall be self-powered, solid state with adjustable trip current. The switches shall be selected to match the current of the application and output requirements of the DDC system.

O. Power and Energy Meter with Modbus Output
1. The power meter shall be fully electronic with multi-line backlit LCD display showing measured parameters as well as alarm functions and pulse output.
2. The power meter shall perform the following measurements:
   a. Accumulated Real Energy (kWh) for each phase and total of all phases
   b. Accumulated Reactive Energy (kVARh) and Apparent Energy (kVAh) totals for all phases
   c. Net Present Demand for Real (kW), Reactive (kVAR) and Apparent (kVA) Power over a user-specified interval (block or sliding window)
   d. Maximum (Peak) Real (kW), Reactive (kVAR) and Apparent (kVA) Demand Intervals
   e. Instantaneous Real (kW), Reactive (kVAR) and Apparent Power (kVA), by phase and in total
   f. Current (amps) for each phase and average of all phases
   g. Phase-to-phase voltage for each phase and average of all phase pairs
   h. Phase-to-neutral voltage for each phase pair and average of all phases
   i. Power factor for each phase and average of all phases
   j. AC frequency
3. The power meter shall communicate all these measurements using the Modbus RTU protocol at speeds from 1200 to 38400 baud; odd, even, or no parity.

4. The power meter shall also provide a separate pulse output (of total Real energy).
5. The meter shall be UL/CUL listed to the latest applicable safety standards.
6. Power meter models must be available to directly accept voltage input over the range of 90 to 600 VAC (50 or 60Hz).
7. The power meter shall accept either 0 to 0.333VAC or 0 to 1VAC input from up to three current transducers to 32000 amps.
8. The measured energy consumption shall be retained in non-volatile ferromagnetic memory for the life of the product warranty.
9. The power meter shall have demand measurement programmable for up to 6 sub-intervals of 10 seconds to 546 minutes duration.
10. Meter shall be optionally available in an outdoor NEMA 4X enclosure.
11. The power meter shall operate from -30C to +70C.
12. The power meter shall have dimensions not exceeding 4.2" x 3.6" x 2.3".
13. The power meter shall be Trane E50C2, Veris E50C2, or equivalent.
14. The power meter shall meet both ANSI C12.20 .5% and IEC 62053-22 Class .5S real power and energy accuracy specifications.
15. The power meter shall meet IEC 62053-22 Class 2 reactive power and energy accuracy specifications.
16. The power meter shall be configurable for operation on Single Phase (AN or AB), Split Phase (ABN), Delta (ABC), and Wye (ABCN) systems.
17. The power meter shall have automatic phase reversal compensation such that it is insensitive to the CT's load orientation.
18. The power meter shall have separate control power inputs such that is may be powered from a different service than it measures.
19. The power meter shall have Phase Loss Alarm contacts with a user configurable phase loss threshold.
20. The power meter shall be configurable for use with Potential Transformers to 32000 volts.
21. The power meter shall have a configurable pulse weight in units of 10, 100, 1000, 10000 Wh.
22. The power meter shall calculate a maximum theoretical system power using the configuration parameters set by the user and use this value to set the slowest pulse duration that will keep up with this power level. If the selected pulse weight doesn't allow the meter to find a pulse duration that can keep up, the meter shall warn the user.
23. The power meter shall support warnings for low power factor (phase current or voltage miss-wired), current over range, voltage over range, and frequency out of range, pulse output overrun and pulse output configuration.
24. The product shall have a 5-year warranty.

P. Thermal Energy Meters
1. Matched RTD or thermistor temperature sensors with a differential temperature accuracy of ±0.15°F.

2. Flow meter that is accurate within ±1% at calibrated typical flow rate and does not exceed ±2% of actual reading over an extended 50:1 turndown range.
3. Unit accuracy of ±1% factory calibrated, traceable to NIST with certification.
4. NEMA 1 enclosure.
5. Panel mounted display.
6. UL listed.
7. Isolated 4–20 ma signals for energy rate and supply and return temperatures and flow.

Q. Pressure Transducers
1. Transducer shall have linear output signal. Zero and span shall be field adjustable.
2. Transducer sensing elements shall withstand continuous operating conditions of positive or negative pressure 50% greater than calibrated span without damage.
3. Water pressure transducer shall have stainless steel diaphragm construction, proof pressure of 150 psi minimum. Transducer shall be complete with 4 to 20 mA output, required mounting brackets, and block and bleed valves.
4. Water differential pressure transducer shall have stainless steel diaphragm construction, proof pressure of 150 psi minimum. Over-range limit (differential pressure) and maximum static pressure shall be 300 psi. Transducer shall be complete with 4 to 20 mA output, required mounting brackets, and five-valve manifold.

R. Local Control Panels
1. All indoor control cabinets shall be fully enclosed NEMA 1 Type construction with hinged door, and removable sub-panels or electrical sub-assemblies.
2. Interconnections between internal and face-mounted devices shall be pre-wired with colorcoded stranded conductors neatly installed in plastic troughs and/or tie-wrapped. Terminals for field connections shall be UL listed for 600-volt service, individually identified per control/interlock drawings, with adequate clearance for field wiring. Control terminations for field connection shall be individually identified per control drawings.
3. Provide on/off power switch with over-current protection for control power sources to each local panel.

PART 3 - EXECUTION

3.01 EXAMINATION

A. The Contract Documents shall be thoroughly examined for coordination of control devices their installation, wiring, and commissioning. Coordinate and review mechanical equipment specifications, locations, and identify any discrepancies, conflicts, or omissions that shall be reported to the Architect/Engineer for resolution before rough-in work is started.

B. The BAS manufacturer shall inspect the jobsite in order to verify that control equipment can be installed as required, and any discrepancies, conflicts, or omissions shall be reported to the Architect/Engineer for resolution before rough-in work is started.

3.02 GENERAL WORKMANSHIP

A. Install equipment, piping, wiring/conduit, parallel to building lines (i.e. horizontal, vertical, and parallel to walls) wherever possible.

B. Provide sufficient slack and flexible connections to allow for vibration of piping and equipment.

C. Install all equipment in readily accessible location as defined by National Electric Code (NEC). Control panels shall be attached to structural walls or properly supported in a free-standing

configuration, unless mounted in equipment enclosure specifically designed for that purpose. Panels shall be mounted to allow for unobstructed access for service.

D. Verify integrity of all control wiring to ensure continuity and freedom from shorts and grounds prior to commencing the startup and commissioning procedures.

E. All control device installation, and wiring shall comply with Contract Documents, acceptable industry specifications, and industry standards for performance, reliability, and compatibility. Installation and wiring shall be executed in strict adherence to local codes and standard practices referenced in Contract Documents.

3.03 WIRING

A. All control and interlock wiring shall comply with the National, Local Electrical Codes, and Division 26 of these Contract Document specifications. Where the requirements of this section differ with those in Division 26, the requirements of this section shall take precedence.

B. Where Class 2 wires are in concealed and accessible locations; including ceiling return air plenums, approved cables outside of electrical raceway can be used provided that the following conditions are met:
   1. Circuits meet NEC Class 2 (current-limited) requirements. (Low-voltage power circuits shall be sub-fused when required to meet Class 2 current-limit.)
   2. All cables shall be UL listed for application (i.e., cables used in ceiling plenums shall be UL listed specifically for that purpose).

C. Do not install Class 2 wiring in conduits containing Class 1 wiring. Boxes and panels containing high voltage may not be used for low voltage wiring except for the purpose of interfacing the two via control relays and transformers.

D. Where Class 2 wiring is run exposed, wiring shall be run parallel along a surface or perpendicular to it, and bundled, using approved wire ties at no greater than 10 ft intervals. Such bundled cable shall be fastened to the structure, using industry approved fasteners, at 5 ft intervals or more often to achieve a neat and workmanlike result.

E. All wire-to-device connections shall be made at a terminal blocks or terminal strip. All wire-to wire connections shall be at a terminal block, or with a crimped connector. All wiring within enclosures shall be neatly bundled and anchored to permit access and prevent restriction to devices and terminals.

F. Maximum allowable voltage for control wiring shall be 120Vac. If only higher voltages are available for use, the BAS manufacturer shall provide step-down transformers to achieve the desired control voltages.

G. All control wiring shall be installed as continuous lengths, where possible. Any required splices shall be made only within an approved junction box or other approved protective device.

H. Install plenum wiring in sleeves where it passes through walls and floors. Maintain fire rating at all penetrations in accordance with Contract Documents and National and/or Local Codes.

I. Conduit and wire sizing shall be determined by the BAS manufacturer in order to maintain manufacturer's recommendation and must meet National and Local Codes.

J. Control and status relays are to be located in pre-fabricated enclosures that meet the application. These relays may also be located within packaged equipment control panel enclosures as coordinated. These relays shall not be located within Class 1 starter enclosures.

K. Follow manufacturer's installation recommendations for all communication and network bus cabling. Network or communication cabling shall be run separately from all control power wiring.

L. Adhere to Division 26 requirements for installation of electrical raceways.

M. BAS manufacturer shall terminate all control and/or interlock wiring and shall maintain updated (as-built) wiring diagrams with terminations identified at the job site.

N. Flexible metal conduits and liquid-tight flexible metal conduits shall not exceed 3' in length and shall be supported at each end. Flexible metal conduit less than 1/2" electrical trade size shall not be used. In areas exposed to moisture, liquid- tight, flexible metal conduits shall be used.

3.04 FIBER OPTIC CABLE SYSTEM (WHERE APPLICABLE)

A. All cabling shall be installed in a neat and workmanlike manner. Minimum cable and unjacketed fibber bend radii as specified by cable manufacturer shall be maintained.

B. Maximum pulling tensions as specified by the cable manufacturer shall not be exceeded during installation. Post installation residual cable tension shall be within cable manufacturer's specifications.

C. Fiber optic cabinets, hardware, and cable entering the cabinet shall be installed in accordance with manufacturers' instructions. Minimum cable and unjacketed fiber bend radii as specified by cable manufacturer shall be maintained.

3.05 INSTALLATION OF SENSORS

A. Sensors required for mechanical equipment operation shall be factory installed and wired as specified in mechanical equipment specifications. BAS manufacturer shall be responsible for coordinating these control devices and ensuring the sequence of operations will be met. Installation and wiring shall be in accordance with the BAS manufacturer's recommendations.

B. Sensors that require field mounting shall meet the BAS manufacturer’s recommendations and be coordinated with the mechanical equipment they will be associated.

C. Mount sensors rigidly and adequately for the environment the sensor will operate.

D. Room temperature sensors shall be installed on concealed junction boxes properly supported by the block wall framing. For installation in dry wall ceilings, the low voltage sensor wiring can be installed exposed in the wall and must meet applicable National and Local Electrical Codes.

E. All wires attached to wall mounted sensors shall be sealed off to prevent air from transmitting in the associated conduit and affecting the room sensor readings.

F. Install duct static pressure tap with tube end facing directly down-stream of air flow.

G. Install space static pressure sensor with static sensing probe applicable for space installation where applicable.

H. Sensors used in mixing plenums, and hot and cold decks shall be of the averaging type. Averaging sensors shall be installed in a serpentine manner horizontally across duct. Each bend shall be supported with a capillary clip.

I. All pipe mounted temperature sensors shall be installed in matched thermowells. Install all liquid temperature sensors with heat conducting fluid in thermal wells for adequate thermal conductance.

J. Wiring for space sensors shall be concealed in building drywall. EMT conduit is acceptable within mechanical equipment and service rooms.

K. Install outdoor air temperature sensors on north wall complete with sun shield at manufacturer's recommended location and coordinated with Engineer.

3.06 DAMPER ACTUATOR INSTALLATION

A. Mount and link multiple control damper actuators where required, per manufacturer's instructions.

B. To compress seals when spring-return actuators are used on normally closed dampers, power the actuator to approximately 5° open position, manually close the damper, and then tighten the linkage.

C. Check operation of damper/actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions. Coordinate any installation problems with Sheet metal Contractor.

3.07 IDENTIFICATION OF HARDWARE AND WIRING

A. All field wiring and cabling, including that within factory mounted, and wired control panels and devices for mechanical equipment, shall be labeled at each end within 2" of termination with a cable identifier and other descriptive information for troubleshooting, maintenance, and service purposes. BAS manufacturer to coordinate this labeling requirement with mechanical equipment manufacturer as it relates to controls.

B. Permanently label or code each point of field terminal strips to show the instrument or item served and correlate them to the BAS design drawings.

C. Identify control panels with minimum ¾" letters on laminated plastic nameplates.

D. Identifiers shall match record documents. All plug-in components shall be labeled such that removal of the component does not remove the label.

3.08 BAS DDC CONTROLLERS

A. Provide a separate DDC Controller for individual HVAC mechanical equipment. DDC Controllers shall be factory mounted, installed, and wired by mechanical equipment manufacturer as specified. BAS manufacturer to furnish and coordinate DDC controllers and control devices and ensure that installation and wiring adhere to BAS manufacturer's design recommendations. For those mechanical equipment units that do not have factory installed controls specified, the BAS manufacturer shall field mount controls and coordinate all installation and termination information to ensure the specified sequence of operations are met.

B. Building Controllers and Custom Application Controllers shall be selected to provide a minimum of 15% spare I/O point capacity for each point type (analog or digital) found at each location. If input points are not universal, 15% of each type is required. If outputs are not universal, 15% of each type is required. A minimum of one spare is required for each type of point used in each controller.

C. Future use of spare I/O point capacity shall require providing the field instrument and control device, field wiring, engineering, programming, and commissioning. No additional Controller boards or point modules shall be required to implement use of these spare points.

3.09 PROGRAMMING

A. Provide sufficient internal memory for all controllers to ensure specified sequence of operations, alarming, trending, and reporting requirements are achieved. BAS manufacturer shall provide a minimum of 25% spare memory capacity for future use.

B. Point Naming: System point names shall be modular in design, allowing easy operator interface without the use of a written point index.

C. Software Programming
   1. Provide programming for individual mechanical systems to achieve all aspects of the sequence of operation specified. It is the BAS manufacturer's responsibility to ensure all mechanical equipment functions and operates as specified in sequence of operations. Provide sufficient programming comments in controller application software to clearly describe each section of the program. The comment statements shall reflect the language used in the sequence of operations.

D. BAS Operator's Interface
   1. Provide color graphics for each piece of mechanical equipment depicting sufficient I/O to monitor and troubleshoot operation. Additionally, provide individual floor plans of the building allowing an operator to quickly view the overall floor plan area for any out of tolerance conditions that may need addressing. Operator color graphics shall include Chiller Plant, Cooling Tower System, Boiler Plant, Air Handling Units, Rooftop Units, VAV Terminal Boxes, Fan Coil Units, Unit Ventilators, Heat Exchangers, Exhaust Fans, etc. These graphics shall depict all points dynamically as specified in the points list and/or indicated in sequence of operation.
   2. The BAS manufacturer shall provide all the labor necessary to install, initialize, start-up, and trouble-shoot all operator interface software and their functions as described in this section. This includes any operating system software, the operator interface data base, and any third party software installation and integration required for successful operation of the operator interface.
   3. As part of this execution phase, the BAS manufacturer shall perform a complete test of the operator interface. Test duration shall be a minimum of (8) hours on-site. Tests shall be made in the presence of the Owner and/or Engineer.

3.10 CLEANING

A. The BAS manufacturer's installing contractor(s) shall clean up all debris resulting from their installation activities on a daily basis. The installation contractors shall remove all cartons, containers, crates, etc. under his control as soon as their contents have been removed. Waste shall be collected and placed in a location designated by the Owner, Construction Manager, General Contractor, and/or Mechanical Contractor.

B. At the completion of work in any area, the installation contractor shall clean all of their work, equipment, etc., making it free from dust, dirt and debris.

C. At the completion of work, all equipment furnished under this Section shall be checked for paint damage. Any factory finished paint that has been damaged shall be repaired to match the adjacent areas. Any metal cabinet or enclosure that has been deformed shall be replaced with new material and repainted to match the adjacent areas.

3.11 PROTECTION

A. The BAS installation contractor shall protect all work and material from damage by their work or personnel, and shall be liable for all damage.

B. The BAS manufacturer shall be responsible for their work and equipment until final inspection, testing, and acceptance. The BAS installing contractor shall protect their work against theft or damage, and shall carefully store material and equipment received on site that is not immediately installed. The Contractor shall close all open ends of work with temporary covers or plugs during storage and construction to prevent entry of foreign objects.

3.12 TRAINING

A. Provide minimum of (2) classroom training sessions, and (4) hours for each session, throughout the contract period. Owner training sessions shall be video taped for owner's future reference. Include two (2) DVD copies of training sessions in the project close-out documents. The training will be provided for personnel designated by the Owner.

B. The Owner training shall enable personnel to proficiently operate the BAS by being able to create, modify and delete programming; add, remove and modify physical points for individual controllers; and add additional controllers when required.

C. These objectives will be divided into three logical groupings; participants may attend one or more of these, depending on level of knowledge required:
   1. Day-to-day BAS Operators
   2. BAS Troubleshooting & Maintenance
   3. Maintenance Manager: Parts Inventory

D. Provide course outline and materials prior to schedule training session. The instructor(s) shall provide one copy of training material per student.

E. The instructor(s) shall be factory-trained and experienced in teaching this technical material.

3.13 FIELD QUALITY CONTROL

A. All work, materials and equipment shall comply with the rules and regulations of applicable local, state, and federal codes and ordinances as identified in Contract Documents.

B. BAS manufacturer shall continually monitor the field installation for building code compliance and quality of workmanship. All visible piping and or wiring runs shall be installed parallel to building lines and properly supported.

C. BAS installing Contractor(s) shall arrange for field inspections by local and/or state authorities having jurisdiction over the work.

3.14 TEST AND BALANCE ASSISTANCE

A. All work related to this project shall be subject to the performance of test and balance. BAS contractor shall provide assistance to the test and balance contractor during test and balance process. BAS contractor must have a representative on site anytime that the test and balance contractor is on site or as required directed by the test and balance contractor. BAS contractor shall receive a minimum of 72 hours' notice before being required onsite.

3.15 ACCEPTANCE

A. The BAS will not be accepted as meeting the requirements of Completion until all tests described in this specification have been performed to the satisfaction of both the Engineer and Owner. Any tests that cannot be performed due to circumstances beyond the control of the Contractor may be exempt from the Completion requirements if stated as such in writing by the Owner's representative. Such tests shall then be performed as part of the warranty.

PART 4 - SEQUENCE OF OPERATION

4.01 EXAMINATION

A. The project plans shall be thoroughly examined for control device and equipment locations, and any discrepancies, conflicts, or omissions shall be reported to the Architect/Engineer for resolution before rough-in work is started.

B. The contractor shall inspect the site to verify that equipment is installable as shown, and any discrepancies, conflicts, or omissions shall be reported to the Architect/Engineer for resolution before rough-in work is started.

4.02 FIELD QUALITY WORK

A. All work, materials and equipment shall comply with the rules and regulations of applicable local, state, and federal codes and ordinances as identified in Part 1 of this Section.

B. Contractor shall continually monitor the field installation for code compliance and quality of workmanship. All visible piping and or wiring runs shall be installed parallel to System lines and properly supported.

C. Contractor shall arrange for field inspections by local and/or state authorities having jurisdiction over the work.

4.03 ROOFTOP UNITS RTU-1 AND RTU-4 SEQUENCE OF OPERATION

A. The temperature controls contractor shall furnish and install all space temperature and humidity sensors required to accomplish the specified sequence of control for these units. Controls contractor shall furnish all required temperature control and interlock wiring.

1. Each units shall be started and stopped each day by the BAS based on the schedule requested by the owner. Once started the unit supply fan shall run continuously and the unit heating, cooling and de-humidification (forced cooling with hot gas reheat) shall operate as necessary to maintain the occupied temperature and relative humidity setpoints.
2. The unit shall be off during un-occupied periods unless the temperature rises above or falls `occupied setpoint. During un-occupied operation the unit fresh air damper shall remain closed.
3. A manual over-ride switch on the unit thermostat or adjacent to the unit thermostat shall permit the unit to be placed into "occupied" mode for up to 4-hours. The duration of timed over-ride shall be programmable thru the BAS.
4. Each unit shall be supplied with integral economizer controls to operate in economizer mode whenever the outdoor temperature and relative humidity are suitable for economizer cooling. Units shall be equipped with power exhaust for space pressurization control during economizer operation.
5. The BAS shall monitor unit operation, unit discharge air temperature and space temperature and relative humidity.

4.04 DIESEL TECH LAB RTU-2 SEQUENCE OF OPERATION

A. The temperature controls contractor shall furnish and install all space temperature and humidity sensors and all duct mounted temperature sensors required to accomplish the specified sequence of control for these units. Controls contractor shall furnish all required temperature control and interlock wiring.

1. RTU-2 shall be interlocked with Carbon Monoxide Vehicle Exhaust Fan VEF-2 to operate in two modes during occupied periods; Make-up air mode whenever VEF-2 is "on" and power exhaust mode when VEF-2 is "off".
2. Make-up Air Mode (VEF-2 On)

a. Whenever Vehicle Exhaust Fan VEF-2 is on, RTU-2 shall operate in make-up air mode for 100% outside air with remote space temperature over-ride. The unit motorized outside air damper shall be open 100% and the unit return air damper shall be closed 100%. Integral exhaust fan in the RTU shall be "off".
b. If the space temperature and relative humidity sensors are satisfied, the unit shall deliver heated/cooled and/or de-humidified supply air (100% outside air) to the Diesel Lab at a neutral temperature with no re-circulation. All air supplied to the room is exhausted through the vehicle exhaust fan.
c. Unit heating, cooling or de-humidification (forced cooling with hot gas reheat to a neutral supply discharge temperature) shall operate as required to maintain the space heating, cooling and relative humidity setpoints. A call for cooling shall over-ride operation in de-humidification mode.

3. Power Exhaust Mode (VEF-2 Off)
   a. Whenever Vehicle Exhaust Fan VEF-2 is off, RTU-2 shall operate in power exhaust mode for 100% outside air with remote space temperature over-ride. The unit motorized outside air damper shall be open 100% and the unit return air damper shall be closed 100%. Power exhaust fan shall operate to exhaust 3,600 CFM from the space to maintain the required continuous exhaust ventilation for the repair garage.
   b. If the space temperature and relative humidity sensors are satisfied, the unit shall deliver heated/cooled and/or de-humidified supply air (100% outside air) to the Diesel Lab at a neutral temperature with no re-circulation. All air supplied to the room is exhausted through the vehicle exhaust fan.
   c. Unit heating, cooling or de-humidification (forced cooling with hot gas reheat to a neutral supply discharge temperature) shall operate as required to maintain the space heating, cooling and relative humidity setpoints. A call for cooling shall over-ride operation in de-humidification mode.
4. Un-occupied Operation
   a. The unit shall be off during un-occupied periods unless the temperature rises above or falls below the un-occupied setpoints. Should the space temperature or relative humidity sensors call for the unit to operate to maintain setpoint during un-occupied periods (and Vehicle exhaust fan VEF-2 is off), the unit shall operate in re-circulation mode. The unit motorized outside air damper shall be closed and the unit return damper shall be open. Note- re-circulation is only permitted during un-occupied times.
   b. Unit heating, cooling or de-humidification (forced cooling with hot gas reheat to a neutral supply discharge temperature) shall operate as required to maintain the space un-occupied heating, cooling and relative humidity setpoints. A call for cooling shall over-ride operation in de-humidification mode.
   c. The system shall permit separate "occupied" and "un-occupied" heating, cooling and relative humidity setpoints and the occupancy schedule for this classroom shall be as directed by the owner. Provide manual over-ride switch at the remote control panel to permit the owner to manually over-ride the timeclock.
5. The BAS shall monitor unit operation, RTU supply fan status, RTU exhaust fan status, OA damper status, RA damper status, RTU discharge air temperature, space temperature and space relative humidity as well as the status of exhaust fan VEF-2.

4.05 DIESEL TECH LAB RTU-3 SEQUENCE OF OPERATION

A. The temperature controls contractor shall furnish and install all space temperature and humidity sensors and all duct mounted temperature sensors required to accomplish the specified sequence of control for these units. Controls contractor shall furnish all required temperature control and interlock wiring.

1. RTU-2 shall be interlocked with Carbon Monoxide Vehicle Exhaust Fan VEF-3 to operate in two modes during occupied periods; Make-up air mode whenever VEF-3 is "on" and power exhaust mode when VEF-3 is "off".
2. Make-up Air Mode (VEF-3 On)
    a. Whenever Vehicle Exhaust Fan VEF-3 is on, RTU-3 shall operate in make-up air mode for 100% outside air with remote space temperature over-ride. The unit motorized outside air damper shall be open 100% and the unit return air damper shall be closed 100%. Integral exhaust fan in the RTU shall be "off".
    b. If the space temperature and relative humidity sensors are satisfied, the unit shall deliver heated/cooled and/or de-humidified supply air (100% outside air) to the Diesel Lab at a neutral temperature with no re-circulation. All air supplied to the room is exhausted through the vehicle exhaust fan.
    c. Unit heating, cooling or de-humidification (forced cooling with hot gas reheat to a neutral supply discharge temperature) shall operate as required to maintain the space heating, cooling and relative humidity setpoints. A call for cooling shall over-ride operation in de-humidification mode.
3. Power Exhaust Mode (VEF-3 Off)
    a. Whenever Vehicle Exhaust Fan VEF-3 is off, RTU-3 shall operate in power exhaust mode for 100% outside air with remote space temperature over-ride. The unit motorized outside air damper shall be open 100% and the unit return air damper shall be closed 100%. Power exhaust fan shall operate to exhaust 3,600 CFM from the space to maintain the required continuous exhaust ventilation for the repair garage.
    b. If the space temperature and relative humidity sensors are satisfied, the unit shall deliver heated/cooled and/or de-humidified supply air (100% outside air) to the Diesel Lab at a neutral temperature with no re-circulation. All air supplied to the room is exhausted through the vehicle exhaust fan.
    c. Unit heating, cooling or de-humidification (forced cooling with hot gas reheat to a neutral supply discharge temperature) shall operate as required to maintain the space heating, cooling and relative humidity setpoints. A call for cooling shall over-ride operation in de-humidification mode.
4. Un-occupied Operation
    a. The unit shall be off during un-occupied periods unless the temperature rises above or falls below the un-occupied setpoints. Should the space temperature or relative humidity sensors call for the unit to operate to maintain setpoint during un-occupied periods (and Vehicle exhaust fan VEF-3 is off), the unit shall operate in re-circulation mode. The unit motorized outside air damper shall be closed and the unit return damper shall be open. Note- re-circulation is only permitted during un-occupied times.
    b. Unit heating, cooling or de-humidification (forced cooling with hot gas reheat to a neutral supply discharge temperature) shall operate as required to maintain the space

un-occupied heating, cooling and relative humidity setpoints. A call for cooling shall over-ride operation in de-humidification mode.

c. The system shall permit separate "occupied" and "un-occupied" heating, cooling and relative humidity setpoints and the occupancy schedule for this classroom shall be as directed by the owner. Provide manual over-ride switch at the remote control panel to permit the owner to manually over-ride the timeclock.

5. The BAS shall monitor unit operation, RTU supply fan status, RTU exhaust fan status, OA damper status, RA damper status, RTU discharge air temperature, space temperature and space relative humidity as well as the status of exhaust fan VEF-3.

4.06 AUTOMOTIVE TECH LAB RTU-5 SEQUENCE OF OPERATION

A. The temperature controls contractor shall furnish and install all space temperature and humidity sensors and all duct mounted temperature sensors required to accomplish the specified sequence of control for these units. Controls contractor shall furnish all required temperature control and interlock wiring.

1. RTU-5 controls shall be interlocked with Carbon Monoxide Vehicle Exhaust Fan VEF-1.
   a. RTU-5 supply and exhaust fans shall operate continuously during occupied periods in make-up air mode for 100% outside air with remote space temperature over-ride. The unit motorized outside air damper shall be open 100% and the unit return air damper shall be closed 100%.
   b. If the space temperature and relative humidity sensors are satisfied, the unit shall deliver heated/cooled and/or de-humidified supply air (100% outside air) to the Diesel Lab at a neutral temperature with no re-circulation. All air supplied to the room is exhausted through the integral RTU power exhaust fan or a combination of the RTU exhaust fan and VEF-1 (see below). This unit shall not re-circulate air during occupied periods.
   c. Unit heating, cooling or de-humidification (forced cooling with hot gas reheat to a neutral supply discharge temperature) shall operate as required to maintain the space heating, cooling and relative humidity setpoints. A call for cooling shall over-ride operation in de-humidification mode.
   d. If vehicle exhaust fan VEF-1 is off, the exhaust fan integral to the rooftop unit shall exhaust 3,800 CFM from the space. Verify setpoint with the balance contractor.
   e. Whenever VEF-1 (1,200 CFM) is in operation, the power exhaust fan at the rooftop unit shall be re-set down to 2,600 CFM to maintain the same space pressure relationship as when the vehicle exhaust fan is on. Verify this second stage exhaust setting with the balance contractor.
2. Un-occupied Operation
   a. The unit shall be off during un-occupied periods unless the temperature rises above or falls below the un-occupied setpoints. Should the space temperature or relative humidity sensors call for the unit to operate to maintain setpoint during un-occupied periods (and Vehicle exhaust fan VEF-1 is off), the unit shall operate in re-circulation mode. The unit motorized outside air damper shall be closed and the unit return damper shall be open. Note- re-circulation is only permitted during un-occupied times.
   b. Unit heating, cooling or de-humidification (forced cooling with hot gas reheat to a neutral supply discharge temperature) shall operate as required to maintain the space

un-occupied heating, cooling and relative humidity setpoints. A call for cooling shall over-ride operation in de-humidification mode.

c. The system shall permit separate "occupied" and "un-occupied" heating, cooling and relative humidity setpoints and the occupancy schedule for this classroom shall be as directed by the owner. Provide manual over-ride switch at the remote control panel to permit the owner to manually over-ride the timeclock.

3. The BAS shall monitor unit operation, RTU supply fan status, RTU exhaust fan status, OA damper status, RA damper status, RTU discharge air temperature, space temperature and space relative humidity as well as the status of exhaust fan VEF-1.

4.07 WELDING LAB CONTROLS

A. Make-Up Air Unit MAU-1.

1. The temperature controls contractor shall furnish and install all required sensors and controls.
2. MAU-1 shall be started and stopped each day based on the owner's occupancy schedule. MAU-1 supply fan shall operate continuously during occupied periods and shall be off during un-occupied periods when the space is not in use.
3. The unit modulating heater shall operate to maintain 70°F (adj.) discharge air temperature during winter. Furnish and install discharge air sensor and all control wiring.
4. The unit motorized damper (integral to the unit) shall close whenever the MAU supply fan is off.
5. Furnish and install differential pressure sensor in the Welding Lab. Differential pressure controls shall control the operation of a low voltage modulating relief air damper (in gravity hood) to prevent the welding lab from being over pressurized while MAU-1 is operating to provide the code mandated space ventilation. See plans for gravity relief hood. This contractor to provide all sensors and wiring.
6. The BAS shall monitor status of MAU-1 supply fan as well as the unit discharge air temperature.

B. Ventilation Fan EF-2 shall be manually started and stopped as needed for ventilation in summer. Provide push-button magnetic starter in the space. Starter shall have pilot light and shall be labeled as "Summer Ventilation Fan". Interlock motorized damper at intake louver (see plans for louver) with EF-2 to open when the fan is "ON" and to be closed when the fan is "OFF".

C. Natural gas unit heaters in the Welding Shop shall be controlled by their respective low voltage heating-only wall thermostats for supplemental heat in winter. The temperature controls contractor to furnish and install all required sensors and controls.

4.08 CARBON DIOXIDE (CO2) MONITORING

A. Furnish and install carbon dioxide (CO2) sensors in each classroom space (Welding Classroom 115 and Diesel Classroom 110A) to monitor the CO2 levels in each space. Locate sensors within 3 ft. and 6 ft. of the floor.

B. Sensors shall be tied to the BAS. The BAS shall signal an audible/visual alarm anytime the CO2 concentration in any classroom exceeds setpoint by more than 10%. Initial setpoint shall be 500 ppm, but shall be adjustable.

4.09 FANS AND MISCELLANEOUS EQUIPMENT SEQUENCES OF OPERATION

A. Restroom exhaust fan EF-1 shall be started and stopped each day by the BAS based on the

owner's occupancy schedule. Exhaust fan shall operate continuously during occupied hours and shall be off when the building is un-occupied. The BAS shall monitor the on/off status of the fan.

B. Carbon Monoxide Vehicle Exhaust Fans VEF-1, VEF-2 and VEF-3 shall each be manually controlled by dedicated push-button magnetic starters located in the space. The BAS shall monitor the status of each fan. The BAS shall also control the associated space rooftop units as previously specified based on the on/off status of the vehicle exhaust fans. Each vehicle exhaust fan starter shall be identified with engraved tag as to the fan served. Starters shall have red pilot light.

C. Electric unit heaters shall be controlled by wall mounted low voltage heating-only thermostat to maintain the thermostat setpoint. The BAS need not monitor

4.10 SMOKE DETECTORS

A. Duct smoke detectors shall be furnished and wired (FA wiring) by Division 28 Fire Alarm Contractor. HVAC sheetmetal contractor shall mount detectors in the duct. HVAC controls contractor shall furnish and install all required fan shut-down interlock wiring.

1. Duct smoke detectors shall be provided in the HVAC systems as required for fan shut-down control. Detectors shall stop the unit and signal the building fire alarm whenever smoke is detected. **Provide duct smoke detectors in the supply and return of each Rooftop Unit this project.** Detectors shall be suitable for the duct size and airflow velocity required per the HVAC drawings. HVAC contractor to coordinate with the fire alarm contractor prior to ordering equipment or beginning any installation.
2. Detectors shall be located in ductwork inside the building (Do not locate in exterior ductwork).
3. All detectors shall be located so as to be accessible for service.

4.11 TESTING AND COMMISSIONING

A. Contractor shall verify all sequences of operation and shall confirm all sensor calibration/operation.

B. Refer to Section 23 08 00 Mechanical and Controls System Commissioning for additional requirements

C. Refer to Section 23 08 13 for Sensor Calibration Checklist

4.12 ENERGY DASHBOARD

A. Furnish and install a permanent, readily accessible (via internet or visible display in the building) energy dashboard capable of displaying the building's current and historical energy demand and consumption for grid-provided electricity and natural gas. Display shall provide current and historical data for each individual fuel as well as total energy consumption for the building. This information shall also be readily available via the BAS graphics.

END OF SECTION

SECTION 23 11 23
NATURAL GAS PIPING

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Natural gas piping

B. Pipe and pipe fittings

C. Valves

D. Painting of exterior exposed piping

1.02 RELATED WORK

A. Section 09 90 00 - Painting.

B. Section 23 05 29 - Hanger and Supports for HVAC Piping and Equipment.

C. Section 23 05 48 - Seismic Bracing for HVAC Piping and Equipment.

1.03 REFERENCES

A. ANSI/ASME B16.3 - Malleable Iron Threaded Fittings Class 150 NS 300.

B. ANSI/ASME Sec. 9 - Welding and Brazing Qualifications.

C. ANSI/AWS D1.1 - Structural Welding Code.

D. ASTM A53 - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.

E. ASTM A120 - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless, for Ordinary Uses.

1.04 QUALITY ASSURANCE

A. Valves: Manufacturer's names and pressure rating marked on valve body.

B. Welding Materials and Procedures: Conform to ASME Code and applicable state labor regulations.

1.05 SUBMITTALS

A. Submit product data under provisions of Sections 01 33 00.

B. Include data on pipe materials, pipe fittings, valves and accessories.

C. Submit gas piping plan with seismic components located as required by local code. Refer to Section 23 05 48.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site under provisions of Section 01 11 00.

B. Store and protect products under provisions of Section 01 11 00.

C. Deliver and store valves in shipping containers with labeling in place.

PART 2 - PRODUCTS

2.01 NATURAL GAS PIPING BELOW GRADE

A. Steel Pipe: ASTM A53 or A120, schedule 40 seamless black steel pipe with polyethylene protective wrap. Welded joints. Cathodic protection as recommended by the local utility company.

B. Plastic Pipe: ASTM D1248 Polyethylene pipe subject to the approval of the local Authority having jurisdiction. Joints: ASTM D2513 heat fusion.

2.02 NATURAL GAS PIPING ABOVE GRADE

A. Steel Pipe Over 2 Inches, all Concealed Piping and all piping over 7" W.C. pressure: ASTM A53 or A120, Schedule 40 black, seamless. Fittings: ASTM A234, forged steel welding type. Joints: ANSI/AWS D1.1, welded.

B. Accessible Low Pressure Steel Pipe, 2 Inches and Under: ASTM A53 or A120, Schedule 40, black, seamless pipe. Fittings: ANSI/ASME B16.3 Malleable Iron. Joints: Screwed.

2.03 FLANGES, UNIONS, AND COUPLINGS

A. Pipe Size 2 inches and Under: 150 psig malleable iron unions for threaded ferrous piping.

B. Pipe Size Over 2 Inches 150 psig forged steel slip-on flanges for ferrous piping.

2.04 GAS COCKS

A. Up to 2 Inches: Bronze body, bronze tapered plug, non-lubricated, teflon packing, threaded ends.

B. Over 2 Inches: Cast iron body and plug, non-lubricated, teflon packing, flanged ends.

PART 3 - EXECUTION

3.01 PREPARATION

A. Ream pipe and tube ends. Remove burrs.

B. Remove scale and dirt, on inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.02 INSTALLATION

A. Install piping to conserve building space and not interfere with use of space.

B. Group piping whenever practical at common elevations.

C. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

D. Provide clearance for access to valves and fittings.

E. Provide access where valves and fittings are not exposed. Coordinate size and location of access doors with the Architect.

F. Establish elevations of buried piping outside the building to ensure not less than two feet of cover.

G. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

H. Install valves with stems upright or horizontal, not inverted.

I. Provide one plug cock wrench for every ten plug cocks sized 2 inches and smaller, minimum of one. Provide each plug cock sized 2-1/2 inches and larger with a wrench with set screw.

J. Paint all exposed piping as directed by the Architect.

K. Do not install underground gas in same trench as other underground utilities.

L. Do not install valves concealed. All gas valves must be accessible.

3.03 APPLICATION

A. Use welded connections for all high pressure gas piping (above 5-ounces), all gas piping over 2" in size, all underground steel piping and for all in-accessible concealed piping.

B. Install unions downstream of valves and at equipment or apparatus connections.

C. Paint all exterior exposed gas piping and associated supports with two coats of weatherproof protective paint. Color shall be as directed by the Architect.

D. Provide cathodic protection for all underground steel piping as recommended by the Local Utility Company. Isolate all steel above grade piping from underground steel lines with the use of isolation flanges where piping rises up from below grade.

E. The minimum acceptable gas line size shall be 3/4".

3.04 FINAL CONNECTIONS

A. Make final gas connections to all natural gas appliances and fixtures; including owner furnished equipment and equipment furnished by other trades.

B. Make final connection in strict compliance with the manufacturer's recommendations.

C. Provide dirtleg, union and cutoff valve at all gas line connections to gas equipment. The dirtleg union and cutoff valve shall be the size called for on the drawings (not connection size). Provide reducer as required immediately at unit connection.

END OF SECTION

SECTION 23 31 13

METAL DUCTS

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Low pressure metal supply, return, exhaust and outside air ducts.

B. Welding Exhaust ductwork.

C. Duct sealing.

1.02 REFERENCES

A. ASHRAE - Handbook 1981 Fundamentals; Chapter 33 - Duct Design.

B. ASHRAE - Handbook 1983 Equipment; Chapter 1 - Duct Construction.

C. ASTM A 90 - Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles.

D. ASTM A 167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.

E. ASTM A 525 - General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.

F. ASTM A 527 - Steel Sheet, Zinc-Coated (Galvanized) by Hot-Dip Process, Lock Forming Quality.

G. ASTM B209 - Aluminum and Aluminum Alloy Sheet and Plate.

H. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.

I. SMACNA - HVAC Duct Construction Standards.

J. NFPA 96 - Standard for the Removal of Smoke and Grease Laden Vapors From Commercial Cooking Equipment.

1.03 REGULATORY REQUIREMENTS

A. Construct ductwork to NFPA 90A, ASHRAE, International Mechanical Code (IMC) and SMACNA Standards.

1.04 SUBMITTALS

A. Submit shop drawings and product data.

B. Indicate duct fittings, particulars such as gages, sizes, welds, and configuration prior to start of work for low pressure and high pressure systems. Submit mfgr's product data for dual-wall insulated ductwork and fittings.

C. Provide a hanger and support schedule.

1.05 QUALITY ASSURANCE

A. SMACNA Duct Construction Manual shall be the minimum requirement for the air distribution system.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site per the manufacturer`s recommendations.

B. Store and protect products per the manufacturer's recommendations.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Steel Duct : ASTM A525 or ASTM A527 galvanized steel sheet, lock-forming quality, having **G90** zinc coating for each side in conformance with ASTM A90.

B. Fasteners: Rivets, bolts, or sheet metal screws.

C. Sealant: Non-hardening, water resistant, fire resistive, compatible with mating materials; liquid used alone or with tape, or heavy mastic.

D. Hanger Rod: Steel, galvanized; threaded both ends, threaded one end, or continuously threaded.

2.02 DUCTWORK

A. Fabricate and support all low pressure supply, return, exhaust and fresh air ducts in accordance with SMACNA HVAC Duct Construction Standards and ASHRAE handbooks, except that **all duct joints shall be sealed**. Seal all longitudinal and transverse joints. All exterior exposed ductwork shall be sealed watertight. Horizontal ductwork exposed to the elements shall be sloped to permit rainwater run-off.

B. Size round ducts installed in place of rectangular ducts in accordance with ASHRAE table of equivalent rectangular and round ducts. No variation of duct configuration or sizes permitted except by written permission.

C. Make round runout taps to rectangular mains using conical taps with manual balancing damper in the runout.

D. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows are used, provide air foil turning vanes.

E. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible. Divergence upstream of equipment shall not exceed 30 degrees; convergence downstream shall not exceed 45 degrees.

F. Use crimp joints with or without bead for joining round duct sizes 8 inch and smaller with crimp in direction of air flow.

G. Use double nuts and lock washers on threaded rod supports.

2.03 RIGID DUCTS FOR WELDING EXHAUST

A. Fabricate in accordance with SMACNA High Pressure Duct Construction Standards and NFPA. United McGill single wall round duct longitudinal seam solid welded. Duct and fittings suitable for 10" w.c. negative pressure.

2.04 DUAL WALL INSULATED DUCTS

A. United Sheetmetal Acousti-K27 or equal.

B. Round and flat oval duct shall be constructed of a perforated inner liner, a 1-inch layer of fiberglass insulation, and an outer pressure shell. Duct shall be of spiral lockseam construction. Duct shall be fabricated from galvanized steel meeting ASTM-A527 standards, and with outer shell gauges in accordance with the following table. For 1-inch insulation, the outer shell major and minor axes will be 2 inches larger than the nominal inner liner dimensions.

Inner Liner Major Axis Dimension (Inches)	Outer Shell Minimum Gauge
7-22	24
23-46	22
47-68	20
69-80	18

Flat over inner liners shall be fabricated in accordance with the following table:

Inner Liner	Gauge	Construction
3-8	28	Standard Spiral
9-42	28	Ribbed Spiral
44-60	26	Ribbed Spiral
62-84	22	Standard Spiral

C. Insulated duct shall have a maximum thermal conductivity (k) factor of 0.27 Btu per hour per square foot per degree Fahrenheit per inch thickness at 75 degrees F. mean ambient temperature.

D. Fittings shall be constructed of a perforated inner liner, a 1-inch layer of fiberglass insulation, and an outer pressure shell. Fittings will be fabricated from galvanized steel meeting ASTM-A527 standards.

E. Joints shall be solid welded or spot welded and bonded. All welded joints shall be coated with a protective paint, inside and out, to prevent damage to the galvanized surface. Spot welded fittings shall have all joints sealed with a UL-Classified zero flame spread and zero smoke developed cement specially formulated for bonding metal-to-metal joints.

F. All 90-degree elbow fittings shall be gored elbow type, mitered elbows shall be used only when space will not permit gored elbows and all mitered elbows shall having turning vanes. Obtain approval from the Engineer prior to installing mitered elbow fittings.

2.05 RESIDENTIAL DRYER VENTS

A. Galvanized round duct with smooth interior finish and joints running in the direction of the exhaust airflow. Joint fasteners that protrude into the duct shall not be used. Comply with dryer manufacturer's venting recommendations.

PART 3 - EXECUTION

3.01 INSTALLATION

A. The design drawings are not intended to be shop drawings. Coordinate all ductwork with the work of all other trades on the project and verify sufficient ceiling space prior to beginning any ductwork fabrication or installation. Immediately notify the Architect of conflicts.

B. Provide openings in ductwork where required to accommodate thermometers, airflow measuring stations, and controllers. 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.

C. Located ducts with sufficient space around equipment to allow normal operating and maintenance activities.

D. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system. Protect ducts from moisture during construction.

E. Provide turning vanes at all offsets and elbows in rectangular supply, return and exhaust ductwork.

F. For ducts specified to be externally insulated (Refer to Section 23 07 00) ensure all duct joints are sealed prior to installing external insulation wrap.

3.02 ADJUSTING AND CLEANING

A. Clean duct system thoroughly to remove all accumulated dust and debris.

3.03 SEALING

A. Seal all joints of supply air, return air, fresh air, relief air and exhaust air ducts with duct sealant.

B. Joints in low pressure and high velocity supply air ducts (except "ductmate" systems) shall be sealed with hard cast pressureless tape with FTA-20 adhesive.

C. All exterior exposed ductwork shall be sealed "water-tight" and the tops sloped to prevent rainwater runoff. Provide suitable flashing and counter flashing where ductwork penetrates exterior walls. Caulk/seal full perimeter.

3.04 DUCTWORK APPLICATION SCHEDULE

AIR SYSTEM	MATERIAL
Supply Air	Steel *
Return and Relief	Steel *
General Exhaust	Steel *
Welding Exhaust	Steel **
Exposed Spiral – See Plans	Dual Wall Steel

* - Seal supply air ducts for 3" w.c. pressure class. Seal all return, relief and exhaust ducts for 1" w.c. pressure class.

** - rated for 10" w.c. negative

3.05 DUCT HANGER AND SUPPORTS

A. Provide duct supports and hangers in accordance with SMACNA. Provide seismic restraint complying with SMACNA Seismic Restraint Manual where required by local code. Anchor risers in the center of the vertical run to allow ends of riser free vertical movements. Attach supports only to structural framing members and concrete slabs. Do not anchor supports to metal decking unless a means is provided and approved for preventing the anchors from puncturing the metal decking. Where supports are required between structural framing member, provide suitable intermediate metal framing.

END OF SECTION

SECTION 23 33 00
AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Volume control dampers.

B. Fire dampers.

C. Backdraft Dampers.

D. Air Turning Devices.

E. Flexible Duct Connections.

F. Duct Access Doors.

G. Duct Test Holes.

1.02 RELATED WORK

A. Section 23 31 13 - Metal Ducts.

1.03 REFERENCES

A. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.

B. SMACNA - Low Pressure Duct Construction Standards.

C. UL 33 - Heat Responsive Links for Fire-Protection Service.

D. UL 555 - Fire Dampers and Ceiling Dampers.

1.04 SUBMITTALS

A. Provide shop drawings for shop fabricated assemblies indicated, including volume control dampers, duct access doors, and duct test holes. Provide product data for hardware used.

B. Submit manufacturer's installation instructions.

PART 2 - PRODUCTS

2.01 VOLUME CONTROL DAMPERS

A. Fabricate in accordance with SMACNA Low Pressure Duct Construction Standards, and as indicated.

B. Fabricate splitter dampers of material same gage as duct to 24 inches size in either direction, and two gages heavier for sizes over 24 inches.

C. Fabricate splitter dampers of single thickness sheet metal to streamline shape. Secure blade with continuous hinge or rod. Operate with minimum 1/4 inch diameter rod in self aligning, universal joint action flanged bushing with set screw.

D. Fabricate single blade dampers for duct sizes to 9-1/2 x 30 inch.

E. Fabricate multi-bade damper of opposed blade pattern with maximum blade sizes 12 x 72 inch. Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.

F. Except in round ductwork 12 inches and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon or sintered bronze bearings.

G. Provide locking, indicating quadrant regulators on single and multi-blade dampers. Where rod

lengths exceed 30 inches provide regulator at both ends.

H. On externally insulated runout ducts mount quadrant regulators on stand-off mounting brackets, bases or adapters **so that the operator completely clears the insulation covering**. Dampers in branch runouts shall be equal to Greenheck Model MBD/MBDR

I. Manual Balancing Dampers installed in areas with "hard" or non-accessible ceilings and in areas with high ceilings or congested ceiling spaces where access to dampers for final balance will be difficult shall be remote powered balancing type with low voltage actuator equal to Greenheck Model RBD-10 (rectangular) or RBDR-60 (round) with EZ Balance hand held 9-volt remote. Dampers shall be wired individually to RJ11 wall plates (multiples as required) secured to the structure and accessible from adjacent spaces with accessible lay-in ceilings or lower accessible ceiling spaces. Furnish all required wiring between the dampers and the accessible plug plates. All wiring and wall jacks shall be concealed. All wiring shall be plenum rated.

2.02 FIRE DAMPERS

A. Furnish in accordance with NFPA 90A and UL 555.

B. Furnish curtain type dampers of galvanized steel with interlocking blades. Provide stainless steel closure springs and latches for horizontal installations. Configure with blades out of air stream.

C. Furnish multiple blade fire dampers with 16 gage galvanized steel frame and blades, oil-impregnated bronze or stainless steel sleeve bearings and plated steel axles, 1/8 x 1/2 inch plated steel concealed linkage, stainless steel closure spring, blade stops, and lock.

D. Fusible links, UL 33, shall separate at 212 degrees F.

E. Provide 10% extra fusible links.

F. All Dampers shall be U.L. listed.

G. Hinged duct access panels shall be provided at each fire damper location to provide adequate access to the damper for servicing.

H. All damper components shall be by a single manufacturer.

2.03 BACKDRAFT DAMPERS

A. Gravity backdraft dampers, size 18 x 18 inches or smaller, furnished with air moving equipment, may be air moving equipment manufacturer's standard construction.

B. Fabricate multi-blade, parallel action gravity balanced back-draft dampers of 16 gage galvanized steel with center pivoted blades of maximum 6 inch width, with felt or flexible vinyl sealed edges, linked together in rattle-free manner with 90 degree stop, steel ball bearings, and plated steel pivot pin; adjustment device to permit setting for varying differential static pressure.

2.04 AIR TURNING DEVICES

A. Multi-blade device with double-thickness airfoil blades aligned in short dimension; steel construction; with individually adjustable blades, mounting straps.

2.05 FLEXIBLE DUCT CONNECTIONS

A. Fabricate in accordance with SMACNA Low Pressure Duct Construction Standards, and as indicated.

B. UL listed fire-retardant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 36 oz per sq yd, approximately 3 inches wide, crimped into metal edging strip.

C. Leaded vinyl sheet, minimum 0.55 inch thick, 0.87 lbs per sq ft, 10 dB attenuation in 10 to 10,000 Hz range.

2.06 DUCT ACCESS DOORS

A. Fabricate in accordance with SMACNA Duct Construction Standards and as indicated.

B. All duct access doors in rectangular ductwork shall be hinged, dual wall insulated construction. Provide two hinges and two sash locks for sizes up to 18 inches square, three hinges and two compression latches with outside and inside handles for sizes up to 24 x 48 inches. Provide an additional hinge for larger sizes. All access doors must be hinged - access doors with sheet metal screw fasteners or cam-locks only are not acceptable.

C. Perimeter gasketing for tight seal.

D. Provide identification stenciling at all duct access doors to identify the fire protection device within in accordance with NFPA 90A. All lettering shall be minimum ½ " tall.

2.07 DUCT TEST HOLES

A. Cut or drill temporary test holes in ducts as required to accomplish all airflow testing. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps. Duct tape over holes is NOT acceptable.

B. Permanent test holes shall be factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation. Provide permanent test holes only where shown on the plans.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install accessories in accordance with manufacturer's instructions.

B. Drop and reset all fire dampers as an integral part of the installation to ensure proper operation after installed. Reset dampers using the duct and/or ceiling access doors provided to ensure the service access is adequate as installed. Demonstrate re-setting of fire dampers to authorities having jurisdiction and Owner's representative if requested.

C. Provide backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.

D. Provide fire dampers where indicated on the plans. All fire dampers shall be installed in accordance with the manufacturer's written installation instructions and SMACNA. Contractor shall also drop and reset each damper after installation. All resetting shall be done thru the duct access doors provided so as to verify that each access door is adequately sized/positioned. Provide SMACNA approved breakaway connections at each fire damper. Brace ducts on both sides of fire damper as necessary to prevent movement of the duct.

E. Interrupt ductliner, at all fire dampers. Seal ductliner edges. Protect ductliner edges facing the air stream with metal nosing.

F. Provide ductwrap insulation at all fire damper frames.

END OF SECTION

SECTION 23 37 13
DIFFUSERS, REGISTERS AND GRILLES

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Diffusers, Registers, Grilles and Louvers for HVAC.

1.02 RELATED WORK

A. Section 23 31 13 - Metal Ducts.

B. Section 23 33 00 - Air Duct Accessories

1.03 REFERENCES

A. ADC 1062 - Certification, Rating and Test Manual.

B. AMCA 500 - Test Method for Louvers, Dampers and Shutters.

C. ANSI/NFPA 90A - Installation of Air Conditioning and Ventilating Systems.

D. ARI 650 - Air Outlets and Inlets

E. ASHRAE 70 - Method of Testing for Rating the Airflow Performance of Outlets and Inlets.

F. SMACNA - Low Pressure Duct Construction Standard.

1.04 QUALITY ASSURANCE

A. Test and rate performance of air outlets and inlets in accordance with ADC Equipment Test Code 1062 and ASHRAE 70.

B. Test and rate performance of louvers in accordance with AMCA 500.

1.05 REGULATORY REQUIREMENTS

A. Conform to ANSI/NFPA 90A.

1.06 SUBMITTALS

A. Submit product data under provisions of Section 013000.

B. Submit schedule of outlets and inlets indicating type, size, location, application and noise level at operating conditions.

C. Review requirements of outlets and inlets as to size, finish and type of mounting prior to submitting product data.

D. Submit manufacturer's installation instructions.

PART 2 - PRODUCTS

2.01 DIFFUSERS, REGISTERS AND GRILLES

A. Devices shall be of the type, size and manufacture as scheduled on the drawings.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install items in accordance with the manufacturer's instructions.

B. Check location of outlets and inlets to make necessary adjustments in position to conform with architectural features, symmetry and lighting arrangement.

C. Install all diffusers, registers and grilles to ductwork with an air tight connection.

D. Frame styles for all ceiling mounted devices shall match the type of ceiling where shown to be installed.

E. Finish colors of all devices shall be as directed by the Architect.

F. Paint all visible duct and/or mechanical liner fastener heads inside diffusers and registers matte black.

G. Unless otherwise notes, all louvers shall be supplied with factory applied baked-on finish in the finish color selected by the architect. Provide color samples to the Architect with product submittal data.

END OF SECTION

SECTION 23 73 33
FUEL FIRED HEATING EQUIPMENT

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Sealed Combustion Unit Heaters and Accessories.

B. Direct Fired Make-up Air Unit.

1.02 REFERENCES

A. ANSI/NFPA 70 - National Electrical Code.

B. American Gas Association (AGA).

1.03 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 01 33 00.

B. Submit manufacturer's installation instructions under provisions of Section 01 33 00.

1.04 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data under provisions of Section 01 78 00.

B. Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listings.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver products to site under provisions of Section 01 51 00.

B. Store and protect products under provisions of Section 01 51 00.

C. Protect units from physical damage by storing in protected areas and leaving factory covers in place.

PART 2 - PRODUCTS

2.01 GAS FIRED UNIT HEATERS

A. Provide high-efficiency, separated-combustion, power vented, gas-fired unit heaters manufactured as Reznor brand units. The units shall be designed for use in building areas with negative pressure and /or where there is a safety, security, or application need to completely seal the combustion circuit.

B. The heater shall be equipped with a multi-cell, 4 pass serpentine style steel heat exchanger. Heat exchange tubes shall be pressure fabricated of 409 stainless steel. All heat exchangers shall be with no welding or brazing, only tool pressed mechanical joints. All heat exchanger cells shall be designed with an aerodynamic cross section to provide maximum airflow.

C. The units shall incorporate a single, one piece burner assembly with a single orifice. The burner shall have a continuous would close pressed stainless steel ribbon separating the flame from the burner interior. All units shall have a single venturi tube and orifice supplying fuel to a one-piece burner housing. Each heat exchanger cell shall use balanced draft induction to maintain optimum flame control.

D. Controls shall include a single stage gas valve; direct spark multi-try ignition with electronic flame supervision with 100% lockout integrally controlled via a printed circuit control board. The control board shall also incorporate diagnostic lights, DIP switches for fan overrun settings, and a relay for fan only operation. All units shall be equipped with a safety limit switch. All controls shall be enclosed in the sealed control compartment to protect them from accidental damage, dust and atmospheric corrosion.

E. The unit shall have a factory installed power venter device to draw combustion air from outside the building. The outside air shall enter the unit through a factory installed round inlet air terminal on the rear of the heater. The control compartment shall be sealed and the access door shall be gasketed to prevent dirt, lint, dust, or other contaminants present in the heated space from entering the unit. The control compartment door shall be equipped with a safety interlock switch to prevent operation when the door is open. The combustion air supply pipe and flue exhaust pipe shall be run in parallel from the heater to a factory supplied concentric adapter assembly, which allows for a single wall or roof penetration. The combustion air/venting system shall include a vibration isolated power vent motor and wheel assembly and a combustion air pressure switch. Unit sizes 30-125 shall include a flame rollout switch.

F. Operation shall be controlled by an integrated circuit board that included LED diagnostic indicator lights. Supply voltage connections shall be made in a sealed junction box. 24-volt control connections shall be made on a n externally mounted terminal strip. All internal wiring, both line and control voltages, shall be terminated by insulated terminal connectors to minimize shock hazard during service.

G. All units will be equipped with a built-in disconnect switch.

H. The unit shall be designed with a full opening service access panel complete with screw closure attachment and lifting handle for removal. Service panel shall be fully gasketed and equipped with a safety inter-lock switch. All components in the gas train, all standard electrical controls, and the power venter shall be within the sealed service compartment.

I. Each unit shall be furnished with concentric vent kit and low voltage thermostat.

2.02 DIRECT FIRED MAKE-UP AIR UNITS

A. Manufacturers
   1. Available Manufacturers: Subject to compliance with specifications contained within this document, manufacturers offering products that may be incorporated into the work include, but are not limited to:
      a. Greenheck Fan Corporation

B. Manufactured Units
   1. Units with Integral Heating shall be fully assembled at the the factory and consist of an insulated metal cabinet, a curb assmembly, an outdoor air intake weatherhood with aluminum mesh, a motorized intake damper, supply air blower assembly, electrical control center. All specified components and internal accessories factory installed and tested and prepared for single-point high voltage connection.

C. Cabinet
   1. Materials: Formed, double wall insulated metal cabinet, fabricated to permit access to internal components for maintenance.
      a. Outside casing: 18 gauge, galvanized (G90) steel meeting ASTM A653 for components that do not receive a painted finish. Pre-painted components as supplied by the factory

shall have polyester urethane paint on 18 gauge G60 galvanized steel. Base rail is 12 gauge, galvazined (G90) steel.

b. Internal Assemblies: 24 gauge galvanized (G90) steel except for motor supports which shall be minimum 14 gauge galvanized (G90) steel.

2. Cabinet Insulation: Comply with NFPA 90A and NFPA 90B and erosion requirements of UL 181.
   a. Materials: Fiberglass insulation. If insulation other than fiberglass is used, it must also meet the Fire Hazard Classification shown below.
      1) Thickness: 1 inch
      2) Fire Hazard Classification: Maximum flame spread of 25 and smoke developed of 50, when tested in accordance with ASTM C 411.
      3) Location and application: Floor of each unit shall be insulated with fiberglass insulation. Full interior coverage of entire cabinet to include walls and roof of unit shall be semi-rigid type and installed between inner and outer shells of all cabinet exterior components when double walls are specified.
      4) Access panels: Unit shall be equipped with insulated hinged access panels to provide easy access to all major components. Access panels shall be fabricated of 18 gauge galvanized G90 steel.
      5) Supply Air blower assembly options:
         a) Direct-drive fan(s): Blower assembly shall consist of an electric motor as specified by A/E. Assembly shall be mounted on heavy gauge galvanized steel rails and further mounted on minimum 1.125 inch thick neoprene vibration isolators. Blower motor(s) shall be capable of continuous speed modulation and controlled by a factory supplied VFD.
3. Control center / connections:
   a. Unit shall have an electrical control center where all high and low voltage connections are made. Control center shall be constructed to permit single-point high voltage power supply connections.
4. Direct Gas-Fired Furnace:
   a. Unit shall be factory assembled, piped, and wired. Direct gas-fired system will be 92% efficient while supplying a burner that is capable of providing 25:1 turndown. Unit will utilize a draw through design and incorporate adjustable burner baffles plates for field adjustments. Unit will have a EconomyPilot ignition system.
   b. Burner construction shall consist of a cast aluminum burner manifold and 400 series stainless steel mixing plates. No air from inside the space shall be allowed to pass across the burner at any time. Flame sensing shall be provided by a flame rod. Burner control shall have a digital coded fault indicator capable of storing the last five faults.
   c. Shall be equipped for operation on Natural gas with a maximum rated inlet gas pressure of 1/2 PSI.
   d. Burner control option to include the following: Discharge temperature.
   e. Shall include the following safety controls:
      1) Manual Reset, High Limit Switch: Main gas valve closes if high-limit temperature is exceeded.
      2) Dual safety shutoff valves shall be provided that do not exceed 120 VAC control signals.
5. Motorized Inlet Air Dampers: to be of low leakage type and shall be factory installed.

6. Curb Assembly: A curb assembly shall be made of galvanized steel provided by the factory for field assembly and installation as part of this division. The curb shall include a duct adapter for supply air. The installing contractor shall be responsible for coordinating with roofing contractor to ensure curb unit is properly flashed to provide protection against weather/moisture penetration. Contractor shall provide and install appropriate insulation for the curb assembly.

D. Blower-DD
   1. Blower assemblies: Shall be statically and dynamically balanced and designed for continuous operation at maximum rated fan speed and horsepower and must have neoprene vibration isolation devices, minimum of 1-1/8 inches thick.
   2. Fan: Airfoil plenum fan statically and dynamically balanced, AMCA certified for air and sound performance.
   3. Blower section motor source quality control: Blower performance shall be factory tested for flow rate, pressure, power, air density, rotation speed and efficiency. Ratings are to be established in accordance with AMCA 210, "Laboratory Methods of Testing Fans for Rating".
   4. Proceed with installation only after all unsatisfactory conditions have been corrected.

E. Motors
   1. General: Blower motors greater than 3/4 horsepower shall be "NEMA Premium" unless otherwise indicated. Compliance with EPAct minimum energy-efficiency standards for single speed ODP and TE enclosures is not acceptable. Motors shall be heavy-duty, permanently lubricated type to match the fan load and furnished at the specified voltage, phase, and enclosure. Drives shall be sized for a minimum of 150% of driven horsepower and pulleys shall be fully machined cast-type, keyed and fully secured to the fan wheel and motor shafts. Electric motors of ten horsepower or less shall be supplied with an adjustable drive pulley. Comply with requirements in Division 23 05 13, matched with fan load.
   2. Motors shall be 60 cycle, 3 phase, 460 volt.

F. Unit Controls
   1. The unit shall be constructed so that it can function as a stand-alone heating system controlled by a factory-supplied remote panel, thermostats and sensors or it can be operated as a heating system controlled by a Building Automation System (BAS).
   2. Variable Frequency Drive (VFD): Unit shall have factory installed variable frequency drives for modulation of the blower motors. The VFDs shall be factory-programmed for unit-specific requirements and shall not require additional field programming to operate.
   3. Sensors to be provided with the unit:
      a. Heating Inlet Air Sensor

G. Filters
   1. Unit shall have 2" thick MERV 13 disposable pleated filters following the outdoor air intake in a V-bank arrangement and shall be accessible from the exterior of the unit.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are ready to receive work and opening dimensions are as indicated on shop drawings. Verify all building openings are correctly positioned.

B. Verify that required utilities are available, in proper location, and ready for use. Verify gas lines are properly regulated.

C. Verify MAU curb is level and roof opening is properly positioned.

3.02 INSTALLATION

A. Install heaters in accordance with the manufacturer's recommendations

B. Protect units with protective covers during balance of construction.

C. Touch-up marred or scratched surfaces of factory-finished cabinets, using finish materials furnished by the manufacturer.

D. Wire and vent units per the manufacturer's installation instructions. Vent unit heaters thru roof to weatherproof concentric vent per manufacturer's recommendations.

E. Seismically brace suspended unit heaters. Refer to section 23 05 48.

END OF SECTION

SECTION 23 74 13
PACKAGED ROOFTOP AIR CONDITIONING UNITS

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Section Includes:
   1. Packaged specialty units for use with high percentage of outside air or for 100% outside air duty

1.02 REFERENCES

A. Air-Conditioning and Refrigeration Institute:
   1. ARI 340/360 - Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment.

B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
   1. ASHRAE 52.1 - Gravimetric and Dust-Spot Procedures for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter.

C. National Fire Protection Association:
   1. NFPA 90A - Standard for the Installation of Air Conditioning and Ventilating Systems.

1.03 SUBMITTALS

A. Product Data: Submit data indicating:
   1. Cooling capacities (at scheduled conditions).
   2. Dimensions.
   3. Weights.
   4. Rough-in connections and connection requirements.
   5. Duct connections.
   6. Electrical requirements with electrical characteristics and connection requirements.
   7. Controls.
   8. Accessories.

Manufacturer's Certificate: Certify products meet or exceed specified requirements.

Manufacturer's Field Reports: Submit start-up report.

1.04 QUALITY ASSURANCE

A. Cooling Capacity: Rate in accordance with ARI 360.

B. Sound Rating: Measure in accordance with ARI 270.

C. Insulation and adhesives: Meet requirements of NFPA 90A.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Accept units on site. Inspect for damage.

B. Protect units from damage by storing off roof until roof mounting supports are in place.

1.06 COORDINATION

A. Coordinate installation of units with roof structure, roof deck and roof membrane installation. Position units so that duct openings do not conflict with roof framing.

1.07 WARRANTY

A. Furnish five-year manufacturer's warranty for compressors; one year parts and labor and

additional 4-year parts-only warranty.

B. Furnish ten-year manufacturer's warranty for stainless steel heat exchangers (units with gas heat); one year parts and labor and additional 9-year parts-only warranty

1.08 EXTRA MATERIALS

A. Furnish one extra sets of fan belts for each unit.

B. Furnish three sets of disposable filters for each unit.

1.09 MANUFACTURER'S COORDINATION WITH BAS CONTROLS

A. Controls provided by equipment suppliers shall be provided with BACnet MS/TP or BACnet IP interface. Controllers must allow for bi-directional data communication and all points needed to control the equipment shall be made available to the BAS Contractor. All controllers, including unitary controllers, shall be native BACnet devices. No gateways shall be used for communication to controllers installed under this section. No communication protocols other than BACnet shall be used.

1.10 MAINTENANCE LOGS

A. The contractor shall maintain an appropriate maintenance log, where applicable, of all interim maintenance tasks performed on all equipment started-up and/or operated during construction so that the manufacturer's warranties are not voided prior to the equipment being turned over to the owner. Maintenance logs shall be submitted to the owner as a part of the project close-out documentation when the building is released to the owner.

1.11 COMMISSIONING COORDINATION

A. The contractor shall be responsible for demonstrating their systems have been installed properly and are functioning in accordance with the design intent of the project documents. Refer to Sections 01 91 13 COMMISSIONING, 01 91 23 PERFORMANCE TESTING IDENTIFICATION FORM, 01 91 26 PERFORMANCE TESTING PROCEDURE FORM AND 01 91 29 FUNCTIONAL PERFORMANCE TEST CERTIFICATE in order to be apprised of, and to become familiar with their respective roles and responsibilities throughout the commissioning process.

PART 2 - PRODUCTS

2.01 SPECIALTY ROOFTOP UNITS

A. The contractor shall furnish and install packaged outdoor air unit(s) as shown and scheduled on the contract documents. The unit(s) shall be installed in accordance with this specification and perform at the specified conditions as scheduled.

B. Approved Manufacturers
   1. Trane: Model Horizon OAU (Packaged Outdoor Air Unit)
   2. Equivalent by Greenheck, Valent, AAON or Daikin

C. General Unit Description
   1. Unit(s) furnished and installed shall be packaged outdoor air unit (s) as scheduled on contract documents and these specifications. Unit(s) shall consist of insulated weather-tight casing with compressor(s), air-cooled condenser coil, condenser fans, evaporator coil, air filters, supply motors and unit controls.
   2. Before shipment, each unit(s) shall be leak tested, dehydrated, charged with refrigerant (R-410A) and compressor oil, and factory run tested for proper control operation.

3. For units greater than 30 nominal tons cooling, the condenser coils must be aluminum fin, mechanically bonded to copper tubing. For units 30 tons or less, coil shall have a series of flat tubes containing a series of multiple, parallel flow microchannels layered between the refrigerant manifolds. Coil construction shall consist of aluminum alloys for fins, tubes, and manifolds in combination with a corrosion-resistant coating.
4. Direct-drive, vertical discharge condenser fans must be provided with built-in thermal overload protection.
5. Unit(s) shall have labels, decals, and/or tags to aid in the service of the unit and indicate caution areas.
6. Unit(s) shall be dedicated downflow or dedicated, thru curb horizontal airflow as manufactured.
7. Wiring internal to the unit shall be colored and numbered for identification.
8. Two inch, MERV 13 throwaway filters shall be standard on all units. Minimum Efficiency Reporting Value (MERV) as determined by ASHRAE 52.2-1999.

D. Unit Casing
1. Cabinet: Zinc-coated, heavy gauge, galvanized steel. Exterior surfaces shall be cleaned, phosphatized, and finished with a weather-resistant baked enamel finish. Unit's surface shall be tested 672 hours in a salt spray test in compliance with ASTM B45. Structural members shall be a minimum of 16 gauge with access doors and removable panels of minimum 20 gauge.
2. Panels: 2" double-wall foamed panel construction throughout the indoor section of unit to provide nonporous, cleanable interior surfaces. All interior seams exposed to airflow shall be sealed.
3. Insulation: 2" polyisocyanurate Foam metal encapsulated with no exposed edges. Initial R value of 6.6 per inch of thickness.
4. Cabinet construction shall provide access panels for all parts requiring service.
5. Cabinet top cover shall be one piece construction or where seams exist, it shall be double-hemmed and gasket-sealed.
6. Panels: Water- and air-tight hinged panels with handles shall provide access to filters, heating section; supply air fan section, evaporator coil section, and unit control section. Door hardware shall be oriented to allow the door swing to be reversed.
   a. Latches with hold down hooks will be factory installed on hinged access doors.
7. Type 304 Stainless steel drain pan sloped in two directions to ensure positive drainage. Pan shall have a minimum depth of 2". Seams exposed to standing water shall be welded liquid tight. Base of pan shall be insulated with 1" thick foam insulation.
8. Provide openings either on side of unit or thru the base for power, control and gas connections.
9. The base of the unit shall have provisions for forklift and crane lifting

E. Power Wiring
1. Field wiring access to be provided thru unit base into isolated enclosure with removable cover.
2. Power wiring to be single point connection.
3. Unit shall be factory wired to field wiring terminal block mounted in isolated enclosure.
4. Factory mount and wire unit main power disconnect device overcurrent and SCCA rated for total unit power connection.
5. Factory installed safety barrier shall isolate all high voltage components, mounted inside electrical compartment, to protect service personnel from incidental contact.

6. Factory to mount and wire optional120 volt convenience outlet. Field wiring of convenience outlet not acceptable.

F. Low Voltage Controls
   1. Factory mount and wire 24 volt control system complete with required transformers and fusing.
   2. Main Control Module (MCM) shall prevent simultaneous operation of any modes and shall enable operation in Dehumidification, Cooling, Heating or Economizer mode based on programmed settings for (select one)
      a. Space conditions
      b. Outdoor air conditions
   3. MCM shall accept separate setpoints for Occupied and Unoccupied states.
   4. MCM shall control based on dew point design settings for Dehumidification and Economizer modes, and sensible temperature settings for heating and cooling modes.
   5. Factory installed and wired sensors shall monitor Outdoor Air (OA) temperature, humidity and evaporator leaving air temperature.
   6. Supply air sensor shall be furnished with unit. Installing contractor shall install remote mounted supply air sensor in supply air duct and LAN connections to unit.
   7. Rh sensor(s) shall be furnished and field wired to unit.
   8. Modulating hot-gas reheat shall be enabled in dehumidification mode with modulation controlled by MCM to maintain (supply air temperature / space temperature).
   9. System controls shall include anti-cycle timing and minimum compressor run/off times.
   10. Systems controls shall be digital, programmable type with access via factory installed and wired touchscreen, or through portable computer connection. All setpoints, unit functions, and status shall be accessible via the touchscreen or portable computer.
   11. MCM shall include preprogrammed test modes, engaged thru operator display, that permit operation in dehumidification, cooling, heating, or economizer test modes and facilitate complete start-up of all unit mechanical and control components.
   12. All low voltage field wiring connections shall be made at factory installed low voltage terminal strip.
   13. Field wiring of zone controls to be NEC Class II.

G. Fans and Motors
   1. Indoor fan shall be direct drive plenum fan, factory installed and wired to on-board Variable Frequency Drive and shall be equipped with slide out service access.
   2. All fan motors shall meet the U.S. Energy Policy Act of 2005/10 (EPACT).
   3. All fan motors shall either be permanently lubricated and/ or have internal thermal overload protection.
   4. Outdoor fans shall be direct drive, statically and dynamically balanced, draw through in the vertical discharge position.
   5. Provide shafts constructed of solid hot rolled steel, ground and polished, with key-way, and protectively coated with lubricating oil.

H. Modulating Indirect Gas-Fired Burner Heating Section
   1. Completely assembled and factory installed heating system shall be integral to unit and approved for use downstream from refrigerant cooling coils in units mounted outdoors. Threaded gas connection shall terminate at manual shut-off valve provided with unit. Provide capability for sidewall or thru-base gas piping.
   2. The unit shall have fully modulating, high turndown, and indirect gas fired heat. The heating section will include high turn-down burners firing into individual stainless steel

tubular heat exchangers. The heat exchangers shall be constructed of type 409 or optional type 304 stainless steel and be a tubular design capable of draining internal condensate. External flue to be constructed of type 304 stainless steel. Units with multiple heaters shall include one fully modulating high turndown heater with additional on-off heater sections. Total heater turndown shall be minimum listed below or higher.

3. Gas Burner Safety Controls: Provide safety controls for the proving of combustion air prior to ignition, and continuous flame supervision.
4. Timed freeze stat shall monitor heat output and shall discontinue all heating attempts and or unit operation in the event the heating section fails to ignite or fails to maintain programmed supply air temperature/time.
5. Inducer fan shall be direct drive high pressure centrifugal type and shall include built- in thermal overload protection.
6. Limit controls: High temperature limit controls will shut off gas flow in the event of excessive temperatures resulting from restricted indoor airflow, loss of indoor airflow or flame rollout.

I. Evaporator Condenser and Reheat Coils

1. Evaporator coils shall be constructed of copper tubes mechanically bonded to a configured aluminum plate fin. For units greater than 30 nominal tons cooling, the hot gas reheat coils must be aluminum fin, mechanically bonded to copper tubing. For units 30 tons or less, hot gas reheat coil shall have a series of flat tubes containing a series of multiple, parallel flow microchannels layered between the refrigerant manifolds. Coil construction shall consist of aluminum alloys for fins, tubes, and manifolds in combination with a corrosion-resistant coating.
2. Coils shall be leak tested at the factory to ensure pressure integrity. The evaporator coil, reheat coil and condenser coil shall be leak tested to 500 psig and pressure tested to 500 psig.
3. The condenser coil shall have a fin designed for ease of cleaning.
4. Evaporator coil shall have six interlaced rows for superior sensible and latent cooling.
5. Reheat coil shall be fully integrated into the supply air and fan system and capable of delivering design supply air temperature.
6. To prevent re-hydration of condensate from evaporator coil, the evaporator coil face and the hot gas reheat coil face shall be separated a minimum of six inches.
7. Factory Mounted and Wired UVC Emitters/Lamps: Ultraviolet light (C band) emitters/lamps shall be incorporated downstream of evaporator coils, upstream of hot gas reheat coils, and above all drain pans to control airborne and surface microbial growth and transfer. Applied fixtures must be specifically manufactured for this purpose. Safety interlocks/features shall be provided to limit hazard to operating staff.

J. Condenser Section

1. Outdoor Fans: vertical discharge, direct drive fans with polymer blades. Fans shall be statically balanced.

K. Refrigerant Capacity Control

1. Units with scroll compressors shall be equipped with Refrigerant Capacity Control (RCC) on the lead circuit to modulate compressor capacity during Dehumidification or Cooling modes to maintain evaporator Dehumidification or Cooling setpoint and prevent evaporator frosting or freezing. RCC shall be (standard mechanical / optional electrical).
2. The RCC setpoint is factory set, and field adjustable, to maintain desired suction pressure and compressor discharge pressure.
3. Capacity control for units equipped with digital scroll compressors, or variable speed compressors, shall be accomplished through compressor controls.

L. Refrigeration System
   1. Compressor(s): All units shall have direct-drive, hermetic, scroll type compressors or digital scroll with centrifugal type oil pumps.
   2. Motor shall be suction gas-cooled and shall have a voltage utilization range of plus or minus 10 percent of unit nameplate voltage.
   3. Internal overloads shall be provided with the scroll compressors.
   4. Each compressor shall have a crankcase heater to minimize the amount of liquid refrigerant present in the oil sump during off cycles.
   5. Provide each unit with hermetically sealed refrigerant circuit(s) factory-supplied completely piped with liquid line filter-drier, liquid line charging port, suction and liquid line pressure ports.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Maintain all manufacturer recommended service and operating clearances at all units. Verify minimum ten feet of clearance between any roof mounted unit and the edge of the roof per IMC requirements. Do not locate units closer than ten feet to the roof edge unless suitable parapet or protective guards (min 42" high) are in place. Guardrails, where required, must be as defined in the International Building Code.

B. Verify that the proper power supply is available.

C. Verify the tops of all supports are level and duct openings properly positioned.

D. Verify natural gas and condensate drain rough-ins are correctly located and sized

3.02 INSTALLATION

A. All units shall be installed in strict accordance with the manufacturer's installation instructions.

B. Set new rooftop units on minimum 18" tall factory fabricated full perimeter seismic roof mounting curbs. Provide seismic spring curbs with acoustical treatments where called for on the drawings – coordinate with Section 23 05 29. All Curbs shall be insulated. Tops of curbs shall be level. Where required, curbs shall be supplied with the proper pitch to match the roof slope - field shimming of curbs will not be acceptable.

C. Maintain all manufacturer's recommended service and operating clearances.

D. Coordinate duct penetrations thru the roof with roof framing prior to beginning any fabrication or installation. **All roof decking and roof insulation shall be continuous under the units except for the required duct openings**. Furnish and install all perimeter angles around the interior of the roof curbs for support of the metal roof deck and insulation as required.

E. Provide temporary filtration for all units operated during the construction phase. At the completion of construction, after the building has been substantially cleaned and immediately prior to the owner's occupancy of the building, replace all unit filters with new, clean filters of the type specified. In addition to these new filters in the unikts, provide spare filters for each unit as specified in this section.

3.03 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory authorized service representative to inspect field assembled components and equipment installation, to include electrical and piping connections. Report results in writing. Inspection must include a complete startup checklist to include (as a minimum) the following: Completed Start-Up Checklists as found in manufacturer's IOM.

B. Verify unit operation and proper sequence of operation of control for all units. Coordinate with Section 23 09 00.

C. Filters: Replace all filtration media immediately prior to occupancy. Filtration media shall have a Minimum Efficiency Reporting Value (MERV) of 13 as determined by ASHRAE 52.2-1999.

3.04 START-UP SERVICE

A. Engage a factory authorized service representative to perform startup service. Clean entire unit, comb coil fins as necessary, and install clean filters.

3.05 DEMONSTRATION AND TRAINING

A. Engage a factory authorized service representative to train owner's maintenance personnel to adjust, operate and maintain the entire unit.

END OF SECTION

SECTION 26 00 00
BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. This section specifies the basic electrical requirements for this project as well as the general requirements which apply to the work of Division 26 in addition to those stipulated in Division 01. Should any discrepancies exist between the requirements of Division 26 and those found in Division 01; the more stringent requirement shall govern except where the two requirements are contradictory in which case the Division 01 requirements shall govern.

B. The electrical work required for this project consists of furnishing all labor, equipment and materials necessary to obtain complete and operational electrical systems as indicated on the drawings and as specified herein.

C. The Contractor shall furnish all material and labor as required for the installation of the new electric service per the local power company's requirements. The Contractor shall coordinate with the local power company for all requirements.

D. The Contractor shall furnish all material and labor as required for the installation of the new telecom service(s) per the local service provider(s)' requirements. The Contractor shall coordinate with the local service provider(s) for all requirements.

1.2 CODES, STANDARDS AND PERMITS:

A. The installation shall comply with the following:

1. All applicable local and state wiring ordinances.
2. The National Electrical Code (NFPA-70-2008).
3. All applicable provisions of the Occupational Safety and Health Act (OSHA).
4. Requirements of the power and telephone companies furnishing services to the project.
5. International Building Code (2009 Edition).
6. Americans with Disabilities Act (ADA).

B. This contractor shall apply for, obtain, and pay for all permits required. At the conclusion of the installation, he/she shall secure a certificate of inspection, properly signed by the controlling building department, which shall state that all rules have been complied with and that the work is satisfactory.

C. Should any part of the plans or specifications be found to be in conflict with applicable codes or ordinances, the contractor shall notify the engineer before submitting his/her bid.

1.3 TRADE NAMES AND EQUALS

A. Manufacturer's trade names or catalog numbers used in these specifications and indicated on the drawings denote type, size, quality, and design of equipment desired.

B. Where equipment is specified as "equal", or "approved equal", it shall mean equal in the opinion of the engineer. This contractor is free to offer substitutions for consideration as equal after the contract is signed; however, he shall be prepared to furnish specified materials where substitutions are not approved.

1.4 DELIVERY, STORAGE, AND HANDLING OF MATERIAL AND EQUIPMENT

A. The contractor shall be responsible for the purchase, delivery, and storage of all materials and equipment indicated to be supplied under this section of the specifications, and it shall be his/her responsibility to schedule the delivery of materials and equipment at such stages of the work as will permit uninterrupted construction of all phases of the work.

B. This contractor shall do all required rigging, hoisting, transporting, etc., of all equipment furnished under this contract, and shall further furnish any additional structural members, as may be required, for the proper support of any and all equipment furnished hereunder.

1.5 USE OF DOCUMENTS:

A. The scope of the electrical work for this project is not limited to the requirements of any one drawing, any portion of the drawings, any one specification division, or any portion of the specifications whose main theme is electrical. The scope of the electrical work for this project consists of all electrical work required to obtain complete and operating systems and equipment as indicated on or as can be reasonably inferred from all drawings and specifications.

B. The drawings indicate diagrammatically the general arrangement of electrically operated equipment & appliances and other work. This data is as accurate as planning can determine, but accuracy is not guaranteed. Field verification of all dimensions, locations, levels, etc., to suit field conditions is directed.

C. Should any structural or mechanical interferences prevent the installation of conduit, setting of junction boxes and cabinets, etc., in the locations indicated on the drawings, the necessary deviations therefrom must be made without additional cost to the owner, where relocation is not over five (5) feet from the location shown on the drawings.

D. Review all drawings and adjust all work to conform to all conditions shown therein. Discrepancies between different drawings, or between drawings and specifications or codes and regulations governing the installation shall be brought to the attention of the Owner's Representative prior to the date of bid opening.

E. The locations of equipment, conduits, etc., as indicated on the drawings are approximate only. Verify all dimensions with the appropriate equipment installer before rough-in. Where conduit or other electrical equipment interfere with construction; remove, relocate and rearrange such material and equipment as required to make a complete and satisfactory installation.

F. Any offsets in conduit required or necessary to avoid interferences with structure, or the work of

other trades, etc., shall be made at no additional cost to the owner.

G. Refer to architectural and structural drawings for all dimensions of building spaces.

1.6 COORDINATION

A. The electrical contractor shall coordinate his/her work with that of other subcontractors on the job and also with that of the owner in order that there be no delay in the proper installation and completion of the several parts of the work.

B. This contractor shall use every precaution to protect the work of others, and he/she will be held responsible for all damage done by his workers to the work of other trades. He/she shall also protect his work from danger of breakage, dirt, foreign materials, etc., and shall replace all work so damaged.

C. Coordinate phases of the work with the owner and other trades to allow the owner to continue normal business operations throughout the duration of the project. Any necessary power outages shall be scheduled for other than the owner's hours of operation, or be pre-arranged with the owner.

1.7 MANUFACTURER'S RECOMMENDATIONS

A. Unless specifically indicated otherwise, all equipment and materials shall be installed in accordance with the best recommendation of the manufacturer.

1.8 CUTTING AND PATCHING

A. This contractor shall be responsible for all cutting and patching required for the installation of his work, and he/she shall employ workers skilled in the trades required for all cutting and patching work.

B. This contractor shall be responsible for the proper location of all chases, recesses, and openings required for his work.

C. This contractor shall provide all sleeves, etc., required for the introduction and placement of his work, and shall be responsible for the correct location of same.

D. Beams or columns shall not be pierced without permission of the structural engineer, and then only as directed.

1.9 PAINTING

A. Painting of materials and equipment furnished under the electrical portion of the contract, if required, will be done under a separate section of the project specifications. The electrical contractor shall, however, refinish and restore to the original condition and appearance, all electrical equipment which has sustained damage to manufacturer's finish paint.

B. All electrical equipment shall be provided with factory applied prime and finish paint, unless

otherwise specified.

1.10 SHOP DRAWINGS (SUBMITTALS)

A. Six copies of shop drawings and/or manufacturer's descriptive data of a nature to completely identify the equality of the material or equipment intended for installation shall be submitted for approval before beginning any construction and within thirty days after signing contract. Failure to submit data for approval within thirty days time limit will be construed as meaning equipment called for by name will be furnished. Data shall be organized in same order as listed below, shall be submitted all in one three ring binder, indexed by flysheet on front page, each item tabbed and labeled, arranged in the order they appear in the specifications, and be bound in sets, all sets identical. No exception will be made to this procedure and time schedule.

B. Each item submitted for review shall have submittal data preceded by a typewritten description (by contractor or item supplier) of the item. Description shall include make and model numbers and shall describe the item. List all options and accessories which are included. List any options or accessories shown on shop drawings which are not included.

1.11 RECORD DRAWINGS

A. This contractor shall maintain a complete up-to-date set of record drawings and specifications on the job site. Drawings shall be maintained in a neat condition and shall clearly show any changes from original drawings and specifications.

B. Contractor shall use a designed set of prints of the contract documents, as prepared by the engineer, to mark up for record drawing purposes.

C. The contractor shall prepare a set of reproducible record drawings. These drawings and a set of specifications shall be turned over to the owner and shall become the property of the owner before final payment will be made.

1.12 TEMPORARY CONSTRUCTION POWER AND LIGHTING

A. This contractor shall furnish and install all temporary wiring for construction power and lighting for the project as required.

B. A temporary electrical service, if required, for construction power and lighting shall be obtained by this contractor in the name of the owner, who will pay all power and energy charges. Any cost for the temporary service connection shall be paid by this contractor.

C. All temporary wiring for construction shall conform to Article 590 of the National Electrical Code and all applicable rules and regulations of OSHA.

1.13 EXCAVATION AND BACKFILLING:

A. Perform all excavation and backfilling required for electrical work including necessary sheathing and bracing in accordance with the requirements of Division 31, "EARTHWORK."

1.14 SAFETY DEVICES

A. Electrical equipment and wiring used during construction shall be installed and insulated in a manner to insure the safety of personnel.

B. Provide suitable guards, signs, etc. to protect personnel from "hot" wiring in panelboards, junction boxes, etc. during the construction period.

1.15 GUARANTEE

A. The contractor shall guarantee to the owner all work performed under this contract to be free from defects in workmanship and material for a period of one (1) year from date of final acceptance. Defects arising during this period will be promptly remedied by the contractor at his own expense upon notice by the owner. All lamps for lighting fixtures shall be excluded from this guarantee, but one (1) complete and operative set of lamps for lighting fixtures shall be in place at the time of final acceptance.

END OF SECTION

SECTION 26 05 19
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Copper building wire rated 600 V or less.
2. Aluminum building wire rated 600 V or less.
3. Connectors, splices, and terminations rated 600 V and less.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Product Schedule: Indicate type, use, location, and termination locations.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE

A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.

B. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. RoHS compliant.
3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

C. Conductor Insulation:

1. Type THHN and Type THWN-2: Comply with UL 83.
2. Type XHHW-2: Comply with UL 44.

2.2 ALUMINUM BUILDING WIRE

A. Description: Flexible, insulated and uninsulated, drawn aluminum current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.

B. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. RoHS compliant.
3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

C. Conductors: Aluminum, complying with ASTM B800 and ASTM B801.

D. Conductor Insulation:

1. Type THHN and Type THWN-2: Comply with UL 83.
2. Type XHHW-2: Comply with UL 44.

2.3 CONNECTORS AND SPLICES

A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper for feeders smaller than No. 4 AWG; copper or aluminum for feeders No. 4 AWG and larger. Conductors shall be solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type XHHW-2, single conductors in raceway.

B. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway.

C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN/THWN-2, single conductors in raceway.

D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.

E. Exposed Branch Circuits, Including in Crawlspaces: Type THHN/THWN-2, single conductors in raceway.

F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway.

G. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.

H. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

B. Complete raceway installation between conductor and cable termination points according to Section 26 05 33 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.

C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

F. Support cables according to Section 26 05 29 "Hangers and Supports for Electrical Systems."

3.4 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

3.5 IDENTIFICATION

A. Identify and color-code conductors and cables according to Section 26 05 53 "Identification for Electrical Systems."

B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.6 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 07 84 13 "Penetration Firestopping."

3.7 FIELD QUALITY CONTROL

A. Perform the following tests and inspections.

1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
2. Perform each of the following visual and electrical tests:

a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
b. Inspect compression-applied connectors for correct cable match and indentation.
c. Inspect for correct identification.
d. Inspect cable jacket and condition.

B. Cables will be considered defective if they do not pass tests and inspections.

END OF SECTION

SECTION 26 05 26
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes grounding and bonding systems and equipment.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: Certified by NETA.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with UL 467 for grounding and bonding materials and equipment.

2.2 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Burndy; Part of Hubbell Electrical Systems.
2. ERICO; a brand of nVent.
3. O-Z/Gedney; a brand of Emerson Industrial Automation.

2.3 CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:

1. Solid Conductors: ASTM B3.
2. Stranded Conductors: ASTM B8.
3. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.

2.4 CONNECTORS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

C. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

2.5 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel, sectional type; 3/4 inch by 10 feet.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.

B. Grounding Conductors: Green-colored insulation with continuous yellow stripe.

C. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
3. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING AT THE SERVICE

A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

3.3 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:

1. Feeders and branch circuits.
2. Lighting circuits.
3. Receptacle circuits.
4. Single-phase motor and appliance branch circuits.
5. Three-phase motor and appliance branch circuits.
6. Flexible raceway runs.
7. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.

B. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

3.4 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade unless otherwise indicated.

1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
2. Use exothermic welds for all below-grade connections.

C. Grounding and Bonding for Piping:

1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.

2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

D. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.

1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
2. Make connections with clean, bare metal at points of contact.
3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
4. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

3.5 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.

B. Grounding system will be considered defective if it does not pass tests and inspections.

C. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION

SECTION 26 05 29
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Steel slotted support systems.
2. Conduit and cable support devices.
3. Support for conductors in vertical conduit.
4. Mounting, anchoring, and attachment components, including powder-actuated fasteners, mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.

B. Related Requirements:

1. Section 26 05 48.16 "Seismic Controls for Electrical Systems" for products and installation requirements necessary for compliance with seismic criteria.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Delegated-Design Submittal: For hangers and supports for electrical systems.

1. Include design calculations for seismic restraints.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Hangers and supports shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the supported equipment and systems will remain in place without separation of any parts when subjected to the seismic forces specified."

2. Component Importance Factor: 1.0.

2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32-inch-diameter holes at a maximum of 8 inches o.c. in at least one surface.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. B-line, an Eaton business.
   b. Thomas & Betts Corporation; A Member of the ABB Group.
   c. Unistrut; Part of Atkore International.

2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
3. Material for Channel, Fittings, and Accessories: Plain steel.
4. Channel Width: Selected for applicable load criteria.
5. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
6. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

C. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be made of malleable iron.

D. Structural Steel for Fabricated Supports and Restraints: ASTM A36/A36M steel plates, shapes, and bars; black and galvanized.

E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      1) Hilti, Inc.
      2) ITW Ramset/Red Head; Illinois Tool Works, Inc.
      3) MKT Fastening, LLC.

2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

    a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

        1) Hilti, Inc.
        2) ITW Ramset/Red Head; Illinois Tool Works, Inc.
        3) MKT Fastening, LLC.

3. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM F3125/F3125M, Grade A325.
6. Toggle Bolts: All-steel springhead type.
7. Hanger Rods: Threaded steel.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with the following standards for application and installation requirements of hangers and supports, except where requirements on Drawings or in this Section are stricter:

1. NECA 1.
2. NECA 101

B. Comply with requirements in Section 07 84 13 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.

C. Comply with requirements for raceways and boxes specified in Section 26 05 33 "Raceways and Boxes for Electrical Systems."

D. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.

E. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slottedsupport system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with single-bolt conduit clamps using spring friction action for retention in support channel.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this article.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMT IMC and RMC may be supported by openings through structure members, according to NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.
3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. To Existing Concrete: Expansion anchor fasteners.
5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
6. To Steel: Beam clamps (MSS SP-58, Type 19, 21, 23, 25, or 27), complying with MSS SP-69.
7. To Light Steel: Sheet metal screws.
8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that comply with seismic-restraint strength and anchorage requirements.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

END OF SECTION

SECTION 26 05 33
RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Metal conduits and fittings.
2. Nonmetallic conduits and fittings.
3. Metal wireways and auxiliary gutters.
4. Boxes, enclosures, and cabinets.

B. Related Requirements:

1. Section 07 84 13 "Penetration Firestopping" for firestopping at conduit and box entrances.

1.3 DEFINITIONS

A. GRC: Galvanized rigid steel conduit.

B. IMC: Intermediate metal conduit.

1.4 ACTION SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

PART 2 - PRODUCTS

2.1 METAL CONDUITS AND FITTINGS

A. Metal Conduit:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allied Tube & Conduit; a part of Atkore International.
b. Republic Conduit.
c. Wheatland Tube Company.

2. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
3. GRC: Comply with ANSI C80.1 and UL 6.
4. IMC: Comply with ANSI C80.6 and UL 1242.
5. EMT: Comply with ANSI C80.3 and UL 797.
6. FMC: Comply with UL 1; zinc-coated steel.
7. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

B. Metal Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allied Tube & Conduit; a part of Atkore International.
b. Republic Conduit.
c. Wheatland Tube Company.

2. Comply with NEMA FB 1 and UL 514B.
3. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
4. Fittings, General: Listed and labeled for type of conduit, location, and use.
5. Fittings for EMT:

a. Material: Steel.
b. Type: Setscrew.

6. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.

C. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS AND FITTINGS

A. Nonmetallic Conduit:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. CANTEX INC.
b. RACO; Hubbell.
c. Thomas & Betts Corporation; A Member of the ABB Group.

2. Listing and Labeling: Nonmetallic conduit shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
3. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.

B. Nonmetallic Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. CANTEX INC.
   b. RACO; Hubbell.
   c. Thomas & Betts Corporation; A Member of the ABB Group.

2. Fittings, General: Listed and labeled for type of conduit, location, and use.
3. Fittings for RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
4. Solvents and Adhesives: As recommended by conduit manufacturer.

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. B-line, an Eaton business.
2. Hoffman; a brand of nVent.
3. Square D.

B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 3R unless otherwise indicated, and sized according to NFPA 70.

1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Wireway Covers: Screw-cover type unless otherwise indicated.

E. Finish: Manufacturer's standard enamel finish.

2.4 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Crouse-Hinds, an Eaton business.
2. O-Z/Gedney; a brand of Emerson Industrial Automation.
3. RACO; Hubbell.
4. Thomas & Betts Corporation; A Member of the ABB Group.

B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, aluminum, Type FD, with gasketed cover.

E. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lb shall be listed and marked for the maximum allowable weight.

F. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

G. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, galvanized, cast iron with gasketed cover.

H. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

I. Device Box Dimensions: 4 inches square by 2-1/8 inches deep.

J. Gangable boxes are prohibited.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed Conduit: GRC.
2. Concealed Conduit, Aboveground: EMT.
3. Underground Conduit: RNC, Type EPC-40-PVC, direct buried.
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Indoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT.
2. Exposed and Subject to Physical Damage: GRC. Raceway locations include the following:

a. Mechanical rooms.
b. Instructional Lab Spaces

3. Concealed in Ceilings and Interior Walls and Partitions: EMT.
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
5. Damp or Wet Locations: GRC.
6. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 nonmetallic in institutional and commercial kitchens and damp or wet locations.

C. Minimum Raceway Size: 1/2-inch trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
2. EMT: Use setscrew, steel fittings. Comply with NEMA FB 2.10.
3. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

3.2 INSTALLATION

A. Comply with requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems" for hangers and supports.

B. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

C. Do not install raceways or electrical items on any "explosion-relief" walls or rotating equipment.

D. Do not fasten conduits onto the bottom side of a metal deck roof.

E. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

F. Complete raceway installation before starting conductor installation.

G. Arrange stub-ups so curved portions of bends are not visible above finished slab.

H. Make bends in raceway using large-radius preformed ells. Field bending shall be according to NFPA 70 minimum radii requirements. Use only equipment specifically designed for material and size involved.

I. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

J. Support conduit within 12 inches of enclosures to which attached.

K. Raceways Embedded in Slabs:

1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot intervals.
2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
3. Arrange raceways to keep a minimum of 2 inches of concrete cover in all directions.
4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
5. Change from RNC, Type EPC-40-PVC to GRC before rising above floor.

L. Stub-Ups to Above Recessed Ceilings:

1. Use EMT, IMC, or RMC for raceways.
2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

M. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

N. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.

O. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

P. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

Q. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

R. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.

S. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

T. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.

U. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where an underground service raceway enters a building or structure.
3. Conduit extending from interior to exterior of building.
4. Conduit extending into pressurized duct and equipment.
5. Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
6. Where otherwise required by NFPA 70.

V. Comply with manufacturer's written instructions for solvent welding RNC and fittings.

W. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations subject to severe physical damage.
2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.

X. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.

Y. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

Z. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

AA. Locate boxes so that cover or plate will not span different building finishes.

BB. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

CC. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

DD. Set metal floor boxes level and flush with finished floor surface.

EE. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section 31 20 00 "Earth Moving" for pipe less than 6 inches in nominal diameter.
2. Install backfill as specified in Section 31 20 00 "Earth Moving."
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 31 20 00 "Earth Moving."
4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.

    a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete for a minimum of 12 inches on each side of the coupling.
    b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.

6. Warning Planks: Bury warning planks approximately 12 inches above direct-buried conduits but a minimum of 6 inches below grade. Align planks along centerline of conduit.
7. Underground Warning Tape: Comply with requirements in Section 26 05 53 "Identification for Electrical Systems."

3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch above finished grade.

D. Install handholes with bottom below frost line, below grade.

E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables but short enough to preserve adequate working clearances in enclosure.

F. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install 0sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 26 05 44 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.6 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 07 84 13 "Penetration Firestopping."

3.7 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION

SECTION 26 05 48.16
SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Restraint channel bracings.
2. Restraint cables.
3. Seismic-restraint accessories.
4. Mechanical anchor bolts.
5. Adhesive anchor bolts.

B. Related Requirements:

1. Section 26 05 29 "Hangers and Supports for Electrical Systems" for commonly used electrical supports and installation requirements.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.

a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an evaluation service member of ICC-ES.
b. Annotate to indicate application of each product submitted and compliance with requirements.

B. Delegated-Design Submittal: For each seismic-restraint device.

1. Include design calculations and details for selecting seismic restraints complying with performance requirements, design criteria, and analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

2. Design Calculations: Calculate static and dynamic loading caused by equipment weight, operation, and seismic forces required to select seismic restraints and for designing vibration isolation bases.

    a. Coordinate design calculations with wind load calculations required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.

3. Seismic-Restraint Details:

    a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
    b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
    c. Preapproval and Evaluation Documentation: By an evaluation service member of ICC-ES, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated and that is acceptable to authorities having jurisdiction.

B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

C. Seismic-restraint devices shall have horizontal and vertical load testing and analysis. They shall bear anchorage preapproval from OSHPD in addition to preapproval, showing maximum seismic-restraint ratings, by ICC-ES or another agency acceptable to authorities having jurisdiction. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) that support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

D. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic-Restraint Loading:

1. Refer to project Structural drawings for seismic design criteria.

2.2 RESTRAINT CHANNEL BRACINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. B-line, an Eaton business.
2. Hilti, Inc.
3. Unistrut; Part of Atkore International.

B. Description: MFMA-4, shop- or field-fabricated bracing assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end, with other matching components, and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

2.3 RESTRAINT CABLES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Gripple Inc.
2. Kinetics Noise Control, Inc.
3. Vibration Mountings & Controls, Inc.

B. Restraint Cables: ASTM A603 galvanized-steel cables. End connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; with a minimum of two clamping bolts for cable engagement.

2.4 SEISMIC-RESTRAINT ACCESSORIES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. B-line, an Eaton business.
2. Kinetics Noise Control, Inc.
3. Mason Industries, Inc.

B. Hanger-Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.

C. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings and restraint cables.

D. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings and matched to type and size of anchor bolts and studs.

E. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings and matched to type and size of attachment devices used.

F. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

2.5 MECHANICAL ANCHOR BOLTS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. B-line, an Eaton business.
2. Hilti, Inc.
3. Mason Industries, Inc.

B. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E488.

2.6 ADHESIVE ANCHOR BOLTS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Hilti, Inc.
2. Kinetics Noise Control, Inc.
3. Mason Industries, Inc.

B. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing PVC or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E488.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 03 30 00 "Cast-in-Place Concrete."

B. Equipment and Hanger Restraints:

1. Install resilient, bolt-isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
2. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES providing required submittals for component.

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

E. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

F. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.3 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in runs of raceways, cables, wireways, cable trays, and busways where they cross seismic joints, where adjacent sections or branches are supported by different structural

elements, and where connection is terminated to equipment that is anchored to a different structural element from the one supporting them as they approach equipment.

3.4 ADJUSTING

A. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION

SECTION 26 05 53
IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Color and legend requirements for raceways, conductors, and warning labels and signs.
2. Labels.
3. Tapes and stencils.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for electrical identification products.

B. Delegated-Design Submittal: For arc-flash hazard study.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with ASME A13.1 and IEEE C2.

B. Comply with NFPA 70.

C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

D. Comply with ANSI Z535.4 for safety signs and labels.

E. Comply with NFPA 70E and Section 26 05 73.19 "Arc-Flash Hazard Analysis" requirements for arc-flash warning labels.

F. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

G. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 COLOR AND LEGEND REQUIREMENTS

A. Color-Coding for Phase- and Voltage-Level Identification, 600 V or Less: Use colors listed below for ungrounded service feeder and branch-circuit conductors.

1. Color shall be factory applied or field applied for sizes larger than No. 8 AWG if authorities having jurisdiction permit.
2. Colors for 208/120-V Circuits:

a. Phase A: Black.
b. Phase B: Red.
c. Phase C: Blue.

3. Colors for 480/277-V Circuits:

a. Phase A: Brown.
b. Phase B: Orange.
c. Phase C: Yellow.

4. Color for Neutral: White or gray.
5. Color for Equipment Grounds: Green.

B. Equipment Identification Labels:

1. Black letters on a white field.

2.3 LABELS

A. Self-Adhesive Wraparound Labels: Write-on, 3-mil-thick, vinyl flexible label with acrylic pressure-sensitive adhesive.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Brady Corporation.
b. Brother International Corporation.
c. Ideal Industries, Inc.

2. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over the legend. Labels sized such that the clear shield overlaps the entire printed legend.
3. Marker for Labels: Machine-printed, permanent, waterproof, black ink recommended by printer manufacturer.

B. Self-Adhesive Labels: Vinyl, thermal, transfer-printed, 3-mil-thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Brady Corporation.
b. Brother International Corporation.
c. Ideal Industries, Inc.

2. Minimum Nominal Size:

a. 1-1/2 by 6 inches for raceway and conductors.
b. 3-1/2 by 5 inches for equipment.
c. As required by authorities having jurisdiction.

2.4 TAPES AND STENCILS

A. Underground-Line Warning Tape:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Brady Corporation.
b. Ideal Industries, Inc.
c. Seton Identification Products.

2. Tape:

a. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
b. Printing on tape shall be permanent and shall not be damaged by burial operations.
c. Tape material and ink shall be chemically inert and not subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.

3. Color and Printing:

a. Comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, ANSI Z535.4, and ANSI Z535.5.
b. Inscriptions for Red-Colored Tapes: "ELECTRIC LINE, HIGH VOLTAGE".
c. Inscriptions for Orange-Colored Tapes: "TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE".

PART 3 - EXECUTION

3.1 PREPARATION

A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.2 INSTALLATION

A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.

B. Install identifying devices before installing acoustical ceilings and similar concealment.

C. Verify identity of each item before installing identification products.

D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.

E. Apply identification devices to surfaces that require finish after completing finish work.

F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.

G. System Identification for Raceways and Cables under 600 V: Identification shall completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.

1. Secure tight to surface of conductor, cable, or raceway.

H. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

I. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.

J. Self-Adhesive Labels:

1. On each item, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high label; where two lines of text are required, use labels 2 inches high.

K. Self-Adhesive Vinyl Tape: Secure tight to surface at a location with high visibility and accessibility.

1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.

L. Underground Line Warning Tape:

1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench exceeds 16 inches overall.
2. Install underground-line warning tape for direct-buried cables and cables in raceways.

M. Cable Ties: General purpose, for attaching tags, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

3.3 IDENTIFICATION SCHEDULE

A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.

B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.

C. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive labels with the conductor or cable designation, origin, and destination.

D. Control-Circuit Conductor Termination Identification: For identification at terminations, provide self-adhesive labels with the conductor designation.

E. Conductors to Be Extended in the Future: Attach marker tape to conductors and list source.

F. Auxiliary Electrical Systems Conductor Identification: Self-adhesive vinyl tape that is uniform and consistent with system used by manufacturer for factory-installed connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.

G. Locations of Underground Lines: Underground-line warning tape for power, lighting, communication, and control wiring and optical-fiber cable.

H. Arc Flash Warning Labeling: Self-adhesive labels.

I. Equipment Identification Labels:

1. Indoor Equipment: Self-adhesive label.

2. Outdoor Equipment: Laminated acrylic or melamine sign.

END OF SECTION

26 08 00 – ELECTRICAL & LIGHTING SYSTEMS COMMISSIONING

PART 1 – GENERAL

1.01 The Functional Performance Testing of the Lighting and Electrical Systems is essential to the operation and performance of the equipment and the completion of the project. Complete all inspections and tests prior to substantial completion of the Work.

PART 2 – PRODUCTS

2.01 The following are suggested testing instruments that could be used but similar types of instruments are acceptable. If the Designer determines that additional instruments are required, provide at no additional charge.

A. Recommended Instruments for Testing Purposes

1. Fluke 43B Single Phase Power Quality Analyzer: With Current Clamp and Voltage Probes
2. EXTECH Instruments: Foot Candle/Lux Light Meter 401025
3. Ideal 61-165 ARCFAULT 165
4. Fluke 1AC-II / 1LAC-II VoltAlert
5. Power Line Disturbance Monitor
6. Load Profiler

PART 3 – EXECUTION

3.01 The Functional Performance Testing Procedures approved by the Designer will be used to document the inspection and testing of the equipment and systems. Provide all necessary manpower and have the appropriate subcontractor and/or manufacturer's representative present during the testing and demonstrate, to the Designers satisfaction, the full operation of all electrical and lighting systems. Coordinate the schedule of the testing so that the Designer and Owner can be present.

A. Prior to starting the final testing of the systems, ensure that all equipment and systems were initially started-up and initialized as prescribed by the manufacturer's instructions or by the manufacturer's representative and that the Contractor has performed a complete inspection and test of all electrical and lighting equipment and systems.

B. Review the Designer's inspection reports and correct all deficiencies.

C. Open and inspect all panels for cleanness and neatness.

D. Check and record voltage and current readings on the Panel board Check Sheet (see Division 26 08).

E. Voltage and Amperage readings off by 5% between phases needs to be investigated and a variance of 10% indicated there is a problem.

F. Check the Ground for leakage current. Ground current of less than 1 amp is OK, 1 to 3 amps needs to be checked and more than 3 amps is a problem.

G. Main breaker settings, Long Term, Short Term, Instantaneous and Ground Fault, need to be checked, recorded and have the Electrical Designer verify they are correct.
NOTE: VFD's will cause noise on neutral and ground and fluctuations on voltage as SCR's fire. They also induce motor bearing currents and shaft voltages that will cause pitting of the shaft and motor failure. If none of the following shaft voltage/current eliminators are utilized on the motors, the motors should be checked for excessive voltage/current to determine if a retrofit is required.

H. Test receptacle circuits for voltage drop, impedance on hot leg and GFI/ARC, at the last receptacle on the branch line. Circuits used for computers or voltage sensitive equipment, at design amperage, must not be less than 6% and for all other circuits less than 10% of design. At all times the load voltage should not drop below 111 volts. Record findings on the Power Circuit Check Sheet (see Division 26 08).

I. Demonstrate the Lighting Control System utilizing the Performance Testing Identification Form and Performance Testing Procedures Form (see Division 01 91) approved by the Designer.

J. Demonstrate lighting levels at desk level after dark to ensure that they are not affected by outside light and record readings on the Lighting Check Sheet (see Division 26 08).

K. Perform power outage test and/or emergency generator test, under load, and utilize the procedure and record findings on the Emergency Generator Testing Procedures (see Division 26 08).

L. Check fuses and overloads in all motor starters.

M. Upon completion of the performance testing procedures, the Installer, General Contractor and Designers representatives who observed the testing will sign the Functional Performance Test Certification form (see Division 01 91) and attach deficiency list.

   1. Emergency Power/Generator System
   2. Electrical Switchgear/Panel boards
   3. Electrical Power Circuits
   4. Electrical Lighting

N. Provide testing instruments, at no charge or the Designer may elect to provide their own instruments.

END OF SECTION

26 08 06 - PANELBOARD CHECK SHEET

SBC Project No:	166/000-04-2013Y3		Page		of
Institution or Campus:	TCAT Improvements - Memphis Phase II		Date:		
Building:			Tests run by:		
Installer:					

System/Unit Identifier:

Location:

ITEM	PANEL	PANEL	PANEL	PANEL
Room sprinkler				
Pipes above panel				
Room air conditioned				
NEC code space				
Conduits secured				
Fire caulking				
Ground buss				
MCB/MLO				
kAIC rating				
Panel Manufacturer				
Panel model number				
Panel circuits ID				
Wire colors				
One wire per breaker				
Wires neatly terminated				
Spare breakers off				
Panel clean				
Measurements				
A amps				
B amps				
C amps				
N amps				
Ground amps				
A-N volts				
B-N volts				
C-N volts				
A-B volts				
A-C volts				
B-C volts				
N-G volts				

26 08 13 - POWER CIRCUIT CHECK SHEET

SBC Project No:	166/000-04-2013Y3	Page	of
Institution or Campus:	TCAT Improvements - Memphis Phase II	Date:	
Building:		Tests run by:	
Installer:			

System/Unit Identifier:

Location:

Floor	Room	Panel	Ckt.	Device	Volts	Wiring	GFI/ARC msec/mA	V-Drop @ Load %	Imp/ohms Hot Leg	Coments

26 08 50 - LIGHTING CHECK SHEET

SBC Project No:	166/000-04-2013Y3	Page	of
Institution or Campus:	TCAT Improvements - Memphis Phase II	Date:	
Building:		Tests run by:	
Installer:			

System/Unit Identifier:

Location:

Floor	Room	Panel	Ckt.	Fixture Type	FC Level	Comment

SECTION 26 22 13
LOW-VOLTAGE DISTRIBUTION TRANSFORMERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes distribution, dry-type transformers with a nominal primary and secondary rating of 600 V and less, with capacities up to 1500 kVA.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type and size of transformer.
2. Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Inspection: On receipt, inspect for and note any shipping damage to packaging and transformer.

1. If manufacturer packaging is removed for inspection, and transformer will be stored after inspection, re-package transformer using original or new packaging materials that provide protection equivalent to manufacturer's packaging.

B. Storage: Store in a warm, dry, and temperature-stable location in original shipping packaging.

C. Handling: Follow manufacturer's instructions for lifting and transporting transformers.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton.
2. Siemens Industry, Inc., Energy Management Division.
3. Square D; by Schneider Electric.

B. Source Limitations: Obtain each transformer type from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Transformers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the transformer will remain in place without separation of any parts when subjected to the seismic forces specified."

2.3 GENERAL TRANSFORMER REQUIREMENTS

A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.

B. Comply with NFPA 70.

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

C. Transformers Rated 15 kVA and Larger:

1. Comply with 10 CFR 431 (DOE 2016) efficiency levels.
2. Marked as compliant with DOE 2016 efficiency levels by an NRTL.

D. Shipping Restraints: Paint or otherwise color-code bolts, wedges, blocks, and other restraints that are to be removed after installation and before energizing. Use fluorescent colors that are easily identifiable inside the transformer enclosure.

2.4 DISTRIBUTION TRANSFORMERS

A. Comply with NFPA 70, and list and label as complying with UL 1561.

B. Provide transformers that are constructed to withstand seismic forces specified in Section 26 05 48.16 "Seismic Controls for Electrical Systems."

C. Cores: Electrical grade, non-aging silicon steel with high permeability and low hysteresis losses.

1. One leg per phase.

D. Enclosure: Ventilated.

1. NEMA 250, Type 2: Core and coil shall be encapsulated within resin compound to seal out moisture and air.
2. KVA Ratings: Based on convection cooling only and not relying on auxiliary fans.
3. Wiring Compartment: Sized for conduit entry and wiring installation.
4. Finish: Comply with NEMA 250.

    a. Finish Color: Gray weather-resistant enamel.

E. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and two 2.5 percent taps below normal full capacity.

F. Insulation Class, Smaller Than 30 kVA: 180 deg C, UL-component-recognized insulation system with a maximum of 115 deg C rise above 40 deg C ambient temperature.

G. Insulation Class, 30 kVA and Larger: 220 deg C, UL-component-recognized insulation system with a maximum of 150 deg C rise above 40 deg C ambient temperature.

H. Grounding: Provide ground-bar kit or a ground bar installed on the inside of the transformer enclosure.

2.5 IDENTIFICATION

A. Nameplates: Engraved, laminated-acrylic or melamine plastic signs for each distribution transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Section 26 05 53 "Identification for Electrical Systems."

2.6 SOURCE QUALITY CONTROL

A. Test and inspect transformers according to IEEE C57.12.01 and IEEE C57.12.91.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.

B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.

C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.

D. Verify that ground connections are in place and requirements in Section 26 05 26 "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.

E. Environment: Enclosures shall be rated for the environment in which they are located. Covers for NEMA 250, Type 4X enclosures shall not cause accessibility problems.

F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install transformers level and plumb on a concrete base with vibration-dampening supports. Locate transformers away from corners and not parallel to adjacent wall surface.

B. Construct concrete bases according to Section 03 30 00 "Cast-in-Place Concrete" and anchor floor-mounted transformers according to manufacturer's written instructions, seismic codes applicable to Project, and requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems."

1. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

C. Secure transformer to concrete base according to manufacturer's written instructions.

D. Secure covers to enclosure and tighten all bolts to manufacturer-recommended torques to reduce noise generation.

E. Remove shipping bolts, blocking, and wedges.

3.3 CONNECTIONS

A. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."

B. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

D. Provide flexible connections at all conduit and conductor terminations and supports to eliminate sound and vibration transmission to the building structure.

3.4 ADJUSTING

A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 5 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.

B. Output Settings Report: Prepare a written report recording output voltages and tap settings.

3.5 CLEANING

A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION

SECTION 26 24 16
PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Distribution panelboards.
2. Lighting and appliance branch-circuit panelboards.

1.3 DEFINITIONS

A. ATS: Acceptance testing specification.

B. GFCI: Ground-fault circuit interrupter.

C. GFEP: Ground-fault equipment protection.

D. HID: High-intensity discharge.

E. MCCB: Molded-case circuit breaker.

F. SPD: Surge protective device.

G. VPR: Voltage protection rating.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Panelboard Schedules: For installation in panelboards.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: ISO 9001 or ISO 9002 certified.

1.6 FIELD CONDITIONS

A. Service Conditions: NEMA PB 1, usual service conditions, as follows:

1. Ambient temperatures within limits specified.
2. Altitude not exceeding 6600 feet.

1.7 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.

1. Panelboard Warranty Period: 18 months from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PANELBOARDS COMMON REQUIREMENTS

A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Section 26 05 48.16 "Seismic Controls for Electrical Systems."

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NEMA PB 1.

D. Comply with NFPA 70.

E. Enclosures: Surface-mounted, dead-front cabinets.

1. Rated for environmental conditions at installed location.

a. Indoor Dry and Clean Locations: NEMA 250, Type 1.

2. Height: 84 inches maximum.
3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims shall cover all live parts and shall have no exposed hardware.

F. Phase, Neutral, and Ground Buses:

1. Material: Hard-drawn copper, 98 percent conductivity.

a. Plating shall run entire length of bus.
b. Bus shall be fully rated the entire length.

G. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Hard-drawn copper, 98 percent conductivity.
2. Terminations shall allow use of 75 deg C rated conductors without derating.
3. Size: Lugs suitable for indicated conductor sizes, with additional gutter space, if required, for larger conductors.
4. Main and Neutral Lugs: Mechanical type, with a lug on the neutral bar for each pole in the panelboard.
5. Ground Lugs and Bus-Configured Terminators: Mechanical type, with a lug on the bar for each pole in the panelboard.
6. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
7. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.

H. Future Devices: Panelboards or load centers shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

I. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed by an NRTL for 100 percent interrupting capacity.

1. Panelboards and overcurrent protective devices rated 240 V or less shall have short-circuit ratings as shown on Drawings, but not less than 10,000 A rms symmetrical.
2. Panelboards and overcurrent protective devices rated above 240 V and less than 600 V shall have short-circuit ratings as shown on Drawings, but not less than 14,000 A rms symmetrical.

2.2 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

2.3 POWER PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton.
2. Siemens Industry, Inc., Energy Management Division.
3. Square D; by Schneider Electric.

B. Panelboards: NEMA PB 1, distribution type.

C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

1. For doors more than 36 inches high, provide two latches, keyed alike.

D. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.

E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers.

2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton.
2. Siemens Industry, Inc., Energy Management Division.
3. Square D; by Schneider Electric.

B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

C. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

D. Doors: Door-in-door construction with concealed hinges; secured with multipoint latch with tumbler lock; keyed alike. Outer door shall permit full access to the panel interior. Inner door shall permit access to breaker operating handles and labeling, but current carrying terminals and bus shall remain concealed.

2.5 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton.
2. Siemens Industry, Inc., Energy Management Division.
3. Square D; by Schneider Electric.

B. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers:

a. Inverse time-current element for low-level overloads.
b. Instantaneous magnetic trip element for short circuits.
c. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

2. Electronic Trip Circuit Breakers:

    a. RMS sensing.
    b. Field-replaceable rating plug or electronic trip.
    c. Digital display of settings, trip targets, and indicated metering displays.
    d. Multi-button keypad to access programmable functions and monitored data.
    e. Ten-event, trip-history log. Each trip event shall be recorded with type, phase, and magnitude of fault that caused the trip.
    f. Integral test jack for connection to portable test set or laptop computer.
    g. Field-Adjustable Settings:

        1) Instantaneous trip.
        2) Long- and short-time pickup levels.
        3) Long and short time adjustments.
        4) Ground-fault pickup level, time delay, and I squared T response.

3. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
4. GFEP Circuit Breakers: Class B ground-fault protection (30-mA trip).
5. Subfeed Circuit Breakers: Vertically mounted.
6. MCCB Features and Accessories:

    a. Standard frame sizes, trip ratings, and number of poles.
    b. Breaker handle indicates tripped status.
    c. UL listed for reverse connection without restrictive line or load ratings.
    d. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
    e. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and HID lighting circuits.
    f. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
    g. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
    h. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.
    i. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

2.6 IDENTIFICATION

A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.

B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.

C. Circuit Directory: Computer-generated circuit directory mounted inside panelboard door with transparent plastic protective cover.

1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify actual conditions with field measurements prior to ordering panelboards to verify that equipment fits in allocated space in, and comply with, minimum required clearances specified in NFPA 70.

B. Receive, inspect, handle, and store panelboards according to NECA 407.

C. Examine panelboards before installation. Reject panelboards that are damaged, rusted, or have been subjected to water saturation.

D. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Comply with NECA 1.

C. Install panelboards and accessories according to NECA 407.

D. Equipment Mounting:

1. Attach panelboard to the vertical finished or structural surface behind the panelboard.
2. Comply with requirements for seismic control devices specified in Section 26 05 48.16 "Seismic Controls for Electrical Systems."

E. Comply with mounting and anchoring requirements specified in Section 26 05 48.16 "Seismic Controls for Electrical Systems."

F. Mount top of trim 90 inches above finished floor unless otherwise indicated.

G. Mount panelboard cabinet plumb and rigid without distortion of box.

H. Install overcurrent protective devices and controllers not already factory installed.

1. Set field-adjustable, circuit-breaker trip ranges.

I. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.

J. Install filler plates in unused spaces.

K. Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into raised floor space or below slab not on grade.

L. Arrange conductors in gutters into groups and bundle and wrap with wire ties.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 26 05 53 "Identification for Electrical Systems."

B. Create a directory to indicate installed circuit loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

D. Device Nameplates: Label each branch circuit device in power panelboards with a nameplate complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

E. Install warning signs complying with requirements in Section 26 05 53 "Identification for Electrical Systems" identifying source of remote circuit.

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Acceptance Testing Preparation:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

C. Tests and Inspections:

1. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

D. Panelboards will be considered defective if they do not pass tests and inspections.

END OF SECTION

SECTION 26 27 26
WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Standard-grade receptacles, 125 V, 20 A.
2. USB receptacles.
3. GFCI receptacles, 125 V, 20 A.
4. Twist-locking receptacles.
5. Pendant cord-connector devices.
6. Occupancy sensors.
7. Wall plates.

1.3 DEFINITIONS

A. AFCI: Arc-fault circuit interrupter.

B. BAS: Building automation system.

C. EMI: Electromagnetic interference.

D. GFCI: Ground-fault circuit interrupter.

E. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

F. RFI: Radio-frequency interference.

G. SPD: Surge protective device.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 GENERAL WIRING-DEVICE REQUIREMENTS

A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

B. Comply with NFPA 70.

C. RoHS compliant.

D. Comply with NEMA WD 1.

E. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:

1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
2. Devices shall comply with requirements in this Section.

F. Devices for Owner-Furnished Equipment:

1. Receptacles: Match plug configurations.
2. Cord and Plug Sets: Match equipment requirements.

G. Device Color:

1. Wiring Devices Connected to Normal Power System: As selected by Architect unless otherwise indicated or required by NFPA 70 or device listing.

H. Wall Plate Color: For plastic covers, match device color.

I. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 STANDARD-GRADE RECEPTACLES, 125 V, 20 A

A. Duplex Receptacles, 125 V, 20 A:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Eaton (Arrow Hart).
b. Hubbell Incorporated; Wiring Device-Kellems.
c. Leviton Manufacturing Co., Inc.
d. Pass & Seymour/Legrand (Pass & Seymour).

2. Description: Two pole, three wire, and self-grounding.

3. Configuration: NEMA WD 6, Configuration 5-20R.
4. Standards: Comply with UL 498 and FS W-C-596.

2.3 USB RECEPTACLES

A. USB Charging Receptacles:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Eaton (Arrow Hart).
   b. Hubbell Incorporated; Wiring Device-Kellems.
   c. Leviton Manufacturing Co., Inc.
   d. Pass & Seymour/Legrand (Pass & Seymour).

2. Description: Single-piece, rivetless, nickel-plated, all-brass grounding system. Nickel-plated, brass mounting strap.
3. USB Receptacles: Dual, USB Type A, 5 V dc, and 2.1 A per receptacle (minimum).
4. Standards: Comply with UL 1310 and USB 3.0 devices.

2.4 GFCI RECEPTACLES, 125 V, 20 A

A. Duplex GFCI Receptacles, 125 V, 20 A:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Eaton (Arrow Hart).
   b. Hubbell Incorporated; Wiring Device-Kellems.
   c. Leviton Manufacturing Co., Inc.
   d. Pass & Seymour/Legrand (Pass & Seymour).

2. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding.
3. Configuration: NEMA WD 6, Configuration 5-20R.
4. Type: Feed through.
5. Standards: Comply with UL 498, UL 943 Class A, and FS W-C-596.

2.5 TWIST-LOCKING RECEPTACLES

A. Twist-Lock, Single Receptacles, 120 V, 20 A:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Eaton (Arrow Hart).

b. Hubbell Incorporated; Wiring Device-Kellems.
c. Leviton Manufacturing Co., Inc.
d. Pass & Seymour/Legrand (Pass & Seymour).

2. Configuration: NEMA WD 6, Configuration L5-20R.
3. Standards: Comply with UL 498.

2.6 PENDANT CORD-CONNECTOR DEVICES

A. Description: Matching, locking-type plug and receptacle body connector, heavy-duty grade.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton (Arrow Hart).
2. Ericson.
3. Hubbell Premise Wiring.
4. Leviton Manufacturing Co., Inc.
5. Pass & Seymour/Legrand (Pass & Seymour).

C. Configuration: NEMA WD 6, Configurations L5-20P and L5-20R.

D. Body: Nylon, with screw-open, cable-gripping jaws and provision for attaching external cable grip.

E. External Cable Grip: Woven wire-mesh type made of high-strength, galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

F. Standards: Comply with FS W-C-596.

2.7 OCCUPANCY SENSORS

A. Wall Switch Sensor Light Switch, Dual Technology **<Insert drawing designation>**:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Eaton (Arrow Hart).
b. Hubbell Incorporated; Wiring Device-Kellems.
c. Leviton Manufacturing Co., Inc.
d. Pass & Seymour/Legrand (Pass & Seymour).
e. Acuity (Sensorswitch)

2. Description: Switchbox-mounted, combination lighting-control sensor and conventional switch lighting-control unit using dual (ultrasonic and passive infrared) technology.
3. Standards: Comply with UL 20.
4. Rated 960 W at 120 V ac for tungsten lighting, 10 A at 120 V ac or 10 A at 277 V ac for fluorescent or LED lighting, and 1/4 hp at 120 V ac.

5. Adjustable time delay of 10 minutes.
6. Able to be locked to Manual-On mode.
7. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc.

2.8 WALL PLATES

A. Single Source: Obtain wall plates from same manufacturer of wiring devices.

B. Single and combination types shall match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: 0.04-inch-thick steel with chrome-plated finish.
3. Material for Unfinished Spaces: Galvanized steel.
4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.

C. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum with lockable cover.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.

B. Coordination with Other Trades:

1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes, and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall comply with NFPA 70, Article 300, without pigtails.

D. Device Installation:

1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the right.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

3.2 GFCI RECEPTACLES

A. Install non-feed-through GFCI receptacles where protection of downstream receptacles is not required.

3.3 IDENTIFICATION

A. Comply with Section 26 05 53 "Identification for Electrical Systems."

END OF SECTION

SECTION 26 28 13
FUSES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cartridge fuses rated 600 V ac and less for use in the following:

a. Control circuits.
b. Enclosed switches.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Bussmann, an Eaton business.
2. Edison; a brand of Bussmann by Eaton.
3. Littelfuse, Inc.

2.2 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, current-limiting, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

1. Type RK-1: **[250]** 600-V, zero- to 600-A rating, 200 kAIC, time delay.
2. Type CC: 600-V, zero- to 30-A rating, 200 kAIC, fast acting.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NEMA FU 1 for cartridge fuses.

D. Comply with NFPA 70.

E. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

3.2 IDENTIFICATION

A. Install labels complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems" and indicating fuse replacement information inside of door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION

SECTION 26 28 16
ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Fusible switches.
2. Nonfusible switches.
3. Receptacle switches.
4. Enclosures.

1.3 DEFINITIONS

A. NC: Normally closed.

B. NO: Normally open.

C. SPDT: Single pole, double throw.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include nameplate ratings, dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

1. Enclosure types and details for types other than NEMA 250, Type 1.
2. Current and voltage ratings.
3. Short-circuit current ratings (interrupting and withstand, as appropriate).

B. Shop Drawings: For enclosed switches and circuit breakers.

1. Include plans, elevations, sections, details, and attachments to other work.
2. Include wiring diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Seismic Qualification Data: Certificates, for enclosed switches and circuit breakers, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Accredited by NETA.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
2. Altitude: Not exceeding 6600 feet.

1.8 WARRANTY

A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: One year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Enclosed switches and circuit breakers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

2.2 GENERAL REQUIREMENTS

A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

C. Comply with NFPA 70.

2.3 FUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton.
2. Siemens Industry, Inc., Energy Management Division.
3. Square D; by Schneider Electric.

B. Type HD, Heavy Duty:

1. Single throw.
2. Three pole.
3. 600-V ac.
4. 1200 A and smaller.
5. UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses.
6. Lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
4. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.4 NONFUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton.
2. Siemens Industry, Inc., Energy Management Division.
3. Square D; by Schneider Electric.

B. Type HD, Heavy Duty, Three Pole, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
4. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.5 RECEPTACLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton.
2. Siemens Industry, Inc., Energy Management Division.
3. Square D; by Schneider Electric.

B. Type HD, Heavy-Duty, Three Pole, Single-Throw Fusible Switch: 600-V ac, 30 A; UL 98 and NEMA KS 1; horsepower rated, with clips or bolt pads to accommodate specified fuses; lockable handle with capability to accept three padlocks; interlocked with cover in closed position.

C. Interlocking Linkage: Provided between the receptacle and switch mechanism to prevent inserting or removing plug while switch is in the on position, inserting any plug other than specified, and turning switch on if an incorrect plug is inserted or correct plug has not been fully inserted into the receptacle.

D. Receptacle: Polarized, three-phase, four-wire receptacle (fourth wire connected to enclosure ground lug).

E. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
4. Lugs: Mechanical type, suitable for number, size, and conductor material.
5. Service-Rated Switches: Labeled for use as service equipment.

2.6 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

B. Conduit Entry: NEMA 250 Types 4, 4X, and 12 enclosures shall contain no knockouts. NEMA 250 Types 7 and 9 enclosures shall be provided with threaded conduit openings in both endwalls.

C. Operating Mechanism: The circuit-breaker operating handle shall be externally operable with the operating mechanism being an integral part of the box, not the cover. The cover interlock mechanism shall have an externally operated override. The override shall not permanently disable the interlock mechanism, which shall return to the locked position once the override is released. The tool used to override the cover interlock mechanism shall not be required to enter the enclosure in order to override the interlock.

D. NEMA 250 Type 7/9 enclosures shall be furnished with a breather and drain kit to allow their use in outdoor and wet location applications.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

1. Commencement of work shall indicate Installer's acceptance of the areas and conditions as satisfactory.

3.2 ENCLOSURE ENVIRONMENTAL RATING APPLICATIONS

A. Enclosed Switches and Circuit Breakers: Provide enclosures at installed locations with the following environmental ratings.

1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
2. Outdoor Locations: NEMA 250, Type 3R.
3. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
4. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

3.3 INSTALLATION

A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

C. Comply with mounting and anchoring requirements specified in Section 26 05 48.16 "Seismic Controls for Electrical Systems."

D. Temporary Lifting Provisions: Remove temporary lifting of eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

E. Install fuses in fusible devices.

F. Comply with NFPA 70 and NECA 1.

3.4 IDENTIFICATION

A. Comply with requirements in Section 26 05 53 "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.5 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections for Switches:

C. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

END OF SECTION

SECTION 26 51 19
LED INTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes the following types of LED luminaires:

1. Materials.
2. Finishes.
3. Luminaire support.

1.2 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color Rendering Index.

C. Fixture: See "Luminaire."

D. IP: International Protection or Ingress Protection Rating.

E. LED: Light-emitting diode.

F. Lumen: Measured output of lamp and luminaire, or both.

G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product, arranged by designation.

B. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.5 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

B. Warranty Period: Five year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Luminaires shall withstand the effects of earthquake motions determined according to ASCE 7.

B. Seismic Performance: Luminaires and lamps shall be labeled vibration and shock resistant.

1. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified."

2.2 LUMINAIRE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Luminaires:

1. Basis of design shall be products listed in the Lighting Fixture Schedule on the drawings.

C. Standards:

1. UL Listing: Listed for damp location.
2. Recessed luminaires shall comply with NEMA LE 4.

D. CRI of minimum 80. CCT of 3500 K unless otherwise noted.

E. Internal driver.

F. Nominal Operating Voltage: 277 V ac unless otherwise noted.

G. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.

2.3 MATERIALS

A. Metal Parts:

1. Free of burrs and sharp corners and edges.
2. Sheet metal components shall be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging

B. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent

doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

2.4 METAL FINISHES

A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.5 LUMINAIRE SUPPORT

A. Comply with requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.

C. Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12 gage.

D. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

C. Install lamps in each luminaire.

D. Supports: Sized and rated for luminaire weight.

E. Flush-Mounted Luminaire Support:

1. As recommended by the luminaire manufacturer.

F. Wall-Mounted Luminaire Support:

1. As recommended by the luminaire manufacturer.

G. Ceiling-Mounted Luminaire Support:

1. As recommended by the luminaire manufacturer.

H. Suspended Luminaire Support:

1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
3. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and wire support for suspension for each unit length of luminaire chassis, including one at each end.
4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

I. Ceiling-Grid-Mounted Luminaires:

1. Support each recessed light fixture independently of the associated ceiling grid. Support each downlight (<10lbs) with one (1) slack #12 safety wire. All other recessed fixtures (up to 2'x4' and <56lbs) shall be supported with two (2) #12 safety wires connected at opposite, diagonal corners. Wiring shall be looped through hanger tabs integral with fixture housings and shall be securely fastened to structure same as ceiling systems. Each end of safety wire shall be wrapped with minimum three (3) turns (1-1/2" length).

J. Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

K. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

3.2 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

END OF SECTION

SECTION 26 52 19
EMERGENCY AND EXIT LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Emergency lighting units.
2. Exit signs.
3. Luminaire supports.

1.2 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color Rendering Index.

C. Emergency Lighting Unit: A lighting unit with integral or remote emergency battery powered supply and the means for controlling and charging the battery and unit operation.

D. Fixture: See "Luminaire" Paragraph.

E. Lumen: Measured output of lamp and luminaire, or both.

F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of emergency lighting unit, exit sign, and emergency lighting support, arranged by designation.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, coordinated with each other, using input from installers of the items involved:

B. Product Certificates: For each type of luminaire.

C. Seismic Qualification Data: Certificates, for luminaires, accessories, and components, from manufacturer.

D. Sample Warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.6 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

B. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Luminaires shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified and the luminaire will be fully operational during and after the seismic event."

2.2 GENERAL REQUIREMENTS FOR EMERGENCY LIGHTING

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. NRTL Compliance: Fabricate and label emergency lighting units, exit signs, and batteries to comply with UL 924.

C. Comply with NFPA 70 and NFPA 101.

2.3 EMERGENCY LIGHTING

A. Emergency Lighting Unit:

1. Refer to Lighting Fixture Schedule on the drawings for basis of design products.
2. Wall mount with universal junction box adaptor.
3. UV stable thermoplastic housing, rated for damp locations.
4. Two LED lamp heads.
5. Self-Test and Diagnostics: Integral to unit.

2.4 EXIT SIGNS

A. Internally Lighted Signs:

1. Refer to Lighting Fixture Schedule on the drawings for basis of design products.
2. Lamps for AC Operation: LEDs; 50,000 hours minimum rated lamp life.
3. Self-Powered Exit Signs (Battery Type): Internal emergency power unit.
4. Self-Test and Diagnostics: Integral to unit.

2.5 MATERIALS

A. Metal Parts:

1. Free of burrs and sharp corners and edges.
2. Sheet metal components shall be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging.

B. Doors, Frames, and Other Internal Access:

1. Smooth operating, free of light leakage under operating conditions.
2. Designed to permit relamping without use of tools.
3. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

2.6 METAL FINISHES

A. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.7 LUMINAIRE SUPPORT COMPONENTS

A. Comply with requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

C. Supports:

1. Sized and rated for luminaire and emergency power unit weight.
2. Able to maintain luminaire position when testing emergency power unit.
3. Provide support for luminaire and emergency power unit without causing deflection of ceiling or wall.
4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire and emergency power unit weight and vertical force of 400 percent of fixture weight.

D. Wall-Mounted Luminaire Support:

1. As recommended by luminaire manufacturer.

E. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

3.2 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION

SECTION 26 56 13
LIGHTING POLES AND STANDARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Poles and accessories for support of luminaires.

1.2 DEFINITIONS

A. EPA: Equivalent projected area.

B. Luminaire: Complete lighting fixture.

C. Pole: Luminaire-supporting structure, including tower used for large-area illumination.

D. Standard: See "Pole."

1.3 ACTION SUBMITTALS

A. Product Data: For each pole and accessory.

1.4 INFORMATIONAL SUBMITTALS

A. Pole and Support Component Certificates: Signed by manufacturers of poles, certifying that products are designed for indicated load requirements according to AASHTO LTS-6-M and that load imposed by luminaire and attachments has been included in design. The certification shall be based on design calculations signed and sealed by a professional engineer.

PART 2 - PRODUCTS

2.1 STEEL POLES

A. Source Limitations: Obtain poles from single manufacturer or producer.

B. Source Limitations: For poles, obtain each color, grade, finish, type, and variety of pole from single source with resources to provide products of consistent quality in appearance and physical properties.

C. Poles: Comply with ASTM A 500/A 500M, Grade B carbon steel with a minimum yield of 46,000 psig; one-piece construction up to 40 feet in height with access handhole in pole wall.

1. Shape: Square.
2. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.

D. Fasteners: Galvanized steel, size and type as determined by manufacturer. Corrosion-resistant items compatible with support components.

1. Materials: Compatible with poles and standards as well as the substrates to which poles and standards are fastened and shall not cause galvanic action at contact points.
2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication unless otherwise indicated.

E. Grounding and Bonding Lugs: Welded 1/2-inch threaded lug, complying with requirements in Section 26 05 26 "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size indicated, and accessible through handhole.

F. Handhole: Oval shaped, with minimum clear opening of 2-1/2 by 5 inches, with cover secured by stainless-steel captive screws.

G. Prime-Coat Finish: Manufacturer's standard prime-coat finish ready for field painting.

H. Powder-Coat Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.

1. Surface Preparation: Clean surfaces according to SSPC-SP 1 to remove dirt, oil, grease, and other contaminants that could impair powder coat bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, according to SSPC-SP 5/NACE No. 1 or SSPC-SP 8.
2. Powder Coat: Comply with AAMA 2604.

a. Electrostatic-applied powder coating; single application and cured to a minimum 2.5- to 3.5-mils dry film thickness. Coat interior and exterior of pole for equal corrosion protection.
b. Color: As selected by Architect from manufacturer's full range.

2.2 POLE ACCESSORIES

A. Base Covers: Manufacturers' standard metal units, finished same as pole, and arranged to cover pole's mounting bolts and nuts.

2.3 MOUNTING HARDWARE

A. Anchor Bolts: Manufactured to ASTM F 1554, Grade 55, with a minimum yield strength of 55,000 psi.

1. Galvanizing: Hot dip galvanized according to ASTM A 153, Class C.

B. Nuts: ASTM A 563, Grade A, Heavy-Hex

1. Galvanizing: Hot dip galvanized according to ASTM A 153, Class C.

C. Washers: ASTM F 436, Type 1.

1. Galvanizing: Hot dip galvanized according to ASTM A 153, Class C.

2.4 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 POLE FOUNDATION

A. Concrete Pole Foundations: Cast in place, with anchor bolts to match pole-base flange. Structural steel complying with ASTM A 36/A 36M and hot-dip galvanized according to ASTM A 123/A 123 M; and with top-plate and mounting bolts to match pole-base flange and strength required to support pole, luminaire, and accessories. Concrete, reinforcement, and formwork are specified in Section 03 30 00 "Cast-in-Place Concrete."

B. Anchor Bolts: Install plumb using manufacturer-supplied template, uniformly spaced.

3.2 POLE INSTALLATION

A. Concrete Pole Foundations: Set anchor bolts according to anchor-bolt templates furnished by pole manufacturer. Concrete materials, installation, and finishing requirements are specified in Section 03 30 00 "Cast-in-Place Concrete."

B. Foundation-Mounted Poles: Mount pole with leveling nuts and tighten top nuts to torque level according to pole manufacturer's written instructions.

C. Raise and set pole using web fabric slings (not chain or cable) at locations indicated by manufacturer.

3.3 CORROSION PREVENTION

A. Steel Conduits: Comply with requirements in Section 26 05 33 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch-thick, pipe-wrapping plastic tape applied with a 50-percent overlap.

3.4 GROUNDING

A. Ground Metal Poles and Support Structures: Comply with requirements in Section 26 05 26 "Grounding and Bonding for Electrical Systems."

1. Install grounding electrode for each pole unless otherwise indicated.
2. Install grounding conductor pigtail in the base for connecting luminaire to grounding system.

END OF SECTION

SECTION 26 56 19
LED EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Exterior solid-state luminaires that are designed for and exclusively use LED lamp technology.
2. Luminaire supports.

1.2 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color rendering index.

C. Fixture: See "Luminaire."

D. IP: International Protection or Ingress Protection Rating

E. Lumen: Measured output of lamp and luminaire, or both.

F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of luminaire.

1.4 FIELD CONDITIONS

A. Mark locations of exterior luminaires for approval by Architect prior to the start of luminaire installation.

1.5 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Luminaires shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

B. Seismic Performance: Luminaires and lamps shall be labeled vibration and shock resistant.

1. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified."

2.2 LUMINAIRE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. CRI of minimum 70. CCT of 4000 K.

C. Source Limitations: Obtain luminaires from single source from a single manufacturer.

D. Source Limitations: For luminaires, obtain each color, grade, finish, type, and variety of luminaire from single source with resources to provide products of consistent quality in appearance and physical properties.

2.3 LUMINAIRE TYPES

A. Basis of design shall be products listed in the Lighting Fixture Schedule on the drawings.

2.4 MATERIALS

A. Metal Parts: Free of burrs and sharp corners and edges.

B. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses.

C. Lens and Refractor Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

D. Housings:

1. Rigidly formed, weather- and light-tight enclosure that will not warp, sag, or deform in use.

2.5 FINISHES

A. Variations in Finishes: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

B. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.

2.6 LUMINAIRE SUPPORT COMPONENTS

A. Comply with requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

A. Comply with NECA 1.

B. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.

C. Supports:

1. Sized and rated for luminaire weight.
2. Able to maintain luminaire position after cleaning.
3. Support luminaires without causing deflection of finished surface.
4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.

D. Wall-Mounted Luminaire Support:

1. As recommended by luminaire manufacturer.

E. Wiring Method: Install cables in raceways. Conceal raceways and cables.

F. Coordinate layout and installation of luminaires with other construction.

G. Adjust luminaires that require field adjustment or aiming.

H. Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables" and 260533 "Raceways and Boxes for Electrical Systems" for wiring connections and wiring methods.

3.2 INSTALLATION OF INDIVIDUAL GROUND-MOUNTED LUMINAIRES

A. Aim as indicated on Drawings.

B. Install on concrete base with top 4 inches above finished grade or surface at luminaire location. Cast conduit into base, and finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Section 03 30 00 "Cast-in-Place Concrete."

3.3 CORROSION PREVENTION

A. Steel Conduits: Comply with Section 26 05 33 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch-thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.4 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

A. Inspect each installed luminaire for damage. Replace damaged luminaires and components.

B. Perform the following tests and inspections:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.

C. Luminaire will be considered defective if it does not pass tests and inspections.

END OF SECTION

SECTION 28 05 13
CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fire alarm wire and cable.
2. Identification products.

1.2 DEFINITIONS

A. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 50 or less.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 FIRE ALARM WIRE AND CABLE

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Allied Wire & Cable Inc.
2. Genesis Cable Products; Honeywell International, Inc.
3. West Penn Wire.

B. General Wire and Cable Requirements: NRTL listed and labeled as complying with NFPA 70, Article 760.

C. Signaling Line Circuits: Twisted, shielded pair, size as recommended by system manufacturer.

D. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation, and complying with requirements in UL 2196 for a two-hour rating.

1. Low-Voltage Circuits: No. 16 AWG, minimum, in pathway.
2. Line-Voltage Circuits: No. 12 AWG, minimum, in pathway.

2.3 IDENTIFICATION PRODUCTS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Brady Corporation.
2. Panduit Corp.

B. Comply with TIA-606-B and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

C. Comply with requirements in Section 26 05 53 "Identification for Electrical Systems."

PART 3 - EXECUTION

3.1 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems" for installation of supports for cables.

3.2 FIRE ALARM WIRING INSTALLATION

A. Comply with NECA 1 and NFPA 72.

B. Wiring Method: Install wiring in metal pathway according to Section 28 05 28 "Pathways for Electronic Safety and Security."

1. Fire alarm circuits and equipment control wiring associated with the fire alarm system shall be installed in a dedicated pathway system. This system shall not be used for any other wire or cable.

C. Wiring installed above lay-in ceilings may be installed openly and supported by j-hooks and/or bridle rings located not more than 5 feet on center.

1. Install plenum cable in environmental air spaces, including plenum ceilings.

D. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal according to the system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

E. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes, cabinets, or equipment enclosures where circuit connections are made.

F. Color Coding: Color code fire alarm conductors differently from the normal building power wiring. Use one color code for alarm circuit wiring and another for supervisory circuits. Color code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire alarm system junction boxes and covers red.

3.3 POWER AND CONTROL-CIRCUIT CONDUCTORS

A. 120-V Power Wiring: Install according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables" unless otherwise indicated.

B. Minimum Conductor Sizes:

1. Class 1 remote-control and signal circuits, No. 14 AWG.
2. Class 2 low-energy, remote-control and signal circuits, No. 16 AWG.
3. Class 3 low-energy, remote-control, alarm and signal circuits, No. 12 AWG.

3.4 CONNECTIONS

A. Comply with requirements in Section 28 31 11 "Digital, Addressable Fire-Alarm System" for connecting, terminating, and identifying wires and cables.

3.5 FIRESTOPPING

A. Comply with requirements in Section 07 84 13 "Penetration Firestopping."

B. Comply with TIA-569-C, "Firestopping" Annex A.

C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.6 GROUNDING

A. For communication wiring, comply with J-STD-607-A and with BICSI TDMM's "Grounding, Bonding, and Electrical Protection" chapter.

B. For low-voltage wiring and cabling, comply with requirements in Section 27 05 26 "Grounding and Bonding for Communication Systems."

3.7 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA-606-B. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

3.8 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
2. Test fire alarm cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross connection.

B. End-to-end cabling will be considered defective if it does not pass tests and inspections.

END OF SECTION

SECTION 28 46 21.11
ADDRESSABLE FIRE-ALARM SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Fire-alarm control unit.
2. Manual fire-alarm boxes.
3. System smoke detectors.
4. Nonsystem smoke detectors.
5. Heat detectors.
6. Notification appliances.
7. Device guards.
8. Remote annunciator.
9. Addressable interface device.

1.3 DEFINITIONS

A. EMT: Electrical Metallic Tubing.

B. FACP: Fire Alarm Control Panel.

C. HLI: High Level Interface.

D. NICET: National Institute for Certification in Engineering Technologies.

E. PC: Personal computer.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product, including furnished options and accessories.

1. Include construction details, material descriptions, dimensions, profiles, and finishes.
2. Include rated capacities, operating characteristics, and electrical characteristics.

B. Shop Drawings: For fire-alarm system.

1. Comply with recommendations and requirements in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
2. Include plans, elevations, sections, details, and attachments to other work.
3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations. Indicate conductor sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.
4. Detail assembly and support requirements.
5. Include voltage drop calculations for notification-appliance circuits.
6. Include battery-size calculations.
7. Include input/output matrix.
8. Include statement from manufacturer that all equipment and components have been tested as a system and meet all requirements in this Specification and in NFPA 72.
9. Include performance parameters and installation details for each detector.
10. Verify that each duct detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
11. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale; coordinate location of duct smoke detectors and access to them.
12. Include alarm signaling-service equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.
13. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits and point-to-point wiring diagrams.

C. General Submittal Requirements:

1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Architect.
2. Shop Drawings shall be prepared by persons with the following qualifications:

    a. Trained and certified by manufacturer in fire-alarm system design.
    b. NICET-certified, fire-alarm technician; Level IV minimum.
    c. Licensed or certified by authorities having jurisdiction.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Seismic Qualification Data: Certificates, for fire-alarm control unit, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field quality-control reports.

1.6 Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following and deliver copies to authorities having jurisdiction:

a. Comply with the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
b. Provide "Fire Alarm and Emergency Communications System Record of Completion Documents" according to the "Completion Documents" Article in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
c. Complete wiring diagrams showing connections between all devices and equipment. Each conductor shall be numbered at every junction point with indication of origination and termination points.
d. Riser diagram.
e. Device addresses.
f. Provide "Inspection and Testing Form" according to the "Inspection, Testing and Maintenance" chapter in NFPA 72, and include the following:

1) Equipment tested.
2) Frequency of testing of installed components.
3) Frequency of inspection of installed components.
4) Requirements and recommendations related to results of maintenance.
5) Manufacturer's user training manuals.

g. Manufacturer's required maintenance related to system warranty requirements.
h. Abbreviated operating instructions for mounting at fire-alarm control unit and each annunciator unit.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm Level IV technician.

B. NFPA Certification: Obtain certification according to NFPA 72 by a UL-listed alarm company.

1.9 PROJECT CONDITIONS

A. Use of Devices during Construction: Protect devices during construction unless devices are placed in service to protect the facility during construction.

1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace fire-alarm system equipment and components that fail in materials or workmanship within specified warranty period.

1. Warranty Extent: All equipment and components not covered in the Maintenance Service Agreement.
2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Source Limitations for Fire-Alarm System and Components: Components shall be compatible with, and operate as an extension of, existing system. Provide system manufacturer's certification that all components provided have been tested as, and will operate as, a system.

B. Noncoded, UL-certified addressable system, with multiplexed signal transmission and horn/strobe evacuation.

C. Automatic sensitivity control of certain smoke detectors.

D. All components provided shall be listed for use with the selected system.

E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 SYSTEMS OPERATIONAL DESCRIPTION

A. Fire-alarm signal initiation shall be by one or more of the following devices and systems:

1. Manual stations.
2. Heat detectors.
3. Smoke detectors.
4. Duct smoke detectors.
5. Automatic sprinkler system water flow.
6. Fire standpipe system.

B. Fire-alarm signal shall initiate the following actions:

1. Continuously operate alarm notification appliances.
2. Identify alarm and specific initiating device at fire-alarm control unit and remote annunciators.
3. Transmit an alarm signal to the remote alarm receiving station.
4. Activate alarm communication system.
5. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.

C. Supervisory signal initiation shall be by one or more of the following devices and actions:

1. Valve supervisory switch.
2. Independent fire-detection and -suppression systems.
3. User disabling of zones or individual devices.
4. Loss of communication with any panel on the network.

D. System trouble signal initiation shall be by one or more of the following devices and actions:

1. Open circuits, shorts, and grounds in designated circuits.
2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
3. Loss of communication with any addressable sensor, input module, relay, control module, remote annunciator, printer interface, or Ethernet module.
4. Loss of primary power at fire-alarm control unit.
5. Ground or a single break in internal circuits of fire-alarm control unit.
6. Abnormal ac voltage at fire-alarm control unit.
7. Break in standby battery circuitry.
8. Failure of battery charging.
9. Abnormal position of any switch at fire-alarm control unit or annunciator.
10. Voice signal amplifier failure.

E. System Supervisory Signal Actions:

1. Initiate notification appliances.
2. Identify specific device initiating the event at fire-alarm control unit and remote annunciators.

2.3 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Fire-alarm control unit and raceways shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

2.4 FIRE-ALARM CONTROL UNIT

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. EST

2. Notifier.
3. SimplexGrinnell LP.

B. General Requirements for Fire-Alarm Control Unit:

1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864.

    a. System software and programs shall be held in nonvolatile flash, electrically erasable, programmable, read-only memory, retaining the information through failure of primary and secondary power supplies.
    b. Include a real-time clock for time annotation of events on the event recorder and printer.
    c. Provide communication between the FACP and remote circuit interface panels, annunciators, and displays.
    d. The FACP shall be listed for connection to a central-station signaling system service.
    e. Provide nonvolatile memory for system database, logic, and operating system and event history. The system shall require no manual input to initialize in the event of a complete power down condition. The FACP shall provide a minimum 500-event history log.

2. Addressable Initiation Device Circuits: The FACP shall indicate which communication zones have been silenced and shall provide selective silencing of alarm notification appliance by building communication zone.
3. Addressable Control Circuits for Operation of Notification Appliances and Mechanical Equipment: The FACP shall be listed for releasing service.

C. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.

1. Annunciator and Display: Liquid-crystal type, 80 characters, minimum.
2. Keypad: Arranged to permit entry and execution of programming, display, and control commands.

D. Initiating-Device, Notification-Appliance, and Signaling-Line Circuits:

1. Pathway Class Designations: NFPA 72, Class B.
2. Pathway Survivability: Level 0.
3. Install no more than 50 addressable devices on each signaling-line circuit.
4. Serial Interfaces:

    a. One dedicated RS 485 port for central-station operation using point ID DACT.
    b. One RS 485 port for remote annunciators, Ethernet module, or multi-interface module (printer port).

E. Notification-Appliance Circuit:

1. Audible appliances shall sound in a three-pulse temporal pattern, as defined in NFPA 72.
2. Where notification appliances provide signals to sleeping areas, the alarm signal shall be a 520-Hz square wave with an intensity 15 dB above the average ambient sound level or 5 dB above the maximum sound level, or at least 75 dBA, whichever is greater, measured at the pillow.
3. Visual alarm appliances shall flash in synchronization where multiple appliances are in the same field of view, as defined in NFPA 72.

F. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.

G. Printout of Events: On receipt of signal, print alarm, supervisory, and trouble events. Identify zone, device, and function. Include type of signal (alarm, supervisory, or trouble) and date and time of occurrence. Differentiate alarm signals from all other printed indications. Also, print system reset event, including same information for device, location, date, and time. Commands initiate the printing of a list of existing alarm, supervisory, and trouble conditions in the system and a historical log of events.

H. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory and digital alarm communicator transmitters shall be powered by 24-V dc source.

1. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the power-supply module rating.

I. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.

1. Batteries: Sealed lead calcium.

J. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

2.5 MANUAL FIRE-ALARM BOXES

A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.

1. Double-action mechanism requiring two actions to initiate an alarm, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
2. Station Reset: Key- or wrench-operated switch.

2.6 SYSTEM SMOKE DETECTORS

A. General Requirements for System Smoke Detectors:

1. Comply with UL 268; operating at 24-V dc, nominal.
2. Detectors shall be two-wire type.
3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
4. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
5. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
6. Integral Visual-Indicating Light: LED type, indicating detector has operated and power-on status.

B. Photoelectric Smoke Detectors:

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:

    a. Primary status.
    b. Device type.
    c. Present average value.
    d. Present sensitivity selected.
    e. Sensor range (normal, dirty, etc.).

C. Duct Smoke Detectors: Photoelectric type complying with UL 268A.

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:

    a. Primary status.
    b. Device type.
    c. Present average value.
    d. Present sensitivity selected.
    e. Sensor range (normal, dirty, etc.).

3. Each sensor shall have multiple levels of detection sensitivity.
4. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
5. Relay Fan Shutdown: Fully programmable relay rated to interrupt fan motor-control circuit.

2.7 HEAT DETECTORS

A. General Requirements for Heat Detectors: Comply with UL 521.

1. Temperature sensors shall test for and communicate the sensitivity range of the device.

B. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F or a rate of rise that exceeds per minute unless otherwise indicated.

1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
3. Mounting: **[Adapter plate for outlet box mounting] [Twist-lock base interchangeable with smoke-detector bases]**.
4. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

2.8 NOTIFICATION APPLIANCES

A. General Requirements for Notification Appliances: Individually addressed, connected to a signaling-line circuit, equipped for mounting as indicated, and with screw terminals for system connections.

1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated, and with screw terminals for system connections.

B. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet from the horn, using the coded signal prescribed in UL 464 test protocol.

C. Visible Notification Appliances: Xenon strobe lights complying with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch-high letters on the lens.

1. Rated Light Output:

   a. 15/30/75/110 cd, selectable in the field.

2. Mounting: Wall mounted unless otherwise indicated.
3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
4. Flashing shall be in a temporal pattern, synchronized with other units.
5. Strobe Leads: Factory connected to screw terminals.
6. Mounting Faceplate: Factory finished, white.

2.9 REMOTE ANNUNCIATOR

A. Description: Annunciator functions shall match those of fire-alarm control unit for alarm, supervisory, and trouble indications. Manual switching functions shall match those of fire-alarm control unit, including acknowledging, silencing, resetting, and testing.

1. Mounting: Flush cabinet, NEMA 250, Type 1.

B. Display Type and Functional Performance: Alphanumeric display and LED indicating lights shall match those of fire-alarm control unit. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.

2.10 ADDRESSABLE INTERFACE DEVICE

A. General:

1. Include address-setting means on the module.
2. Store an internal identifying code for control panel use to identify the module type.
3. Listed for controlling HVAC fan motor controllers.

B. Monitor Module: Microelectronic module providing a system address for alarm-initiating devices for wired applications with normally open contacts.

C. Control Module:

1. Operate notification devices.
2. Operate solenoids for use in sprinkler service.

2.11 DIGITAL ALARM COMMUNICATOR TRANSMITTER

A. Digital alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL 632.

B. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit and automatically capture **[one]** **[two]** telephone line(s) and dial a preset number for a remote central station. When contact is made with central station(s), signals shall be transmitted. If service on either line is interrupted for longer than 45 seconds, transmitter shall initiate a local trouble signal and transmit the signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. Transmitter shall automatically report telephone service restoration to the central station. If service is lost on both telephone lines, transmitter shall initiate the local trouble signal.

C. Local functions and display at the digital alarm communicator transmitter shall include the following:

1. Verification that both telephone lines are available.
2. Programming device.

3. LED display.
4. Manual test report function and manual transmission clear indication.
5. Communications failure with the central station or fire-alarm control unit.

D. Digital data transmission shall include the following:

1. Address of the alarm-initiating device.
2. Address of the supervisory signal.
3. Address of the trouble-initiating device.
4. Loss of ac supply.
5. Loss of power.
6. Low battery.
7. Abnormal test signal.
8. Communication bus failure.

E. Secondary Power: Integral rechargeable battery and automatic charger.

F. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements for ventilation, temperature, humidity, and other conditions affecting performance of the Work.

1. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment and wiring are installed, before installation begins.

B. Examine roughing-in for electrical connections to verify actual locations of connections before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EQUIPMENT INSTALLATION

A. Comply with NFPA 72, NFPA 101, and requirements of authorities having jurisdiction for installation and testing of fire-alarm equipment. Install all electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."

1. Devices placed in service before all other trades have completed cleanup shall be replaced.
2. Devices installed but not yet placed in service shall be protected from construction dust, debris, dirt, moisture, and damage according to manufacturer's written storage instructions.
3. Install seismic bracing. Comply with requirements in Section 27 05 48.16 "Seismic Controls for Communications Systems."

B. Install wall-mounted equipment, with tops of cabinets not more than 78 inches above the finished floor.

1. Comply with requirements for seismic-restraint devices specified in Section 27 05 48.16 "Seismic Controls for Communications Systems."

C. Manual Fire-Alarm Boxes:

1. Install manual fire-alarm box in the normal path of egress within 60 inches of the exit doorway.
2. Mount manual fire-alarm box on a background of a contrasting color.
3. The operable part of manual fire-alarm box shall be between 42 inches and 48 inches above floor level. All devices shall be mounted at the same height unless otherwise indicated.

D. Smoke- or Heat-Detector Spacing:

1. Comply with the "Smoke-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for smoke-detector spacing.
2. Comply with the "Heat-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for heat-detector spacing.
3. Smooth ceiling spacing shall not exceed 30 feet.
4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Annex A in NFPA 72.
5. HVAC: Locate detectors not closer than 36 inches from air-supply diffuser or return-air opening.
6. Lighting Fixtures: Locate detectors not closer than 12 inches from any part of a lighting fixture and not directly above pendant mounted or indirect lighting.

E. Install a cover on each smoke detector that is not placed in service during construction. Cover shall remain in place except during system testing. Remove cover prior to system turnover.

F. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct. Tubes more than 36 inches long shall be supported at both ends.

1. Do not install smoke detector in duct smoke-detector housing during construction. Install detector only during system testing and prior to system turnover.

G. Remote Status and Alarm Indicators: Install in a visible location near each smoke detector, sprinkler water-flow switch, and valve-tamper switch that is not readily visible from normal viewing position.

H. Audible Alarm-Indicating Devices: Install not less than 6 inches below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille. Install all devices at the same height unless otherwise indicated.

I. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches below the ceiling. Install all devices at the same height unless otherwise indicated.

J. Device Location-Indicating Lights: Locate in public space near the device they monitor.

3.3 PATHWAYS

A. Pathways above recessed ceilings and in nonaccessible locations may be routed exposed.

1. Exposed pathways located less than 96 inches above the floor shall be installed in EMT.

B. Exposed EMT shall be painted red enamel.

3.4 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 27 05 53 "Identification for Communications Systems."

B. Install framed instructions in a location visible from fire-alarm control unit.

3.5 GROUNDING

A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

B. Ground shielded cables at the control panel location only. Insulate shield at device location.

3.6 FIELD QUALITY CONTROL

A. Field tests shall be witnessed by authorities having jurisdiction.

B. Perform tests and inspections.

C. Perform the following tests and inspections:

1. Visual Inspection: Conduct visual inspection prior to testing.

a. Inspection shall be based on completed record Drawings and system documentation that is required by the "Completion Documents, Preparation" table in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
b. Comply with the "Visual Inspection Frequencies" table in the "Inspection" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.

2. System Testing: Comply with the "Test Methods" table in the "Testing" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
3. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" section of the "Fundamentals" chapter in NFPA 72

and the "Inspection and Testing Form" in the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

D. Fire-alarm system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

END OF SECTION

SECTION 31 00 00
EARTHWORK

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Excavation and backfilling for construction.

B. Preparation and grading of subgrade.

C. Filling and backfilling.

D. Excavation and backfilling of trenches for underground mechanical and electrical utilities and appurtenances.

1.02 DEFINITIONS

A. Excavation: Removal of material encountered to subgrade elevations indicated and subsequent reuse or disposal of materials removed.

B. Unauthorized Excavation: Removal of materials beyond indicated subgrade elevations or dimensions without specific direction of Engineer.

C. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.

D. Borrow: Soil material obtained off site when sufficient approved soil material is not available from excavations.

E. Base Course: The layer placed below surface pavement in a paving system.

F. Undercutting: Removal of earth, beyond the indicated limits of excavations that is unsuitable for support of fill, slabs, paving, or foundations.

G. Utilities: Includes on-site underground pipes, conduits, ducts, and cables.

1.03 SUBMITTALS – REVIEW

A. Comply with requirements of Section 01 33 00 Submittal Procedures.

B. Product Data:

1. Each type of plastic warning tape.

1.04 SUBMITTALS – INFORMATIONAL

A. Test Reports:

1. Field quality control reports.
2. Laboratory analysis of each soil material proposed for fill and backfill from on-site or borrow sources.
3. One optimum moisture-maximum density curve for each soil material.
4. Verification of subgrade.

1.05 PROJECT CONDITIONS

A. Locate existing underground utilities in areas of Work. Where utilities are to remain in place, provide support and protection during earthwork operations.

1. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, consult utility owner immediately for directions.
2. Cooperate with Owner and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to satisfaction of utility owner.

B. The Contractor shall, upon becoming aware of subsurface or latent physical conditions differing from those stated in the original soil investigation report, promptly notify the Engineer of the nature of the differing conditions. No claim by the Contractor for conditions differing from those anticipated in the plans and specifications and stated in the original soil investigation report will be allowed unless the Contractor has so notified the Engineer.

C. Existing site is sloped to allow free draining of rainwater. Modifications during construction shall maintain drainage and shall not hold or pond rain water.

1.06 ARCHEOLOGICAL DISCOVERIES

A. If artifacts or other items of historical nature are discovered during work of this Section, temporarily discontinue work in the affected area. Engineer will direct Contractor regarding procedure to preserve significant items.

B. All artifacts and other significant items shall remain the property of the Owner. Items not claimed by Owner become property of Contractor and shall be removed from site.

1.07 SEQUENCING

A. Sequence backfilling to allow enough time for observations, inspections, testing, and other specified requirements before concealing finished work.

PART 2 – PRODUCTS

2.01 SOIL MATERIALS

A. Fill Materials: Free of organic of other deleterious materials, maximum particle size of 3 inches, relatively well graded, liquid limit less than 45, and plasticity index of less than 25.

B. Bedding: Sand or naturally sandy soil of particle sizes that all will pass 3/8" sieve and not more than 10 percent passes #200 sieve.

C. Borrow Material: Furnish satisfactory soil materials from off-site sources if sufficient satisfactory soil materials are not available from excavations.

2.02 ACCESSORIES

A. Filter Fabric: Nonwoven geotextile fabric of polyester, polypropylene, or nylon fiber.

1. Weight: Minimum 4.2 oz/sq yard.
2. Grab Tensile Strength: Minimum 120 lb when tested per ASTM D4632.
3. Puncture Resistance: Minimum 70 lb when tested per ASTM D4833.
4. Apparent Opening Size: Equivalent to no. 70 US sieve size per ASTM D4751.
5. Flow Rate: Minimum 120 gallons/minute/sq ft when tested per ASTM D4491.

B. Warning Tape: Acid and alkali resistant polyethylene film tape manufactured for marking and identifying underground utilities; 6 inches wide, 4 mils thick, bright color, continuously printed with description of the utility.

PART 3 - EXECUTION

3.01 PROTECTION

A. Provide barricades around open excavations and other hazards. Provide warning signs and lights as recommended by governing authorities.

B. Protect persons and property from damage caused by settlement, lateral movement, undermining, washout, cave-ins, and other hazards caused by earthwork operations.

C. See Section 32 01 90 for tree preservation. Perform excavation within drip-line of large trees to remain by hand, and protect the root system from damage or dryout to the greatest extent possible. Maintain moist condition for root system and cover exposed roots with burlap. Paint root cuts of 1-1/2 inch diameter and larger with emulsified asphalt tree paint.

D. Prevent erosion of displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties, pavements, and structures.

E. Protect subgrades soils against freezing temperatures and frost. Provide protective insulating materials as necessary.

3.02 PREPARATION

A. Identify required lines, levels, contours, and elevation data.

B. Locate, identify, and protect utilities that remain from damage.

C. Maintain bench marks and other reference points.

3.03 DEWATERING

A. Prevent surface water and subsurface or ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding areas.

B. Protect subgrades from softening and damage by rain or water accumulations.

3.04 EXCAVATION - GENERAL

A. Maintain sides, edges, and slopes of excavations in safe, stable condition until completion of backfilling.

B. Excavation is unclassified, and includes excavation to subgrade elevations indicated, regardless of character of materials and obstructions encountered.

C. Excavate subsoil to accommodate new construction.

D. Where unsuitable bearing materials are encountered at required subgrade elevations, carry excavations deeper and replace excavated material as directed by Engineer. Removal of unsuitable material and its replacement will be paid for per Contract provisions for changes in Work.

E. Stockpile satisfactory excavated materials until needed for backfill or fill.

1. Place, grade, and shape stockpiles for proper drainage. Use sheet protection if needed to control erosion and soil movement.
2. Locate and retain soil materials away from edge of excavations.
3. Do not store soil materials within drip line of trees indicated to remain.

F. Demolish and completely remove from site those existing underground utilities indicated to be removed. Coordinate with utility companies for shut-off of services if lines are active.

G. Fill unauthorized excavation.

3.05 EXCAVATION - WALKS AND OTHER PAVEMENTS

A. Cut surface under pavements to conform to indicated cross sections, elevations, and grades.

3.06 EXCAVATION - UTILITY TRENCHES

A. Excavate trenches to depth needed to establish indicated slopes and invert elevations, and to support bottoms of pipe and conduit on undisturbed soil. Provide trench depth outside building perimeter sufficient to allow installation of top of pipe below frost line.

B. Excavate trenches to uniform width, sufficiently wide to afford access for installation and inspection. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit.

C. Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes, and for joints, fittings, and bodies of conduits. Remove stones and sharp objects to prevent point loading.
   1. See drawings and other portions of specifications for conditions requiring sand bedding.

D. For pipes and conduit less than 6 inches in nominal diameter and flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support pipe and conduit on undisturbed subgrade.

E. For pipes and conduit 6 inches or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe circumference. Fill depressions with tamped sand backfill.

F. Hand excavate bottom cuts to accurate elevations. Remove loose material. Fill depressions with tamped sand.

G. At pipe joints dig bell holes sufficient to relieve pipe bell of loads and ensure continuous bearing of pipe barrel on bearing surface.

H. Where indicated widths of utility trenches are exceeded, provide stronger pipe or special installation procedures, as directed by Engineer.

3.07 EXCAVATION - APPROVAL OF SUBGRADE

A. When excavation has reached required subgrade elevations, notify Engineer and Geotechnical Engineer for inspection.

B. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities as directed by Engineer.

3.08 INSTALLATION - BACKFILL

A. Backfill excavations as promptly as work permits, but not until completion of the following:

   1. Acceptance of construction below finish grade.
   2. Survey and recording of locations of underground utilities and recording on Project Record Documents.
   3. Inspection, testing, and approval of underground utilities.
   4. Removal of concrete formwork.

5. Removal of temporary shoring and bracing, and sheeting.
6. Removal of trash and debris from excavation.
7. Permanent or temporary horizontal bracing is in place on horizontally supported walls.

B. Place and compact backfill per requirements for fills.

3.09 INSTALLATION - UTILITY TRENCH BACKFILL

A. Place and compact bedding course where indicated, and to fill unauthorized excavations.

B. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes, and for joints, fittings, and bodies of conduit.

C. Do not backfill trenches until tests and inspections are completed and satisfactory.

D. Trench Backfill Under Pavement: Use only approved fill materials.

E. Place and compact initial backfill of satisfactory soil material, free of particles larger than 1 inch, to height of 12 inches over the utility pipe or conduit.

F. Carefully compact material under pipe haunches and bring backfill evenly up on both sides and along full length of utility piping or conduit to avoid damage or displacement of utility system.

G. Fill voids with approved backfill materials as shoring, bracing, and sheeting are removed.

H. Place and compact final backfill of satisfactory soil material to final subgrade.

I. Install warning tape directly above and in line with utility lines 6 inches below subgrade under pavements and slabs, 12 inches below finished grade elsewhere.

3.10 INSTALLATION - BASE COURSES

A. Proof roll areas to receive base to locate soft areas with a loaded dump truck or similar pneumatic-tired equipment, if considered to be appropriate by the Geotechnical Engineer of the Soils Testing Laboratory.

B. Under asphaltic concrete paving use soil cement base.

C. Shape base to required crown elevations and cross slope grades. Fine grade base after asphalt removal to assure uniform consistency and to remove irregular grades.

D. Where thickness of compacted base course is 6 inches or less, place material in single layer.

E. Where thickness of compacted subbase or base course is more than 6 inches, place material in equal layers 3 to 6 inches thick when compacted.

3.11 INSTALLATION - FILL

A. Proof roll areas to receive fill to locate soft areas with a loaded dump truck or similar pneumatic-tired equipment, if considered to be appropriate by the Geotechnical Engineer of the Soils Testing Laboratory.

B. If undercutting is required, dispose of excavated material off site or reprocess on site to reduce moisture to acceptable limits for reuse (as acceptable to Engineer), and replace this undercut material with compacted fill made with approved borrow. Depth of undercut is to be measured from a point 6 inches below bottom of required 6 inch deep stripping.

    1. Engineer will determine extent of undercutting on the basis of recommendations by the Soils Testing Laboratory representative documented in written reports. Adjustments to the Contract for the actual quantity of work performed shall be made.

C. Where subgrade or existing ground surface to receive fill has density less than that required for fill, break up ground surface to depth required (minimum 6 inch depth), pulverize, moisture condition or aerate soil, and recompact to required density.

    1. Remove soft areas of existing subgrade that cannot be compacted in place to required densities.

D. Remove vegetation, debris, wet and unsatisfactory soil materials, obstructions, and deleterious materials from ground surface before placement of fills.

E. Plow, strip, or break-up sloped surfaces steeper than 1 vertical to 4 horizontal so that fill material will bond with existing surface.

F. Place fill material in layers to required subgrade elevations.

    1. Grass Areas: Satisfactory excavated or borrow soil material.
    2. Under Walks and Pavements: Leveling fill, base material, or satisfactory

3.12 INSTALLATION - MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill layer before compaction to within 3 percent below to 2 percent above optimum moisture content.

B. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.

C. Remove and replace, or scarify and air-dry satisfactory soil material that is too wet to compact to specified density.

D. Stockpile or spread and dry removed wet satisfactory soil material.

E. Soil material that has been removed because it is too wet to permit compaction may be stockpiled or spread and allowed to dry. Assist drying by discing, harrowing or pulverizing until moisture content is reduced to satisfactory level.

3.13 INSTALLATION - COMPACTION

A. Place backfill and fill materials in layers maximum 8 inches in loose depth for material compacted by heavy compaction equipment, maximum 4 inches for material compacted by hand operated tampers.

B. Place backfill and fill materials evenly on all sides of structures, piping or conduit to required elevations. Place backfill and fill uniformly along entire length of each structure.

C. Place backfill and fill materials without wedging action of backfill against structures or displacement of piping or conduit.

D. Where compacted aggregate courses are shown to be 6 inches thick or less, place material in single layer; where shown to be more than 6 inches thick, place material in equal layers 3 to 6 inches thick.

E. Compact fills, backfills, and granular support courses to following minimum percentages of maximum dry density according to ASTM D698.

1. Below Vehicle Pavements: Compact top 6 inches below subgrade and each layer of backfill or fill to 90 percent.
3. Below Pedestrian Pavements: Compact subgrade and each layer of backfill or fill to 90 percent.
4. Below Lawn and Planting Areas: Compact top 6 inches below subgrade and each layer of backfill or fill to 90 percent.

3.14 INSTALLATION - ROUGH GRADING

A. Grade subgrade to smooth surface free of irregular surface changes.

B. Shape subgrade surface to indicated levels and slopes with uniform slopes between points where elevations are indicated.

C. Provide smooth transitions between existing grades and new grades.

D. Cut out and fill soft areas, fill low areas, and trim high areas to conform to required surface tolerances.

E. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades within following tolerances.

1. Lawn, Unpaved Areas: Plus or minus 0.10 ft.
2. Pedestrian Walks: Plus or minus 0.10 ft.
3. Vehicular Pavements: Plus or minus 1/2 inch.

3.15 FIELD QUALITY CONTROL

A. Comply with requirements of Division 01.

B. Provide services of Geotechnical Engineer to inspect and test each subgrade, and each fill or backfill layer. Do not proceed until test results for previously completed work verify conformance to requirements.

3.16 PROTECTION

A. Protect newly graded areas from traffic and erosion.

B. Keep graded areas free of trash and debris.

3.17 ADJUSTING

A. Repair and re-establish grades to specified tolerances in settled, eroded, and rutted areas, and where there is loss of compaction due to subsequent construction operations, adverse weather, or other causes.

B. Where settling occurs during correction of work period, remove finished surfacing (pavement, lawn, or other finish), add backfill material, compact, and reconstruct surfacing. Restore appearance, quality, and condition of surface or finish to match adjacent work, and eliminate evidence of restoration insofar as possible.

3.18 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus satisfactory soil materials and wastes, including unsatisfactory excavated material, trash, and debris, and dispose of them off Owner's property.

END OF SECTION

SECTION 31 10 00
SITE CLEARING

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.02 DESCRIPTION OF WORK

A. Extent of site clearing is shown on drawings.

B. Site clearing work includes, but is not limited to:
   1. Removal of trees and other vegetation.
   2. Clearing and grubbing in areas where vegetation is removed.
   3. Removing above grade improvements.
   4. Removing below grade improvements to extent indicated or described.

1.03 JOB CONDITIONS

A. Traffic: Conduct site clearing operations to ensure minimum interference with existing parking area, roads, streets, walks, and other adjacent occupied or used facilities. Do not close or obstruct streets, walks or other occupied or used facilities without permission from authorities having jurisdiction.

B. Protection of Existing Improvements: Provide protections necessary to prevent damage to existing improvements indicated to remain in place.

   1. Protect improvements on adjoining properties and on Owner's property.
   2. Restore damaged improvements to their original condition, as acceptable to parties having jurisdiction.

C. Salvageable Improvements: Carefully remove items indicated to be salvaged, and store on Owner's premises where indicated or directed.

PART 2 - PRODUCTS

Not applicable to work of this section.

PART 3 - EXECUTION

3.01 SITE CLEARING

A. General: Remove trees, shrubs, grass and other vegetation, improvements, or obstructions interfering with total clearing of site, grading and new construction. Removal includes digging out stumps and roots.

B. Clearing and Grubbing: Clear site of trees, shrubs and other vegetation, as indicated.
   1. Completely remove stumps, roots, and other debris protruding through ground surface.
   2. Fill depressions caused by clearing and grubbing operations with satisfactory soil material, unless further excavation or earthwork is indicated. Place fill material for small areas in horizontal layers not exceeding 6" loose depth, and thoroughly compact to specified density.

C. Removal of Improvements: Remove existing above-grade and below-grade improvements necessary to permit construction, and other work as indicated.
   1. Abandonment or removal of certain underground pipe or conduits may be shown on drawings. Removal of abandoned underground piping or conduit interfering with construction is included under this section.

D. Disposal of Waste Materials
   1. Burning on Owner's Property: Burning is not permitted on Owner's property.
   2. Removal from Owner's Property: Remove waste materials and unsuitable and excess soil from Owner's property and dispose of off site in legal manner.

END OF SECTION

SECTION 31 32 00
SOIL CEMENT BASE

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Soil cement base.

1.02 RELATED SECTIONS

A. Section 31 00 00: Earthwork.

B. Section 32 12 16: Asphaltic Concrete Paving.

1.03 SUBMITTALS – INFORMATIONAL

A. Before starting operations, the contractor shall name his source of cement materials and shall submit reports of quality tests.

1.04 QUALITY ASSURANCE

A. The Contractor shall engage the services of a recognized independent testing laboratory to perform the following services:

1. Verify thickness and cement content of soil cement base.
2. Obtain copies of cement scale tickets as each truck enters the site.
3. The testing laboratory shall continuously monitor operations and make density tests determined in accordance with ASTM D698.
4. Mix Designs and Testing: The Contractor shall submit a mix design for the cement-treated base showing the proportions and compressive strength obtained by the mix at 7 days. The mix design shall include copies of test reports, including test dates, and a complete list of materials including type, brand, source and amount of cement, soil/aggregate, water, and admixtures. The mix design shall be submitted to the Engineer at least 7 days prior to the start of operations. Production shall not begin until the engineer approves the mix design in writing. The mix design shall develop a 7-day compressive strength of at least 350 psi when tested in accordance with ASTM D1633. The testing laboratory shall conduct one compressive strength test, ASTM C31, for every 10,000 square foot of paved area, but in no case less than 3 tests. Cores shall be obtained and tested for the 7 day compressive strength. Replace any base material failing to obtain a minimum 7 day compressive strength of 350 psi at no additional cost to the Owner.
5. The Contract Base Bid shall include a cement content of 10% of cement per volume of soil.

PART 2 – PRODUCTS

2.01 SOIL CEMENT BASE

A. Soil-cement base courses shall consist of soil and Portland cement uniformly mixed, moistened, compacted, finished and cured in accordance with these specifications, and it shall conform to the lines, grades, thickness and typical cross-sections shown on the plans.

B. Portland cement shall comply with the latest specifications for Portland cement, AASHO M85, M134, M151; or ASTM C150, C175, C205; or Federal SS-C-CO197 for the type specified. One cubic foot of Portland Cement shall be considered to weigh 94 lbs.

C. Water shall be free from substance deleterious to the hardening of the soil cement.

D. Soil shall consist of the material existing in the area to be paved, of approved select material, or of a combination of these materials proportioned as directed. The soil shall not contain gravel or stone retained on a 3 inch sieve or more than 45 percent retained on #4 sieve.

PART 3 – EXECUTION

3.01 SOIL CEMENT

A. Prepare the subgrade to the lines and elevations required to obtain the finished paving elevations indicated by cutting and/or filling as applicable. Remove all soft and yielding subgrade prior to soil cement operation.

B. Pulverization: The soil shall be so pulverized that, at the completion of moist-mixing, 100 percent by dry weight passes a 1 inch sieve, and minimum 80 percent passes #4 sieve, exclusive of gravel or stone retained on these sieves.

C. Cement Application, Mixing and Spreading: Mixing of the soil, cement and water shall be accomplished by the mixed-in-place method. No cement or soil-cement mixture shall be spread when the soil or subgrade is frozen or when the air temperature is less than 40 degrees F in the shade.

D. The percentage of moisture in the soil, at the time of cement application, shall not exceed the quantity that will permit a uniform and intimate mixture of soil and cement during mixing operations; and it shall not exceed the specified optimum moisture content for the soil cement as determined by the testing laboratory.

E. The operations specified shall be continuous and completed in daylight.

F. Soil and cement mixture that has not been compacted and finished shall not remain undisturbed for more than 30 minutes.

G. The specified quantity of cement shall be spread uniformly on the soil. Spread cement that has been displaced shall be replaced before mixing is started. After the cement has been applied it shall

be mixed with the soil. Mixing shall continue until the cement has been sufficiently blended with the soil to prevent the formation of cement balls when water is applied. Immediately after the soil and cement have been mixed, water shall be incorporated into the mixture. Excessive concentrations of water on or near the surface shall be avoided. A water supply and pressure distributing equipment shall be provided that will assure the application within 3 hours of all mixing water required on the section being processed. After all mixing water has been applied, mixing shall continue until a uniform and intimate mixture of soil, cement and water has been obtained.

H. Compaction: At the start of compacting, the percentage of moisture in the mixture and in unpulverized soil lumps, based on oven-dry weights, shall not be below or more than two percentage points above the specified optimum moisture content, and shall be less than that quantity which will cause the soil-cement mixture to become unstable during compaction and finishing. The specified optimum moisture content and density shall be determined in the field by a moisture-density test, AASHO T134 or ASTM D558, on representative samples of soil cement mixture obtained from the area being processed at the time compaction begins.

I. Prior to the beginning of compaction, the mixture shall be in loose condition for its full depth. The loose mixture then shall be uniformly compacted to 98 percent of field compaction specimen density within 2 hours. During compaction operations, shaping may be required to obtain uniform compaction and required grade and cross-section.

J. Finishing: After compaction the surface of the soil-cement shall be shaped to the required lines, grades and cross-section. If necessary, during shaping operations, the surface of the base shall be lightly scarified to remove any tire imprints or smooth surfaces left by equipment. The resulting surface shall then be compacted to the specified density. Rolling shall be supplemented by broom-dragging if required.

K. The moisture content of the surface material must be maintained at not less than its specified optimum content during finishing operations. Surface compaction and finishing shall be done in such a manner as to produce, in not longer than 2 hours, a smooth, dense surface free of compaction planes, cracks, ridges or loose material. Any portion of the soil cement that has a density of 5 lbs. or more below that specified shall be corrected or replaced to meet these specifications.

L. Curing: After the soil-cement has been finished as specified herein, it shall be protected against drying for 7 days by the application of bituminous material. The curing material shall be applied as soon as possible, but not later than 24 hours after the completion of finishing operations. The finished soil-cement shall be kept continuously moist until the curing material is placed. The bituminous material specified shall be uniformly applied to the surface of the completed soil-cement at the rate of approximately 0.2 gal. per square yard with approved heating and distributing equipment. The exact rate and temperature of application for complete coverage without excessive runoff will be specified by the Soils Engineer. At the time the bituminous material is applied the soil-cement surface shall be dense, shall be free of all loose and extraneous material, and shall contain sufficient moisture to prevent penetrations of the bituminous materials. Water shall be applied in sufficient quantity to fill the surface void of the soil-cement immediately before the bituminous curing material is applied. Should it be necessary for construction equipment or other

traffic to use the bituminous-covered surface before the bituminous material has dried sufficiently to prevent pickup, sufficient granular cover shall be applied before such use.

M. The curing material shall be maintained by the Contractor during the 7 day protection period so that all of the soil-cement will be covered effectively during this period.

N. Finished portions of soil-cement that are traveled on by equipment used in constructing an adjoining section shall be protected in such a manner as to prevent equipment from marring or damaging completed work.

O. Sufficient protection from freezing shall be given the soil-cement for 7 days after its construction and until it has hardened.

P. Construction Joints: At the end of each day's construction a straight transverse construction joint shall be formed by cutting back into the completed work to form a true vertical face.

Q. Soil-cement for large, wide areas shall be built in a series of parallel lanes of convenient length and width meeting the approval of the Soils Engineer. Straight longitudinal joints shall be formed at the edge of each day's construction by cutting back into the completed work to form a true vertical face free of loose or shattered material.

R. Traffic: Completed portions of soil-cement may be opened to construction equipment and to all traffic after the 7 day curing period, provided the soil-cement has hardened sufficiently to prevent marring or distorting of the surface by equipment or traffic, and provided the curing, as specified is not impaired.

S. Maintenance: The contractor shall be required, within the limits of his contract, to maintain the soil-cement in good condition until all work has been completed and accepted. Maintenance shall include immediate repairs of any defects that may occur. This work shall be done by the contractor at his own expense and repeated as often as may be necessary to keep the area continuously intact. Faulty work shall be replaced for the full depth of treatment. Any low areas shall be remedied by replacing the material for the full depth of treatment rather than by adding a thin layer of soil-cement to the completed work.

T. Application of asphalt paving shall not occur until at least 7 days after soil cement has been placed and not until it has hardened.

END OF SECTION

SECTION 31 57 13
EROSION AND SEDIMENT CONTROL

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Temporary slope protection, erosion and sediment control.

1.02 RELATED SECTIONS

A. Section 31 00 00 – Earthwork.

1.03 MATERIALS

A. Mulches: Oat or wheat straw, fiber mats, netting, bark, wood chips, or other suitable material reasonably clean, and free of harmful weeds or materials.

B. Silt Barriers: Hay, or wheat straw bales free of harmful weeds.

C. Synthetic Filter Fabric: Pervious sheet of woven propylene, nylon, polyester, or ethylene yarn, 700x minimum, certified by manufacturer or supplier to be in compliance with applicable Federal, state, and local regulations.

D. Wire fence reinforcing for silt fence: Minimum 24" height, 6" x 6" by 14 gauge.

E. Posts for Silt Fences: 1-1/2" x 1-1/2" wood or 1.33 pounds per linear foot steel with minimum length of 48". Steel posts shall have projections for fastening wire.

F. Stakes for Silt Barriers: 1" x 2" wood or equivalent metal by 36" long.

1.04 SLOPE PROTECTION & EROSION CONTROL

A. Provide erosion control in accordance with approved SWPPP.

B. Do not burn-off ground cover.

C. Before existing soils are disturbed, provide erosion and sediment control.

D. Protect slopes immediately after completing rough grading. Coordinate erosion and sediment control with earthwork so as to minimize duration of exposure of unprotected soils.

E. Temporary Protection of Erodible Soils: Use methods necessary to prevent erosion and to control sediment, including any or all of methods listed below.

F. Mechanical Retardation & Runoff Control: Mechanically retard and control rate of runoff from construction site. Use temporary diversion ditches and berms to retard and divert runoff to protected drainage courses.

G. Sediment Basins: Trap sediment in temporary or permanent sediment basins. Size basins to accommodate runoff of local 5-year storm. Pump basins dry and remove accumulated sediment after each storm. Use paved weir or vertical overflow pipe to drain overflow from basins. Collect sediment and (1) return to source of erosion; (2) use for fill on construction site; or (3) dispose of off-site. Provide effluent quality monitoring programs as required by state and local environmental agencies.

H. Borrow is not allowed in areas where suitable environmental controls are not possible.

I. Vegetation & Mulch: Provide temporary protection on slopes when rough grading is completed or when enough soil is exposed to require protection to prevent erosion. Protect soil by accelerated growth of permanent vegetation, temporary vegetation, mulching or netting. For slopes too steep for stabilization by other means, stabilize by hydroseeding, mulching anchored in place, covering with anchored netting, sodding, or combination of these and other necessary methods for effective erosion control.

J. Silt Barriers: Place rows of straw or hay bales, or install silt fencing securely anchored, or both to prevent soil erosion.

1.05 MAINTENANCE

A. Check and repair, as necessary, all control measures twice weekly during dry periods, and within 24 hours after rainfall of 0.5". During prolonged rainfall, check daily and repair damage.

B. Maintain records of checks and repairs.

C. Maintain erosion and sediment control features until Final Completion.

1.06 CLEANING

A. When the Work is complete, immediately remove materials used to aid erosion and sediment control.

B. Excess sediment and organic materials may be wasted evenly over site when an area has been designated by Engineer.

PART 2 – PRODUCTS

Not applicable to work of this section.

PART 3 – EXECUTION

Not applicable to work of this section.

END OF SECTION

SECTION 32 12 16
ASPHALTIC CONCRETE PAVING

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Asphaltic concrete surface course.

B. Asphaltic concrete base.

C. Pavement striping and marking.

1.02 RELATED SECTIONS

A. Section 01 45 23: Testing Laboratory Services.

B. Section 31 00 00: Earthwork.

1.03 SUBMITTALS - INFORMATIONAL

A. Comply with requirements of Section 01 33 00.

B. Submit manufacturer's product data and laboratory tested physical properties of bituminous mix proposed to be used.

C. Submit data verifying compliance with TDOT specifications.

1.04 QUALITY ASSURANCE

A. Reference Standard: Perform Work in accordance with applicable requirements for asphaltic concrete paving of Tennessee Department of Transportation Standard Specifications for Road and Bridge Construction. Provide copy at project site for Architect's reference.

1.05 DELIVERY, STORAGE, & HANDLING

A. Transport asphalt concrete mixtures from mixing site in trucks having tight, clean compartments.

B. Coat hauling compartments with lime-water mixture to prevent asphalt concrete mixture from sticking.

C. Elevate and drain compartment of excess solution before loading mix.

D. Provide covers over asphalt concrete mixture when transporting to protect from weather and to prevent loss of heat.

E. During periods of cold weather or for long-distance deliveries, provide insulation around entire truck bed surfaces.

1.06 ENVIRONMENTAL REQUIREMENTS

A. Do not place asphaltic concrete when ambient temperature is below 40°F or during wet weather conditions.

PART 2 - PRODUCTS

2.01 HERBICIDE

A. Provide commercial chemical for weed control, registered by Environmental Protection Agency. Provide granular, liquid, or wettable powder form.

2.02 ASPHALTIC CONCRETE MATERIALS

A. Coarse Aggregates: Natural crushed limestone conforming to ASTM D692.

B. Fine Aggregates: Aggregate passing #4 sieve and conforming to ASTM D1073.

C. Prime Coat: Cut-back asphalt conforming to ASTM D2027, Type MC-30 or MC-70; or ASTM D2028, Type RC-70.

D. Tack Coat: Emulsified asphalt; ASTM D977, Type SS-1 diluted with one part water to one part emulsified asphalt.

E. Asphalt Cement: Viscosity grade AC-20 conforming to ASTM D3381.

F. Mineral Filler: Rock or slag dust, hydraulic cement, or other inert material complying with ASTM D242.

2.03 ASPHALTIC CONCRETE MIX

A. Surface Course:

1. Materials shall conform to requirements of TDOT Section 411, Grading E.
2. Aggregate: Comply with TDOT, Subsection 903.11. Crushed limestone and natural sand graded as follows:

Sieve Size	Percentage Passing
5/8"	100
1/2"	95-100
3/8	80-93
#4	54-76
#8	35-57
#30	17-29
#50	10-18
#100	3-11
#200	0-8

3. Asphalt Cement Content: 5.3% to 7.0% as determined by approved job mix formula.

B. Base Course

1. Materials shall conform to requirements of TDOT Section 307-BM2.
2. Aggregate: Comply with TDOT, Subsection 903.06.

C. Mixing Plant

1. Provide with suitable means for heating and drying mineral aggregate.
2. Provide thoroughly dry aggregate. Hot aggregate shall then be passed through suitable screen into storage bin. Proportion aggregates from storage bin into weighing box resting upon scales, and after weighing, pass into "Twin Pug" mixer. Heat asphalt cement to temperature of about 275°F, weigh and add to material in mixer.
3. Mix materials until every particle of mineral aggregate is completely coated with asphalt cement, and a thoroughly homogenous mixture achieved. Provide mixing period of at least one minute.
4. Mixture shall have a temperature of from 250°F to 350°F upon reaching pavement areas. Loads failing to meet specified temperature range are subject to rejection.

2.04 TRAFFIC MARKING PAINTING

A. Fast dry waterbourne acrylic alkyd traffic paint. Color shall be white unless indicated otherwise on the plans.

1. Sherwin-Williams Pro-Park
2. Farrell-Calhoun Tuff-Boy Waterbourne Zone Marking
3. Approved Equal

PART 3 – EXECUTION

3.01 SUBBASE PREPARATION

A. After subgrade has been completed as specified, fine grade and roll surface to even uniform texture free of lumps, pockets, soft spots and spongy areas.

B. Proof roll prepared subbase to check for unstable areas and areas requiring additional compaction. Notify Architect of unsatisfactory conditions. Do not begin paving until deficient subbase areas have been corrected.

C. Apply herbicide over entire area to be paved, applying according to manufacturer's printed directions and recommended application rate.

3.02 PRIME COAT

A. Apply at rate of 0.20 to 0.50 gallons per square yard, over compacted gravel base. Apply material to penetrate and seal, but do not flood surface. Cure and dry as necessary to achieve penetration and evaporation of volatile.

3.03 PAVING

A. Place asphalt concrete mixture on prepared surface, spread and strike-off using paving machine.

B. Spread mixture at minimum temperature of 250°F, plus or minus 10°F.

C. Areas inaccessible by machine may be placed by hand.

D. Place each course at thickness so that when compacted it will conform to indicated grade, cross-section, finish thickness, and density specified.

E. Sequence of Placing:

1. Begin placing along centerline of areas to be paved on crowned section, and at high side of sections on one-way slope, and in direction of traffic flow.
2. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips.
3. Place mixture in continuous operation as practicable.

F. Hand Placing:

1. Spread, tamp, and finish mixture using hand tools in areas where machine spreading is not possible.
2. Place mixture at rate that will assure handling and compaction before mixture becomes cooler than acceptable working temperature.

G. Joints:

1. Carefully make joints between old and new pavements, or between successive days' work, to assure continuous bond between adjoining work.
2. Construct joints to have same texture, density and smoothness as adjacent sections of asphalt concrete course.
3. Clean contact surfaces free of sand, dirt, or other objectionable material and apply tack coat.
4. Offset transverse joints in succeeding courses not less than 24".
5. Cut back edge of previously placed course to expose an even, vertical surface for full course thickness.
6. When edges of longitudinal joints are irregular, honeycombed, or inadequately compacted, cut back unsatisfactory sections to expose an even, vertical surface for full course thickness.

3.04 COMPACTING ASPHALTIC CONCRETE

A. Provide enough rollers to obtain required pavement density. Use self-propelled steel-wheeled 10 ton rollers that can reverse directions without backlash.

B. Begin rolling operations as soon after placing when mixture will bear weight of roller without excessive displacement.

C. Do not allow heavy equipment, including rollers to stand on finished surface before it has thoroughly cooled or set.

D. Compact mixture with hot hand tampers or vibrating place compactors in areas inaccessible to rollers.

E. Start rolling longitudinally at extreme lower side of sections and proceed toward center of pavement. Roll to slightly different lengths on alternate roller runs.

F. Do not roll centers of sections first under any circumstances.

G. Breakdown Rolling:

1. Accomplish breakdown or initial rolling immediately following rolling of transverse and longitudinal joints and outside edge.
2. Operate rollers as close as possible to paving machine without causing pavement displacement.
3. Check crown, grade, and smoothness after breakdown rolling.
4. Repair displaced areas by loosening at once with lutes or rakes and filling, if required, with hot loose material before continuing rolling.

H. Second Rolling:

1. Follow breakdown rolling as soon as possible, while mixture is hot and in condition for compaction.
2. Continue second rolling until mixture has been thoroughly compacted.

I. Finish Rolling:

1. Perform finish rolling while mixture is still warm enough for removal of roller marks.
2. Continue rolling until roller marks are eliminated and course has attained specified density.

J. Patching:

1. Remove and replace defective areas.
2. Cut-out and fill with fresh, hot asphalt concrete.
3. Compact by rolling to specified surface density and smoothness.
4. Remove deficient areas for full depth of course.
5. Cut sides perpendicular and parallel to direction of traffic with edges vertical.
6. Apply tack coat to exposed surfaces before placing new asphalt concrete mixture.
7. "Skin Patching" is not allowed.

3.05 TRAFFIC AND LANE MARKINGS

A. Cleaning: Sweep and clean surface to eliminate loose material and dust.

B. Apply paint with mechanical equipment to produce uniform straight edges. Apply at manufacturer's recommended rates. Arrows and letters painted on pavement are to be painted with manual of traffic control devices standard stencils, (reduced in size to 2/3 to 3/4 that required for secondary streets).

3.06 TOLERANCES

A. Surface Course: Finished surface of surface course shall vary not more than 1/4" when tested with a 10 foot straight edge. Compacted thickness shall not vary more than 1/4" from indicated thickness.

B. Average of all thickness tests for each course shall be not less than indicated thickness.

3.07 TESTING

A. Provide the following testing by an independent, qualified testing agency. Comply with requirements of Division 01.

B. During placement of each course, take about 30 pounds of material and make density tests using Marshall method; make one test for each half-day's placement.

C. During placement of final course, take not less than one 4" diameter pavement specimen for each 1000 square yards; extend through each completed course.

D. Determine in place density using a nuclear gage according to ASTM D2950. Provide reading for each 1,000 square yards of each course.

3.08 CLEANING

A. After completion of paving operations, clean surfaces of excess or spilled asphalt materials.

3.09 PROTECTION OF FINISHED WORK

A. After final rolling, do not allow vehicular traffic on asphalt concrete pavement until it has cooled and hardened, and in no case sooner than 6 hours.

B. Provide barricades and warning devices as required to protect pavement and general public.

C. Cover openings of structures in area of paving until permanent coverings are placed.

END OF SECTION

SECTION 32 13 13
CONCRETE PAVING AND CURBS

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents. All work within the public right of way shall conform to City of Memphis Standard Construction Specifications.

1.02 DESCRIPTION

A. This section includes furnishing materials and installation of sidewalks, paving, and curbs and gutters, as indicated on the drawings and/or specified herein.

B. Related work: The following items of related work are specified in other sections.

1. Section 31 00 00 - Earthwork
2. Section 32 12 16 - Asphaltic Concrete Paving
3. Section 03 30 00 - Cast-In-Place Concrete

1.03 QUALITY ASSURANCE

A. Paving on public property shall comply with all laws, rules and regulations of governmental authorities having jurisdiction over such work.

B. Mockups: Cast 5' x 5' mockups of full-size sections of concrete pavement for each finish type to demonstrate typical joints, surface finish, texture, color, and standard of workmanship.

1. Build mockups in the location and of the size indicated or, if not indicated, as directed by Designer.
2. Notify Designer seven days in advance of dates and times when mockups will be constructed.
3. Obtain Designer's approval of mockups before starting construction.
4. Maintain approved mockups during construction in an undisturbed condition as a standard for judging the completed pavement.
5. Demolish and remove approved mockups from the site where directed by Designer.
6. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.04 TESTING SERVICES

A. The testing laboratory to be employed by the Contractor will be responsible for conducting and interpreting test, and shall state in each report whether or not the test specimens conform to all requirements of the Contract Documents and specifically note any deviation therefrom.

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver, handle and store material at the job site in a manner as to prevent damage. Packaged material shall be in original containers with seals unbroken and labels intact until time of use. All damaged or otherwise unsuitable material when so ascertained shall be immediately removed from the job site.

PART 2 - PRODUCTS

2.01 MATERIALS: CONCRETE WALKS, PAVING, AND CURBS

A. Portland Cement: ASTM C150, Type I.

B. Aggregates: All fine and coarse aggregates shall conform to ASTM C33.

1. Fine Aggregates: Natural or artificial, hard clean sand.
2. Coarse Aggregates: Crushed limestone, size number 67.

C. Water: Potable, free from deleterious amounts of acids, alkalies, and organic materials.

D. Air-Entraining Admixture: ASTM C260, "SIKA AER" (Sika Chemical Corp.); "MBAE-10" (Master Builders Co.); "Darex AEA" (W.R. Grace & Co.).

E. Liquid Membrane Curing Compound (100% Resin Type): ASTM C309, Type 1 "Horncure 30C" (W.R. Grace & Co.); "WR-30 Curing Compound" (W.R. Meadows, Inc.); "Clear Bond" (Guardian Chemical Company).

F. Preformed Fiber Joint Filler: ASTM C1751, "Fiber Expansion Joint Filler, Code 1390" (W.R. Grace & Co.); "Fibre Expansion Joint" (W.R. Meadows, Inc.); "Flexcell" (The Celotex Corporation), non-extruding, for expansion joints.

G. Tie Bars: ASTM A615, Grade 60, deformed.

H. Welded Wire Fabric: ASTM A185.

I. Formwork: Rigid steel for straight sections and flexible steel or plywood for curved sections.

J. Concrete Mix: 4,000 lb. class, air entrained, and conforming to requirements of Section 03 30 00.

K. Coarse Aggregate except as noted: Clean, natural, crushed limestone. Coarse Aggregate at washed aggregate finish: Pea gravel.

L. Expansion Joint Material: Bituminous preformed unless otherwise shown on drawings.

M. Fibrous Reinforcing:

1. Synthetic or natural fiber for concrete reinforcement.
2 Use one of the following or equal.
   a. Buckeye Ultra Fiber 500, rate = 1.5 lbs/cubic yard.
   b. Fibermesh 150, rate = 1.5 lbs/cubic yard.

2.03 PROPORTIONING AND MIXING

A. The concrete mix shall be in accordance with Section 03 30 00 of specifications. The concrete mix shall be uniform throughout and shall contain no less than 5 percent nor more than 7 percent entrained air by volume. The slump shall be no more than 4 in.

B. The compressive strength shall be determined in accordance with Standard Method of Making and Curing Concrete Test Specimens in the Laboratory, ASTM C192 and Standard Method of Test for Compressive Strength of Molded Concrete Cylinders, ASTM C39. The minimum 28-day compressive strength shall be 4000 psi.

C. No admixtures, other than those needed to provide air entrainment, shall be added, unless approved by the Owner.

D. All concrete shall be mixed until there is a uniform distribution of the materials and shall be discharged completely before the mixer is recharged. The proportions of aggregate to cement for any concrete shall be such as to produce a mixture which will work readily into the corners and angles of the forms and around reinforcement without segregation of materials or accumulation of excess free water on the surface.

E. Ready-mixed concrete shall be mixed and delivered in accordance with requirements set forth in Specifications for Ready-Mixed Concrete, ASTM C94.

F. The firm supplying ready-mixed concrete will be required to furnish the Owner with copies of all delivery tickets for concrete delivered to the job site. If any water is added to the concrete at time of delivery, the amount added shall be indicated on the delivery ticket and the person authorizing the addition shall sign the ticket.

PART 3 - EXECUTION

3.01 PREPARING SUBGRADE

A. Clear subgrade of all large stones, organic topsoil, sod, wood, and other debris. Remove all mud and soil in spongy areas and replace with approved fill. Fill all holes and other irregularities and compact fill before concrete is placed.

B. Fill material, if required, shall be as approved by the Owner and shall be placed in compacted layers not exceeding 6 in. in depth approximately parallel to the plane of the slab. Fill material shall be thoroughly compacted to at least 95 percent maximum density at optimum moisture, as

determined by ASTM D698, by rolling, vibrating, tamping, or by a combination of these methods. Bulldozers, trucks, etc., shall not be considered suitable compacting equipment.

C. After all trenches have been backfilled and the subgrade and/or fill has been compacted, the surface shall be shaped to conform with the required contours. The subgrade so prepared shall be protected from displacement by equipment movement and other operations.

D. The subgrade shall be in a moist condition at the time of concreting. If necessary, it shall be dampened with water. There shall be no free water on the subgrade nor shall there be muddy or soft spots when concrete is placed.

3.02 FORMS

A. Concrete shall be placed with side forms. Forms may be made of either wood or metal provided they are true as to alignment and are stable when in place. Forms shall be set to the required line and grade and checked with a 10-ft. straight edge just before the concrete is placed. If they vary from the required line and grade, they shall be reset or removed as directed by the Owner.

3.03 PLACING CONCRETE

A. Concrete shall be placed as uniformly as possible on the subgrade in order to minimize the amount of additional spreading. The concrete shall be struck off and consolidated to grade with a vibrating screed or mechanical finishing machine and finished with standard tools and methods. The Contractor is encouraged to vibrate all placed concrete to ensure consolidation and to prevent honeycombs. Hand strike-off methods may be used with the approval of the Owner. Curbs, if integral, shall be constructed simultaneously with the pavement. In no case shall "dryers" be used on the surface of the work. A final uniform texture shall be obtained by brooming.

B. Welded wire fabric, if shown, shall be located at midplane of slabs.

C. Where walks are bounded on each side by lawns or planting, provide slight crown to allow drainage to each side.

D. Where walks are bounded on one side by a curb, provide a 1% slope toward curb.

E. Provide tooled joints at approximately 5 ft. o.c. unless otherwise shown on drawings.

F. Provide expansion joints at approximately 30 ft. o.c. unless otherwise shown on drawings.

3.04 PLACING CONCRETE DURING HOT AND COLD WEATHER

A. During cold weather, equipment and materials shall be provided to maintain a temperature of at least 50 degrees F. in the freshly placed concrete during the curing period. No frozen materials or materials containing snow or ice shall be used in the mix. No dependence shall be placed on salt or other chemicals for the prevention of freezing. No concrete shall be placed on frozen subgrade.

B. During hot weather, suitable precautions shall be taken to avoid drying of the concrete prior to finishing. Windbreaks, sunshades, covering, for sprays, etc. shall be used as required, or directed

by the Owner. Concrete deposited in hot weather shall have a placing temperature not greater than 80 degrees F., and shall be maintained at a temperature not greater than 90 degrees during the curing period.

3.05 CURING

A. The surface of the newly placed concrete shall be wetted if it becomes dry before the curing material is placed. The water shall be applied as a fine spray so that it will not mar or injure the surface. The top and edges of the concrete shall not be unprotected for a period of more than 1/2 hour at the time forms are removed.

B. Curing shall be maintained for at least 7 days and may be accomplished by wetting and covering with wetted burlap, impermeable paper, polyethylene sheeting, or in lieu of wetting and covering, by membrane spray.

3.06 JOINTS

A. All longitudinal and transverse joints shall be straight and perpendicular to the pavement surface. The transverse joint shall be at right angles to the edge of the pavement.

B. All joints, except sawed and pre-molded type, shall be edged with a tool having a maximum radius of 1/8 in.

C. Transverse construction/expansion joints shall be placed whenever the placing of concrete is suspended for more than 30 minutes.

D. Saw joints shall not exceed 15'-0" feet apart each way and shall be to 1/4 the depth of the slab. Sawing shall be done within 24 hours after placing slab.

E. Expansion joints shall be 1/2 in. wide and receive suitable fillers. Expansion joints in the run of the pavement shall receive recessed, non-extruding type fillers and hot or cold applied material specified as part of the paving work. Expansion joints at abutting construction, if so indicated, shall receive recessed non-extruding fillers as part of the paving work and elastomeric sealant by others.

3.07 CONCRETE CURBS AND GUTTERS

A. Construct concrete curbs and gutters with control joints at ten feet maximum spacing. Concrete to be either extruded or poured with fixed forms.

B. Provide 1/2 inch expansion joints, with pre-molded filler cut to shape of cross section at ends of all returns and not more than 30 foot intervals.

C. Tamp and screed concrete as soon as placed. Remove face forms as soon as practicable; fill and honey-combed places with 1:2 mortar and give exposed surfaces a smooth wood float finish, without plastering.

D. Remove no forms, except face forms, for 24 hours after placing concrete. Protect against pedestrian traffic for three (3) days and against vehicular traffic for 14 days. Compact thoroughly and backfill behind curb.

E. Finish on concrete curbs shall match and blend in with finish on existing concrete curbs. After placement of concrete lightly tamp with proper tools to provide sufficient mortar to trowel; screed to bring to the level and shape shown on the drawings. While the concrete is still green, it shall be given a light broom finish. Cure concrete in accordance with Section 03 30 00.

3.08 BACKFILLING

A. After the concrete has been cured, the spaces along the edges of the pavement shall be backfilled to the required elevation with material approved by the Owner. The material shall then be compacted until firm, and the surface neatly graded.

3.09 INSPECTION AND TESTS

A. Testing Laboratory shall make the following inspections and tests:

1. Test materials for compliance, or review available test reports.
2. Inspect batch plant, batching, mixing and discharge concrete meeting specified requirements.
3. Verify Contractor's mix designs.

4. Perform tests on placed concrete in accordance with ACE 301-72 (Revised 1975) and the following:
   a. Perform compression strength test for each 25 cu. yds. of concrete, or fraction thereof, on specimens taken at point of discharge from the truck immediately before placing. Make a minimum of one strength test for concrete placed in one day. A set of specimens for a test shall consist of four standard 6 x 12 cylinders. Test two cylinders at 7 days and two cylinders at 28 days. The set of cylinders shall be picked up 24 hours after casting and shall be delivered to testing laboratory for further curing and for testing.
   b. Three additional concrete cylinders shall be made during a placement which requires temporary heating. These cylinders shall be left in the enclosure in same environment as concrete placed. One cylinder shall be tested at 3 days, one at 7 days and the third at 28 days to verify adequacy of temporary heating system.
   c. Perform slump tests in accordance with ASTM C143. Furnish slump cone at the site. Perform a minimum of one slump test for each strength test.
   d. Test of air content in accordance with ASTM C173, or ASTM C231. Furnish and maintain equipment for testing air content at the site. Perform a minimum of one air content test for each strength test.

B. If, in the opinion of the Designer, foregoing tests indicate concrete strengths below those required, or visual defects indicate concrete of poor quality has been placed, additional tests shall be made and reported as directed by the Designer at the expense of the Contractor.

3.10 FINISHING CONCRETE WALKS AND PAVING

A. Cure concrete walks in accordance with requirements of Section 03 30 00.

B. Broom Finish:

1. The broom shall be drawn from side to side on one continuous stroke with adjacent strokes slightly overlapping. Where distance will not permit a continuous stroke, the broom shall be drawn from the center to the edge.
2. Execute brooming operation so that corrugations produced in the surface will be uniform in appearance and not more than 1/16 inch in depth. At ramps provide a coarse surface not more than 1/8" in depth.
3. Complete brooming before concrete is in such condition that the surface will be torn or unduly roughened.

3.11 OPENING TO TRAFFIC

A. The concrete pavement shall be closed to vehicular traffic for a period of fourteen (14) days after the concrete is placed or until compressive strengths of field cured specimens average 2,500 psi.

END OF SECTION

SECTION 32 16 13
DRAINAGE APPURTENANCES

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.02 DESCRIPTION

A. This Section included furnishing materials and labor for the drainage system work covered in this Section and shown on the drawings including new inlets and connection to existing storm drainage pipes.

B. Related Work: The following items of related work are specified in other Sections:

1. Section 31 00 00 - Earthwork
2. Section 33 40 00 - Storm Drainage System

1.03 QUALITY ASSURANCE

A. Applicable Standards: Conform to the following standards:

American Society for Structural Steel with 36000 PSI Yield Testing and Materials (ASTM) Publications:

A36	Class 35 Gray Iron.
A536	Grade 65-45-12 Ductile Iron.
C32-73 (79)	Sewer and Manhole Brick (Made From Clay or Shale).
C139-73 (79)	Concrete Masonry Units for Construction of Catch Basins and Manholes.
C144-81	Aggregate for Masonry Mortar.
C150-83A	Cement, Portland.
C207-79	Hydrated Lime for Masonry Purposes.
C270-82	Mortar for Unit Masonry.
C478-82	Precast Reinforced Concrete Manhole Sections.

1.04 SUBMITTALS

A. Shop Drawings: Shop drawings shall be submitted for the following:

1. Metal work.
2. Reinforcing for Concrete Structures.

B. Manufacturer's Data: Manufacturer's standard drawings or catalog cuts for manhole and catch basin frame, cover, and grating.

C. Certified Test Reports: Certified test reports in triplicate are required for the following:

1. Concrete masonry units.
2. Brick.
3. Aggregates.
4. Masonry cement.
5. Cast-iron frames, covers, and gratings.

1.05 DELIVERY AND STORAGE

A. Cement and Lime: Cement and lime shall be stored immediately upon receipt at the site of the work. Cement and lime in bags shall be stored in a suitable waterproof structure which shall be as air-tight as practicable; floors shall be elevated above the ground a distance sufficient to prevent the absorption of moisture. Bags shall be stacked close together to reduce circulation of air, but shall not be stacked against outside walls; the manner of storage shall permit easy access for inspection and identification of each shipment. Bulk cement and lime shall be transferred to elevated air-tight and weatherproof bins. At the time of use, all cement and lime shall be free-flowing and free of lumps. Cement or lime that has been in storage longer than 6 months will be tested by standard mortar tests or other tests as deemed necessary by the Government to determine its suitability for use, and such cement or lime shall not be used without the approval of the Designer.

B. Brick, Concrete Masonry Units and Precast Concrete Manholes: Brick masonry units, and precast concrete manholes shall be handled with care to avoid chipping and breakage, and shall be stored as directed by the Designer or his authorized representative. Masonry materials and precast concrete shall be protected from contact with the earth and exposure to the weather, and shall be kept dry until used. Masonry units or precast concrete containing frost or ice shall not be used.

C. Metal Items: Metal items shall be checked upon arrival and identified and segregated as to types, functions, and sizes. They shall be stored in a manner which will afford ready accessibility and not cause excessive rusting or coating with grease or other objectionable materials.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Materials: Materials shall conform to the respective specifications and the other requirements specified below.

1. Concrete Materials: Concrete materials shall be as specified in Section entitled "Cast-in-Place Concrete".
2. Precast Concrete Manhole Sections: ASTM C478.

3. Masonry Materials:
   a. Brick: ASTM C32, Grade MS.
   b. Concrete Masonry Units: ASTM C139.
   c. Portland Cement: ASTM C150, Type I or Type II.
   d. Aggregate for Masonry Mortar: ASTM C144.
   e. Hydrated Lime: ASTM C207, Type S.
   f. Water: Water for masonry mortar shall be fresh, clean, and potable.

4. Metals:
   a. Frames, Covers, and Gratings: Frames, covers, and gratings, shall conform to ASTM A48 or ASTM-A536 and shall be of cast iron; figure numbers shall be as shown on drawings.
   b. Manhole Steps: Manhole steps shall be of cast iron. Aluminum steps or rungs will not be permitted. Steps Are not required in manholes, or inlets less than 4 feet deep.
   c. Sidewalk drain tops to be constructed with embossed surface non-slip top plates that are reinforced with steel channels, and bearing on embedded steel angles with stud anchors, as detailed on drawings. All steel elements to be hot dip galvanized after fabrication with a minimum of G120 coating.

PART 3 - EXECUTION

3.01 CONCRETE CONSTRUCTION

A. Cast-in-place concrete is included in Section 03 30 00 Cast-in-Place Concrete.

3.02 MASONRY WORK

A. Mortar for Masonry: Mortar for brick masonry, concrete unit masonry, rubble stone masonry, and for bedding cast iron frames in masonry shall be type M, consisting of one part portland cement, 1/4 part lime paste, and 3 to 3-1/4 parts sand, conforming to ASTM C270.

B. Mortar for Parging Masonry Walls: Mortar for parging masonry walls below grade shall be mixed in the proportions of one part portland cement, 1/4 part hydrated lime and three parts sand. Parging shall be done on both inside and outside of walls of drainage structures.

C. Brickwork: Walls shall be constructed in horizontal courses, with vertical joints broken. Bricks shall be laid in mortar and all joints shall be filled completely with mortar. Brickwork around pipe inlets and outlets shall be built neatly, using sufficient mortar to seal the pipe tightly in the wall.

D. Concrete Unit Masonry: Walls shall be constructed in horizontal courses, with vertical joints broken. Units shall be laid in mortar and all joints shall be filled completely with mortar. Work around pipe inlets and outlets shall be built neatly, using sufficient mortar to seal the pipe tightly in the wall.

3.03 METAL WORK

A. Workmanship and Finish: Workmanship and finish shall be equal to the best practice in modern structural shops and foundries. Iron shall be formed to shape and size with sharp lines and angles.

Castings shall be sound and free from warp, cold shuts, and blow holes that may impair their strength or appearance. Exposed surfaces shall have a smooth finish and sharp well-defined lines and arieses. The necessary rabbets, lugs, and brackets shall be provided.

3.04 FIELD TESTS

A. All work shall be provided to be in first class condition and constructed properly in accordance with the drawings and specifications. All defects shall be corrected.

END OF SECTION

SECTION 32 90 00
TREES, PLANTS AND GROUNDCOVER

PART 1 - GENERAL

1.01 DESCRIPTION

A. Provide and furnish all trees, plants, groundcovers, labor, miscellaneous materials and equipment required or inferred from drawings and specifications to complete the work of this section.

1.02 RELATED SECTIONS

A. Related sections include the following:
   1. Section 01 40 00 – Quality Requirements
   2. Section 01 60 00 – Product Requirements
   3. Section 01 70 00 – Execution Requirements

1.03 DEFINITIONS

A. Weeds: Includes Dandelion, Jimsonweed, Quackgrass, Horsetail, Morning Glory, Rush Grass, Mustard, Lambsquarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Nutgrass, Poison Oak, Blackberry, Tansy ragwort, Johnson grass, Poison Ivy, Nut Sedge, Nimble Will, Bindweed, Bent Grass, Wild Garlic, Perennial Sorrel, Brome Grass and depending upon situation and location Bermuda grass.

B. Plants: Living trees, plants and groundcover specified in this Section and described in ANSI Z60.1-2004.

C. Nomenclature: Plant names used in plant material schedule will conform to "Standardized Plant Names" by American Joint Committee on Horticultural Nomenclature.

1.04 QUALITY ASSURANCE

A. Nursery: Company specializing in growing and cultivating the plants specified in this Section with minimum three (3) years documented experience.

B. Contractor (Installer): Company specializing in installing plant materials specified in this Section with minimum three (3) years documented experience.

C. Standards: Comply with American Standard for Nursery Stock as published by the American Nursery and Landscape Association. No inspection or sealing of plant materials, herein specified, shall change or modify the requirements in any way. Should it be necessary to make substitutions, submit a letter to the Owner and Landscape Architect stating reason and any difference in price resulting from such substitutions.

D. All plants shall be grown in a recognized nursery in accordance with good horticultural practice. Provide healthy stock free of disease, insects, eggs, larvae and defects such as knots, sun scald injuries, abrasions or disfigurement.

E. Approval and Selection of Materials and Work: The selection of all materials and the execution of all operations required under the specifications and drawings are subject to the approval of the Landscape Architect. The Landscape Architect has the right to reject any and all materials and any and all work which, in the opinion of the Landscape Architect, does not meet the requirements of the Contract documents at any stage of the operations. The Contractor (Installer) shall remove rejected work and/or materials from job site and replace promptly.

1.05 SUBMITTALS

A. Soil tests, per 3.1

B. Product submittals

1.06 REGULATORY REQUIREMENT

A. Comply with regulatory requirements for fertilizer, herbicide and pesticide composition and application.

B. Plant materials: Certified by federal and state department of agriculture, free of disease or hazardous insects.

1.07 ENVIRONMENTAL REQUIREMENTS

A. Do not install plant life when ambient temperatures may drop below thirty-five (35) degrees F or rise above ninety (90) degrees F.

B. Do not install plants when wind velocity exceeds thirty (30) mph.

1.08 DELIVERY, STORAGE AND HANDLING

A. Deliver products to site under provisions of Section 01 60 00 - Product Requirements.

B. Store and protect products under provisions of Section 01 60 00 - Product Requirements.

C. Deliver fertilizer in original, unopened, waterproof containers showing weight, manufacturer's guaranteed chemical analysis, and name of manufacturer.

D. Store fertilizer in such a manner that will keep it dry.

E. Handle all plants so that roots are adequately protected at all times. During shipment, protect the entire plant with tarpaulins or other suitable covering. Plant material suffering from wind burn or other wind damage is not acceptable.

F. Plants designated “B&B” in the plant material schedule shall be balled and burlapped. They shall be dug with firm, natural balls of earth of sufficient diameter and depth to encompass the fibrous and feeding root system necessary for full recovery of the plant. Root balls shall be firmly wrapped with hemp burlap or similar material and bound with twine or cord.

G. Root balls shall have a minimum diameter in feet equal to ten inches (10”) per caliper inch of the tree to be transplanted.

H. No material required to be balled and burlapped shall be accepted if the root ball is cracked or broken (either before or during the process of planting) or if burlap, staves, ropes or platform have been removed.

I. The root balls of balled and burlapped plants which cannot be planted immediately upon delivery shall be covered with moist soil or mulch, or other protection from drying winds and sun. Contractor (Installer) shall water all plants, as necessary, until planting.

J. No plant shall be bound with wire or rope at any time so as to damage the bark, break branches or disfigure/destroy its natural shape.

K. Do not remove container grown stock from containers until planting time.

L. Label at least one (1) tree, plant and groundcover of each variety with a waterproof tag bearing legible designation of botanical and common name either securely attached or installed adjacent to plant.

M. Do not remove labels attached to plant material until directed to do so by the Landscape Architect.

1.09 SEQUENCING AND SCHEDULING

A. If underground irrigation system is to be installed, coordinate the work of this Section with installation of underground irrigation system.

B. If underground irrigation system is to be installed, coordinate all work with irrigation subcontractor as required. Locate, protect and maintain the irrigation system during planting operations. Repair irrigation system components damaged during planting operations at the Contractor’s (Installer’s) expense.

C. Coordinate the work of this Section with the installation of all underground utilities.

1.10 OPERATION AND MAINTENANCE DATA

A. Submit instructions for continuing Owner maintenance under provision of Section 01 70 00 - Execution Requirements.

B. Contractor (Installer) to prepare and provide project specific information on operation and maintenance including cutting and trimming methods; types, application frequency and recommended coverage of fertilizer, herbicide and pesticide applications for a preventive maintenance program.

1.11 WARRANTY

A. Contractor (Installer) shall provide a warranty on the work of this Section for a minimum of one (1) year, including one (1) continuous growing season. Warranty shall commence on date of the final acceptance.

B. Warranty: Includes coverage of plants from death, unhealthy conditions and unsatisfactory growth characteristics in the opinion of the Landscape Architect. Contractor (Installer) shall provide supplemental watering during the one (1) year warranty period as necessary for vigorous plant health.

C. Contractor (Installer) to monitor and fill treegator watering system during the one (1) year warranty period to insure appropriate water amounts for plant material. See recommended water amounts 3.5 Planting.

D. Replacements: Plants of same size and species as specified.

E. Remove and immediately replace all plants as determined by the Landscape Architect to be unsatisfactory during the initial planting installation and through one (1) year warranty period.

F. Repair grades, lawn areas, paving and any other site damage resulting from replacement planting operations at no additional cost to the Owner.

G. Inspect job site monthly during warranty period to determine what changes, if any, should be made in the maintenance program. Submit all recommended changes in writing to the Landscape Architect and the Owner. In the absence of monthly written reports from the Contractor (Installer), it shall be assumed that the Contractor (Installer) is satisfied with the Owner's maintenance operations and procedures and waives any and all claims for damage against the Owner with respect to the warranty requirements of this specification section.

H. At the close of the warranty period (one (1) year after final acceptance) notify the Owner and Landscape Architect in writing of the date for Warranty Inspection. Make any repairs and/or replacements indentified by the Landscape Architect in the Warranty Inspection.

I. Upon satisfactory completion of repairs and/or replacements the Landscape Architect shall certify, in writing, the final acceptance of the work.

PART 2 - PRODUCTS

2.01 TOPSOIL

A. Topsoil: free of weeds, rocks, trash, vegetation and/or debris.

2.02 SOIL AMENDMENTS

A. Fertilizer: The nitrogen content shall be derived from a minimum fifty percent (50%) organic matter. Fertilizer for trees, shrubs and groundcover areas shall be a slow release type.

B. Pro Mix: Sandy loam, pine fines, mulch fines, compost and sand.

C. Bone Meal: Raw, finely ground, commercial grade, minimum of three percent (3%) nitrogen and twenty (20%) percent phosphorus.

D. Lime: Ground limestone, dolomite type with minimum ninety-five percent (95%) carbonates. Ground to such fineness that the residue on #30 and #200 sieves is not more than five-one hundredths of a percent (.05%) and fifteen percent (15%) respectively.

E. Water: Clean, fresh and free of substances or matter which could inhibit vigorous growth of plants.

2.03 MULCH MATERIALS

A. Mulching Material: Mulch shall consist of partially decomposed hardwood or approved substitute and shall be of sufficient character as not to be displaced by wind or water runoff.

B. All mulch beds shall be excavated to receive a minimum three inch (3") deep layer of mulch.

2.04 PLANT MATERIALS

A. General:
1. Plant material Schedule: A list of plants included on the construction drawings.
2. A complete plant material schedule including schedule of sizes, quantities and other requirements is shown on the construction drawings. Dimensions for height, spread and trunk caliper, as specified on the plant material schedule, are the minimum required size of each plant. In the event that quantity discrepancies or material omissions occur in the plant materials schedule, the planting plan shall govern.
3. Specific requirements concerning plant material and the manner in which it is to be supplied are shown on the drawings and plant material schedule.
4. Trees, Plants and Groundcover: Species and size identifiable in plant material schedule and grown in climate conditions similar to those in locality of the project site.
5. Substitutions: Do not make substitutions without prior Owner and Landscape Architect approval. Should it be necessary to make substitutions, submit a letter to the Owner and Landscape Architect stating reason and any difference in price resulting from such substitutions. Written authorization from Owner and Landscape Architect is required prior to proceeding with substitutions.

B. Quality and Size:

1. Plants shall have a habit of growth that is normal for a well maintained specimen of the species and shall be sound, healthy, vigorous and free from insects, pests, plant disease, and injuries.
2. Plants to be selected for specific branching habit where a range of habit occurs within a species shall be furnished thickly branched as noted on the plant material schedule.
3. All plants shall equal or exceed the measurements specified in the plant material schedule, which are minimum acceptable sizes. Plants shall be measured before pruning with branches in normal position.
4. Each tree or shrub shall be pruned at the discretion of or as directed by Landscape Architect, and in accordance with standard horticultural practice, to preserve the natural character of the plant, but in no case shall the plants supplied under this contract be pruned back to such an extent that they no longer meet specifications.
5. Remove or cut back broken, dead, damaged, sucker growth and unsymmetrical growth of new wood as directed by the Landscape Architect.
6. Requirements of plants in the plant material schedule generally follow the code of standards currently recommended by the American Nursery and Landscape Association in the American Standard of Nursery Stock.

C. Trees:
1. Provide trees of height and caliper listed or shown and with branching configuration recommended by ANSI Z60.1-2004 for type and species required. Provide single stem trees except where special forms are shown or listed on the construction drawings.

D. Shrubs:
1. The measurements for height shall be taken from the ground level to the average height of the top of the plant and not the longest branch. Single stemmed or thin plants will not be acceptable.
2. Side branches shall be generous, well-twigged, and the plant as a whole well-bushed to the ground.

E. Groundcover:
1. Provide good groundcover plants established and well-rooted in removable containers or integral peat pots and with not less than minimum number and length of runners as specified by ANSI Z60.1-2004 for the pot size shown and as listed in plant material schedule.

F. Perennials:
1. Provide perennial bulbs, corns and tubers which are fleshy and free of rot and not less than the grade and size recommended by ANSI Z60.1-2004 for the size shown or listed.
2. Provide good perennials in either a dormant condition or actively growing. Actively growing perennials shall be furnished rooted in removable containers or field dug. Field dug perennials shall be in a moist, vigorous condition with no sign of desiccation.

2.05 ACCESSORIES

A. Wrapping Materials: Use only “hemp” burlap and twine. Do not use preserved burlap or twine. Remove all hemp twine attached to the tree trunk after planting. Remove all burlap and twine from the top one-third (1/3) of the root ball after planting.

B. Stakes: Contractor (Installer) shall plumb trees as specified, as necessary through the warranty period. Use green or black metal T posts for stakes.

C. Cable and Wire: shall be non-corrosive and of sufficient strength to withstand wind pressure and resultant movement of plant life. Minimum wire size is ten (10) gauge. No direct contact with plant will be permitted.

D. Plant Protectors: shall be rubber sleeves over cable to protect plant stems, trunks, and branches. A minimum three-quarter inch (3/4”) diameter two (2)–ply garden hose (green or black only).

E. Pre-emergent herbicide: (TREFLAN or approved equal) Apply at rates, times and manner recommended by the manufacturer.

F. Duckbill Root Ball Kit: Stake trees as indicated on plans with Duckbill Root Ball Kit.

G. Treegator: Installer shall provide one (1) treegator, single bag per tree www.treegator.com

H. Soil Moist: Installer shall provide Soil Moist as directed per the plans and in accordance with manufacturer recommendations.

PART 3 - EXECUTION

3.01 TESTS

A. Provide analysis of topsoil under provisions of Section 01 40 00 – Quality Requirements.

B. Perform soil testing prior to installation of specified material.

C. Collect soil samples at locations as identified on plans. If specific soil test locations are not indicated on plans the contractor is to provide a site plan markup indicating soil sample locations for submission and approval by Landscape Architect prior to collection and testing.

D. Collect one to one and a half cups of soil. Approved tools include; spade or shovel, soil sampling tube, or soil auger. Sample tubes or augers should either be stainless steel or chrome plated.

E. The soil sample should be obtained from three (3) areas at the specified test location. Mix cores or slices together in a clean plastic container and take enough subsample to fill the soil sample bag provided by the laboratory.

F. When sampling, scrape away any plant residue and sample to six inches (6”)

G. The soil test report should provide the following data: soil ph, phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), sulfur (S), boron (B), copper (Cu), iron (Fe), manganese (Mn), zinc (Z) and organic matter .

H. Provide test results to Landscape Architect.

I. Recommended ranges - Soil ph 6.0 to 8.0, phosphorous (P) 20-40 ppm, potassium (K) 150-250 ppm, calcium (Ca) to magnesium (Mg) ratio between 5:1 and 8:1, magnesium (Mg) 30-70 ppm, sulfur (S) 12-25 ppm, boron (B) 0.9-1.5 ppm, copper (Cu) 0.9-1.2 ppm, iron (Fe) 100-200 ppm, manganese (Mn) 40-60 ppm, zinc (Z) 3.1-20 ppm, organic matter 5%

J. Soils not meeting the requirements are to be amended and re tested every six weeks until satisfactory ranges are achieved.

3.02 EXAMINATION

A. Verify that prepared subsoil is ready to receive work of this Section.

B. Notify Landscape Architect immediately of all unsatisfactory drainage or soil conditions. Obtain approval of method of correction from Landscape Architect before continuing the affected portion of the work. Alternate plant locations may be selected by Landscape Architect. Contractor (Installer) to prepare such alternate plant pits at no additional cost to the Owner.

C. Prior to the excavation of plant pits and driving or placing of stakes or deadmen, Contractor (Installer) shall locate all electric cables, conduits, utility lines, etc. and take proper precautions to prevent damage to such subsurface improvements. In the event that any utilities are disturbed, The Contractor (Installer) shall promptly notify the project manager. For line locations call 811 or visit www.call811.com.

D. Contractor (Installer) shall ensure percolation of all planting pits prior to installation.

E. Contractor (Installer) shall verify that required underground utilities are available, in the proper location and ready for use.

F. In areas where beds are to be created or trees installed in existing turf, turf is to be removed prior to construction of the bed or excavation of the tree pit.

G. Beginning installation means acceptance of existing conditions.

3.03 PREPARATION OF SUBSOIL

A. Prepare subsoil to eliminate uneven areas. Maintain profiles and contours. Make changes in grade gradual. Blend slopes into level areas.

B. Remove foreign materials, weeds and undesirable plants and their roots; remove contaminated subsoil.

C. All planting beds are to be roto-tilled to a minimum of twelve inches (12") deep. Amend existing soil with a composted organic matter to bring the organic content of the soil to a five percent (5%) dry weight.

D. Perform soil test at all planting areas to determine if the proper soil pH is present. Amend the soil as needed based on results of soil testing.

3.04 FERTILIZING

A. Apply fertilizer in accordance with manufacturer's instructions.

Trees and Shrubs	Rate of Application
March – May: 10-10-10	Trees – one pound (1 lb.) per inch in caliper
May – October: 6-10-10	Shrubs – one half pound (1/2 lb.) per foot in height
October – March: 6-12-12	

B. Apply after initial raking of topsoil.

C. Mix thoroughly into upper three inches (3") of topsoil.

D. Lightly water to aid the dispersion of fertilizer.

3.05 PLANTING

A. All plantings to remain three feet (3') clear of any fire hydrant. Fire hydrants to have a six foot (6') diameter clear area. Contractor (Installer) to notify Landscape Architect of any proposed plantings which conflict with this six foot (6') diameter clear area. Proposed plantings will be adjusted as required.

B. Any series of trees or shrubs to be placed in a particular arrangement will be field checked for accuracy by the Landscape Architect. Relocate any plants incorrectly arranged as directed by the Landscape Architect.

C. Set plants vertical.

D. Remove non-biodegradable root containers.

E. Set plants in pits or beds, partly filled with prepared topsoil mixture. Remove burlap, ropes and wires from the top one-third (1/3) of root ball. Backfill as specified.

F. Pre-emergent herbicide (Treflan or approved equal) shall be applied (in accordance with the manufacturer's instructions) to all plant beds prior to planting, for noxious weed control.

G. Installer shall provide one (1) treegator, single bag, per tree. Install per manufacturer's recommendation, two (2) fills, per bag, per week as recommended by the manufacturer for 2 to 5 inch caliper trees. Adjust rate as needed, per manufacturers recommendations for trees of differing sizes.

H. Soil Moist:

1. Contractor shall use Soil Moist polymer granular for planting beds and large coverage areas only.
2. Contractor shall use two inches (2") Soil Moist disks for tree and shrub planting pits only.
3. Soil Moist shall be incorporated into all planting areas.
4. Soil Moist shall not be used for sodded or seeded areas.
5. Soil Moist must be incorporated into the soil at the root-level of the plant.
6. Contractor shall not top dress or place Soil Moist on the surface.
7. Soil Moist shall be introduced per specified application rates only.
8. Contractor shall mix one-half of amount around planting area and mix the remainder into the backfill. Do not amend the top two inches (2") of backfill.
9. Contractor shall use two pounds (2 LB.) of Soil Moist per cubic yard of soil for bulk mixing. Do not amend the top two inches (2") of backfill.
10. Contractor shall use bulk mixing instructions for planting masses and large coverage areas only.
11. Contractor may apply a maximum of one pound (1LB.) of Soil Moist per 100 sq. ft. of coverage area.
12. Contractor may use two inches (2") Soil Moist disks for tree and shrub applications only. One inch (1") Soil Moist disks may only be used in small containers.
13. Contractors shall place one (1) or two (2) soil most disks per each caliper inch on trees and shrubs. A maximum of three (3) disks may be used for heavy feeders.
14. Contractor shall place Soil Moist disks at base of planting pit, place plant and fill with backfill. Do not amend the top two inches (2") of backfill.
15. Contractors shall only use Soil Moist in accordance with application rate specifications provided by KWA or JRM Chemical.
16. Contractor shall liberally water all plant materials after installation to activate Soil Moist.
17. Product shall meet JRM Chemical Technical Specifications as follows;
    Shall be a cross linked polyacrylamide polymer with a potassium salt base that has a minimum of 99.5% active material. Polymer shall be able to hold 200 times its weight in tap water rated at 160mg of Naci per liter of water, with a ph of 6.0-7.0 Grade size shall be 1000-2000 in micron size, as manufactured by JRM Chemical, Inc. of Cleveland, Ohio, 800-962-4010 or equal (submittal of detail composition required.).
18. B & B Application Rate

Caliper Size	Average Amount (Granular)	Sandy Soils (Granular)	Average Amount (2"disk)
1"	2 oz.	3 oz.	2
2"	4 oz.	6 oz.	4
3"	6 oz.	9 oz.	6
4'	8 oz.	12 oz.	8

Balled and Burlapped		Soil Moist
Caliper Size	Average Amount	Sandy Soils

1”	2 oz.	3 oz.
2”	4 oz.	6 oz.
3”	6 oz.	9 oz.
4’	8 oz.	12 oz.

Boxed Trees

Caliper Size	Average Amount
24”	7.oz.
36”	14 oz
48”	18 oz.

3.06 EXCAVATING AND BACKFILLING

A. Excavating: Excavate pits circular in outline with vertical sides and to dimensions as indicated. Increase depth as much as necessary to accommodate the root ball and topsoil mixture. Excavate pits and set root ball or roots so that they rest on compacted subsoil base when plant is properly set to finished grade. Dispose of excess earth on site, in area designated by Landscape Architect.

B. Tree or Shrub Sizes: Minimum diameter (width) and depth of planting pits for balled and burlapped and container grown plants shall be as follows:
   1. Diameter – Two (2) times the diameter of ball or spread of roots.
   2. Depth – As necessary to assure root crown is two inches (2”) above adjacent finished grade. (Trees as well as large, heavy shrubs shall sit directly on pit bottom to prevent settlement).

C. Backfilling: When the pit has been excavated, amend existing soil with a composted organic matter to bring the organic content of the backfill to a five percent (5%) dry weight then backfill as specified in the typical installation details shown on the construction drawings. When planting pits have been backfilled approximately two-thirds (2/3) full, water thoroughly, then install the remainder of soil. Eliminate all air pockets.

3.07 PLANT SUPPORT

A. Brace plants vertically as specified on drawings with plant protector wrapped guy wires and stakes to the following specifications:

Tree Caliper	Tree Support Method
One to two inches (1”-2”)	Two (2) stakes with two (2) ties
Two to four inches (2”-4”)	Three (3) stakes with three (3) ties
Over four inches (4”+)	Four (4) stakes with four (4) ties

B. Stakes to be driven a 2’ depth minimum into undisturbed soil. Top of stake to be 4’ above grade

C. Brace plants vertically as specified on drawings with Duckbill Root ball Kits as indicated on plans to the following specifications:

Tree Caliper	Tree Support Method
Up to two inches (2”)	40 RBK kit
Up to three inches (3”)	68 RBK kit
Up to six inches (6”)	88 RBK kit

D. See plant notes and details on plans for further plant support information.

E. All above grade plant supports shall be removed immediately prior to the end of the warranty period.

3.08 MAINTENANCE SERVICE

A. Maintenance services: Performed by Contractor (Installer).

B. Maintenance shall commence when each plant is planted and shall continue until final acceptance.

C. Maintain planting by watering, filling gator bags, removing dead branches, resetting plants to proper grades or upright position, tightening and repairing of guys, furnishing and applying such sprays and invigorants as are necessary to keep the planting free of weeds, insects and disease and in thriving condition.

D. Replace any plants deemed unacceptable by the Landscape Architect during the maintenance period at no cost to the Owner.

3.09 INSPECTION AND ACCEPTANCE

A. Field inspection will be performed under provisions of Section 01 40 00 – Quality Requirements.

B. Upon completion of work, notify Landscape Architect at least ten (10) working days prior to requested date of inspection. Where inspected landscape work does not comply with requirements, replace rejected work and continue specified maintenance until work is re-inspected by Landscape Architect and found to be acceptable. Remove rejected plants and materials promptly from project site.

C. Upon satisfactory completion of repairs and/or replacements, the Landscape Architect shall certify, in writing, the acceptance of the work in total.

D. The one (1) year warranty period begins on the date of the final acceptance.

END OF SECTION

SECTION 32 92 00
LAWNS AND GRASSES

PART 1 - GENERAL

1.01 DESCRIPTION

A. Provide sodded lawn areas as shown and/or specified on the drawings. The work includes:
   1. Soil preparation.
   2. Sodding lawns and other indicated areas.
   3. Maintenance.

1.02 RELATED SECTIONS

A. Related sections include the following:
   1. Section 01 40 00 – Quality Requirements

1.03 DEFINITIONS

A. Weeds: Includes Dandelion, Jimsonweed, Quackgrass, Horsetail, Morning Glory, Rush Grass, Mustard, Lambsquarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Nutgrass, Poison Oak, Blackberry, Tansy ragwort, Johnson grass, Poison Ivy, Nut Sedge, Nimble Will, Bindweed, Bent Grass, Wild Garlic, Perennial Sorrel, Brome Grass and depending upon situation and location Bermuda grass.

1.04 QUALITY ASSURANCE

A. Sod: Comply with American Sod Producers Association (ASPA) classes of sod materials.

B. Sod Producer: Company specializing in sod production and harvesting with minimum five (5) years documented experience, and certified by the State of where the project is located.

C. Sod: Type specified on drawings with a minimum of six (6) months of root development that will support its own weight, without tearing, when suspended vertically by holding the upper two (2) corners.

D. Submit sod certificate to Owner and Landscape Architect for grass species and location of sod source.

1.05 SUBMITTALS

A. Soil test, per 3.1

1.06 REGULATORY REQUIREMENTS

A. Comply with regulatory agencies for fertilizer, pesticide and herbicide composition and application.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver sod on pallets. Protect exposed roots from dehydration.

B. Lay sod as soon as it is delivered to planting areas. Lay only healthy, moist, green sod. Any sod which is brown and under stress is unacceptable. Any sod which is not laid within twenty four (24) hours of delivery is unacceptable.

C. Deliver fertilizer in original, unopened, waterproof containers showing weight, manufacturer's guaranteed chemical analysis and name of manufacturer.

D. Store fertilizer in a manner that prevents wetting and deterioration.

1.08 MAINTENANCE SERVICE

A. Maintenance services: Performed by Contractor (Installer).

B. Maintenance shall commence when specified areas have been sodded and shall continue until final acceptance.

C. Maintain sodded lawn areas, including watering, spot weeding, mowing, application of herbicides, fungicides, insecticides and resodding until a full, uniform stand of grass free of weeds, undesirable grass species, disease and insects is achieved and is accepted by the Landscape Architect.

D. Replace any unacceptable sodded areas during the maintenance period at no cost to the Owner.

1.09 MAINTENANCE DURING CONSTRUCTION

A. Maintain sodded areas immediately after placement and assure grass is well established and exhibits a vigorous growing condition.

B. After grass growth has started all areas or parts of areas which fail to show a uniform stand of grass, for any reason whatsoever, shall be resodded in accordance with the plans and as specified herein. Such areas and parts of areas shall be resodded repeatedly until all areas are covered with a satisfactory growth of grass at no additional cost to the Owner.

C. Water for the execution and maintenance of this work shall be provided by the Owner at no expense to the Contractor (Installer). The Contractor (Installer) shall furnish his own portable tank, pumps, hoses, pipes, connections, nozzles, and any other equipment required to transport the water from the available outlets and apply it to the sodded areas in an approved manner.

D. When the amount of grass is heavy, it shall be removed to prevent destruction of the underlying turf. If weeds or other undesirable vegetation threatens to smother the planted species, such vegetation shall be mowed or in the case of rank growths, shall be uprooted, raked and removed from the area by methods approved by the Landscape Architect.

E. Protect grassed areas against trespassing while the grass is becoming established. Furnish and install fences, signs, barriers or any other necessary temporary protective devices. Damage resulting from trespass, erosion, washout, settlement or other causes shall be repaired by the Contractor (Installer) at no additional cost to the Owner.

F. Remove all fences, signs, barriers or other temporary protective devices promptly after final acceptance.

PART 2 - PRODUCTS

2.01 SOD MATERIALS

A. Sod: Type as specified on drawings, certified grade, cultivated grass sod; Species per plan with strong fibrous root system, free of stones, burned or bare spots, and weeds.

2.02 HARVESTING SOD

A. Machine cut sod and load on pallets in accordance with ASPA guidelines.

B. Cut sod in area not exceeding one square yard (1 sq. yd.), with minimum one-half inch (1/2") and maximum one inch (1") topsoil base.

2.03 PROMIX

A. Promix shall be a mix of sandy loam, pine fines, mulch fines, compost and sand.

2.04 TOPSOIL

A. Excavated from site and free of weeds and debris. If sufficient quantities are not available on site, import as required.

2.05 MULCHING MATERIAL

A. Dry oat or wheat straw, free from weeds and/or foreign matter detrimental to plant life. Hay or chopped cornstalks are not acceptable.

2.06 FERTILIZER

A. Federal Specification O-F-241, Type 1, grade A; recommended for grass, with fifty percent (50%) of the elements derived from organic sources and of proportion necessary to eliminate any deficiencies of topsoil as indicated in analysis.

2.07 WATER

A. Clean, fresh and free of substances or matter which could inhibit vigorous growth of grass.

2.08 EROSION FABRIC

A. Jute matting, open weave. Poly jute 465GT by Synthetic Industries, Contech excelsior Blanket (Standard grade) or approved equal.

2.09 HERBICIDE

A. Type approved by Landscape Architect.

2.10 STAKES

A. Stakes –Use where sod slopes greater than 3:1 or in drainage swales.
   1. Softwood, ¾" dia. X 8" long or,
   2. Steel, tee shaped pins, 4"head x 8" leg.

PART 3 - EXECUTION

3.01 TESTS

A. Provide analysis of topsoil under provisions of Section 01 40 00 – Quality Requirements.

B. Perform soil testing prior to installation of specified material.

C. Collect soil samples at locations as identified on plans. If specific soil test locations are not indicated on plans the contractor is to provide a site plan markup indicating soil sample locations for submission and approval by Landscape Architect prior to collection and testing.

D. Collect one to one and a half cups of soil. Approved tools include; spade or shovel, soil sampling tube, or soil auger. Sample tubes or augers should either be stainless steel or chrome plated.

E. The soil sample should be obtained from three (3) areas at the specified test location. Mix cores or slices together in a clean plastic container and take enough subsample to fill the soil sample bag provided by the laboratory.

F. When sampling, scrape away any plant residue and sample to six inches (6")

G. The soil test report should provide the following data: soil ph, phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), sulfur (S), boron (B), copper (Cu), iron (Fe), manganese (Mn), zinc (Z) and organic matter .

H. Provide test results to Landscape Architect.

I. Recommended ranges - Soil ph 6.0 to 8.0, phosphorous (P) 20-40 ppm, potassium (K) 150-250 ppm, calcium (Ca) to magnesium (Mg) ratio between 5:1 and 8:1, magnesium (Mg) 30-70 ppm, sulfur (S) 12-25 ppm, boron (B) 0.9-1.5 ppm, copper (Cu) 0.9-1.2 ppm, iron (Fe) 100-200 ppm, manganese (Mn) 40-60 ppm, zinc (Z) 3.1-20 ppm, organic matter 5%

J. Soils not meeting the requirements are to be amended and re tested every six weeks until satisfactory ranges are achieved.

3.02 INSPECTION

A. Verify that prepared soil base is ready to receive the work of this section.

B. Beginning of installation means acceptance of existing site conditions.

3.03 PREPARATION OF SUBSOIL

A. Prepare subsoil during dry weather and on dry unfrozen subgrade to eliminate uneven areas and low spots. Maintain lines, levels, profiles, and contours. Make changes in grade gradual. Blend slopes into level areas.

B. Remove any existing turf grass, foreign materials, weeds, and undesirable plants and their roots. Remove contaminated subsoil.

C. Thoroughly till soil to depth of four inches (4”) with six cubic foot (6 cu. ft.) of Pro Mix, twenty five pounds (25 lbs.) of a complete fertilizer and one cubic yard (1 cu. yd.) of sand per thousand (1000 sq. ft.) square feet.

D. Following this, the area shall be fine graded to remove all ridges and depressions and the surface cleared of all stones, weeds, sticks and other debris.

3.04 FERTILIZING

A. Apply approved fertilizer in accordance with manufacturer’s instructions

B. Apply after smooth raking of topsoil and prior to roller compaction.

C. Apply fertilizer no more than twenty four (24) hours before laying sod.

D. Mix thoroughly into upper four inches (4”) of topsoil.

E. Lightly water to aid the dissipation of fertilizer.

3.05 LAYING SOD

A. Clearly define all document areas to receive sod.

B. Moisten prepared surface immediately prior to laying sod.

C. Lay sod within twenty four (24) hours after harvesting to prevent deterioration.

D. Lay sod tight with no open joints and no overlapping; stagger end joints twelve inches (12") minimum. Do not stretch or overlap sod pieces.

E. Lay smooth. Align with adjoining grass areas.

F. Sod pieces smaller than eight inches (8") square are acceptable only when site conditions mandate.

G. Top dressing with clean, weed-free sand may be required as deemed necessary by the Landscape Architect.

H. Water sodded areas immediately after installation. Saturate sod to four inches (4") of soil depth.

I. After sod and soil have dried, roll sodded areas to ensure good bond between sod and soil and to remove minor depressions and irregularities.

3.06 MAINTENANCE

A. Maintain all sodded areas until there is a stand of grass acceptable to both the Owner and Landscape Architect.

3.07 FIELD QUALITY CONTROL

A. Field inspection will be performed under provisions of Section 01 40 00 – Quality Requirements

B. Upon completion of work, notify Landscape Architect at least ten (10) working days prior to requested date of inspection. Where inspected landscape work does not comply with requirements, replace rejected work and continue specified maintenance until work is re-inspected by Landscape Architect and found to be acceptable.

C. Upon satisfactory completion of repairs and/or replacements, the Landscape Architect shall certify, in writing, the acceptance of the work in total.

END OF SECTION

SECTION 33 11 00
WATER DISTRIBUTION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section includes underground domestic, fire-suppression water-service piping and related components from local utility company services to within about 5 feet of the buildings.

B. Contact utility company serving the site for information.

C. Cost related to connecting to local utilities.

1.03 REFERENCES

A. ASTM A53 – Pipe, Steel, Black and Hot-Dipped Zinc-Coated, Welded and Seamless

B. ASTM C94 – Ready-Mixed Concrete

C. ASTM D1785 – Poly (Vinyl Chloride) (PVC) Plastic Pipe Schedules 40, 80, and 120

D. ASTM D2774 – Underground Installation of Thermoplastic Pressure Piping

E. ASTM D2855 – Making Solvent-Cement Joints with Poly (Vinyl Chloride) PVC) Pipe and Fittings

F. ASTM D3033 – Type PSP PVC Sewer Pipe and Fittings

G. ASTM D3034 – Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings

H ASTM D3139 – Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals

I. ASTM F477 – Elastomeric Seals (Gaskets) for Jointing Plastic Pipe

J. AWWA C104 – Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water

K. AWWA C110 – Ductile-Iron and Gray-Iron Fittings, 3" Through 48", for Water and Other Liquids

L. AWWA C111 – Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings

M. AWWA C500 – Gate Valves for Water and Sewage Systems

N. AWWA C502 – Dry-Barrel Fire Hydrants

O. AWWA C600 – Installation of Ductile Iron-Water Mains and Appurtenances

P. AWWA C651 – Disinfecting Water Mains

Q. AWWA C900 – Polyvinyl Chloride (PVC) Pressure Pipe, 4" Through 12", for Water Service

R. AWWA M17 – Installation, Field Testing, and Maintenance of Fire Hydrants

S. AWWA M23 – PVC Pipe-Design and Installation

T. NFPA 24 – Private Fire Service Mains and Their Appurtenances

U. NFPA 1963 – Screw Threads and Gaskets for Fire Hose Connections

V. NSF 14 – Plastic Piping System Components and Related Materials

1.04 SUBMITTALS

A. Product Data: For each type of product indicated.

1. Fire hydrants.
2. Fire department connections.
3. Valves.
4. Piping.
5. Meter.
6. Other material proposed for use.

B. Coordination Drawings: For piping and specialties including relation to other services in same area, drawn to scale. Show piping and specialty sizes and valves, and specialty locations, and elevations.

C. Field quality-control reports.

D. Certification: Submit manufacturer's material certifications stating that materials comply with or exceed specification requirements.

1.05 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Comply with requirements of utility company supplying water.
2. Comply with standards of authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.

B. Piping materials shall bear label, stamp, or other markings of specified testing agency.

C. Comply with the "Approval Guide," published by UL's "Fire Protection Equipment Directory" for fire-service-main products.

D. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-suppression water-service piping.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Preparation for Transport: Prepare valves, including fire hydrants, according to the following:

1. Ensure that valves are dry and internally protected against rust and corrosion.
2. Protect valves against damage to threaded ends and flange faces.
3. Set valves in best position for handling. Set valves closed to prevent rattling.

B. During Storage: Use precautions for valves, including fire hydrants, according to the following:

1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
2. Protect from weather. Store indoors and maintain temperature higher than ambient dew point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.

C. Handling: Use sling to handle valves and fire hydrants if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

D. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.

E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.

F. Protect flanges, fittings, and specialties from moisture and dirt.

G. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

1.07 PROJECT CONDITIONS

A. Interruption of Existing Fire-Suppression Water-Service Piping: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water-distribution service according to requirements indicated:

1. Notify General Contractor and Owner no fewer than two days in advance of proposed interruption of service.
2. Do not proceed with interruption of service without General Contractor's and Owner's written permission.

1.08 COORDINATION

A. Coordinate connection to water main with utility company.

PART 2 - PRODUCTS

2.01 PIPE SERVICE & MATERIAL

A. Domestic Water: ASTM D1785, Schedule 40 with NSF Seal.

B. Fire Protection: AWWA C900, PVC Pressure Pipe, Class 200 & conforming with NFPA 24.

1. Pipe Marking: NSF 14, "NSF-pvc cto only."

C. Where domestic water and fire protection system are combined, use pipe material to comply with more stringent requirements.

2.02 PIPE JOINTS & COUPLINGS

A. Domestic Water: PVC, solvent weld. Where pipe is over 4" diameter (100 mm), use PVC bell & Spigot with flexible elastomeric rings, pressure rated.

B. Fire Protection: PVC, Bell & Spigot with ASTM D3139 flexible elastomeric rings, pressure rated.

1. Gaskets: ASTM F477, elastomeric seal.

C. Fire Hydrant Tees: AWWA C110, with AWWA C104 standard thickness bituminous sealed cement-mortar lining, bituminous outside coating, and ends as required for proper joining to PVC water mains. Provide AWWA C111 ends, plain rubber gaskets, branch outlet, spigot type with locked-on rotatable gland ring, suitable for connecting and anchoring to a mechanical bell-end cut-off valve, and on-the-run ends, push-on or mechanical joint type.

2.03 PIPING SPECIALTIES

A. Transition Fittings: Manufactured fitting or coupling same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

2.04 GATE VALVES

A. AWWA Gate Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Clow Valve Company; a division of McWane, Inc.
   b. Crane Co.; Crane Valve Group; Stockham Division.
   c. Kennedy Valve; a division of McWane, Inc.

d. M&H Valve Company; a division of McWane, Inc.
e. Mueller Co.; Water Products Division.
f. NIBCO INC.
g. Tyler Pipe; a division of McWane, Inc.; Utilities Division.
h. U.S. Pipe.

2. 200-psig, AWWA, Iron, Nonrising-Stem, Resilient-Seated Gate Valves:
   a. Description: Gray- or ductile-iron body and bonnet; with bronze or gray- or ductile-iron gate, resilient seats, bronze stem, and stem nut.
   b. Standard: AWWA C509.
   c. Pressure Rating: 200 psig.
   d. End Connections: Mechanical or push-on joint.
   e. Interior Coating: Complying with AWWA C550.

B. UL-Listed or FM-Approved Gate Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Clow Valve Company; a division of McWane, Inc.
   b. Crane Co.; Crane Valve Group; Jenkins Valves.
   c. Crane Co.; Crane Valve Group; Stockham Division.
   d. Hammond Valve.
   e. Kennedy Valve; a division of McWane, Inc.
   f. M&H Valve Company; a division of McWane, Inc.
   g. Milwaukee Valve Company.
   h. Mueller Co.; Water Products Division.
   i. NIBCO INC.

2.05 GATE VALVE ACCESSORIES AND SPECIALTIES

A. Valve Boxes: Comply with AWWA M44 for cast-iron valve boxes. Include top section, adjustable extension of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over valve and with a barrel approximately 5 inches in diameter.

1. Operating Wrenches: Steel; with tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut.
2. Description: Vertical-type, cast-iron body with operating wrench, extension rod, and adjustable cast-iron barrel of length required for depth of burial of valve.
3. Standards: UL 789.

B. Indicator Posts:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. American AVK Company; Valves & Fittings Division.
   b. American Cast Iron Pipe Company; American Flow Control Division.
   c. American Cast Iron Pipe Company; Waterous Company Subsidiary.
   d. Clow Valve Company; a division of McWane, Inc.
   e. Crane Co.; Crane Valve Group; Stockham Division
   f. Kennedy Valve; a division of McWane, Inc.
   g. Mueller Co.; Water Products Division.
   h. NIBCO INC.
   i. Tyco Fire & Building Products LP.

2. Description: Vertical-type, cast-iron body with operating wrench, extension rod, and adjustable cast-iron barrel of length required for depth of burial of valve.
3. Standards: UL 789 and "Approval Guide," published by FM Global, listing.

2.06 FIRE HYDRANTS

A. AWWA Dry-Barrel Fire Hydrants:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Clow Valve Company; a division of McWane, Inc.
   b. Kennedy Valve; a division of McWane, Inc.
   c. M&H Valve Company; a division of McWane, Inc.
   d. Mueller Co.; Water Products Division.
   e. Troy Valve; a division of Penn-Troy Manufacturing, Inc.
   f. U.S. Pipe.

2. Description: Post type, with one NPS 4-1/2 and two NPS 2-1/2 outlets; and with 5-1/4-inch main valve, drain valve, and NPS 6 mechanical-joint inlet. Include interior coating according to AWWA C550. Hydrant shall have cast-iron body and compression-type valve opening against pressure and closing with pressure.
3. Standard: AWWA C502.
4. Pressure Rating: 200 psig minimum.

2.07 WARNING TAPE

A. Polyethylene plastic tape with metallic core, 6" wide by 4 mils thick, solid blue in color, continuously imprinted in black letters with "CAUTION – WATER LINE BURIED BELOW."

PART 3 - EXECUTION

3.01 EARTHWORK

A. Comply with excavating, trenching, and backfilling requirements in Division 31 Section 31 00 00 Earthwork.

3.02 PIPING INSTALLATION

A. Water-Main Connection: Tap water main according to requirements of water utility company and of size and in location indicated.

B. Make connections larger than NPS 2 (DN 50) with tapping machine according to the following:

1. Install tapping sleeve and tapping value according to MSS SP-60.
2. Install tapping sleeve on pipe to be tapped. Position flanged outlet for gate value.
3. Use tapping machine compatible with valve and tapping sleeve; cut hole in main. Remove tapping machine and connect water-service piping.
4. Install gate valve onto tapping sleeve. Comply with MSS SP-60. Install valve with stem pointing up and with valve box.

C. Comply with NFPA 24 for fire-service-main piping materials and installation.

D. Install PVC, AWWA pipe according to ASTM F 645 and AWWA M23.

E. Bury piping with depth of cover over top at least 30 inches, with top at least 12 inches below level of maximum frost penetration, and according to the following:

1. Under Driveways: With at least 36 inches of cover over top.
2. In Loose Gravelly Soil and Rock: With at least 12 inches of additional cover.

F. Install piping by tunneling or jacking, or combination of both, under streets and other obstructions that cannot be disturbed.

G. Extend water-service piping and connect to water-supply source and building-water-piping systems outside face of building wall in locations and pipe sizes indicated.

1. Terminate water-service piping at building wall until building-water-piping systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building-water-piping systems when those systems are installed.

H. Extend fire-suppression water-service piping and connect to water-supply source to fire hydrant locations.

I. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports.

J. Install piping with even, uniform bearing. Provide sand bed or excavate for bell of piping.

K. Lay pipe with joints and fitting properly aligned to allow for expansion and contraction without causing excessive stress. Do not snake pipe into trenches.

L. Maintain 72" (1800 mm) horizontal and 24" (600 mm) vertical separation of domestic water and sanitary sewers. In all cases run water above sewers.

M. For PVC lines 4" in diameter add less, make solvent weld joints according to ASTM D2855.

N. For PVC lines larger than 4" diameter, use AWA C900 joining materials. Construct joints with elastomeric seals and lubricant according to ASTM D2774 or ASTM D3139 and pipe manufacturer's printed instructions.

O. Warning Tape: Install detectable warning tape directly over buried pipe at about 6" beneath finished grade.

3.03 JOINT CONSTRUCTION

A. Install couplings, flanges, flanged fittings, and transition and special fittings that have finish and pressure rating same as or higher than systems pressure rating for aboveground applications unless otherwise indicated.

B. Install flanges or flange adaptors on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

C. Remove scale, slag, dirt, and debris from outside and inside of pipes, tubes, and fittings before assembly.

D. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with bolts according to ASME B31.9.

E. PVC Piping Gasketed Joints: Use joining materials according to AWWA C900. Construct joints with elastomeric seals and lubricant according to ASTM D 2774 or ASTM D 3139.

F. Dissimilar Materials Piping Joints: Use adapters compatible with both piping materials, with OD, and with system working pressure.

G. Do not use flanges or unions for underground piping.

3.04 ANCHORAGE INSTALLATION

A. Anchorage, General: Install water-distribution piping with restrained joints. Anchorages and restrained-joint types that may be used include the following:

1. Concrete thrust blocks.

B. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches in fire-suppression water-service piping according to NFPA 24 and the following:

1. Gasketed-Joint, PVC Water-Service Piping: According to AWWA M23.

C. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

3.05 VALVE INSTALLATION

A. AWWA Gate Valves: Comply with AWWA C600 and AWWA M44. Install each underground valve with stem pointing up and with valve box.

B. AWWA Valves Other Than Gate Valves: Comply with AWWA C600 and AWWA M44.

C. MSS Valves: Install as component of connected piping system.

3.06 WATER METER INSTALLATION

A. The City of Newbern will provide water meters. Contractor to install meter, piping, and specialties according to utility company's written instructions. Contractor to pay costs associated with meter.

3.07 FIRE HYDRANT INSTALLATION

A. General: Install each fire hydrant with separate gate valve in supply pipe, anchor with restrained joints or thrust blocks, and support in upright position.

B. AWWA Fire Hydrants: Comply with AWWA M17.

C. UL-Listed Approved Fire Hydrants: Comply with NFPA 24.

3.08 FIELD QUALITY CONTROL

A. Use test procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described below.

B. Piping Tests: Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.

C. Hydrostatic Tests: Test at not less than one-and-one-half times the working pressure for two hours.

1. Increase pressure in 50-psig increments and inspect each joint between increments. Hold at test pressure for one hour; decrease to 0 psig. Slowly increase again to test pressure and hold for one more hour. Maximum allowable leakage is 2 quarts per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.

D. Prepare test and inspection reports.

3.09 IDENTIFICATION

A. Install continuous underground detectable warning tape during backfilling of trench for underground fire-suppression water-service piping. Locate below finished grade, directly over piping.

B. Permanently attach equipment nameplate or marker indicating plastic fire-suppression water-service piping or fire-suppression water-service piping with electrically insulated fittings, on main electrical meter panel.

3.10 CLEANING & TESTING

A. Clean and disinfect fire-suppression water-service piping as follows:

1. Purge new piping systems and parts of existing systems that have been altered, extended, or repaired before use.
2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in NFPA 24 for flushing of piping. Flush piping system with clean, potable water until dirty water does not appear at points of outlet.

3. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or do as follows:
   a. Fill system or part of system with water/chlorine solution containing at least 50 ppm of chlorine; isolate and allow to stand for 24 hours.
   b. Drain system or part of system of previous solution and refill with water/chlorine solution containing at least 200 ppm of chlorine; isolate and allow to stand for three hours.
   c. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
   d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows evidence of contamination.

B. Prepare reports of purging and disinfecting activities.

3.11 PIPING SCHEDULE

A. Underground fire-suppression water-service piping shall be the following:

1. PVC, Class 200 pipe listed for fire-protection service; PVC fittings of same class as pipe; and gasketed joints.

B. Domestic Water:

1. ASTM D1785, Schedule 40 with NSF Seal.

3.12 VALVE SCHEDULE

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

B. Underground fire-suppression water-service shutoff valves NPS 3 and larger shall be one of the following:

1. 200-psig, AWWA, iron, nonrising-stem, resilient-seated gate valves.

C. Fire-suppression water-service check valves NPS 3 and larger shall be one of the following:

1. AWWA or UL-listed or FM-approved check valves.

END OF SECTION

SECTION 33 30 00
SANITARY SEWER SYSTEM

PART 1 - GENERAL

1.01 DESCRIPTION

A. Furnish all labor, materials, equipment, and supplies necessary in performing all operations in connection with the construction of exterior sanitary sewer system, manhole connection, and all other structures, complete, in strict accordance with this section of the specifications and as indicated on Drawings. This work includes but is not limited to the following:

1. PVC Schedule 40 Pipe or SDR26, including trenching, bedding, backfill, fittings and joint material as specified for pipe.
2. Manhole construction, connections and clean-outs, including excavation, backfill and all associated castings, metal work, portland cement concrete, and reinforcing steel for such.

B. Exterior sanitary sewer and structures shall be constructed of materials specified in this section or as shown on the Drawings.

1.02 RELATED WORK

A. The following items of related work are specified and included in other sections of these specifications:

1. Section 31 00 00 – Earthwork.
2. Section 03 30 00 – Cast-in-Place-Concrete.
3. Division 22 – Plumbing.

1.03 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

1. American National Standards Institute (ANSI) Publications: A14.3-84 Fixed Ladders, Safety Requirements
2. American Society for Testing and Materials (ASTM) Publications:

C 94-96e1	Ready Mixed Concrete
C 150-97	Portland Cement
C 478-96	Pre-cast Reinforced Concrete Manhole Sections
C 923-96	Resilient Connectors Between Reinforced Concrete Manhole Structures and Pipes
D 1785-96	Polyvinyl Chloride (PVC) Plastic Pipe, Schedule 40, 80 and 120.
D 2466-96a	Socket-Type Polyvinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 40.
D 2564-96a	Solvent Cements for Polyvinyl Chloride (PVC) Plastic Pipe and Fittings.

D2241 Specifications for Polyvinyl Chloride (PVD) Pipe Pressure Rated SDR Series.

1.04 SYSTEM DESCRIPTION

A. Sanitary Sewer Gravity Pipeline: Provide PVC pipe. Provide brick masonry, concrete, or pre-cast concrete manholes as indicated.

1.05 SUBMITTALS

A. Shop Drawings: Submit for the following:

1. Pre-cast concrete manholes
2. Metal work

B. Manufacturer's Data: Submit manufacturer's standard drawings or catalog cuts of the following items:

1. Fittings
2. Joints and couplings

C. Certificates of Compliance: Submit the following:

1. Pipe and fittings, including factory-applied linings
2. Pipe joint materials
3. Cast iron frames, covers, and gratings
4. Pre-cast concrete manhole sections
5. Certificates shall attest that tests set forth in each applicable referenced publication have been performed, whether specified in that publication to be mandatory otherwise. Production control tests shall have been performed at the intervals or frequency specified in the referenced publication. Other tests shall have been performed within 3 years of the date of submittal of certificates on the same type, class, grade, and size of material as is being provided for the project.

1.06 DELIVERY, STORAGE, AND HANDLING:

A. Delivery and Storage:

1. Piping: Inspect materials delivered to site for damage; store with minimum of handling. Store materials on site in enclosures or under protective coverings. Do not store materials directly on the ground. Keep inside of pipes and fittings free of dirt and debris.
2. Metal Items: Check upon arrival; identify and segregate as to types, functions, and sizes. Store off the ground in a manner affording each accessibility and not causing excessive rusting or coating with grease or other objectionable materials.
3. Cement, Aggregate, and Reinforcement: As specified in Section 03 30 00, "Cast-In-Place-Concrete.
4. Handling: Handle pipe, fittings, and other accessories in such manner as to ensure delivery to the trench in sound undamaged condition.

PART 2 - PRODUCTS

2.01 PIPE AND PIPE FITTINGS AND APPURTENANT CONSTRUCTION

A. PVC Piping:

1. Pipe: ASTM D 1785, ASTM D 2241, Polyvinyl Chloride (PVC) Plastic Pipe, Schedule 40, 80 and 120. Use Schedule 40 or SDR 26.
2. Fittings: ASTM D 2466, Socket-Type Polyvinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 40.
3. Joining Materials: ASTM D 2564, Solvent Cements for Polyvinyl Chloride (PVC) Plastic Pipe and Fittings.

2.02 CONCRETE MATERIALS

A. Concrete materials shall be as specified in Section 03 30 00, "Cast-In-Place Concrete".

2.03 MISCELLANEOUS MATERIALS

A. Pre-cast Concrete and Associated Materials.

1. Pre-cast Concrete Manhole Sections: Pre-cast concrete manhole risers, base sections, and tops shall conform to ASTM C 478. Base and first riser shall be monolithic.
2. Gaskets and Connectors: Gaskets for joints between manhole sections shall conform to ASTM C 443. Resilient connectors for making joints between manhole and pipes entering manhole shall conform to ASTM C 923.

B. Metal Items:

1. Frames, Covers, and Gratings for Manholes: cast iron; figure numbers shall be as indicated.
2. Manhole Steps: Zinc-coated steel, as indicated, conforming to ANSI A14.3. As an option, plastic or rubber coating pressure-molded to the steel may be used. Plastic coating shall conform to ASTM D 4101, copolymer polypropylene. Aluminum steps or rungs will not be permitted. Steps are not required in manholes less than 4 feet deep.

PART 3 - EXECUTION

3.01 INSTALLATION OF PIPELINES AND APPURTENANT CONSTRUCTION

A. General requirements for installation of pipeline:

1. Location: The work covered by this section shall terminate at approximately 5 feet from the building, unless otherwise indicated on the drawings.
2. Earthwork: Perform earthwork operations in accordance with Section 31 00 00 "Earthwork".

3. Pipe Laying and Jointing: Inspect each pipe and fitting before and after installation; replace those found defective and remove from site. Provide proper facilities for lowering sections of pipe into trenches. Lay non-pressure pipe with the bell ends in the upgrade direction. At the end of each work day, close open ends of pipe temporarily with wood blocks or bulkheads. Provide batter boards not more than 25 feet apart in trenches for checking and ensuring that pipe invert elevations are as indicated. Laser beam method may be used in lieu of batter boards for the same purpose.
4. Connections to Existing Lines: Connect to the existing sewer manhole as indicated on the property line in the construction of the new manhole at that location.
5. Clean-outs: Construct clean-outs of PVC-DWV Schedule 40 pipe and fittings.

B. Manhole Construction: Construct base slab of cast-in-place concrete or use pre-cast concrete base sections. Make inverts in cast-in-place concrete and pre-cast concrete bases with a smooth-surfaced semi-circular bottom conforming to the inside contour of the adjacent sewer sections. For changes in direction of the sewer and entering branches into the manhole, make a circular curve in the manhole invert of as large a radius as manhole size will permit. For cast-in-place concrete construction, either pour bottom slabs and walls integrally or key and bond walls to bottom slab. No parging will be permitted on interior manhole walls. For pre-cast concrete construction, make joints between manhole sections with the gaskets specified for this purpose; install in the manner specified for installing joints in concrete piping. Parging will not be required for pre-cast concrete manholes. Cast-in-place concrete work shall be in accordance with the requirements specified under paragraph entitled, "Concrete Work" of this section. Make joints between concrete manholes and pipes entering manholes with the resilient connectors specified for this purpose; install in accordance with the recommendations of the connector manufacturer. Where a new manhole is constructed on an existing line, remove, existing pipe as necessary to construct the manhole. Cut existing pipe so that pipe ends are approximately flush with the interior face of manhole wall, but not protruding into the manhole. Use resilient connectors as previously specified for pipe connectors to concrete manholes.

C. Miscellaneous Construction and Installation:

1. Metal Work:
   a. Workmanship and Finish: Perform metal work so that workmanship and finish will be equal to the best practice in modern structural shops and foundries. Form iron to shape and size with sharp lines and angles. Do shearing and punching so that clean true lines and surfaces are produced. Make castings sound and free from warp, cold shuts, and blow holes that may impair their strength or appearance. Give exposed surfaces a smooth finish with sharp well-defined lines and arises. Provide necessary rabbets, lugs, and brackets wherever necessary for fitting and support.
   b. Field Painting: After installation, clean cast-iron frames, covers, gratings, and steps not buried in concrete to bare metal of mortar, rust, grease, dirt, and other deleterious materials and apply a coat of bituminous paint. Do not paint surfaces subject to abrasion.

2. Concrete Work: Cast-in-place concrete is included in Section 03 30 00, "Cast-In-Place Concrete".

3.02 FIELD QUALITY CONTROL

A. Field Tests and Inspections: The Architect/Engineer will conduct field inspections and witness field tests specified in this section. The Contractor shall perform field tests and provide labor, equipment, and incidentals required for testing. Be able to produce evidence, when required, that each item of work has been constructed in accordance with the drawings and specifications.

B. Leakage Tests: Test lines for leakage by ex-filtration tests, or by low pressure air tests. Prior to testing for leakage, backfill trench up to at least lower half of pipe. When necessary to prevent pipeline movement during testing, place additional backfill around pipe sufficient to prevent movement, but leaving joints uncovered to permit inspection. When leakage or pressure drop exceeds the allowable amount specified, make satisfactory correction and retest pipeline section in the same manner. Correct visible leaks regardless of leakage test results.

1. Ex-filtration Test in accordance with paragraph 2501.4.2.1 of the City of Memphis Standard Construction Specification.
2. Low-pressure Air Test in accordance with paragraph 2501.4.2.2 of the City of Memphis Standard Construction Specification or in accordance with ASTM C 828.

END OF SECTION

SECTION 33 40 00
STORM DRAINAGE SYSTEM

PART 1 – GENERAL

1.01 GENERAL REQUIREMENTS

A. Work on this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

B. Regulatory Requirements: Comply with applicable portions of City of Memphis Engineering Department.

1.02 DESCRIPTION

A. Section includes furnishing materials and the installation of underground piping required for the storm drainage system as indicated on the drawings.

B. Related Work: The following items of related work are specified in other sections.

1. Section 31 00 00 – Earthwork.
2. Section 32 16 13 – Drainage Appurtenances.

1.03 QUALITY ASSURANCE

A. Applicable Standards: Conform to following Standards:

Federal Specifications (Fed. Spec.):

SS-S-210A(1)	Sealing Compound, Preformed Plastic, for Expansion Joints and Pipe Joints.

American Society for Testing and Materials (ASTM):

C 14-80	Concrete Sewer, Storm Drain, and Culvert Pipe Reinforced.
C 76-80	Concrete Culvert. Storm Drain and Sewer Pipe.
C 443-79	Joints for Circular Concrete Sewer and Culvert Pipe, Using Flexible, Watertight, Rubber Type Gaskets.
D 1785-96	Polyvinyl Chloride (PVC) Plastic Pipe, Schedule 40, 80, and 120.
D 2466-96a	Socket-Type Polyvinyl Chloride (PVC) Plastic Pipe Fittings. Schedule 40.
D 2564-96a	Solvent Cements for Polyvinyl Chloride (PVC) Plastic Pipe and Fittings.
F 2648	Standard Specification for 2" to 60" Annular Corrugated Profile Wall Polyethylene (PE) Pipe and Fittings for Land Drainage Applications.

Uni-Bell Plastic Pipe Association

UNI-B-5	Installation of Polyvinyl Chloride (PVC) Sewer Pipe.

1.04 SUBMITTALS

A. Certified Test Reports: Before delivery of materials and equipment, certified copies of the reports of all tests specified herein shall be submitted and approved.

B. Concrete Pipe: Certified copies of test reports shall include strength tests of concrete pipe. Strength tests for concrete piping shall be the three-edge bearing tests. Test reports shall be furnished prior to installation of piping.

C. Storage and Handling: Proper facilities shall be provided for handling and lowering sections of pipe into place to avoid injury or damage. Damaged pipe shall be removed from the site and replaced with satisfactory pipe at no additional cost to the Owner.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Reinforced Concrete Pipe: Pipe shall conform to ASTM Specifications C 76 and shall be of sizes shown. Pipe shall be Class III, unless otherwise indicated.

B. Joints for Concrete Pipe: Joints shall be one of the following types:

1. Bell and spigot with rubber gaskets.
2. Tongue and groove with rubber gaskets.
3. Tongue and groove with preformed plastic gaskets

C. Rubber Gaskets: Gaskets shall conform to ASTM Specification C 443. Only a neutral agent shall be used as a lubricant.

D. Preformed Plastic Gaskets: Gaskets shall conform to Specifications SS-S-210, type I-rope form.

E. Drainage Structures: Drainage structures are specified in Section 32 16 13 titled, "Drainage Appurtenances".

F. HDPE Pipe: Double wall corrugated with smooth interior heavy duty polyethylene pipe, ASTM F 2648, soil tight.

G. PVC Pipe: ASTM D 1785, Polyvinyl Chloride (PVC) Plastic Pipe, Schedule 40, 80, and 120. PVC Pipe shall be schedule 40, or SDR 26.

H. PVC Fittings: ASTM D 2466, Socket-Type Polyvinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 40, or SDR 26.

I. PVC Pipe Jointing Materials: ASTM D 2564, Solvent Cements for Polyvinyl Chloride (PVC) Plastic Pipe and Fittings.

J. Clean-outs Exterior to Buildings: Provide PVC clean-outs and countersunk plugs. Provide concrete slab with clean-out located in center of slab. Provide cast-iron clean-out box with cover.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General Requirements: Concrete and pipe shall be used for storm drainage system as indicated. Catch basins and drainage troughs are specified in Section 32 16 13 titled, "Drainage Appurtenances". Excavating, trenching, backfilling, and density tests are specified in Section 31 00 00 titled, "Earthwork".

B. Installation: Each section of pipe shall be carefully examined before being laid, and defective or damaged pipe shall not be used. Proper facilities shall be provided for lowering sections of pipe into trenches. Under no circumstances shall pipe be laid in water, and no pipe shall be laid when trench conditions or weather are unsuitable for such work. Diversion of drainage or dewatering of trenches during construction shall be provided as necessary. Pipe shall be laid true to the grades indicated and shall rest upon the pipe bed for the full length of each section. Runs of pipe shall be laid with outside laps or grooved ends up-grade beginning at the lower end of the pipe line. Pipe having its grade and/or joint disturbed after laying shall be taken up, cleaned, and relaid. When pipes are protected by head walls or connect with drainage structures, the exposed ends of the pipe shall be placed or cut flush with the face of the structure. After the pipe is cut, the rough edges shall be smoothed up in an approved manner. All pipe shall be laid so that markings are on top and the inner surfaces abut neatly, tightly, and smoothly. All pipe in place shall be inspected and approved before being covered and concealed.

C. Concrete Pipe: Joints installation shall be in accordance with the recommendations of the manufacturer of the joint material. Surfaces to receive lubricants, cements, or adhesives shall be clean and dry. Gaskets and jointing materials shall be affixed to the pipe not more than 24 hours prior to the installation of the pipe, and shall be protected from the sun, blowing dust, and other deleterious agents at all times. Gaskets and jointing materials shall be inspected before installation of the pipe, and any loose or improperly affixed gaskets and jointing materials shall be removed and replaced. The pipe shall be aligned with the previously installed pipe, and the joint pulled together. If, while making the joint, the gasket or jointing material becomes loose and can be seen through the exterior joint recess when the joint is pulled up to within one inch of closure, the pipe shall be removed and the joint remade.

D. Field Tests and Inspection: A light held in a manhole or inlet shall show a practically full circle of light through the pipe when viewed from the adjoining end of the line to verify alignment. Lines under pavement shall be tested for infiltration by means of a suitable weir or other device as directed. When determination of infiltration is not practicable because of dry trench conditions, an exfiltration test shall be applied by filling with water so that the hydraulic head will be at least 4 feet above the crown of the upper end of the section being tested. The amount of leakage (infiltration or exfiltration) shall not exceed 500 gallons per inch of diameter per day per mile of pipe. Water for testing shall be furnished by the Contractor.

END OF SECTION