



SPECIFICATIONS

SHARYLAND WATER SUPPLY
CORPORATION
New Building

Alton, Texas 78573

More Attentive Service

MILNET ARCHITECTURAL SERVICES PLLC

608 S. 12th Street
McAllen, Texas 78501

Phone: 956-688-5656
Fax: 956-687-9289

Website: www.milnet-archservices.com

Project No. 217017

Set No.

SHARYLAND WATER SUPPLY
CORP NEW BUILDING

PROJECT MANUAL

Plans and Specifications – Project No. 217017

**Sharyland Water Supply Corporation
New Building
Alton, Texas 78573**



10/19/2018

**TEXAS BOARD OF ARCHITECTURAL EXAMINERS
333 Guadalupe, Suite 2-350, AUSTIN, TX 78701-3942
(Tel: 512/305-9000)
HAS JURISDICTION OVER INDIVIDUALS LICENSED UNDER
THE ARCHITECT'S REGISTRATION LAW
ARTICLE 249a, VERNON'S CIVIL STATUTES".**

**MILNET ARCHITECTURAL SERVICES, PLLC
608 S. 12th St.
McALLEN, TEXAS 78501
(956) 688-5656 - FAX (956) 687-9289**

Sharyland Water Supply Corporation
New Building
Alton, Texas 78573
MAS Project No. 217017

Division	Section Title	Pages
DIVISION 00 - PROCUREMENT AND CONTRACTING REQUIREMENTS		
00 11 00	ADVERTISEMENT AND INVITATION	2
00 11 19	REQUEST FOR COMPETITIVE SEALED PROPOSALS	2
00 21 16	INSTRUCTIONS TO PROPOSERS	4
00 42 00	PROPOSAL FORM FOR COMPETITIVE SEALED PROPOSALS	3
00 43 00	RANKING/SELECTION CRITERIA	2
00 52 13	AGREEMENT FORM - STIPULATED SUM	1
00 61 00	PERFORMANCE BOND AND LABOR AND MATERIAL PAYMENT BOND	1
00 62 76.13	TAX EXEMPT ORGANIZATION CERTIFICATE	1
00 73 00	SUPPLEMENTARY CONDITIONS	4
--	GEOTECHNICAL ENGINEERING REPORT	50
--	AIA A101-2007 AGREEMENT BETWEEN OWNER AND CONTRACTOR	7
--	AIA A201-2007 GENERAL CONDITIONS	39
DIVISION 01 - GENERAL REQUIREMENTS		
01 20 00	PRICE AND PAYMENT PROCEDURES	2
01 21 00	ALLOWANCES	2
01 25 00	SUBSTITUTION PROCEDURES	3
01 30 00	ADMINISTRATIVE REQUIREMENTS	3
01 33 00	SUBMITTALS	4
01 40 00	QUALITY REQUIREMENTS	2
01 50 00	TEMPORARY FACILITIES AND CONTROLS	5
01 77 00	CLOSEOUT PROCEDURES	6
DIVISION 02 - EXISTING CONDITIONS		
DIVISION 03 - CONCRETE		
03 30 00	CAST-IN-PLACE CONCRETE	5
DIVISION 04 - MASONRY		
04 05 13	MORTAR	3
04 22 00	CONCRETE MASONRY UNIT	5
04 40 00	GRANITE	5
04 73 00	MANUFACTURED VENEER STONE	5
DIVISION 05 - METALS		
05 41 00	LIGHT GAGE METAL FRAMING SYSTEMS AND GYPSUM SHEATHING	4
DIVISION 06 - WOOD AND PLASTICS		
06 10 00	ROUGH CARPENTRY	3
06 40 23	INTERIOR ARCHITECTURAL WOODWORK	12
DIVISION 07 - THERMAL AND MOISTURE PROTECTION		
07 10 00	DAMPPROOFING AND WATERPROOFING	4
07 21 00	BUILDING INSULATION	4
07 26 16	UNDER-SLAB VAPOR BARRIER	3
07 41 13	INSULATED METAL ROOF PANEL	8

07 92 00	JOINT SEALANTS	2
DIVISION 08 - DOORS AND WINDOWS		
08 11 13	HOLLOW METAL DOORS & FRAMES	9
08 14 16	FLUSH WOOD DOORS	7
08 33 23	OVERHEAD COILING SERVICE DOORS	5
08 41 13	ALUMINUM STOREFRONT	8
08 71 00	DOOR HARDWARE	17
08 81 00	GLASS AND GLAZING	4
08 91 00	LOUVERS AND VENTS	6
DIVISION 09 - FINISHES		
09 20 00	LATH AND PLASTER	5
09 21 16	INTERIOR DRYWALL SYSTEMS	8
09 30 00	WALL AND FLOOR TILE	5
09 51 00	ACOUSTICAL TILE CEILING	4
09 65 19	RESILIENT FLOORING AND BASE	4
09 68 00	CARPET TILE	6
09 91 00	PAINTING AND FINISHING	5
DIVISION 10 - SPECIALTIES		
10 14 00	GRAPHICS AND SIGNAGE	4
10 14 53	TRAFFIC STRIPING AND PARKING SIGNAGE	2
10 21 13	TOILET COMPARTMENTS	5
10 44 00	FIRE EXTINGUISHERS AND CABINETS	3
10 75 00	FLAGPOLES	3
DIVISION 11 – EQUIPMENT		
DIVISION 12 – FURNISHINGS		
12 21 13	HORIZONTAL LOUVER BLINDS	3
DIVISION 13 – SPECIAL CONSTRUCTION		
13 34 19	PRE-ENGINEERED METAL BUILDINGS	4
DIVISION 31 – EARTHWORK		
31 10 00	SITE CLEARING, GRADING AND FILLING	3
31 31 16	TERMITE CONTROL	2
DIVISION 32 – EXTERIOR IMPROVEMENTS		
32 11 00	FLEXIBLE BASE	8
32 13 13	CONCRETE PAVING, CURBS AND SIDEWALK	9
DIVISION 33 – UTILITIES		
33 05 00	SITE DRAINAGE	3
END OF TABLE OF CONTENTS		

SHARYLAND WATER SUPPLY CORPORATION

NEW ADMINISTRATION BUILDING

TECHNICAL SPECIFICATIONS TABLE OF CONTENTS

DIVISION 01 – GENERAL REQUIREMENTS

01 22 10	MEASUREMENT AND BASIS
01 33 00	SUBMITTAL PROCEDURES
01 56 26	TEMPORARY FENCING

DIVISION 03 – CONCRETE

03 10 00	CONCRETE FORMING AND ACCESSORIES
03 20 00	CONCRETE REINFORCING
03 30 00	CAST IN PLACE CONCRETE
03 39 00	CONCRETE CURING

DIVISION 05 – METALS

05 21 00	REINFORCING STEEL
----------	-------------------

DIVISION 31 - EARTHWORK

31 10 10	SITE CLEARING GRADING AND FILLING
31 11 00	CLEARING AND GRUBBING
31 22 16	FINE GRADING
31 23 00	EXCAVATION AND FILL
31 23 16	EXCAVATION
31 23 33	TRENCH EXCAVATION AND BACKFILL
31 25 00	EROSION AND SEDIMENTATION CONTROLS
31 41 10	REINFORCED CONCRETE PIPE
31 41 30	TRENCH SHORING REQUIREMENTS
31 41 33	TRENCH PROTECTION SYSTEM

DIVISION 32 – EXTERIOR IMPROVEMENTS

32 11 00	BASE COURSES
32 11 20	SUBGRADE PREPARATION
32 11 23	AGGREGATE BASE COURSES
32 11 24	ROLLING
32 11 25	PROOF ROLLING
32 11 40	FLEXIBLE BASE
32 11 41	FLEXIBLE BASE PARAMETERS
32 12 16	ASPHALT PAVING

32 12 20	ASPHALT OILS AND EMULSIONS
32 12 21	HOT MIX ASPHALT
32 13 13	CONCRETE PAVING
32 16 13	CONCRETE CURBS AND GUTTERS AND COMBINED CURB AND GUTTER
32 17 23.13	PAINTED PAVEMENT MARKINGS
32 17 23.23	RAISED PAVEMENT MARKINGS
32 17 23.33	THERMOPLASTIC PAVEMENT MARKINGS
32 80 00	IRRIGATION
32 84 12	VEGETATIVE WATERING
32 84 23	SPRINKLING
32 90 00	PLANTING
32 92 00	LAWNS AND HYDROMULCH
32 92 19	SEEDING FOR EROSION CONTROL

DIVISION 33 – UTILITIES

33 05 13	MANHOLES AND STRUCTURES
33 11 00	WATER TRANSMISSION AND SEWER PRESSURE LINES
33 41 00	STORM SEWER STRUCTURE
33 41 10	SITE DRAINAGE

DIVISION 34 – TRANSPORTATION

34 14 16	TRAFFIC CONTROL EQUIPMENT
----------	---------------------------



10/18/2018

DIVISION 21 – FIRE PROTECTION

- 21 22 00 CLEAN-AGENT FIRE SUPPRESSION SYSTEM
- 21 13 13 WET-TYPE PIPE SPRINKLER SYSTEM

DIVISION 22 – PLUMBING

- 22 00 00 SUMMARY OF PLUMBING WORK
- 22 05 00 COMMON WORK RESULTS FOR PLUMBING
- 22 05 29 HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT
- 22 05 53 IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT
- 22 07 19 PLUMBING PIPING INSULATION
- 22 11 16 DOMESTIC WATER PIPING
- 22 11 19 DOMESTIC WATER PIPING SPECIALTIES
- 22 13 13 FACILITY SANITARY SEWERS
- 22 13 19 FACILITY SANITARY SEWERS SPECIALTIES
- 22 33 00 ELECTRIC DOMESTIC WATER HEATERS
- 22 42 00 COMMERCIAL PLUMBING FIXTURES
- 22 47 13 DRINKING FOUNTAINS

DIVISION 23 – HEATING VENTILATION & AIR CONDITIONING

- 23 00 00 HVAC
- 23 05 00 COMMON WORK RESULT FOR HVAC
- 23 05 29 HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT
- 23 05 63 IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT
- 23 05 93 TESTING, ADJUSTING AND BALANCING FOR HVAC
- 23 07 13 DUCT INSULATION
- 23 09 23 DIRECT DIGITAL CONTROL SYSTEM FOR HVAC
- 23 23 00 REFRIGERANT PIPING
- 23 31 13 METAL DUCTS
- 23 33 00 DUCT ACCESSORIES
- 23 33 46 FLEXIBLE DUCTS
- 23 34 16 CENTRIFUGAL HVAC FANS
- 23 37 13 DIFFUSERS, REGISTERS AND GRILLES

DIVISION 26/27/28 – ELECTRICAL

- 26 00 00 ELECTRICAL
- 26 01 20 OPERATIONS AND MAINTENANCE OF LOW-VOLTAGE ELECTRICAL DISTRIBUTION
- 26 05 00 COMMON WORK RESULTS FOR ELECTRICAL
- 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 43 UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS
- 26 05 53 IDENTIFICATION FOR ELECTRICAL SYSTEMS





3533 Moreland Dr. Suite A | Weslaco, Texas 78596
P: 956.973.0500 | F: 956.351.5750
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26 05 73	POWER SYSTEM STUDIES
26 09 23	LIGHTING CONTROL DEVICES
26 09 43	DISTRIBUTED DIGITAL LIGHTING CONTROL SYSTEM
26 24 16	PANELBOARDS
26 27 17	EQUIPMENT WIRING
26 27 26	WIRING DEVICES
26 28 13	FUSES
26 28 16.16	ENCLOSED SWITCHES
26 32 13	DIESEL ENGINE DRIVEN GENERATOR SETS
26 36 23	AUTOMATIC TRANSFER SWITCH
26 43 13	SURGE PROTECTIVE DEVICES FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS
26 51 00	INTERIOR LIGHTING
26 56 00	EXTERIOR LIGHTING
27 05 33	CONDUITS AND BACKBOXES FOR COMMUNICATIONS SYSTEMS
28 31 00	INTRUSION DETECTION SYSTEM (IDS)
28 46 21.11	DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEMS

SECTION 00 11 00 —INVITATION

PART 1 - GENERAL

1.1 PROJECT DESCRIPTION:

- A. This project consists of the construction of a new 10,800 sq. ft. office facility for the Sharyland Water Supply Corporation also included is an 8,668 sq. ft. warehouse (Alt #1). The project site is located at the corner of Shary Road and E. Main Ave (5 Mile) in Alton, Texas 78573.

1.2 INSTRUCTIONS TO OFFERORS:

- A. Refer to Section 00 21 16 – Instructions to Proposers.

1.3 PRE-PROPOSAL CONFERENCE:

- A. The purpose of the Pre-Proposal Conference is to answer any questions that any bidder may have. This is the last date for questions. All questions must be asked in a written format only and directed to Rudy Molina, AIA, Milnet Architectural Services, 608 S. 12th St., McAllen, Texas 78501/ (956) 688-5656 Phone – (956) 687-9289 Fax, or email at: rudym@milnet-archservices.com & juanmart@milnet-archservices.com . All questions will be answered in a written addendum only.
- B. Date and Time: Tuesday, October 30, 2018 @ 10:30 A.M.
- C. Location: Sharyland Water Supply Corporation
4210 E. Main Ave.
Alton, Texas 78573

1.4 DEADLINE FOR PROPOSALS:

- A. Place:
1. Competitive sealed proposals will be received at the office of:

Owner: Sharyland Water Supply Corporation
Address: 4210 E. Main Ave.
Alton, Texas 78573

Attention: Mrs. Sherilyn Dahlberg,
General Manager
- B. Date: **Thursday, November 8, 2018**
- C. Hour: **3:00 P.M.**
- D. Copies: **Submit one (1) original and three (3) copies of proposals.**

1.5 REJECTION:

- A. The Owner reserves the right to reject any or all Proposals, and to waive any irregularities or formalities.

END OF SECTION

REQUEST FOR COMPETITIVE SEALED PROPOSALS

PROJECT: Sharyland Water Supply Corporation – New Building

OWNER: Sharyland Water Supply Corporation
Sherilyn Dahlberg
4210 E. Main Ave.
Alton, TX 78573

ARCHITECT: Milnet Architectural Services, PLLC.
608 South 12th Street
McAllen, Texas 78501

RFCSP DEADLINE: **Thursday, November 8, 2018 @ 3:00 p.m.**

INVITATION: Your firm is invited to submit Competitive Sealed Proposals to the Owner, at the Owner's address indicated above, for the work described above, on or before the RFCSP deadline indicated above. The proposals shall be sealed and proposals sent after the RFCSP Deadline will not be accepted.

PRE-PROPOSAL CONFERENCE: A Pre-Proposal Conference will be conducted at the Sharyland Water Supply Corporation located 4210 E. Main Ave., Alton, Texas, on **Tuesday, October 30, 2018 at 10:30 a.m.** All contractors proposing to submit competitive sealed proposals on this project are strongly encouraged to attend.

PROPOSALS are invited for the construction of a new 10,800 square foot building for the Owner. The project site is located at the corner of Shary Rd. and E. Main Ave (5 Mile) in Alton, Texas 785735. Construction Services will be selected through Competitive Sealed Proposals in accordance with Chapter 2269 of the Texas Government Code. The Owner will evaluate and rank the proposals on the selection criteria provided for in the Proposal Documents.

OPENING OF PROPOSALS: The Owner shall publicly open and read aloud the submitted proposals on November 8, 2018 at 3:00 pm at the Sharyland Water Supply Corporation located 4210 E. Main Ave., Alton, Texas

INSPECTION OF SITE: The proposed site is also accessible for inspection at other times upon notification to Mrs. Sherilyn Dahlberg, General Manager, at 956-585-6081. Proposers are encouraged to visit the site and assess existing conditions.

PROPOSAL DOCUMENTS: Copies of the Proposal Documents, including Drawings and Project Manual (Proposal Requirements & Contract Forms, General Conditions of the Contract for Construction, Specifications) may be obtained, from the Architect's office by depositing \$250.00 in cash, check or money order payable to Milnet Architectural Services PLLC. Deposits will be refunded in full if the complete, undamaged Contract Documents are returned within **10 days** of the proposal Deadline date. Copies of the proposal Documents are on file at the Architect's office, Builders Exchange of Texas, and at the local Associated General Contractors (AGC) and Dodge Plan Rooms. The successful proposer will be required to enter into the contract in substantially the same form as provided in the Contract Documents. Electronic copies of the construction documents can be provided on CD ONLY for a fee of \$50 which is non-refundable.

PROPOSAL SECURITY: Proposers will be required to provide Proposal Security in the form of a Proposal Bond in the amount of 5 percent of the largest possible total proposal, including consideration of alternates, with each proposal. A Proposal Bond shall be issued by a Surety acceptable to the Owner and meeting the requirements of General Conditions of the Contract for Construction. Proposal Bonds shall be prepared on forms meeting all the requirements of applicable States of Texas statutes. Proposal Bonds shall be issued on forms acceptable to the Owner and shall include, as a minimum standard, the information, requirements and standard illustrated by AIA Document A310, latest revised edition available. Failure to provide the Proposal Bond with the proposal will constitute a non-responsive proposal and the proposal will not be considered.

PERFORMANCE AND LABOR AND MATERIAL PAYMENT BONDS: The successful offeror will be required to provide 100% Performance and Labor and Materials Payment Bonds in strict conformance with all the requirements of the Contract Documents. Failure to do so will result in cancellation of the contract award and forfeiture of the Proposal Bond security as liquidated damages.

PROPOSAL WITHDRAWAL: Proposals will be required to be submitted under a condition of irrevocability for a period of 60 days after submission. No proposal may be withdrawn for a period of 60 days.

DELEGATION OF AUTHORITY: Pursuant to Section 2269.053 of the Texas Government Code, Owner hereby provides notice that at the T.B.D board meeting, the Board of Directors delegated the authority to a committee to receive, consider, rank and select a contractor from the submitted competitive sealed proposals and to negotiate a contract. The committee consists of T.B.D.

OWNER'S RIGHT OF REJECTION: The Owner reserves the right to accept or reject any or all offers (competitive sealed proposals).

SECTION 00 21 16 — INSTRUCTIONS TO PROPOSERS

PART 1 - GENERAL

1.1 SECURITY BOND:

- A. Security bond in the amount of five (5%) of the Proposal must accompany each Proposal. Security bond shall be issued by an insurance company authorized to provide bonds on work in the State of Texas and shall be payable to the Owner.

1.2 DOCUMENTS:

- A. Qualified offerors may obtain two (2) sets of Drawings and Project Manuals from: **MILNET ARCHITECTURAL SERVICES PLLC, 608 S. 12th St., McAllen, Texas 78501 (956) 688-5656**
- B. Subcontractors may obtain one (1) set of Drawings and Project Manuals from the office: **MILNET ARCHITECTURAL SERVICES PLLC, 608 S. 12th St., McAllen, Texas 78501 (956) 688-5656**
- C. A deposit of **TWO HUNDRED FIFTY DOLLARS (\$250.00)** will be required for each set of Drawings and Project Manuals issued. Partial sets will not be issued. Make checks payable to **MILNET ARCHITECTURAL SERVICES PLLC**.
- D. Deposits will be refunded to offerors and subcontractors provided that all sets are returned to the **MILNET ARCHITECTURAL SERVICES PLLC** within **TEN {10}** days after date of opening of proposals. The offeror awarded the Project may retain the Construction Documents, and his deposit will be refunded upon execution of the Contract.
- E. Deposit amount will be refunded as soon as practical, provided sets are in good condition. Costs of reproducing missing or damaged sheets or pages will be deducted from the deposit amount.
- F. Offerors may obtain additional sets by paying the cost of reproduction, which will not be refunded, and complete sets shall be returned to the Architects.
- G. Complete sets of Construction Documents shall be used in preparing proposals; neither the Owner nor the Architect assumes any responsibility for errors or misinterpretations resulting from the use of incomplete sets of Construction Documents.
- H. The Owner or Architect in making copies of the Construction Documents available on the above terms, does so only for the purpose of obtaining proposals on the work and does not confer a license or grant for any other use.
- I. Complete sets of Drawings and Project Manuals are on file at the following locations and subcontractors may examine them there:
 - Milnet Architectural Services, 608 S. 12th St., McAllen, TX.
 - A.G.C. PLAN ROOMS, (McAllen, Harlingen, Brownsville)
 - DODGE REPORTS (Online)

1.3 EXAMINATION:

- A. Offerors shall carefully examine the Construction Documents and the construction site to familiarize themselves with existing local conditions under which the Work is to be performed.
- B. Extra payments will not be authorized for work that could have been foreseen by careful examination of the site. Submission of a proposal shall constitute acceptance, by the offeror, of existing site conditions ***work in and around the proposed site*** as a part of the requirements for this work.
- C. Offerors shall carefully examine the Construction Documents to verify that they agree with the Table of Contents in the Project Manual, the Index of Drawings Sheet on the Drawings, and the Cover Page of all Addenda. Offerors shall be responsible for obtaining any pages or sheets which have been inadvertently left out during the printing process.
 - 1. All entities providing proposals on any portion of the work contained in the Construction Documents shall ascertain the completeness of the set of documents.
 - 2. The Construction Documents are printed by an independent vendor and, although the Architect endeavors to check the documents for completeness, the Architect has, in the past, discovered missing or misplaced sheets in the Drawings and the Specifications.
 - 3. Each entity receiving a set of Construction Documents shall check the indexes against the sheets or pages contained in the sets.
 - 4. Should pages or sheets be found to be misplaced or missing, immediately notify the Architect who will give direction as to placement or provide the sheets or pages that are missing.
 - 5. Failure to notify the Architect means the offeror is providing a proposal based on a complete set of Construction Documents.

1.4 INTERPRETATION OF CONSTRUCTION DOCUMENTS:

- A. Offerors shall promptly notify the Architect of any ambiguity, inconsistency or error which they may discover upon examination of the Construction Documents or of the site and local conditions.
- B. **Do not dimension the drawings. Any dimensions, questions, should be directed to the Architect.**
- C. Submit all questions regarding clarification or interpretation of Construction Documents to the Office of the Architects: ***MILNET ARCHITECTURAL SERVICES 608 S. 12TH ST., (attn: Rudy Molina, Jr.) AIA-(956) 688-5656; FAX NUMBER (956) 687-9289.***
- D. Submit all questions in writing. In the interest of time, requests may be made by telephone, but they must be confirmed in writing the same day. Replies to questions will be issued to all Offerors in the form of an Addenda. General contractor and subcontractors shall submit questions in writing forty eight (48) hours prior to opening of proposals.
- E. Make requests for interpretations as early as possible so as to allow adequate time to prepare and issue Addenda.
- F. All Offerors shall check with the Architect within ***six (6) hours*** prior to Opening of proposals to secure all Addenda. The Architect will not be responsible for oral clarification.

1.05 BASIS OF PROPOSALS:

- A. Proposals shall be on a lump sum basis for each and or combined proposal packages and shall include all costs for these projects as described and indicated by the Construction Documents. Basis for proposals shall be on brands, materials, processes, products, persons or organizations, etc.,
- B. Proposals shall include all unit price costs and all Alternate costs as indicated by the Construction Documents and Proposal Form.

1.06 ALTERNATES:

- A. The Owner may, at his option, elect to proceed with any or all Alternates as set forth in the Contract Requirements.
- B. Amount shown in proposal for each Alternate shall include profit, insurance, contingencies and other costs incidental to performance under under such Alternative.
- C. Amount shown in Proposal for each Alternate shall include the making of all changes and the installation of all materials and equipment necessary to the accomplishment of the Alternate requirements.

1.07 PROPOSALS:

- A. Proposals shall be made on unaltered Proposal Forms furnished by the Architect. No oral, telephone or personal Proposals will be considered. All blank spaces shall be properly filled in by typewriter or manually in ink.
- B. Where so indicated by the makeup of the Proposal Form, sums shall be expressed in both words and figures, and in case of discrepancy between the two, the written amount shall govern.
- C. Any alteration or erasure to information entered in the blank spaces must be initialed by the signer of the proposal.
- D. Original typed sheets shall be submitted, signed in longhand below the typed name of the person authorized to bind the offeror to a Contract.
- E. Where offeror is a corporation, Proposal must be signed with the legal name of the corporation followed by the name of the State of Incorporation and the legal signature of a person authorized to bind the corporation to a Contract.
- F. Failure to submit a proposal on the form requested, or the inclusion of conditions, limitations or provisions distorting the intent of the Construction Documents, will render the proposal irregular and subject to rejection.

1.08 SUBMITTALS:

- A. Submit Proposal, Security Bond and other required data in an opaque, sealed envelope. Submit proposal at the time and place shown in the Notice for competitive Sealed Proposals.
- B. Envelope shall be addressed to the Owner and identified with the Project Name and the name and address of the offeror. **Please submit one (1) original and three (3) copies of proposal.**
- C. If the Proposal sent by mail, the sealed envelope shall be enclosed in a separate mailing envelope with the notation "PROPOSAL ENCLOSED" on the face thereof. No envelopes shall be opened until the date and time proposals are to be received.

1.09 MODIFICATION OR WITHDRAWAL OF PROPOSAL:

- A. A proposal may not be withdrawn or canceled by the offeror during the stipulated time period following the time and date designated for the receipt of Proposals, unless the award of Contract has been delayed more than sixty (60) days.
- B. Prior to the time and date designated for receipt of Proposals, Proposals submitted early may be modified or withdrawn only by notice to the party receiving Proposals at the place and prior to the time designated for receipt of Proposals.
- C. Modification of Proposals shall be in writing over the signature of the offeror or be by telegram; if by telegram, written confirmation over the signature of offeror must have been mailed and postmarked on or before the date and time set for receipt of proposals; it shall be so worded as not to reveal the amount of the original Proposal.
- D. Withdrawn Proposal may be resubmitted up to the time designated for the receipt of proposals provided that they are then fully in conformance with these Proposal Instructions.
- D. Security bond shall be in an amount sufficient for the proposal as modified or resubmitted.

1.10 CONSIDERATION OF PROPOSAL:

- A. Properly identified Proposals received on time will be considered.
- B. The Owner shall have the right to reject any or all Proposal and in particular to reject a Proposal not accompanied by any required security bond or data required by the Contract Documents or a Proposal in any way incomplete or irregular.
- C. The Owner shall have the right to waive any formality or irregularity in any proposal received.
- D. If the Owner accepts any Alternates, he shall have the right to accept them in any order or combination.
- E. It is the intent of the Owner to award a contract to the offeror submitting the proposal providing the "best value" to the Owner provided the Proposal has been submitted in accordance with the requirements of the Contract Documents, selection criteria and adopted by the Owner.

1.11 LOCATION AND ACCESS TO PREMISES:

- A. The project site location: Refer to Vicinity Drawings.
- B. The offeror shall have free access to the premises for the purpose of acquainting himself with the conditions, delivering equipment, and performing the work necessary to fulfill the contract. Offeror shall cooperate with the other contractors who may concurrently be working on the premises, integrating his work with that of others, all to the best interest of the total work and its orderly completion.

1.12 STATE SALES TAX:

- A. This project is exempt from state taxes. A sales tax exemption certificate may be obtained from the State Comptroller.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION

SECTION 00 42 00 — PROPOSAL FORM FOR COMPETITIVE SEALED PROPOSALS

RE: Sharyland Water Supply Corp
New Building

ATTN: Sherilyn Dahlberg
4210 E. Main Ave.
Alton, TX 78573

The Undersigned proposes to furnish all labor, services, materials, tools, and necessary equipment for the construction of the renovations at the Sharyland Water Supply Corp – New Building (Alton, TX) and to perform the work required for the construction of said project at the location set out by the Drawings, Project Manual and Specifications, in strict accordance with the Contract Documents for the complete work.

In submitting this Proposal, it is understood that this Proposal may not be altered or withdrawn for sixty {60} days from submission date and that the Owner has reserved the right to reject any and all Proposals.

The Undersigned certifies that this Proposal is made in good faith, without collusion or connection with any other person, persons, partnership, company, firm, association, or corporation offering on this work, for the following sum or prices to wit:

PART 1 - BASE PROPOSAL:

\$ _____ (Base proposal number)

\$ _____ (Base proposal words)

_____ (Base proposal words)

ALTERNATE #1: WAREHOUSE, COVERED AREA & CANOPY

\$ _____ (number)

\$ _____ (words)

_____ (words)

ALTERNATE #2: BASKETBALL COURT

\$ _____ (number)

\$ _____ (words)

_____ (words)

ALTERNATE #3: FENCE MASONRY COLUMNS

\$ _____ (number)

\$ _____ (words)

_____ (words)

ALTERNATE #4: DRIVE CONNECTING TO 5 MILE

\$ _____ (number)

\$ _____ (words)

_____ (words)

ALTERNATE #5: NEW GENERATOR, ADD TO RELOCATION OF EXISTING GENERATOR COST.

\$ _____ (number)

\$ _____ (words)

_____ (words)

The Undersigned hereby declares that he has visited the site and has carefully examined the Drawings, Specifications, Contract Documents and Proposal Documents related to the Work covered by his proposal.

Upon receipt of "*NOTICE TO PROCEED*", the Undersigned will immediately execute the formal contract (Agreement).

The Undersigned agrees to commence work within ten (10) days of receiving the Notice to Proceed and to substantially complete the work on or before **300 Calendar days after Notice to Proceed.**

The Contract required will be that Standard Form of the American Institute of Architects and shall provide for payment on accounts of ***ninety-five (95%)*** percent of the value monthly.

The Proposal, the Agreement, the Drawings, the General Conditions, Supplementary General Conditions, the Specifications and any Addenda shall all become a part of the Contract.

I hereby acknowledge receipt of the following Addendum:

BONDING COMPANY (IES):

(Name and address)

The Undersigned proposes to use the following Subcontractors, Manufacturers, Products, Material Suppliers for the principal portions of the work.

NAME(S) OF SUB-CONTRACTORS:

NAME(S) OF MANUFACTURERS:

NAME(S) OF MATERIAL SUPPLIERS:

Name of Company (Proposer)

Printed Name

Address

Title

City State

Signature

Telephone

Sworn to and subscribed before me this _____ day of _____, 2018

SEAL

Notary Public in and for the State of Texas

SEAL (If Proposal is By a Corporation) _____

END OF SECTION

SECTION 00 43 00 – RANKING/SELECTION CRITERIA

1.0 Ranking /Selection Criteria

- A. The selection of offeror will be based on the following: Ranking/Selection Criteria Sharyland Water Supply Corporation retains the right to apply the selection criteria as allowed in Texas Government Code, Sec. 2269.155.

1. Monetary Value: 50 Points Max

Based on Proposals Submitted and Pricing Differential

1.1 Base Proposal

1.2 Alternate Proposal(s)

2. Support Information: 50 Points Max

The following support information shall be submitted in separate sealed envelope attached with proposal.

2.1 Reputation / 2 points each – 8 points maximum

- 2.1A Provide contractor's qualification statement form AIA 305 (to purchase original blank form call LRGV-AIA office 956-994-0939)
- 2.1B Provide information on company acting as surety on performance and payment bonds.
- 2.1C Provide three (3) letters of recommendation/references.
- 2.1D How long has your company been in existence?

2.2 Past experience / 2 points each – 10 points maximum

- 2.2A List all relevant projects for which company has provided services in the past five years. Provide name and telephone number of contact person.
- 2.2B Describe proposed cooperative efforts in working with owner and its agents in resolving construction issues.
- 2.2C Describe history of providing fair assessment of change order pricing and proposed method for detailing cost documentation of change orders.
- 2.2D Explain what types of warranty documents are provided and how well the proposer is on completing warranty work timely and staying on schedule.
- 2.2E In the past, has the proposer worked with Sharyland Water Supply Corp and its agents?

2.3 Contractor Personnel / 4 points each – 8 points maximum

- 2.3A Provide resume of proposed project manager, project superintendent and other key personnel.
- 2.3B Address History and process for maintaining assigned personnel for the duration of the project.

2.4 Workforce / 4 points each – 4 points maximum

- 2.4A Provide list of work to be performed by contractor's own forces and list of proposed subcontractors. (include roofing subcontractor.)

2.5 Times Lines / 4 points each – 8 points maximum

- 2.5A Address history and proposed procedures to adhere to construction schedule from date of notice to proceed to completion of punchlist items.
- 2.5B Address history and procedure for assuring timely payment to subcontractors and suppliers.

2.6 Financial Strength / 2 points each – 4 points maximum

- 2.6A Provide a bank letter of reference with regard to the company's financial strength.
- 2.6B Has the company or company's principals ever filed for bankruptcy?

2.7 Other relevant factors / 8 points maximum

- 2.7A Other relevant factors that the District would consider in selecting a general contractor.

SECTION 00 52 13 — AGREEMENT FORM - STIPULATED SUM

PART 1 - GENERAL

1.1 AGREEMENT FORM:

- A. The modified "Standard Form of Agreement Between Owner and Contractor where the Basis of Payment is a Stipulated Sum", AIA Document A101, 2007 Electronic Format Edition, will be the form used as a Contract for this Project.
- B. General Condition AIA – A201 will be used in this project. See attached
- C. A copy of the Standard AIA Document may be examined at the office of the Architect. Copies may be purchased from the American Institute of Architects, 1735 New York Avenue, N.W., Washington, D.C., 20006.
- D. Modification may be made to the above Agreement & General Conditions A201 form or an Owner provided agreement and general conditions may be utilized. Either of which will be provided to contractor for review upon award of project, for final execution of the contract. See attached.
- E. Section 00 73 00 Supplementary Conditions forms part of this Agreement.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION

SECTION 00 61 00 — PERFORMANCE BOND AND LABOR AND MATERIAL PAYMENT BOND

PART 1 - GENERAL

- 1.1 RELATED DOCUMENTS: PERFORMANCE BOND AND LABOR AND MATERIAL PAYMENT BOND:
- A. The Contractor shall, prior to the execution of the Contract, furnish bonds covering the faithful performance of the Contract and the payment of all obligations arising thereunder in the amount of 100% of the Contract Price covering 100% performance and 100% payment, and with such sureties secured through the contractor's usual sources as may be agreeable to the parties.
 - B. The Contractor shall deliver the required bonds to the Owner not later than the date of execution of the Contract, or if the work is commenced prior thereto in response to a letter of intent, the Contractor shall, prior to commencement of the Work, submit evidence satisfactory to the Owner that such bonds will be finished.
 - C. The Contractor shall require the Attorney-In-Fact who executes the required bonds on behalf of the surety to affix thereto a certificate and current copy of his Power of Attorney.
 - D. Any Payment Bond and Performance Bond furnished pursuant to the provisions of Art. 5160, Vernon's Texas Civil Statutes, connected with this project, shall be furnished by a corporate surety or corporate or corporate sureties in accordance with Article 7.19-1, Vernon's Texas Insurance Code, that has a stated capital and surplus (as reported by it to the Texas Insurance Commission in its most recent report) that is in excess of ten times the stated amount of the Payment Bond or the Performance Bond. Provided however, that if any Payment Bond or any Performance Bond is in an amount in excess of ten percent (10%) of the surety company's capital and surplus (as reported to the Texas Insurance Commission in its most recent report), as a condition to accepting the bond, the Owner must receive written certification and information, satisfactory in form and substance to the Owner, that the surety company has reinsured the portion of the risk that exceeds ten percent (10%) of the surety company's capital and surplus, with one or more reinsurers who are duly authorized, accredited or trustee to do business in the State of Texas. For the purpose of this requirement, any amount reinsured by any reinsurer may not exceed ten percent (10%) of the reinsurer's capital and surplus (as reported to the Texas Insurance Commission by the reinsurer in its most recent report). In the event there is one or more reinsurer, the surety company must provide all necessary information and certification related to the current financial condition of the surety company and any and all reinsurers required by the Owner, together with copies of all reinsurance contracts with the surety company, before any such Payment Bond and Performance Bond is eligible to be considered acceptable by the Owner.
 - E. ALL CONTRACTORS SHALL SUBMIT THE NAME, ADDRESS AND TELEPHONE NUMBER OF THE CORPORATED SURETIES PROVIDING THE PAYMENT BOND AND PERFORMANCE BOND AND THE LOCAL AGENT.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION

SECTION 00 62 76.13 — TAX EXEMPT ORGANIZATION CERTIFICATE

PART 1 - GENERAL

1.1 DEFINITION

- A. This Contract is to be performed for an exempt organization as defined by Title 2; Subtitle E; Chapter 150 of the Texas Limited Sales, Excise and Use Tax Act and Section 151.311 of the State Statutes. The Owner will furnish the Contractor proof or Certificate of Exemption upon award of contract.
- B. Proposer shall not include sales tax in their Proposal.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION

SECTION 00 73 00 — SUPPLEMENTARY CONDITIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS: SUPPLEMENTARY CONDITIONS

- A. The Supplementary Conditions modify, change, delete from or add to the General Conditions and shall apply to each and every Section of the Work as though written in full therein.
- B. The following paragraphs and subparagraphs take precedence over the General Conditions. Where any part of the General Conditions is modified or deleted by the Supplementary Conditions, the unaltered provisions remain in effect.
- C. Paragraph numbers and titles refer to like numbers and titles in the General Conditions.

1.2 EXECUTION, CORRELATION AND INTENT

1.3 Add the following subparagraphs.

- 1.4 1.2.6 Scope paragraphs placed at the beginning of the SECTIONS present a brief indication of the principal Work included in that SECTION, but do not limit Work to subject mentioned nor purport to itemize Work that may be included.

- 1.5 The Relation of Specifications and Drawings shall be equal in authority and priority. Should they disagree in themselves, or with each other, bids shall be based on the most expensive combination of quality and quantity of work indicated. The appropriate Work, in the event of the above mentioned disagreements, shall be determined by the Architect, at no additional cost to the Owner.

- 1.6 1.2.8 Failure to report a conflict in the Contract Documents, prior to opening of Proposal, shall be deemed evidence that the Contractor has elected to proceed in the more expensive manner, at no additional cost to the Owner.

- A. 1.2.9 The Specifications have been partially “streamlined” and some words and phrases have been intentionally omitted. Missing portions shall be supplied by inference as with notes on drawings.
- B. 1.2.10 The words “approved”, “inspected”, “directed”, “selected”, and similar words and phrases shall be presumed to be followed by “by Architect”. The words “satisfactory”, “submitted”, “reported”, and similar words and phrases shall be presumed to be followed by “to Architect”. Words like “install”, “provide”, “locate”, “furnish”, and “supply” shall be construed to include complete furnishing and installing of construction. Words like “Bids”, “Bidders”, shall be construed to be “Proposals”, “Proposers”, or “offers”, offerors”, respectively.

C. INFORMATION AND SERVICES REQUIRED OF THE OWNER

- D. Delete 2.2.5 and replace with the following subparagraph.

- E. 2.2.5 The General Contractor will be furnished, free of charge, fifteen (15) sets of Drawings and Specifications for use in construction of this Project. Additional Drawings and Specifications will be

furnished the General Contractor at the Contractor's expense, but shall remain the property of the Architect. Cost of additional sets will be the cost of reproduction.

F. LABOR AND MATERIALS

G. Add the following subparagraphs 3.4.3 and 3.4.4 to 3.4:

H. After the Contract has been executed, the Owner and the Architect will consider a formal request for the substitution of products in place of those specified only under the conditions set forth in the General Requirements (Division 1 of the Specifications).

I. By making requests for substitutions based on subparagraph 3.4.3 above, the Contractor:

1. Represents that the Contractor has personally investigated the proposed substitute product and determined that it is equal or superior in all respects to that specified;
2. Represents that the Contractor will provide the same warranty for the substitution that the Contractor would for that specified;
3. Will coordinate the installation of the accepted substitute, making such changes as may be required for the Work to be complete in all respects, all at no additional cost to the Owner.

7.3 CONSTRUCTION CHANGE DIRECTIVES

7.3.3.1 CHANGE TO READ:

Mutual acceptance of a lump sum properly itemized in accordance with 7.3.6.1, 7.3.6.2 and 7.3.6.3. Items listed in 7.3.6.4 and 7.3.6.5 shall be a part of the overhead scheduled 7.3.10 following. Items shall be supported by sufficient substantiating data to permit evaluation;

7.3.6 In the first sentence, delete the words "a reasonable allowance for overhead and profit" and substitute "an allowance for overhead and profit in accordance with Clauses 7.3.10.1 through 7.3.10.6 following:

7.3.6.4 DELETE the final "and" then add the following to the sentence: are a part of overhead schedule in 7.3.10 following".

7.3.6.5 ADD the following to the sentence: "are apart of overhead schedule in 7.3.10 following".

ADD the following subparagraph 7.3.10 to 7.3:

7.3.10 In subparagraph 7.3.6, the allowance for the combined and profit included in the total cost to the Owner shall be based on the following schedule:

1. For the Contractor, for Work performance by the Contractor's own forces, 10 percent of the cost.
2. For the Contractor, for Work performance by the Contractor's contractor, 6 percent of the amount due to the Sub-subcontractor.
3. For each Subcontractor or Sub-subcontractor involved, for Work performed by that Subcontractor's or Sub-subcontractor's own forces, 10 percent of the cost.
4. For each Subcontractor, for Work performed by the Subcontractor's, Sub-subcontractor's, 6 percent of the amount due the Sub-subcontractor.
5. Cost to which overhead and profit is to be applied shall be determined in accordance with Subparagraph 7.3.6.
6. In order to facilitate checking of quotations for extras or credits, all proposals, except those so minor that their propriety can be seen by inspection, shall be accompanied by a complete itemization of costs including labor, materials and Subcontracts. Labor and materials shall be itemized in the manner prescribed above. Where major cost items are Subcontracts, they shall be itemized also. In no case will a change involving over \$500.00 be approved without such itemization.

8.1 DEFINITIONS

Add the following subparagraph.

8.1.5 The term working Day as used in the Contract Documents for extensions of time shall mean normal working day excluding weekends and legal holidays.

8.3 DELAYS AND EXTENSIONS OF TIME

Delete paragraph 8.3.2 and replace with the following subparagraph.

8.3.2 Any claim for extension of time shall be made in writing to the Architect not more than ten (10) days after the commencement of the delay; otherwise, it shall be waived. In case of a continuing delay only one claim is necessary. In case of claims for extensions of time because of adverse weather, such extensions of time shall be granted only when such adverse weather prevented the execution of major items of Work on normal working days

and exceeds the number of days included in the Contract time. The Contractor shall provide an estimate of the probable effect of such delay on the progress of the Work. In the event an extension of time is granted such extension shall be the complete claim allowed. Contractor shall not be entitled to additional compensation such as, but not limited to, compensable extended overhead or lost profit.

9.6 PROGRESS PAYMENTS

Add the following subparagraph to 9.6.1

1. Unless otherwise indicated in the Agreement, the Owner will pay ninety-five (95%) percent of the amount due the Contractor on account of progress payment until final payment.

Add the following paragraphs to 9.11 to Article 9:

9.11 LIQUIDATED DAMAGES:

9.11.1 If the Contractor neglects, fails or refuses to complete the Work within the time specified in the Contract, or any proper extension thereof granted by the Owner, then the Contractor does hereby agree, as part consideration of the awarding of this Contract, to pay the Owner the amount of **SEVEN HUNDRED DOLLARS (\$700.00)** not as a penalty but as a liquidated damages for such breach of Contract as hereinafter set forth, for each and every calendar day that the Contractor shall be in default after the time stipulated in the Contract for completing the Work.

9.11.2 The said amount is fixed and agreed upon by and between the Contractor and the Owner because of the impracticability and extreme difficulty of fixing and ascertaining the actual damages the Owner would, in such event, sustain.

9.11.3 TIME SPECIFIED IN CONTRACT IS AS FOLLOWS:

The Undersigned agrees to commence work within ten (10) days of Notice to Proceed and to substantially complete the work on or before October 4, 2019.

11.1 Article 11.1 Modify to include the following:

The Contractor shall furnish three (3) copies of insurance certificates to the Architect's office two (2) days after award of the project and before signing of the contract. The Certificate of Insurance shall include thirty (30) Day Notice of Cancellation; Architect and Owner shall receive the same notice in regard to any policy changes.

Owner and Architect shall be named as additional insured by the Contractor but not with respect to payment of premiums due under Contractor's policies. Coverage shall include any off site-work on adjacent public or private property.

Insurance Company/Carrier issuing the certificates must be listed by A.M. Best and have an "A" rating or better and based in the United States Mainland.

The insurance as required in Article 11.1 shall have "Minimum Limits" as follows:

A. WORKER'S COMPENSATION INSURANCE: Statutory Requirements-

1. All States Endorsements (Broad)
2. Voluntary Compensation
3. Waiver of Subrogation Endorsement

B. MINIMUM EMPLOYER'S LIABILITY: \$100,000/\$100,000/\$500,000

C. COMPREHENSIVE GENERAL LIABILITY INSURANCE MINIMUM LIABILITY AND COVERAGE:

1. Bodily Injury \$500,000 each person/\$500,000 each occurrence
2. Property Damage \$100,000 each occurrence/\$100,000 aggregate

OR-

3. \$500,000 Combined Single Limit Per Occurrence Bodily Injury and Property Damage.

- a. Premises and operations coverage
- b. Explosion and collapse hazard coverage
- c. Underground hazard coverage
- d. Products/completed operation hazard coverage with limits and coverage continuing one (1) year after job completion.
- e. Broad Form property damage coverage
- f. Personal injury coverage
- g. Waiver of subrogation endorsement
- h. Contractual liability (Broad Form) coverage
- i. Independent contractors coverage (Owners, Architects, and Contractors protective)

NOTE: If General Liability coverage is written on a "Claims Made" basis, the Certificate of Insurance should so indicate. If so written, Contractor agrees that coverage so certified beyond job completion and that coverage written will apply to claims made DURING CONSTRUCTION AND FOR ONE (1) YEAR THEREAFTER.

- D. AUTOMOBILE LIABILITY INSURANCE with minimum limits of:
1. Bodily Injury: \$250,000 each person/\$500,000 each occurrence
 2. Property Damage: \$250,000 each occurrence/\$500,000 Combined Single Limit per Occurrence Bodily Injury and Property Damage.
 3. Automobile Liability Insurance shall include coverage for owned, non-owned, and hired vehicles with limits not less than shown above.
- E. OWNER'S AND CONTRACTOR'S PROTECTIVE LIABILITY:
1. Bodily Injury \$500,000 Single limit each occurrence
 2. Property Damage \$250,000 each occurrence/\$250,000 aggregate
- F. UMBRELLA LIABILITY:
Minimum combined single limits \$100,000 with same inception and expiration dates as underlying liability policies and with coverage no less broad than in primary program.
- G. BUILDER'S RISK INSURANCE:
The Contractor shall FURNISH AND PAY FOR and issue a Certificate of Builder's Risk Coverage to the Owner/Architect in accordance with the General Conditions and Conditions of the Contract.
- H. ARTICLE 11.4: PERFORMANCE BOND AND PAYMENT BOND:
Delete in its entirety and substitute the following:
11.4.1: Prior to signing of the Contract, the CONTRACTOR, at HIS/HER OWN EXPENSE, shall furnish a Performance Bond, and a Labor and Materials Payment Bond for one hundred (100%) percent of the Contract price on such form and with such sureties as the Owner may approve. ***Surety company furnishing the Bond must be listed by A.M. BEST and have an "A" rating or better and be based in the United States Mainland and authorized to provide such bonds on public work in the State of Texas.***
- J. Any Payment Bond and Performance Bond furnished pursuant to the provisions of Art. 5160, Vernon's Texas Civil Statutes, connected with this project, shall be furnished by a corporate surety or corporate or corporate sureties in accordance with Article 7.19-1, Vernon's Texas Insurance Code, that has a stated capital and surplus (as reported by it to the Texas Insurance Commission in its most recent report) that is in excess of ten times the stated amount of the Payment Bond or the Performance Bond. Provided however, that if any Payment Bond or any Performance Bond is in an amount in excess of ten percent (10%) of the surety company's capital and surplus (as reported to the Texas Insurance Commission in its most recent report), as a condition to accepting the bond, the Owner must receive written certification and information, satisfactory in form and substance to the Owner, that the surety company has reinsured the portion of the risk that exceeds ten percent (10%) of the surety company's capital and surplus, with one or more reinsurers who are duly authorized, accredited or trusted to do business in the State of Texas. For the purpose of this requirement, any amount reinsured by any reinsurer may not exceed ten percent (10%) of the reinsurer's capital and surplus (as reported to the Texas Insurance Commission by the reinsurer in its most recent report). In the event there is one or more reinsurer, the surety company must provide all necessary information and certification related to the current financial condition of the surety company and any and all reinsurers required by the Owner, together with copies of all reinsurance contracts with the surety company, before any such Payment Bond and Performance Bond is eligible to be considered acceptable by district.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION



Geotechnical Engineering Report

SWSC – New Campus

Alton, Texas

August 3, 2018

Terracon Project No. 88185036

Prepared for:

Sharyland Water Supply Corporation

Alton, Texas

Prepared by:

Terracon Consultants, Inc.

Pharr, Texas

terracon.com

Terracon

Environmental



Facilities



Geotechnical



Materials

August 3, 2018

Sharyland Water Supply Corporation
4210 E. Main Avenue
Alton, Texas 78573



Attn: Ms. Sherilyn Dahlberg, General Manager

Re: Geotechnical Engineering Report
SWSC – New Campus
Shary Road (FM 494) and 5 Mile Line (SWQ)
Alton, Texas
Terracon Project No. 88185036

Dear Ms. Dahlberg:

We have completed the Geotechnical Engineering services for the above referenced project. This study was performed in general accordance with Terracon Proposal No. P88185036 dated July 11, 2018. This report presents the findings of the subsurface exploration and provides geotechnical recommendations concerning earthwork and the design and construction of foundations and pavements for the proposed project.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report, or if we may be of further service, please contact us.

Sincerely,

Terracon Consultants, Inc.

(Texas Firm Registration No.: F-3272)

A handwritten signature in blue ink, appearing to read "S Chacón".

Stephany Chacón, E.I.T.
Staff Engineer


A handwritten signature in blue ink, appearing to read "Alfonso A. Soto".

Alfonso A. Soto, P.E., D.GE
Principal



REPORT TOPICS

REPORT SUMMARY	i
INTRODUCTION	1
SITE CONDITIONS	1
PROJECT DESCRIPTION	2
GEOTECHNICAL CHARACTERIZATION	3
GEOTECHNICAL OVERVIEW	4
EARTHWORK	5
SHALLOW FOUNDATIONS	9
DEEP FOUNDATIONS	14
SEISMIC CONSIDERATIONS	17
FLOOR SLABS	18
PAVEMENTS	21
GENERAL COMMENTS	27

Note: This report was originally delivered in a web-based format. **Orange Bold** text in the report indicates a referenced section heading. The PDF version also includes hyperlinks which direct the reader to that section and clicking on the  logo will bring you back to this page. For more interactive features, please view your project online at client.terracon.com.

ATTACHMENTS

EXPLORATION AND TESTING PROCEDURES

SITE LOCATION AND EXPLORATION PLANS

EXPLORATION RESULTS (Boring Logs and Laboratory Data)

SUPPORTING INFORMATION (General Notes and Unified Soil Classification System)

REPORT SUMMARY

Topic ¹	Overview Statement ²
Project Description	We anticipate that the project may include the construction of two single-story buildings of approximately 10,850 (office) and 6,000 (warehouse) square feet (sf) in footprint plan area. Development should also include construction of a basketball court, canopy structure and flexible and/or rigid pavements for the main access lanes and parking areas.
Geotechnical Characterization	<ul style="list-style-type: none"> ■ Groundwater was encountered at depths between 6½ and 10 feet below existing grade during drilling operations. ■ The subsurface soils at this site generally consist of Clayey Sand (SC) and Fat Clay (CH).
Potential Vertical Rise (PVR)	The existing Potential Vertical Rise (PVR) of the soils within the proposed building area in present condition is about 1 inch or less.
Seismic Site Classification	The subsurface conditions within the site are consistent with the characteristics of Site Class D as defined in the International Building Code (IBC) Site Classification.
Foundations	A shallow foundation system would be appropriate to support the structural loads of the proposed buildings, provided the pad is prepared as recommended in this report. Deep foundations may be used for the proposed canopy.
Earthwork	The subgrade should be prepared as noted in Earthwork .
Pavements	<p>Flexible and rigid pavement systems may be considered for this project. We anticipate traffic may consist primarily of small vehicles, midsize trucks and occasional garbage trucks.</p> <p>The subgrade should be prepared as noted in Earthwork, flexible pavement sections vary from 2 to 2½ inches of Hot Mix Asphaltic Concrete (HMAC) over 6 to 10 inches of granular base material with treated subgrade or moisture conditioned subgrade. The rigid pavement system varies from 5 to 7 inches of reinforced concrete with moisture conditioned subgrade.</p>
General Comments	This section contains important information about the limitations of this geotechnical engineering report.
<ol style="list-style-type: none"> 1. If the reader is reviewing this report as a pdf, the topics above can be used to access the appropriate section of the report by simply clicking on the topic itself. 2. This summary is for convenience only. It should be used in conjunction with the entire report for design purposes. 	

Geotechnical Engineering Report
SWSC – New Campus
Shary Road (FM 494) and 5 Mile Line (SWQ)
Alton, Texas
Terracon Project No. 88185036
August 3, 2018

INTRODUCTION

This report presents the results of our subsurface exploration and geotechnical engineering services performed for the proposed SWSC – New Campus to be located in the southwest quadrant (SWQ) of the intersection of Shary Road (FM 494) and 5 Mile Line in Alton, Texas. The purpose of these services is to provide information and geotechnical engineering recommendations relative to:

- Subsurface soil conditions
- Groundwater conditions
- Site preparation and earthwork
- Excavation considerations
- Foundation design and construction
- Floor slab design and construction
- Seismic site classification per IBC
- Pavement design and construction

The geotechnical engineering scope of services for this project included the advancement of 8 test borings to depths ranging from approximately 5 to 25 feet below existing site grades.

Maps depicting the site and boring locations are shown in the **Site Location** and **Exploration Plan** sections, respectively. The results of the laboratory testing performed on soil samples obtained from the site during the field exploration are included on the boring logs in the **Exploration Results** section of this report.

SITE CONDITIONS

The following description of site conditions is derived from our site visit in association with the field exploration and our review of publicly available geologic and topographic maps.

Item	Description
Parcel Information	The project site is located on the SWQ of Shary Road (FM 494) and 5 Mile Line in Alton, Texas. Boring B-1: Latitude: 26.2790° N Longitude: 98.2749° W. See Site Location

Item	Description
Existing Improvements	Undeveloped land.
Current Ground Cover	Native grasses and soils.
Existing Topography	Relatively flat and level.
Geology	<p>Based on the Geologic Atlas of Texas, McAllen – Brownsville prepared by The University of Texas, the site is located on the Lissie Formation of the Pleistocene Period of the Quaternary Age. The soils are mostly composed of clay, silt, sand, gravel and caliche. The soils are gray to brown to pale yellow in color. The gravel is mainly siliceous and locally cemented by and interbedded with sandy caliche. The caliche is massive to nodular. The surface is characterized by many undrained circular to irregular depressions, by relic clay dunes, and by stabilized northwest-trending longitudinal dunes.</p> <p>The Windblown Deposits of the Recent (Holocene) Period of the Quaternary Age is also mapped at this site. These soils are stabilized sand dune deposits with strong relict eolian grain, sparse grass and includes active blowout areas with depressed relief and hummocky. The areas locally become fresh-water marsh in the wet season and well stabilized sand dunes with dense live-oak mottos and scrub. The soils are of moderate to very high permeability, low to moderate water-holding capacity, low compressibility, low shrink-swell potential, good to fair drainage, high shear strength, low plasticity and a shallow water table.</p>

PROJECT DESCRIPTION

Item	Description
Information Provided	By Ms. Patrice Berglund, PMP with SDI Engineering, LLC on April 3, 2018.
Project Description	We anticipate that the project may include the construction of two single-story buildings of approximately 10,850 (office) and 6,000 (warehouse) square feet (sf) in footprint plan area. Development should also include construction of a basketball court, canopy structure, and flexible and/or rigid pavements for the main access lanes and parking areas.
Construction Type	We anticipate that the building construction may consist of CMU walls with steel frame supported on a shallow foundation system.
Finished Floor Elevation (FFE)	Information was not provided at this time. Assumed to be about 2 feet above existing grade.
Maximum loads (assumed)	<ul style="list-style-type: none"> ■ Columns: 30- 50 kips ■ Walls: 3 kips per linear foot ■ Slabs: 250 pounds per square foot

Item	Description
Pavements	Flexible and rigid pavements may be considered for this project.
Estimated Start of Construction	Information was not provided at this time.

GEOTECHNICAL CHARACTERIZATION

Subsurface Profile

Subsurface conditions at the boring locations can be generalized as follows:

Description	Depth (ft)	Plasticity Index (%)	In-situ Moisture Content (%)	Moisture content vs. Plastic limit ¹ (%)		SPT N-Value ² (bpf)	Fines ³ (%)
				Dry	Wet		
Clayey Sand (SC) ⁴	0 - 10	16 - 33	3 - 43	2 - 11	3 - 5	3 - 10	33 - 47
Fat Clay (CH)	6½ - 25	33 - 65	20 - 32	4 - 5	4	6 - 30	55 - 63

1. The difference between a soil sample's in-situ moisture content and its corresponding plastic limit.
2. bpf = blows per foot.
3. Amount of material in-soil finer than the No. 200 mesh (75-µm) sieve.
4. With Sandy Lean Clay (CL) seams

Conditions encountered at each boring location are indicated on the individual boring logs shown in the **Exploration Results** section and are attached to this report. Stratification boundaries on the boring logs represent the approximate location of changes in native soil types; in situ, the transition between materials may be gradual.

Groundwater Conditions

The boreholes were observed during and after completion of drilling for the presence and level of groundwater. The water levels observed are noted on the attached boring logs, and are summarized below.

Location	Depth to groundwater (feet)	
	During drilling	15 minutes after initial groundwater reading
B-1	7	6½
B-2	7½	6½

B-3	10	9
* Groundwater was not observed in the rest of the borings.		

Groundwater level fluctuations occur due to seasonal variations in the amount of rainfall, runoff and other factors not evident at the time the borings were performed. Therefore, groundwater levels during construction or at other times in the life of the structure may be higher or lower than the levels indicated on the boring logs. The possibility of groundwater level fluctuations should be considered when developing the design and construction plans for the project. The boreholes were backfilled with on-site soil cuttings after completion of the groundwater level observations.

GEOTECHNICAL OVERVIEW

Our findings indicate the proposed building structure can be supported on a shallow foundation system. The desired foundation system may be used at this site provided the site and foundation are designed and constructed as recommended in this report.

The suitability and performance of a soil supported foundation for a structure depends on many factors including the magnitude of soil movement expected, the type of structure, the intended use of the structure, the construction methods available to stabilize the soils, and our understanding of the owner's expectations of the completed structure's performance.

Expansive soils and very loose to loose compressible soils are present on this site. This report provides recommendations to help mitigate the effects of soil settlement, shrinkage and expansion. However, even if these procedures are followed, some movement in the structure should be anticipated. Eliminating the risk of movement may not be feasible, but it may be possible to further reduce the risk of movement if significantly more expensive measures are used during construction. We would be pleased to discuss other construction alternatives with you upon request.

Geotechnical engineering recommendations for foundation systems and other earth connected phases of the project are outlined below. The recommendations contained in this report are based upon the results of data presented herein, engineering analyses, and our current understanding of the proposed project.

The **General Comments** section provides an understanding of the report limitations.

EARTHWORK

Earthwork will include clearing and grubbing, excavations and fill placement. The following sections provide recommendations for use in the preparation of specifications for the work. Recommendations include critical quality criteria as necessary to render the site in the state considered in our geotechnical engineering evaluation for foundations and pavements.

Site Preparation

Construction areas should be stripped of all vegetation, topsoil and other unsuitable material. Additional excavation as recommended in this report or as needed should be performed within the proposed building area. Once final subgrade elevation has been achieved, the exposed subgrade should be carefully proofrolled with a 15-ton pneumatic roller or a fully loaded dump truck to detect weak zones in the subgrade. Special care should be exercised when proofrolling the fill soils to detect soft/weak areas. Weak areas detected during proofrolling, as well as zones of fill containing organic matter and/or debris should be removed and replaced with select fill in the proposed building area. Proper site drainage should be maintained during construction, so that ponding of surface runoff does not occur and cause construction delays and/or inhibit site access.

Subsequent to proofrolling, and just prior to placement of fill, the exposed subgrade within the construction area should be evaluated for moisture and density. If the moisture, density, and/or the requirements do not meet the criteria described in the table below, the subgrade should be scarified to a minimum depth of 8 inches, moisture adjusted and compacted to at least 95 percent of the Standard Effort (ASTM D 698) maximum dry density. Select fill should meet the following criteria.

Fill Material Types

Engineered fill should consist of approved materials, free of organic material, debris and particles larger than about 2 inches. The maximum particle size criteria may be relaxed by the geotechnical engineer of record depending on construction techniques, material gradation, allowable lift thickness and observations during fill placement. Soils for use as engineered fill material should conform to the following specifications:

Fill Type ¹	USCS Classification	Acceptable Location for Placement
Aggregate Base Course ²	SC, GC, Caliche, Crushed Limestone, Crushed Concrete	Top 6 inches of building pad area.
Select Fill	CL and/or SC (7≤PI≤20)	Must be used to construct the building pad, pavements and all grade adjustments within the construction area.
On-Site Soils	SC	On-site SC soils are suitable for use as fill within the building, pavement and landscaping areas.

1. Prior to any filling operations, samples of the proposed borrow and on-site materials should be obtained for laboratory moisture-density testing. The tests will provide a basis for evaluation of fill compaction by in-place density testing. A qualified soil technician should perform sufficient in-place density tests during the filling operations to evaluate that proper levels of compaction, including dry unit weight and moisture content, are being attained.
2. Crushed limestone and crushed concrete material should meet the requirements of 2014 TxDOT Item 247, Type A, or D, Grades 1-2 and 3. The select fill materials should be free of organic material and debris, and should not contain stones larger than 2 inches in the maximum dimension. The clayey gravel and caliche materials should meet the gradation requirements of Item 247, Type B, Grades 1-2 and 3 as specified in the 2014 TxDOT Standard Specifications Manual and a Plasticity Index between 7 and 20.

Fill Compaction Requirements

Structural and general fill should meet the following compaction requirements.

Item	Description
Fill Lift Thickness	The fill should be placed in thin; loose lifts of about 8 inches, with compacted thickness not exceeding 6 inches.
Compaction Requirements (on-site soils and select fill)	The on-site soils and select fill should be compacted to at least 95 percent of The Standard Effort (ASTM D698) maximum dry density within 2 percentage points of the optimum moisture content.

Wet Weather/Soft Subgrade Considerations

Construction operations may encounter difficulties due to the wet or soft surface soils becoming a general hindrance to equipment due to rutting and pumping of the soil surface, especially during and soon after periods of wet weather.

If the subgrade cannot be adequately compacted to minimum densities as described above, one of the following measures will be required: 1) removal and replacement with select fill, 2) chemical treatment of the soil to dry and increase the stability of the subgrade, or 3) drying by natural means if the schedule allows.

In our experience with similar soils in this area, chemical treatment is the most efficient and effective method to increase the supporting value of wet and weak subgrade. Terracon should be contacted for additional recommendations if chemical treatment of the soils is needed.

Prior to placing any fill, all surface vegetation, topsoil, possible fill material and any otherwise unsuitable materials should be removed from the construction areas. Wet or dry material should either be removed or moisture conditioned and recompacted. After stripping and grubbing, the subgrade should be proof-rolled where possible to aid in locating loose or soft areas. Proof-rolling can be performed with a 15-ton roller or fully loaded dump truck. Soft, dry and low-density soil should be removed or compacted in place prior to placing fill.

Grading and Drainage

Positive drainage should be provided during construction and maintained throughout the life of the development. Infiltration of water into utility trenches or foundation excavations should be prevented during construction. Planters and other surface features which could retain water in areas adjacent to the building should be sealed or eliminated. In areas where sidewalks or paving do not immediately adjoin the structure, we recommend that protective slopes be provided with a minimum grade of approximately 3 percent for at least 10 feet from perimeter walls, except in areas where ADA ramps are required, these areas should comply with state and local regulations. Backfill against exterior walls, and in utility and sprinkler line trenches, should be well compacted and free of all construction debris to reduce the possibility of moisture infiltration.

Downspouts, roof drains or scuppers should discharge into extensions when the ground surface beneath such features is not protected by exterior slabs or paving. Consideration should be given to extending drainage piping to day light at the face of curbs then empty onto pavement surfaces. Sprinkler systems should not be installed within 5 feet of foundation walls. Landscaped irrigation adjacent to the foundation systems should be minimized or eliminated.

Where paving or flatwork abuts the structure, effectively seal and maintain joints to prevent surface water infiltration. The joint between the sidewalk curb and building should be sealed. The sidewalk curb along the building line is recommended to prevent water from standing over the joint between the building and sidewalk should the outside edge of the slab rise due to soil swelling at the sidewalk edge.

Utility trenches are a common source of water infiltration and migration. All utility trenches that penetrate beneath the building should be effectively sealed to restrict water intrusion and flow through the trenches that could migrate below the building.

We recommend constructing an effective clay “trench plug” that extends at least 5 feet out from the face of the building exterior. The plug material should consist of clay compacted at a water

content at or above the soils optimum water content. The clay fill should be placed to completely surround the utility line and be compacted in accordance with recommendations in this report.

Earthwork Construction Considerations

Shallow excavations, for the proposed structures, are anticipated to be accomplished with conventional construction equipment. Upon completion of filling and grading, care should be taken to maintain the subgrade water content prior to construction of floor slabs. Construction traffic over the completed subgrades should be avoided. The site should also be graded to prevent ponding of surface water on the prepared subgrades or in excavations. Water collecting over, or adjacent to construction area should be removed. If the subgrade freezes, desiccates, saturates, or is disturbed, the affected material should be removed, or the materials should be scarified, moisture conditioned, and recompact, prior to floor slab construction.

As a minimum, excavations should be performed in accordance with OSHA 29 CFR, Part 1926, Subpart P, "Excavations" and its appendices, and in accordance with any applicable local, and/or state regulations.

Construction site safety is the sole responsibility of the contractor who controls the means, methods, and sequencing of construction operations. Under no circumstances shall the information provided herein be interpreted to mean Terracon is assuming responsibility for construction site safety, or the contractor's activities; such responsibility shall neither be implied nor inferred.

Construction Observation and Testing

The earthwork efforts should be monitored under the direction of the Geotechnical Engineer. Monitoring should include documentation of adequate removal of vegetation and top soil, proof-rolling and mitigation of areas delineated by the proof-roll to require mitigation.

Each lift of compacted fill should be tested, evaluated, and reworked as necessary until approved by the Geotechnical Engineer prior to placement of additional lifts. Each lift of fill should be tested for density and water content at a frequency of at least one test for every 2,500 square feet of compacted fill in the building area and 5,000 square feet in pavement areas. One density and water content test for every 50 linear feet of compacted utility trench backfill.

In areas of foundation excavations, the bearing subgrade should be evaluated under the direction of the Geotechnical Engineer. In the event unanticipated conditions are encountered, the Geotechnical Engineer should prescribe mitigation options.

In addition to the documentation of the essential parameters necessary for construction, the continuation of the Geotechnical Engineer into the construction phase of the project provides the

continuity to maintain the Geotechnical Engineer's evaluation of subsurface conditions, including assessing variations and associated design changes.

SHALLOW FOUNDATIONS

If the site is prepared in accordance with the requirements noted in **Earthwork**, the following design parameters are applicable for shallow foundations.

Design Parameters - Slab-on-Grade Foundation

The foundation design parameters presented below are based on our evaluation using published theoretical and empirical design methods.

These were developed based on our understanding of the proposed project, our interpretation of the information and data collected as a part of this study, our area experience and the results of our evaluation. The structural engineer should select the appropriate slab design method and code for the amount of anticipated slab movement indicated.

The slab-on-grade foundation may be designed using the following parameters provided the subgrade is prepared as outlined in the **Earthwork** and **Floor Slabs** sections of this report:

Item	Description
Select Fill Pad	Minimum 2 feet of select fill over 6 inches of moisture conditioned and compacted on-site soils.
Allowable Bearing Pressure ¹ ■ Compacted select fill	Net Total Load - 2,000 psf
Climatic Rating	15
Design Plasticity Index	19
Soil Support Index	0.95
Estimated PVR ²	Less than 1 inch
Approximate total settlement ³	About 1 inch
Estimated Differential Settlement ³	Approximately ½ of total settlement
Min. perimeter grade beam embedment ⁴	18 inches below finished grade

Item	Description
1.	The net allowable bearing pressure provided above include a factor of safety of at least 2.
2.	The slab-on-grade foundation system should be designed to tolerate the anticipated soil movement and provide satisfactory support to the proposed structure. The foundation should have adequate exterior and interior grade beams to provide sufficient rigidity to the foundation system such that the slab deflections that result are considered tolerable to the supported structure.
3.	This estimated post-construction settlement is assuming proper construction practices are followed. Settlement response of a select fill supported slab is influenced more by the quality of construction than by soil-structure interaction. Therefore, it is essential that the recommendations for foundation construction be strictly followed during the construction phases of the building pad and foundation.
4.	To bear within the select fill or moisture conditioned and recompacted on-site soils. The grade beams may be thickened and widened where necessary to support column loads.

Construction Considerations for Slab-on-grade Foundation

Excavations for grade beams should be performed with equipment capable of providing a relatively clean bearing area. The bottom 6 inches of the excavations should be completed with a smooth-mouthed bucket or by hand labor. The excavations should be neatly excavated and properly formed. Debris in the bottom of the excavation should be removed prior to reinforcing steel placement. Water should not be allowed to accumulate at the bottom of the excavation. Due to the presence of dry soils, caving of grade beam excavation may occur. Therefore, the foundation contractor should be prepared to use forms.

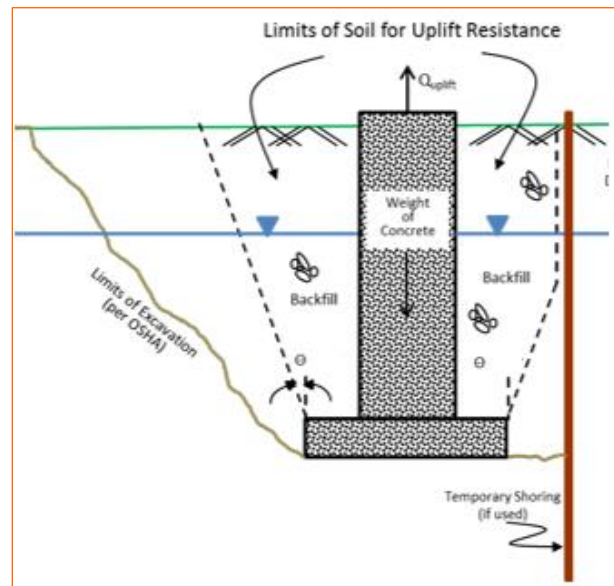
To reduce the potential for groundwater seepage into the excavations and to minimize disturbance to the bearing area, we recommend that concrete and reinforcing steel be placed as soon as possible after the excavations are completed. Excavations should not be left open for more than 36 hours. The bearing surface of the grade beams should be evaluated after excavation is completed and immediately prior to placing concrete.

Design Parameters - Spread Footing Foundation

Spread footings may be considered in the design of the foundations to support the main column loads for the building and canopy. Lateral loads transmitted to the footings should be resisted by a combination of soil-concrete friction on the base of the footing and passive pressure on the side of the footing. To resist lateral forces, a net allowable passive resistance may be utilized for portions of footings extending at least 30 inches below finished grade. If the footing is formed during construction, the open space between the footing and the in-situ soils should be backfilled with concrete. Also, care should be taken to avoid disturbance of the footing bearing area since loose material could increase settlement and decrease resistance to lateral loading.

The spread footings can provide some uplift resistance for those structures subjected to wind or other induced structural loading.

Uplift resistance of spread footings can be developed from the effective weight of the footing and the overlying soils. As illustrated on the subsequent figure, the effective weight of the soil prism defined by diagonal planes extending up from the top of the perimeter of the foundation to the ground surface at an angle, θ , of 20 degrees from the vertical can be included in uplift resistance. The maximum allowable uplift capacity should be taken as a sum of the effective weight of soil plus the dead weight of the foundation, divided by an appropriate factor of safety. A soil unit weight of 120 pcf should be used for the backfill. This unit weight should be reduced to 40 pcf for portions of the backfill or natural soils below the groundwater elevation.



Design values for the footings are presented below.

Item	Description
Minimum Embedment Below Finished Grade ¹	2½ feet
Net Allowable Bearing Pressure ⁷	Total Load - 2,000 psf
Approximate total settlement ²	About 1 inch
Estimated Differential Settlement ³	Approximately ½ of total settlement
Allowable Passive Pressure ⁴	700 psf (if considered)
Coefficient of Sliding Friction ⁵	0.40
Uplift Resistance ⁶	Foundation Weight (150 pcf) & Soil Weight (120 pcf)

Item	Description
1.	To bear within the native soils or select fill.
2.	This estimated post-construction settlement of the shallow footings is without considering the effect of stress distribution from adjacent foundations and assuming proper construction practices are followed. A clear distance between the footings of one footing size should not produce overlapping stress distributions and would essentially behave as independent foundations.
3.	Differential settlement may result from variances in subsurface conditions, loading conditions and construction procedures. The settlement response of the footings will be more dependent upon the quality of construction than upon the response of the subgrade to the foundation loads. We estimate that the differential settlement should be approximately one-half of the total settlement. Settlement of footings will be more sensitive to installation techniques than to soil-structure interaction.
4.	The passive pressure along the exterior of the footings should be neglected unless pavement is provided up to the edge of the structure. For interior footings, the allowable passive pressure may be used for the entire depth of the footing. The passive pressure provided above includes a factor of safety of at least 3.
5.	Lateral loads transmitted to the footings will be resisted by a combination of soil-concrete friction on the base of the footings and passive pressure on the side of the footings.
6.	The ultimate uplift capacity of shallow footings should be reduced by an appropriate factor of safety to compute allowable uplift capacity.
7.	The net allowable bearing pressure provided above include a factor of safety of at least 2.

Construction Considerations for Spread Footing Foundation

As noted in **Earthwork**, the footing excavations should be evaluated under the direction of the Geotechnical Engineer. The base of all foundation excavations should be free of water and loose soil, prior to placing concrete. Concrete should be placed soon after excavating to reduce bearing soil disturbance. Care should be taken to prevent wetting or drying of the bearing materials during construction. Excessively wet or dry material or any loose/disturbed material in the bottom of the footing excavations should be removed/reconditioned before foundation concrete is placed. Due to the presence of dry soils, caving of excavation may occur. Therefore, the foundation contractor should be prepared to use forms.

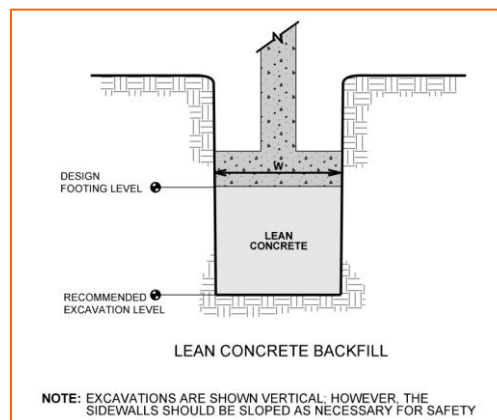
Excavation should be accomplished with a smooth-mouthed bucket. If a toothed bucket is used, excavation with this bucket should be stopped 6 inches above the final bearing surface and the excavation completed with a smooth-mouthed bucket or by hand labor.

If the footing foundations are over-excavated and formed, the backfill around the foundation sides should be achieved with compacted select fill, lean concrete, compacted cement stabilized sand (two sacks cement to one cubic yard of sand) or flowable fill. Compaction of select fill should be as described later in this section of the report.

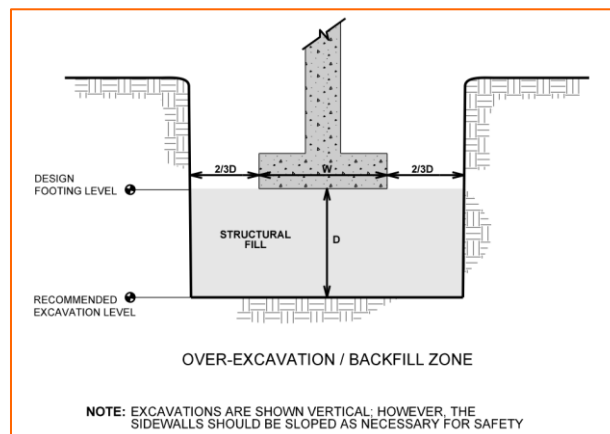
The bearing surface should be excavated with a slight slope to create an internal sump for runoff water collection and removal. If surface runoff water in excess of 2 inches accumulates at the bottom of the excavation, it should be pumped out prior to concrete placement. Under no circumstances should water be allowed to adversely affect the quality of the bearing surface. If the spread footing is buried, backfill above the foundation may be the excavated on-site soils or select fill soils. Backfill soils should be compacted to at least 95 percent of the maximum dry

density as determined by the standard moisture/density relationship test (ASTM D 698). Moisture contents for on-site soils and imported select fill soils should be within 2 percentage points of the optimum moisture content. The backfill should be placed in thin, loose lifts of about 8 inches, with compacted thickness not to exceed 6 inches.

If unsuitable bearing soils are encountered at the base of the planned footing excavation, the excavation should be extended deeper to suitable soils, and the footings could bear directly on these soils at the lower level or on lean concrete backfill placed in the excavations. This is illustrated on the sketch below.



Over-excavation for structural fill placement below footings should be conducted as shown below. The over-excavation should be backfilled up to the footing base elevation, with select fill placed, as recommended in the **Earthwork** section.



DEEP FOUNDATIONS

Drilled Pier Design Parameters

Drilled pier foundations may be considered to support the proposed canopy structure. Drilled piers may be designed using the following parameters.

Description	Column
Minimum embedment depth ¹	13 feet
Maximum embedment depth ¹	25 feet
Allowable bearing pressure	Net total load – 12,000 psf
Average allowable side-shear	700 psf
Estimated uplift pressure (kips) ²	negligible
Minimum percentage of steel ³	As per structural engineer
Approximate total settlement ⁴	1 inch
Estimated differential settlement ⁵	Approximately ½ of total settlement
Allowable passive pressure ⁶	700 psf

1. Below existing grade (grade at the time of our field activities). To be bear within the native clay soils.
2. The magnitude of uplift is difficult to predict and will vary with in-situ moisture contents. Additionally, structural uplift loads on the drilled piers will be resisted by the dead weight of the piers and supported structure plus the weight of a soils wedge above the footing. For uplift resistance, we recommend total unit weights of 120 pounds per cubic foot (pcf) for soil and 150 pcf for reinforced concrete be utilized.
3. The drilled piers should contain sufficient vertical reinforcing steel throughout the entire shaft length to resist uplift (tensile) forces due to post-construction heave of the clay soils.
4. Provided proper construction practices are followed. A clear distance between the piers of three times the pier diameter should be provided to develop the recommended bearing pressures and to control settlements. If this clearance cannot be maintained in every case, the above bearing capacities should be reduced by 20 percent for a clearance between two and two and one half pier diameters. Drilled piers closer than a clearance of two times the diameter are not recommended.
5. Will result from variances in subsurface conditions, loading conditions and construction procedures, such a cleanliness of the bearing area or flowing water in the shaft.
6. For piers placed against an undisturbed vertical face of the in-situ soils. Lateral resistance of the drilled piers is primarily developed by passive resistance of the soils against the side of the pier. Due to surface effects, the lateral resistance of the upper 3 feet of the soils at the surface for exterior piers should be neglected unless area paving is provided up to the edge of the proposed building.

Drilled Pier Construction Considerations

Drilled excavations to a maximum depth of 25 feet beg (at the time of our field activities) may be performed for installation of the drilled piers for the proposed canopy.

Groundwater was observed in the borings between 6½ and 10 feet bgs. Depending on weather conditions, groundwater levels may vary from the levels observed during our field program.

Water must not be allowed to accumulate in the bottom of the pier excavations. Subsurface water and sand soils were observed within the explored depths in the borings. Sloughing is likely to occur below the subsurface water table during construction. Therefore, the contractor should be prepared to remove water from the drilled piers if necessary. We recommend that slurry or casing drilling techniques be used to control sloughing of the subsurface soils during pier construction. Casing should only be used in drilled piers terminating in the Clay soils. Slurry drilling techniques are appropriate for piers terminating in all soil types encountered in the boring.

Slurry Method- Water or a weighted drilling fluid may be considered to install the pier foundations. Slurry displacement drilling can only prevent sloughing and water influx but cannot control sloughing once it has occurred. Therefore, slurry displacement drilling techniques must begin at the ground surface, not after sloughing materials are encountered.

Typical drilling fluids include those which contain polymers or bentonite. If a polymer is used with “hard” mixing water, a water softening agent may be required to achieve intimate mixing and the appropriate viscosity. The polymer manufacturer should be consulted concerning proper use of the polymer. If bentonite slurry is used, the bentonite should be mixed with water several hours before placing in the pier excavation. Prior mixing gives the bentonite sufficient time to hydrate properly. The drilling fluid should only be of sufficient viscosity to control sloughing of the excavation walls and subsurface water flow into the excavation. Care should be exercised while extracting the auger so that suction does not develop and cause disturbance or create “necking” in the excavation walls as described above. Casing should not be employed in conjunction with the slurry drilling technique due to possible trapping of loose soils and slurry between the concrete and natural soil.

The use of weighted drilling fluid when installing drilled pier foundations requires extra effort to ensure an adequate bearing surface is obtained. A clean-out bucket should be used just prior to pier completion in order to remove any cuttings and loose soils which may have accumulated in the bottom of the excavation. Reinforcing steel and concrete should be placed in the excavation immediately after pier completion. A closed-end tremie should be used to place the concrete completely to the bottom of the excavation in a controlled manner to effectively displace the slurry during concrete placement.

When the pier excavation depth is achieved and the bearing area has been cleaned, steel and concrete should then be placed immediately in the excavation. The concrete should be placed completely to the bottom of the excavation with a closed-end tremie in the pier excavation if more than 3 inches of water is ponded on the bearing surface or the slurry drilling technique is used. A short tremie may be used if the excavation has less than 3 inches of ponded water or if the water is pumped out prior to concrete placement. The

fluid concrete should not be allowed to strike the pier reinforcement, temporary casing (if required) or excavation sidewalls during concrete placement.

Casing Method- Casing should provide stability of the excavation walls and should reduce water influx; however, casing may not completely eliminate groundwater influx potential or stability of the pier excavation bottom unless the casing penetrates below any pervious soils. Casing that terminates in pervious soils may generate “boils” due to the head differential between the inside and outside of the casing and require that the casing be extended until the excess seepage or boils are eliminated. Also, in order for the casing to be effective, a “water tight” seal must be achieved between the casing and surrounding clay soils. The drilling subcontractor should determine casing depths and casing procedures. Water that accumulates in excess of 3 inches in the bottom of the pier excavation should be pumped out prior to reinforcing steel and concrete placement. If the water is not pumped out, a closed-end tremie should be used to place the concrete completely to the bottom of the pier excavation in a controlled manner to effectively displace the water during concrete placement. If water is not a factor, concrete may be placed with a short tremie so the concrete is directed to the bottom of the pier excavation. The concrete should not be allowed to ricochet off the walls of the pier excavation nor off the reinforcing steel. If this operation is not successful or to the satisfaction of the foundation contractor, the pier excavation should be flooded with fresh water to offset the differential water pressure caused by the unbalanced water levels inside and outside of the casing. The concrete should be tremied completely to the bottom of the excavation with a closed-end tremie.

Removal of casing should be performed with extreme care and under proper supervision to reduce mixing of the surrounding soil and water with the fresh concrete. Rapid withdrawal of casing or the auger may develop suction that could cause the soil to intrude into the excavation. An insufficient head of concrete in the casing during its withdrawal could also allow the soils to intrude into the wet concrete. Both of these conditions may induce “necking”, a section of reduced diameter, in the pier.

All aspects of concrete design and placement should comply with the American Concrete Institute (ACI) 318-14 Code Building Code Requirements for Structural Concrete; ACI 336.1-01 entitled Reference Specification for the Construction of Drilled Piers, and ACI 336.3R-14 entitled Report on Design and Construction of Drilled Piers. Concrete should be designed to achieve the specified 28-day strength when placed at a 7-inch slump with a ± 1 -inch tolerance. Adding water to a mix that has been designed for a lower slump does not meet the intent of this recommendation. If a high range water reducer is used to achieve this slump, the span of slump retention for the specific admixture under consideration should be thoroughly investigated. Compatibility with other concrete admixtures should also be considered. A technical representative of the admixture supplier should be consulted on these matters.

Successful installation of drilled piers is a coordinated effort involving the general contractor, design consultants, subcontractors and suppliers. Each must be properly equipped and prepared to provide their services in a timely fashion. Several key items of major concern are:

- Proper drilling rig with proper equipment (including casing, augers, rock bits and teeth);
- Reinforcing steel cages tied to meet project specifications;
- Proper scheduling and ordering of concrete for the piers; and
- Monitoring of installation by design professionals.

Pier construction should be carefully monitored to assure compliance of construction activities with the appropriate specifications. Particular attention to the referenced publication is warranted for pier installation. A number of items of concern for pier installation include those listed below.

- Pier locations
- Vertical alignment
- Competent bearing
- Casing removal
- Reinforcing steel placement
- Concrete properties and placement
- Slurry viscosity

If the contractor has to deviate from the recommended foundations, Terracon should be notified immediately so additional engineering recommendations can be provided for an appropriate foundation type.

SEISMIC CONSIDERATIONS

The seismic design requirements for the structures are based on Seismic Design Category. Site Classification is required to determine the Seismic Design Category for the structure. The Site Classification is based on the upper 100 feet of the site profile defined by a weighted average value of either shear wave velocity, standard penetration resistance, or undrained shear strength in accordance with Section 20.4 of ASCE 7.

Description	Value
2012/15 International Building Code Site Classification (IBC) ¹	D ²
Site Latitude	26.27860° N
Site Longitude	98.27500° W
S _s Spectral Acceleration for a Short Period ³	0.042 g
S ₁ Spectral Acceleration for a 1-Second Period ³	0.014 g

Description	Value
1. Seismic site classification in general accordance with the 2012/15 <i>International Building Code</i> , which refers to ASCE 7.	
2. The 2012/15 <i>International Building Code</i> (IBC) uses a site profile extending to a depth of 100 feet for seismic site classification. Borings at this site were extended to a maximum depth of 25 feet. The site properties below the borings depth to 100 feet were estimated based on our experience and knowledge of geologic conditions of the general area. Additional deeper borings or geophysical testing may be performed to confirm the conditions below the current borings depth.	
3. These values were obtained using online seismic design maps and tools provided by the USGS (http://earthquake.usgs.gov/hazards/designmaps/).	

FLOOR SLABS

The Finished Floor Elevation (FFE) was not available at the time of this report. However, we anticipate that the FFE may be at about 2 feet above existing grade.

Floor Slab Design Parameters

The subsurface soils at this site generally exhibit low to moderate expansion potential. Based on the information developed from our field and laboratory programs and on method TEX-124-E in the Texas Department of Transportation (TxDOT) Manual of Testing Procedures, we estimate that the subgrade soils at this site exhibit a Potential Vertical Rise (PVR) of about 1 inch or less in present condition.

The actual movements could be greater if poor drainage, ponded water, and/or other sources of moisture are allowed to infiltrate beneath the structure after construction. We have provided recommendations to maintain / reduce the site PVR to about 1 inch or less. In addition, positive structure perimeter drainage should be carefully observed.

After site stripping and over-excavation activities as recommended, re-used on-site soil or select fill over 6 inches of moisture conditioned and compacted subgrade soils should be constructed directly below the floor slab and should also extend a minimum of 3 feet beyond the edge of the proposed building area, including any movement sensitive flatwork that abuts the structure such as sidewalks. The final exterior grade adjacent to the building should be sloped to promote positive drainage away from the structure.

The subgrade and select fill soils should be prepared as outlined in the **Earthwork** section of this report, which contains material and placement requirements for select fill, as well as other subgrade preparation recommendations. The floor slab should be designed using the following recommendations.

Item	Description
Excavation	Minimum 6 inches.
Floor Slab Support ¹	Min. 6 inches of moisture conditioned and compacted native soils plus 2 feet of select fill as needed to achieve Finished Building Pad Elevation. This recommendation applies to building area and flatwork that abuts the structure such as sidewalks.
Estimated Modulus of Subgrade Reaction ²	125 pounds per square inch per inch (psi/in) for point loads.
Estimated Potential Vertical Rise (PVR)	Less than 1 inch

1. Floor slabs should be structurally independent of building footings or walls to reduce the possibility of floor slab cracking caused by differential movements between the slab and foundation.
2. Modulus of subgrade reaction is an estimated value based upon our experience with the subgrade condition, the requirements noted in **Earthwork**, and the floor slab support as noted in this table. It is provided for point loads. For large area loads the modulus of subgrade reaction would be lower.

The use of a vapor retarder should be considered beneath concrete slabs on grade covered with wood, tile, carpet, or other moisture sensitive or impervious coverings, or when the slab will support equipment sensitive to moisture. When conditions warrant the use of a vapor retarder, the slab designer should refer to ACI 302 and/or ACI 360 for procedures and cautions regarding the use and placement of a vapor retarder.

Saw-cut control joints should be placed in the slab to help control the location and extent of cracking. For additional recommendations refer to the ACI Design Manual. Joints or cracks should be sealed with a water-proof, non-extruding compressible compound specifically recommended for heavy duty concrete pavement and wet environments.

Where floor slabs are tied to perimeter walls or turn-down slabs to meet structural or other construction objectives, our experience indicates differential movement between the walls and slabs will likely be observed in adjacent slab expansion joints or floor slab cracks beyond the length of the structural dowels. The Structural Engineer should account for potential differential settlement through use of sufficient control joints, appropriate reinforcing or other means.

Floor Slab Loads and Abrasion - Portions of the floor slab may be subject to vehicle traffic. ACI 360 Design of Slabs on Grade discusses slab foundations and vehicle traffic in more detail. Modulus of Subgrade Reaction, k, value provided above that can be used to analyze/design the floor slab with regard to vehicle traffic.

The abrasion resistance to vehicle traffic should also be considered for the floor slab. The required abrasion resistance will be in part due to the frequency of the vehicle traffic loading, but

also on the weight, wheel configuration, and wheel type of vehicle. Some techniques used to increase the floor slab abrasion resistance include:

- Increasing the compressive strength of the concrete;
- Using a more durable aggregate in the concrete mix design (such as, a traprock or chert aggregate versus a limestone aggregate);
- Specifying a surface treatment and finish (such as, using a traprock or metallic aggregate treatment or topping with a hard steel trowel finish); and
- A combination of these techniques.

Vehicle traffic can create significant distress in the floor slab if the slab is not properly designed for the loading conditions.

Saw-cut control joints should be placed in the slab to help control the location and extent of cracking. For additional recommendations refer to the ACI Design Manual. Joints or cracks should be sealed with a water-proof, non-extruding compressible compound specifically recommended for heavy duty concrete pavement and wet environments.

Where floor slabs are tied to perimeter walls or turn-down slabs to meet structural or other construction objectives, our experience indicates differential movement between the walls and slabs will likely be observed in adjacent slab expansion joints or floor slab cracks beyond the length of the structural dowels. The Structural Engineer should account for potential differential settlement through use of sufficient control joints, appropriate reinforcing or other means.

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Floor Slab Construction Considerations

Finished subgrade within and for at least 10 feet beyond the floor slab should be protected from traffic, rutting, or other disturbance and maintained in a relatively moist condition until floor slabs are constructed. If the subgrade should become damaged or desiccated prior to construction of floor

slabs, the affected material should be removed and structural fill should be added to replace the resulting excavation. Final conditioning of the finished subgrade should be performed immediately prior to placement of the floor slab support course.

The Geotechnical Engineer should approve the condition of the floor slab subgrades immediately prior to placement of the floor slab support course, reinforcing steel and concrete. Attention should be paid to high traffic areas that were rutted and disturbed earlier, and to areas where backfilled trenches are located.

PAVEMENTS

Both flexible and rigid pavements may be considered for this project. Pavement subgrade preparations are included in this section to limit changes in soil moisture conditions to help mitigate the effects of soil movement. However, even if these recommendations are followed some pavement distress could still occur.

General Pavement Comments

Traffic conditions and pavement life conditions were not available at the time of this report. A critical aspect of pavement performance is site preparation. Pavement designs, noted in this section, must be applied to the site, which has been prepared as recommended in the **Earthwork** section.

We recommend the moisture content and density of the top 6 inches of the subgrade be evaluated and the pavement subgrades be proofrolled within two days prior to commencement of actual paving operations. Areas not in compliance with the required ranges of moisture or density should be moisture conditioned and re-compacted.

Particular attention should be paid to high traffic areas that were rutted and disturbed earlier and to areas where backfilled trenches are located. Areas where unsuitable conditions are located should be repaired by removing and replacing the materials with properly compacted fills.

If a significant precipitation event occurs after the evaluation or if the surface becomes disturbed, the subgrade should be reviewed by qualified personnel immediately prior to paving. The subgrade should be in its finished form at the time of the final review.

Based on the subsurface conditions, we anticipate that the pavement subgrade will generally consist of the on-site soils. The top 6 inches of the finished subgrade soils directly beneath the pavements may be chemically treated. Chemical treatment will increase the supporting value of the subgrade and decrease the effect of moisture on subgrade soils. These 6 inches of treatment should be considered as required part of the pavement design and is not a part of site and

subgrade preparation for wet/soft subgrade conditions.

If chemical treatment of the subgrade is chosen, we anticipate that the on-site surficial soils should be treated with about 3 percent of cement. This percentage is given as application by dry weight and is typically equivalent to about 14 pounds of modifier per square yard per 6-inch depth. The recommended percentage of modifier is for estimating and planning. The actual quantity of modifier required should be determined at the time of construction by laboratory tests on bulk samples of the subgrade soils. Specifications for treated subgrade are presented later in this section. An alternative pavement sections without treated subgrade is also provided.

After proofrolling and repairing deep subgrade deficiencies, the entire subgrade should be scarified and developed as recommended in **Earthwork** section of this report to provide a uniform subgrade for pavement construction. Areas that appear severely desiccated following site stripping may require further undercutting and moisture conditioning. If a significant precipitation event occurs after the evaluation or if the surface becomes disturbed, the subgrade should be reviewed by qualified personnel immediately prior to paving. The subgrade should be in its finished form at the time of the final review.

Pavement Design Considerations

Traffic patterns and anticipated loading conditions were not available at the time that this report was prepared. However, we anticipate that traffic loads will be produced primarily by light traffic and occasional delivery and trash removal trucks. Pavement thickness can be determined using AASHTO, Asphalt Institute and/or other methods if specific wheel loads, axle configurations, frequencies, and desired pavement life are provided.

Terracon can provide thickness recommendations for pavements subjected to loads other than the above mentioned traffic if this information is provided.

Pavement performance is affected by its surroundings. In addition to providing preventive maintenance, the civil engineer should consider the following recommendations in the design and layout of pavements:

- Final grade adjacent to parking lots and drives should slope down from pavement edges at a minimum 2%;
- The subgrade and the pavement surface should have a minimum ¼ inch per foot slope to promote proper surface drainage;
- Install pavement drainage surrounding areas anticipated for frequent wetting (e.g., garden centers, wash racks);
- Install joint sealant and seal cracks immediately;
- Seal all landscaped areas in, or adjacent to pavements to reduce moisture migration to subgrade soils;

- Place compacted, low permeability backfill against the exterior side of curb and gutter; and,
- Place curb, gutter and/or sidewalk directly on low permeability subgrade soils rather than on unbound granular base course materials.

Estimated Minimum Pavement Thickness

As a minimum, we recommend the following typical pavement sections be considered.

Pavement Area	Traffic Design Index	Description
Automobile Parking Areas	DI-1	Light traffic (Few vehicles heavier than passenger cars, no regular use by heavily loaded two axle trucks). (EAL ⁽¹⁾ < 6)
Driveways	DI-2	Light to medium traffic (Similar to DI-1 including not over 50 loaded two axle trucks or lightly loaded larger vehicles per day. No regular use by heavily loaded trucks with three or more axles). (EAL = 6-20)
Driveways for Truck Traffic Areas	DI-3	Medium to heavy traffic (Including not over 300 heavily loaded two axle trucks plus lightly loaded trucks with three or more axles and no more than 30 heavily loaded trucks with more than three axles per day). (EAL = 21-75)

1. Equivalent daily 18-kip single-axle load applications.

Listed below are pavement component thicknesses, which may be used as a guide for pavement systems at the site for the traffic classifications stated herein. These systems were derived based on general characterization of the subgrade. Specific testing (such as CBR's, resilient modulus tests, etc.) was not performed for this project to evaluate the support characteristics of the subgrade.

Minimum Recommended <u>Flexible</u> Pavement Section Thickness, inches		
Component	DI-1 ¹	DI-2 ¹
Hot Mix Asphaltic Concrete (HMAC) ^{2, 3}	2	2
Granular Base Material ²	6	8
Treated Subgrade ²	6	6

1. See **Pavements** for more specifics regarding traffic classifications.
2. All materials should meet the current Department of Transportation (TxDOT) Standard Specifications for Highway and Bridge Construction.
3. A minimum 2-inch surface course should be used on ACC pavements.

Alternative Minimum Recommended <u>Flexible</u> Pavement System, inches		
Component	DI-1 ¹	DI-2 ¹
Hot Mix Asphaltic Concrete (HMAC) ^{2, 3}	2	2½
Granular Base Material ²	8	10
Moisture Conditioned Subgrade	6	6

1. See **Pavements** for more specifics regarding traffic classifications.
2. All materials should meet the current Department of Transportation (TxDOT) Standard Specifications for Highway and Bridge Construction.
3. A minimum 2-inch surface course should be used on ACC pavements.

Minimum Recommended <u>Rigid</u> Pavement Section Thickness, inches			
Component	DI-1 ¹	DI-2 ¹	DI-3 ^{1, 3}
Reinforced PC concrete ²	5	6	7
Granular Base Material ³	4	4	4
Moisture conditioned subgrade	6	6	6

1. See **Pavements** for more specifics regarding traffic classifications.
2. All materials should meet the current Department of Transportation (TxDOT) Standard Specifications for Highway and Bridge Construction.
3. In areas of anticipated heavy traffic, fire trucks, delivery trucks, or concentrated loads (e.g. dumpster pads), and areas with repeated turning or maneuvering of heavy vehicles.

The listed pavement component thicknesses should be used as a guide for pavement systems at the site for the traffic classifications stated herein. These recommendations assume a 20-year pavement design life. If pavement frequencies or loads will be different than that specified Terracon should be contacted and allowed to review these pavement sections.

We recommend a Portland Cement Concrete (PCC) pavement be utilized in the main access lanes, parking lots, dumpster pads or other areas where extensive wheel maneuvering are expected.

We recommend that waste dumpster areas be constructed of at least 7-inches of reinforced concrete pavement. The concrete pad areas should be designed so that the vehicle wheels of the collection truck are supported on the concrete while the dumpster is being lifted to support the large wheel loading imposed during waste collection.

Although not required for structural support of rigid pavement systems, a base course layer may be considered to help reduce potentials for slab curl, shrinkage cracking, and subgrade “pumping” through joints.

Proper joint spacing will also be required to prevent excessive slab curling and shrinkage cracking. All joints should be sealed to prevent entry of foreign material and dowelled where necessary for load transfer.

Presented below are our recommended material requirements for the various pavement sections.

Reinforced Concrete Pavement – The materials and properties of reinforced concrete pavement shall meet applicable requirements in the ACI Manual of Concrete Practice. The Portland cement concrete mix should have a minimum 28-day compressive strength of 4,000 psi.

Reinforcing Steel - Reinforcing steel should consist of the following:

DI-1: #3 bars spaced at 18 inches or #4 bars spaced at 24 inches on centers in both directions.

DI-2: #3 bars spaced at 12 inches or #4 bars spaced at 18 inches on centers in both directions.

DI-3: #4 bars spaced at 12 inches on centers in both directions.

Control Joint Spacing – ACI recommendations indicate that control joints should be spaced at about 30 times the thickness of the pavement. Furthermore, ACI recommends a maximum control joint spacing of 12.5 feet for 5-inch pavements and a maximum control joint spacing of 15 feet for 6-inch or thicker pavements. Saw cut control joints should be cut within 6 to 12 hours of concrete placement or as soon as it is practical.

Expansion Joint Spacing – ACI recommendations indicate that regularly spaced expansion joints may be deleted from concrete pavements. Therefore, the installation of expansion joints is optional and should be evaluated by the design team.

Dowels at Expansion Joints – The dowels at expansion joints should be spaced at 12-inch centers and consist of the following:

DI-1: 5/8-inch diameter, 12-inches long with 5-inch embedment

DI-2: 3/4-inch diameter, 14-inches long with 6-inch embedment

DI-3: 7/8-inch diameter, 14-inches long with 6-inch embedment

Hot Mix Asphaltic Concrete Surface Course – The asphaltic concrete surface course should be plant mixed, hot laid Type C or D (Fine Graded Surface Course) meeting the specifications requirements in 2014 TxDOT Standard Specifications Item 340. Specific criteria for the job specifications should include compaction to within an air void range of 5 to 9 percent calculated using the maximum theoretical gravity mix measured by TxDOT Tex-227-F. The asphalt cement

content by percent of total mixture weight should be within ± 0.5 percent asphalt cement from the job mix design.

Granular Base Material: Base material should be composed of crushed limestone or crushed concrete meeting the requirements of 2014 TxDOT Standard Specifications Item 247, Type A or D, Grade 1.

As an alternate to the Type A base, treated “caliche” material meeting the requirements of 2014 TxDOT Standard Specification Manual Item 247, Type B, Grade 1 or 2 may be used.

The granular base should be compacted to at least 95 percent of the maximum dry density determined in accordance with the modified moisture-density relationship (ASTM D 1557) at moisture content within 2 percentage points of the optimum moisture content.

Treated Subgrade: The subgrade soils should be treated with cement in accordance with 2014 TxDOT Standard Specifications Item 275. The recommended percentage of modifier is for estimating and planning. The actual quantity of modifier required should be determined at the time of construction by laboratory tests on bulk samples of the subgrade soils.

If chemical treatment of the subgrade is chosen, we anticipate that the on-site surficial soils be treated with about 3 percent of cement. This percentage is given as application by dry weight and is typically equivalent to about 14 pounds of modifier per square yard per 6-inch depth. The subgrade should be compacted to a minimum of 95 percent of the Standard Effort (ASTM D 698) maximum dry density within 2 percentage points of the optimum moisture content. Preferably, traffic, should be kept off the treated subgrade for about 3 to 5 days to facilitate curing of the soil - chemical mixture; in addition, the subgrade is not suitable for heavy construction traffic prior to paving.

Post-construction subgrade movements and some cracking of the pavements are not uncommon for subgrade conditions such as those observed at this site. Although chemical treatment of the subgrade will help to reduce such movement/cracking, this movement/cracking cannot be economically eliminated.

Moisture Conditioned Subgrade: The subgrade should be scarified to a depth of 8 inches and moisture conditioned within 2 percentage points of the optimum moisture content. The subgrade should then be compacted to at least 95 percent of the maximum dry density determined in accordance with ASTM D 698. This should result in a compacted, moisture conditioned layer about 6 inches thick.

Pavement Drainage

Pavements should be sloped to provide rapid drainage of surface water. Water allowed to pond on or adjacent to the pavements could saturate the subgrade and contribute to premature pavement deterioration. In addition, the pavement subgrade should be graded to provide positive drainage within the granular base section. Appropriate sub-drainage or connection to a suitable daylight outlet should be provided to remove water from the granular subbase.

Pavement Maintenance

The pavement sections provided in this report represent minimum recommended thicknesses and, as such, periodic maintenance should be anticipated. Therefore, preventive maintenance should be planned and provided for through an on-going pavement management program.

Maintenance activities are intended to slow the rate of pavement deterioration and to preserve the pavement investment. Maintenance consists of both localized maintenance (e.g. crack and joint sealing and patching) and global maintenance (e.g. surface sealing). Preventive maintenance is usually the first priority when implementing a pavement maintenance program. Additional engineering observation is recommended to determine the type and extent of a cost effective program. Even with periodic maintenance, some movements and related cracking may still occur and repairs may be required.

GENERAL COMMENTS

As the project progresses, we address assumptions by incorporating information provided by the design team, if any. Revised project information that reflects actual conditions important to our services is reflected in the final report. The design team should collaborate with Terracon to confirm these assumptions and to prepare the final design plans and specifications. This facilitates the incorporation of our opinions related to implementation of our geotechnical recommendations. Any information conveyed prior to the final report is for informational purposes only and should not be considered or used for decision-making purposes.

Our analysis and opinions are based upon our understanding of the project, the geotechnical conditions in the area, and the data obtained from our site exploration. Natural variations will occur between exploration point locations or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. Terracon should be retained as the Geotechnical Engineer, where noted in the final report, to provide observation and testing services during pertinent construction phases. If variations appear, we can provide further evaluation and supplemental recommendations. If variations are noted in the absence of our observation and testing services on-site, we should be immediately notified so that we can provide evaluation and supplemental recommendations.

Geotechnical Engineering Report

SWSC – New Campus ■ Alton, Texas

August 3, 2018 ■ Terracon Project No. 88185036



Our scope of services does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

Our services and any correspondence or collaboration through this system are intended for the sole benefit and exclusive use of our client for specific application to the project discussed and are accomplished in accordance with generally accepted geotechnical engineering practices with no third party beneficiaries intended. Any third party access to services or correspondence is solely for information purposes to support the services provided by Terracon to our client. Reliance upon the services and any work product is limited to our client, and is not intended for third parties. Any use or reliance of the provided information by third parties is done solely at their own risk. No warranties, either express or implied, are intended or made.

Site characteristics as provided are for design purposes and not to estimate excavation cost. Any use of our report in that regard is done at the sole risk of the excavating cost estimator as there may be variations on the site that are not apparent in the data that could significantly impact excavation cost. Any parties charged with estimating excavation costs should seek their own site characterization for specific purposes to obtain the specific level of detail necessary for costing. Site safety, and cost estimating including, excavation support, and dewatering requirements/design are the responsibility of others. If changes in the nature, design, or location of the project are planned, our conclusions and recommendations shall not be considered valid unless we review the changes and either verify or modify our conclusions in writing.

ATTACHMENTS

EXPLORATION AND TESTING PROCEDURES

Field Exploration

Number of Borings	Boring Depth (feet) ¹	Location
1	25	Canopy Area
2	20	Office and warehouse areas
5	5	Pavements

¹. Below ground surface

The drilling depths were based on topographic conditions at the time of our drilling operations.

Boring Layout and Elevations: Terracon personnel provided the boring layout. Coordinates were obtained with a handheld GPS unit (estimated horizontal accuracy of about ±10 feet).

Subsurface Exploration Procedures: We advanced the soil borings with a truck-mounted drill rig using continuous flight augers (solid stem and/or hollow stem as necessary depending on soil conditions). Five samples were obtained in the upper 10 feet of the borings and at intervals of 5 feet thereafter. Soil sampling was performed using thin-wall tube and/or split-barrel sampling procedures. We observed and recorded groundwater levels during drilling and sampling. For safety purposes, the borings were backfilled with auger cuttings after their completion.

The sampling depths, penetration distances, and other sampling information were recorded on the field boring logs. The samples were placed in appropriate containers and taken to our soil laboratory for testing and classification by a geotechnical engineer. Our exploration team prepared field boring logs as part of the drilling operations. The field logs included visual classifications of the materials encountered during drilling and our interpretation of the subsurface conditions between samples. Final boring logs were prepared from the field log. The final boring logs represent the geotechnical engineer's interpretation of the field logs and include modifications based on observations and tests of the samples in our laboratory.

Laboratory Testing

The project engineer reviewed the field data and assigned various laboratory tests to better understand the engineering properties of the various soil strata as necessary for this project.

- ASTM D2216 Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
- ASTM D4318 Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

Geotechnical Engineering Report

SWSC – New Campus ■ Alton, Texas

August 3, 2018 ■ Terracon Project No. 88185036



- ASTM D422 Standard Test Method for Particle-Size Analysis of Soils
- ASTM D4546 Standard Test Methods for One-Dimensional Swell or Collapse of Soils

Our laboratory testing program often includes examination of soil samples by an engineer. Based on the material's texture and plasticity, we described and classified soil samples in accordance with the Unified Soil Classification System (USCS).

SITE LOCATION AND EXPLORATION PLANS

SITE LOCATION

SWSC - New Campus ■ Alton, TX

July 31, 2018 ■ Terracon Project No. 88185036

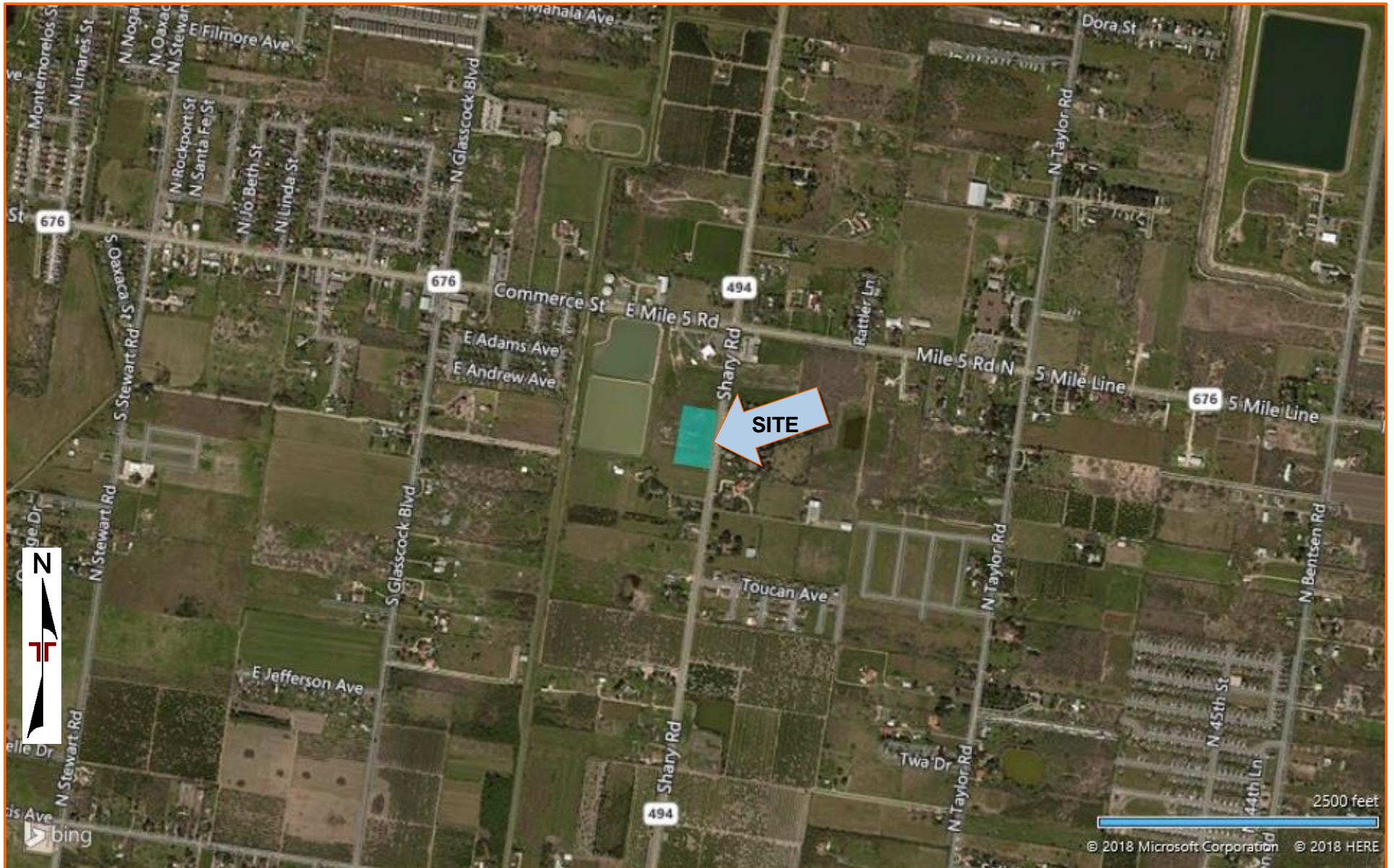


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT
INTENDED FOR CONSTRUCTION PURPOSES

AERIAL PHOTOGRAPHY PROVIDED BY MICROSOFT BING MAPS

EXPLORATION PLAN

SWSC - New Campus ■ Alton, TX

July 31, 2018 ■ Terracon Project No. 88185036

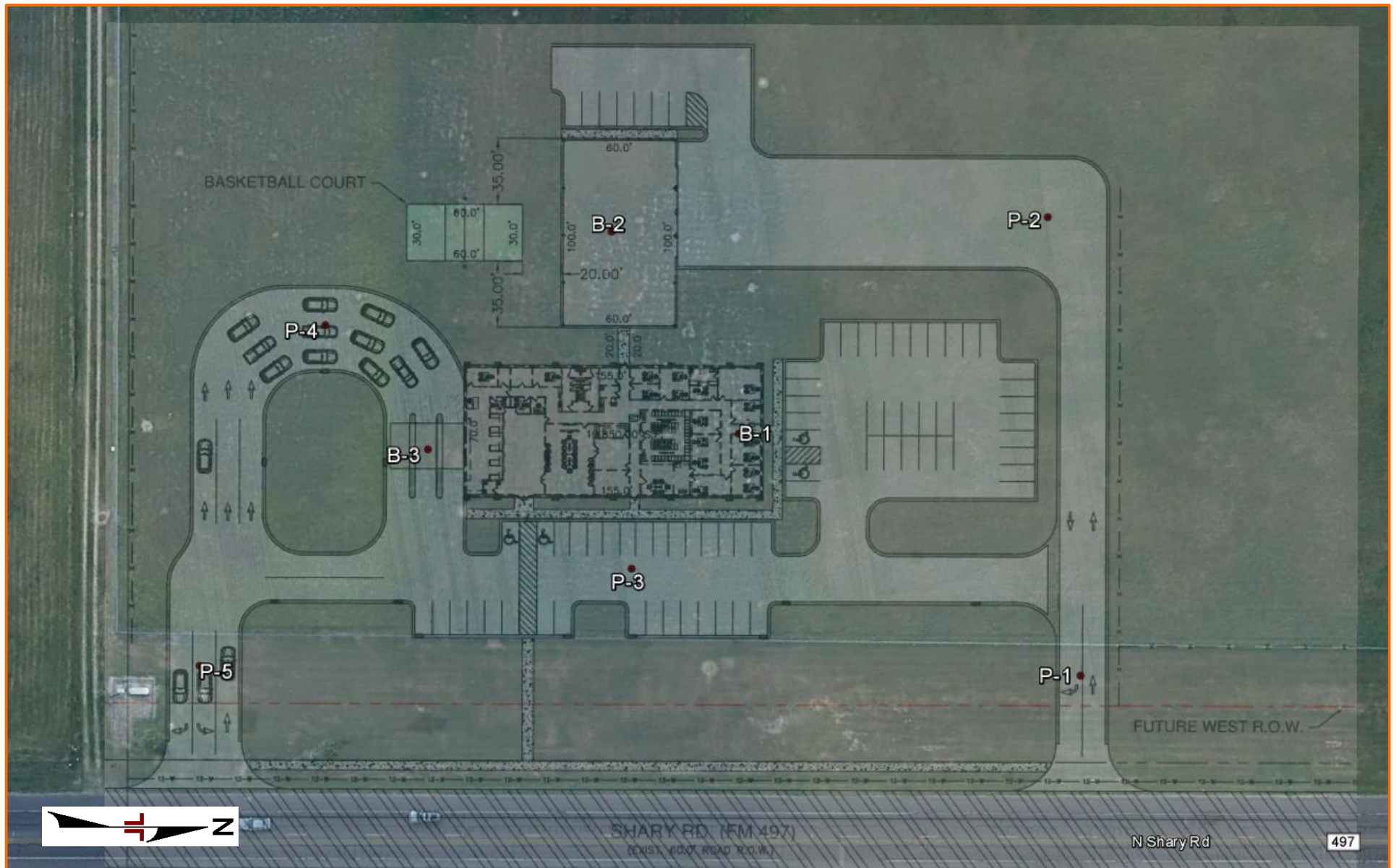


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT
INTENDED FOR CONSTRUCTION PURPOSES

EXPLORATION RESULTS












BORING LOG NO. B-1

Page 1 of 1

PROJECT: SWSC - New Campus

CLIENT: Sharyland Water Supply Corporation
Alton, TX

SITE: Shary Road
Alton, Texas

GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 26.279° Longitude: -98.2749°	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST			WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS	PERCENT FINES
						TEST TYPE	COMPRESSIVE STRENGTH (tsf)	STRAIN (%)			LL-PL-PI	
DEPTH												
	<u>CLAYEY SAND (SC)</u> , brown, loose to medium dense light brown below 6 feet	5			3-2-4 N=6				10		31-15-16	
					2.5 (HP)				16			47
					3.5 (HP)				14		33-16-17	
					1.0 (HP)				21			
					1.0 (HP)				23		39-17-22	
10.0		10										
	<u>FAT CLAY (CH)</u> , sandy, light brown, very stiff to hard	15			9-13-17 N=30				29			
												
					6-11-14 N=25				20			
20.0		20										
	Boring Terminated at 20 Feet											

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Dry Augered.

See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (If any).

Notes:

Abandonment Method:
Boring backfilled with soil cuttings after delayed water levels were measured.

See [Supporting Information](#) for explanation of symbols and abbreviations.

WATER LEVEL OBSERVATIONS

▽ While drilling
▽ After 15 minutes

Terracon
1506 Mid Cities Dr
Pharr, TX

Boring Started:

Boring Completed: 07-18-2018

Drill Rig: CME 55

Driller: SWD

Project No.: 88185036

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL_88185036 SWSC - NEW CAMPUS GPJ TERRACON DATATEMPLATE GDT 7/31/18


BORING LOG NO. B-2

Page 1 of 1

PROJECT: SWSC - New Campus

CLIENT: Sharyland Water Supply Corporation
Alton, TX

SITE: Shary Road
Alton, Texas

GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 26.2789° Longitude: -98.2753°	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST			WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
						TEST TYPE	COMPRESSIVE STRENGTH (tsf)	STRAIN (%)				
	DEPTH											
	CLAYEY SAND (SC) , brown, loose to medium dense - light brown below 4½ feet FAT CLAY (CH) , sandy, light brown, stiff to very stiff				5-4-6 N=10				43			
					3-2-3 N=5				19		41-16-25	
		5			3-4-3 N=7				24			
			▽		4-4-5 N=9				24		53-20-33	
			▽		3-5-4 N=9				22			63
		10										
					5-9-11 N=20				32		102-37-65	
		15										
					6-9-14 N=23				27			
		20										
	Boring Terminated at 20 Feet											

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Dry Augered.

See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (If any).

Notes:

Abandonment Method:
Boring backfilled with soil cuttings after delayed water levels were measured.

See [Supporting Information](#) for explanation of symbols and abbreviations.

WATER LEVEL OBSERVATIONS

▽ While drilling
▽ After 15 minutes

Terracon
1506 Mid Cities Dr
Pharr, TX

Boring Started:

Boring Completed: 07-18-2018

Drill Rig: CME 55

Driller: SWD

Project No.: 88185036

BORING LOG NO. B-3

Page 1 of 1

PROJECT: SWSC - New Campus

CLIENT: Sharyland Water Supply Corporation
Alton, TX

SITE: Shary Road
Alton, Texas

GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 26.2786° Longitude: -98.275°	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST			WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
						TEST TYPE	COMPRESSIVE STRENGTH (tsf)	STRAIN (%)				
	DEPTH											
	CLAYEY SAND (SC) , brown, very loose to loose - light brown below 4½ feet	5			4-4-3 N=7				3		31-14-17	
					1-2-1 N=3				17			45
					2-2-2 N=4				23		37-17-20	
					3-2-2 N=4				24			
					3-3-3 N=6				25			
	FAT CLAY (CH) , sandy, light brown, medium stiff to very stiff	15			6-8-11 N=19				29		85-33-52	
					8-12-14 N=26				31			
					10-13-17 N=30				28		98-36-62	
	Boring Terminated at 25 Feet	25										

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Dry Augered.

See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (If any).

Notes:

Abandonment Method:
Boring backfilled with soil cuttings after delayed water levels were measured.

See [Supporting Information](#) for explanation of symbols and abbreviations.

WATER LEVEL OBSERVATIONS

While drilling
 After 15 minutes

Terracon
1506 Mid Cities Dr
Pharr, TX

Boring Started: Boring Completed: 07-18-2018
Drill Rig: CME 55 Driller: SWD
Project No.: 88185036



BORING LOG NO. P-1

Page 1 of 1

PROJECT: SWSC - New Campus

CLIENT: Sharyland Water Supply Corporation
Alton, TX

SITE: Shary Road
Alton, Texas

GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 26.2795° Longitude: -98.2745°	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST			WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
						TEST TYPE	COMPRESSIVE STRENGTH (tsf)	STRAIN (%)				
	DEPTH											
	CLAYEY SAND (SC) , brown, loose	5.0			3-2-3 N=5				11			
					3-4-3 N=7				18		33-14-19	
	Boring Terminated at 5 Feet											

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Dry Augered.

See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (If any).

Notes:

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See [Supporting Information](#) for explanation of symbols and abbreviations.

WATER LEVEL OBSERVATIONS

Groundwater was not observed.

Terracon
1506 Mid Cities Dr
Pharr, TX

Boring Started:

Boring Completed: 07-18-2018

Drill Rig: CME 55

Driller: SWD

Project No.: 88185036



BORING LOG NO. P-2

Page 1 of 1

PROJECT: SWSC - New Campus

CLIENT: Sharyland Water Supply Corporation
Alton, TX

SITE: Shary Road
Alton, Texas

GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 26.2795° Longitude: -98.2752°	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST			WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
						TEST TYPE	COMPRESSIVE STRENGTH (tsf)	STRAIN (%)				
	DEPTH											
	CLAYEY SAND (SC) , brown, loose	5.0			4-3-4 N=7				11			40
					3-3-3 N=6				18		29-13-16	
	Boring Terminated at 5 Feet											

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Dry Augered.

See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (If any).

Notes:

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See [Supporting Information](#) for explanation of symbols and abbreviations.

WATER LEVEL OBSERVATIONS

Groundwater was not observed.

Terracon
1506 Mid Cities Dr
Pharr, TX

Boring Started:

Boring Completed: 07-18-2018

Drill Rig: CME 55

Driller: SWD

Project No.: 88185036


BORING LOG NO. P-3

Page 1 of 1

PROJECT: SWSC - New Campus

CLIENT: Sharyland Water Supply Corporation
Alton, TX

SITE: Shary Road
Alton, Texas

GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 26.2788° Longitude: -98.2748°	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST			WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
						TEST TYPE	COMPRESSIVE STRENGTH (tsf)	STRAIN (%)				
	DEPTH											
	CLAYEY SAND (SC) , brown, loose			X	4-4-5 N=9				10		31-13-18	
	- light brown, Sandy Lean Clay (CL), at 3½ feet			X	3-3-3 N=6				24			55
	5.0 Boring Terminated at 5 Feet	5										

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Dry Augered.

See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (If any).

Notes:

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See [Supporting Information](#) for explanation of symbols and abbreviations.

WATER LEVEL OBSERVATIONS

Groundwater was not observed.

Terracon
1506 Mid Cities Dr
Pharr, TX

Boring Started:

Boring Completed: 07-18-2018

Drill Rig: CME 55

Driller: SWD

Project No.: 88185036



BORING LOG NO. P-4

Page 1 of 1

PROJECT: SWSC - New Campus

CLIENT: Sharyland Water Supply Corporation
Alton, TX

SITE: Shary Road
Alton, Texas

GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 26.2785° Longitude: -98.2752°	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST			WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
						TEST TYPE	COMPRESSIVE STRENGTH (tsf)	STRAIN (%)				
	DEPTH											
	CLAYEY SAND (SC) , brown, loose	5.0			4-3-3 N=6				6			
					3-2-2 N=4				6		23-14-9	
	Boring Terminated at 5 Feet											

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Dry Augered.

See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (If any).

Notes:

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See [Supporting Information](#) for explanation of symbols and abbreviations.

WATER LEVEL OBSERVATIONS

Groundwater was not observed.

Terracon
1506 Mid Cities Dr
Pharr, TX

Boring Started:

Boring Completed: 07-18-2018

Drill Rig: CME 55

Driller: SWD

Project No.: 88185036


BORING LOG NO. P-5

Page 1 of 1

PROJECT: SWSC - New Campus

CLIENT: Sharyland Water Supply Corporation
Alton, TX

SITE: Shary Road
Alton, Texas

GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 26.2782° Longitude: -98.2748°	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST			WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
						TEST TYPE	COMPRESSIVE STRENGTH (tsf)	STRAIN (%)				
	DEPTH											
	CLAYEY SAND (SC) , brown, loose	5.0		X	6-4-4 N=8				9			33
					4-3-4 N=7				7		22-12-10	
	Boring Terminated at 5 Feet											

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Dry Augered.

See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (If any).

Notes:

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See [Supporting Information](#) for explanation of symbols and abbreviations.

WATER LEVEL OBSERVATIONS

Groundwater was not observed.

Terracon
1506 Mid Cities Dr
Pharr, TX

Boring Started:

Boring Completed: 07-18-2018

Drill Rig: CME 55

Driller: SWD

Project No.: 88185036






SUPPORTING INFORMATION

GENERAL NOTES

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

SWSC - New Campus ■ Alton, Texas

7/31/2018 ■ Terracon Project No. 88185036

SAMPLING	WATER LEVEL	FIELD TESTS
 Shelby Tube  Split Spoon	 Water Initially Encountered  Water Level After a Specified Period of Time  Water Level After a Specified Period of Time <p>Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.</p>	N Standard Penetration Test Resistance (Blows/Ft.) (HP) Hand Penetrometer (T) Torvane (DCP) Dynamic Cone Penetrometer UC Unconfined Compressive Strength (PID) Photo-Ionization Detector (OVA) Organic Vapor Analyzer

DESCRIPTIVE SOIL CLASSIFICATION

Soil classification is based on the Unified Soil Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

LOCATION AND ELEVATION NOTES

Unless otherwise noted, Latitude and Longitude are approximately determined using a hand-held GPS device. The accuracy of such devices is variable. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

STRENGTH TERMS

RELATIVE DENSITY OF COARSE-GRAINED SOILS (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance		CONSISTENCY OF FINE-GRAINED SOILS (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance		
Descriptive Term (Density)	Standard Penetration or N-Value Blows/Ft.	Descriptive Term (Consistency)	Unconfined Compressive Strength Qu, (tsf)	Standard Penetration or N-Value Blows/Ft.
Very Loose	0 - 3	Very Soft	less than 0.25	0 - 1
Loose	4 - 9	Soft	0.25 to 0.50	2 - 4
Medium Dense	10 - 29	Medium Stiff	0.50 to 1.00	4 - 8
Dense	30 - 50	Stiff	1.00 to 2.00	8 - 15
Very Dense	> 50	Very Stiff	2.00 to 4.00	15 - 30
		Hard	> 4.00	> 30

RELATIVE PROPORTIONS OF SAND AND GRAVEL		RELATIVE PROPORTIONS OF FINES	
Descriptive Term(s) of other constituents	Percent of Dry Weight	Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	<15	Trace	<5
With	15-29	With	5-12
Modifier	>30	Modifier	>12
GRAIN SIZE TERMINOLOGY		PLASTICITY DESCRIPTION	
Major Component of Sample	Particle Size	Term	Plasticity Index
Boulders	Over 12 in. (300 mm)	Non-plastic	0
Cobbles	12 in. to 3 in. (300mm to 75mm)	Low	1 - 10
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)	Medium	11 - 30
Sand	#4 to #200 sieve (4.75mm to 0.075mm)	High	> 30
Silt or Clay	Passing #200 sieve (0.075mm)		

UNIFIED SOIL CLASSIFICATION SYSTEM

SWSC – New Campus ■ Alton, Texas

August 3, 2018 ■ Terracon Project No. 88185036



Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests ^A					Soil Classification	
					Group Symbol	Group Name ^B
Coarse-Grained Soils: More than 50% retained on No. 200 sieve	Gravels: More than 50% of coarse fraction retained on No. 4 sieve	Clean Gravels:	Cu ≥ 4 and 1 ≤ Cc ≤ 3 ^E		GW	Well-graded gravel ^F
		Less than 5% fines ^C	Cu < 4 and/or 1 > Cc > 3 ^E		GP	Poorly graded gravel ^F
		Gravels with Fines:	Fines classify as ML or MH		GM	Silty gravel ^{F, G, H}
		More than 12% fines ^C	Fines classify as CL or CH		GC	Clayey gravel ^{F, G, H}
	Sands: 50% or more of coarse fraction passes No. 4 sieve	Clean Sands:	Cu ≥ 6 and 1 ≤ Cc ≤ 3 ^E		SW	Well-graded sand ^I
		Less than 5% fines ^D	Cu < 6 and/or 1 > Cc > 3 ^E		SP	Poorly graded sand ^I
		Sands with Fines:	Fines classify as ML or MH		SM	Silty sand ^{G, H, I}
		More than 12% fines ^D	Fines classify as CL or CH		SC	Clayey sand ^{G, H, I}
Fine-Grained Soils: 50% or more passes the No. 200 sieve	Silts and Clays: Liquid limit less than 50	Inorganic:	PI > 7 and plots on or above “A”		CL	Lean clay ^{K, L, M}
			PI < 4 or plots below “A” line ^J		ML	Silt ^{K, L, M}
		Organic:	Liquid limit - oven dried	< 0.75	OL	Organic clay ^{K, L, M, N}
			Liquid limit - not dried		Organic silt ^{K, L, M, O}	
	Silts and Clays: Liquid limit 50 or more	Inorganic:	PI plots on or above “A” line		CH	Fat clay ^{K, L, M}
			PI plots below “A” line		MH	Elastic Silt ^{K, L, M}
		Organic:	Liquid limit - oven dried	< 0.75	OH	Organic clay ^{K, L, M, P}
			Liquid limit - not dried		Organic silt ^{K, L, M, Q}	
Highly organic soils:	Primarily organic matter, dark in color, and organic odor				PT	Peat

^A Based on the material passing the 3-inch (75-mm) sieve

^B If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

^C Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

^D Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay

$$^E Cu = D_{60}/D_{10} \quad Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$$

^F If soil contains $\geq 15\%$ sand, add "with sand" to group name.

^G If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

^H If fines are organic, add "with organic fines" to group name.

^I If soil contains $\geq 15\%$ gravel, add "with gravel" to group name.

^J If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

^K If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

^L If soil contains $\geq 30\%$ plus No. 200 predominantly sand, add "sandy" to group name.

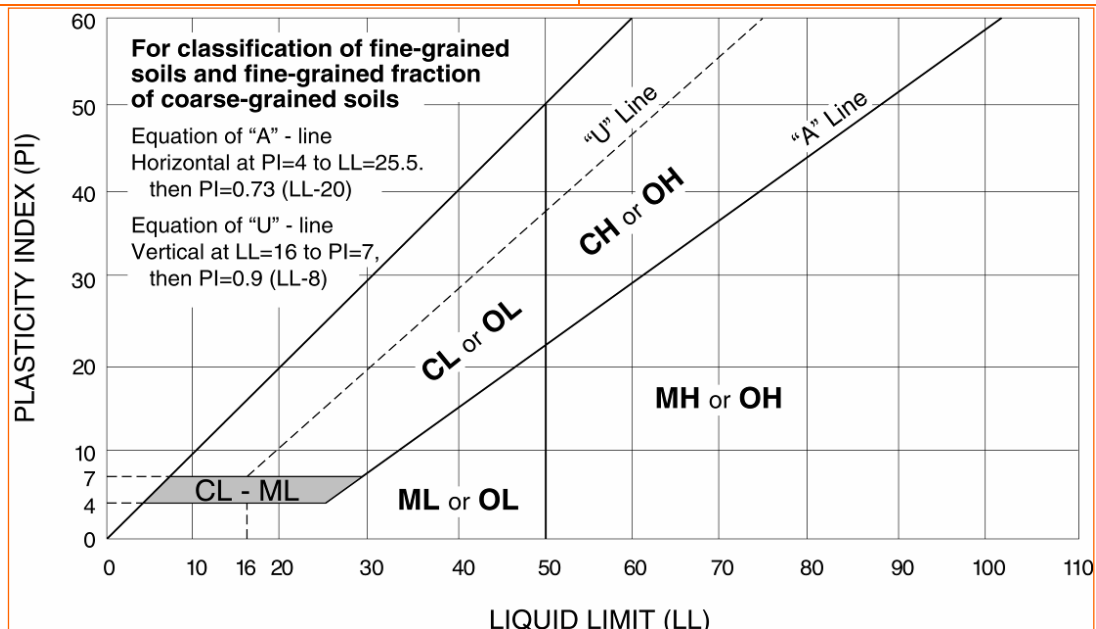
^M If soil contains $\geq 30\%$ plus No. 200, predominantly gravel, add "gravelly" to group name.

^N $PI \geq 4$ and plots on or above "A" line.

^O $PI < 4$ or plots below "A" line.

^P PI plots on or above "A" line.

^Q PI plots below "A" line.



DRAFT AIA® Document A101™ – 2007

Standard Form of Agreement Between Owner and Contractor where the basis of payment is a Stipulated Sum

AGREEMENT made as of the « » day of « » in the year « »
(In words, indicate day, month and year.)

BETWEEN the Owner:
(Name, legal status, address and other information)

«Sharyland Water Supply Corp.
New Building
4210 E. Main Ave
Alton, TX 78573 »
« »
« »
« »

and the Contractor:
(Name, legal status, address and other information)

« »
« »
« »
« »

for the following Project:
(Name, location and detailed description)

«New Building»
«4210 E. Main Ave»
«Alton, TX 78573
A new 10,800 square foot administration building and a 8,668 warehouse alternate #1.»

The Architect:
(Name, legal status, address and other information)

«Milnet Architectural Services, PLLC
608 South 12th Street
McAllen, TX 78501 »
« »
« »
« »

The Owner and Contractor agree as follows.

ADDITIONS AND DELETIONS: The author of this document has added information needed for its completion. The author may also have revised the text of the original AIA standard form. An *Additions and Deletions Report* that notes added information as well as revisions to the standard form text is available from the author and should be reviewed.

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

AIA Document A201™-2007, General Conditions of the Contract for Construction, is adopted in this document by reference. Do not use with other general conditions unless this document is modified.



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TABLE OF ARTICLES

1	THE CONTRACT DOCUMENTS
2	THE WORK OF THIS CONTRACT
3	DATE OF COMMENCEMENT AND SUBSTANTIAL COMPLETION
4	CONTRACT SUM
5	PAYMENTS
6	DISPUTE RESOLUTION
7	TERMINATION OR SUSPENSION
8	MISCELLANEOUS PROVISIONS
9	ENUMERATION OF CONTRACT DOCUMENTS
10	INSURANCE AND BONDS

ARTICLE 1 THE CONTRACT DOCUMENTS

The Contract Documents consist of this Agreement, Conditions of the Contract (General, Supplementary and other Conditions), Drawings, Specifications, Addenda issued prior to execution of this Agreement, other documents listed in this Agreement and Modifications issued after execution of this Agreement, all of which form the Contract, and are as fully a part of the Contract as if attached to this Agreement or repeated herein. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations or agreements, either written or oral. An enumeration of the Contract Documents, other than a Modification, appears in Article 9.

ARTICLE 2 THE WORK OF THIS CONTRACT

The Contractor shall fully execute the Work described in the Contract Documents, except as specifically indicated in the Contract Documents to be the responsibility of others.

ARTICLE 3 DATE OF COMMENCEMENT AND SUBSTANTIAL COMPLETION

§ 3.1 The date of commencement of the Work shall be the date of this Agreement unless a different date is stated below or provision is made for the date to be fixed in a notice to proceed issued by the Owner.

(Insert the date of commencement if it differs from the date of this Agreement or, if applicable, state that the date will be fixed in a notice to proceed.)

«Date will be fixed in a notice to proceed »

If, prior to the commencement of the Work, the Owner requires time to file mortgages and other security interests, the Owner's time requirement shall be as follows:

« »

§ 3.2 The Contract Time shall be measured from the date of commencement.

§ 3.3 The Contractor shall achieve Substantial Completion of the entire Work not later than July 1, 2018.

ARTICLE 4 CONTRACT SUM

§ 4.1 The Owner shall pay the Contractor the Contract Sum in current funds for the Contractor's performance of the Contract. The Contract Sum shall be « » (\$ « »), subject to additions and deductions as provided in the Contract Documents.

§ 4.2 The Contract Sum is based upon the following alternates, if any, which are described in the Contract Documents and are hereby accepted by the Owner:

(State the numbers or other identification of accepted alternates. If the bidding or proposal documents permit the Owner to accept other alternates subsequent to the execution of this Agreement, attach a schedule of such other alternates showing the amount for each and the date when that amount expires.)

<< >>

§ 4.3 Unit prices, if any:

(Identify and state the unit price; state quantity limitations, if any, to which the unit price will be applicable.)

Item	Units and Limitations	Price Per Unit (\$0.00)

§ 4.4 Allowances included in the Contract Sum, if any:

(Identify allowance and state exclusions, if any, from the allowance price.)

Item	Price

ARTICLE 5 PAYMENTS

§ 5.1 PROGRESS PAYMENTS

§ 5.1.1 Based upon Applications for Payment submitted to the Architect by the Contractor and Certificates for Payment issued by the Architect, the Owner shall make progress payments on account of the Contract Sum to the Contractor as provided below and elsewhere in the Contract Documents.

§ 5.1.2 The period covered by each Application for Payment shall be one calendar month ending on the last day of the month, or as follows:

<< >>

§ 5.1.3 Provided that an Application for Payment is received by the Architect not later than the <> day of a month, the Owner shall make payment of the certified amount to the Contractor not later than the <> day of the <> month. If an Application for Payment is received by the Architect after the application date fixed above, payment shall be made by the Owner not later than <> (<>) days after the Architect receives the Application for Payment.

(Federal, state or local laws may require payment within a certain period of time.)

§ 5.1.4 Each Application for Payment shall be based on the most recent schedule of values submitted by the Contractor in accordance with the Contract Documents. The schedule of values shall allocate the entire Contract Sum among the various portions of the Work. The schedule of values shall be prepared in such form and supported by such data to substantiate its accuracy as the Architect may require. This schedule, unless objected to by the Architect, shall be used as a basis for reviewing the Contractor's Applications for Payment.

§ 5.1.5 Applications for Payment shall show the percentage of completion of each portion of the Work as of the end of the period covered by the Application for Payment.

§ 5.1.6 Subject to other provisions of the Contract Documents, the amount of each progress payment shall be computed as follows:

- .1 Take that portion of the Contract Sum properly allocable to completed Work as determined by multiplying the percentage completion of each portion of the Work by the share of the Contract Sum allocated to that portion of the Work in the schedule of values, less retainage of <> percent (<> %). Pending final determination of cost to the Owner of changes in the Work, amounts not in dispute shall be included as provided in Section 7.3.9 of AIA Document A201™–2007, General Conditions of the Contract for Construction;
- .2 Add that portion of the Contract Sum properly allocable to materials and equipment delivered and suitably stored at the site for subsequent incorporation in the completed construction (or, if approved in advance by the Owner, suitably stored off the site at a location agreed upon in writing), less retainage of <> percent (<> %);

- .3 Subtract the aggregate of previous payments made by the Owner; and
- .4 Subtract amounts, if any, for which the Architect has withheld or nullified a Certificate for Payment as provided in Section 9.5 of AIA Document A201–2007.

§ 5.1.7 The progress payment amount determined in accordance with Section 5.1.6 shall be further modified under the following circumstances:

- .1 Add, upon Substantial Completion of the Work, a sum sufficient to increase the total payments to the full amount of the Contract Sum, less such amounts as the Architect shall determine for incomplete Work, retainage applicable to such work and unsettled claims; and
(Section 9.8.5 of AIA Document A201–2007 requires release of applicable retainage upon Substantial Completion of Work with consent of surety, if any.)
- .2 Add, if final completion of the Work is thereafter materially delayed through no fault of the Contractor, any additional amounts payable in accordance with Section 9.10.3 of AIA Document A201–2007.

§ 5.1.8 Reduction or limitation of retainage, if any, shall be as follows:

(If it is intended, prior to Substantial Completion of the entire Work, to reduce or limit the retainage resulting from the percentages inserted in Sections 5.1.6.1 and 5.1.6.2 above, and this is not explained elsewhere in the Contract Documents, insert here provisions for such reduction or limitation.)

« »

§ 5.1.9 Except with the Owner’s prior approval, the Contractor shall not make advance payments to suppliers for materials or equipment which have not been delivered and stored at the site.

§ 5.2 FINAL PAYMENT

§ 5.2.1 Final payment, constituting the entire unpaid balance of the Contract Sum, shall be made by the Owner to the Contractor when

- .1 the Contractor has fully performed the Contract except for the Contractor’s responsibility to correct Work as provided in Section 12.2.2 of AIA Document A201–2007, and to satisfy other requirements, if any, which extend beyond final payment; and
- .2 a final Certificate for Payment has been issued by the Architect.

§ 5.2.2 The Owner’s final payment to the Contractor shall be made no later than 30 days after the issuance of the Architect’s final Certificate for Payment, or as follows:

« »

ARTICLE 6 DISPUTE RESOLUTION

§ 6.1 INITIAL DECISION MAKER

The Architect will serve as Initial Decision Maker pursuant to Section 15.2 of AIA Document A201–2007, unless the parties appoint below another individual, not a party to this Agreement, to serve as Initial Decision Maker.

(If the parties mutually agree, insert the name, address and other contact information of the Initial Decision Maker, if other than the Architect.)

« »

« »

« »

« »

§ 6.2 BINDING DISPUTE RESOLUTION

For any Claim subject to, but not resolved by, mediation pursuant to Section 15.3 of AIA Document A201–2007, the method of binding dispute resolution shall be as follows:

(Check the appropriate box. If the Owner and Contractor do not select a method of binding dispute resolution below, or do not subsequently agree in writing to a binding dispute resolution method other than litigation, Claims will be resolved by litigation in a court of competent jurisdiction.)

[« »] Arbitration pursuant to Section 15.4 of AIA Document A201–2007

[☒] Litigation in a court of competent jurisdiction

[☐] Other (*Specify*)

« »

ARTICLE 7 TERMINATION OR SUSPENSION

§ 7.1 The Contract may be terminated by the Owner or the Contractor as provided in Article 14 of AIA Document A201–2007.

§ 7.2 The Work may be suspended by the Owner as provided in Article 14 of AIA Document A201–2007.

ARTICLE 8 MISCELLANEOUS PROVISIONS

§ 8.1 Where reference is made in this Agreement to a provision of AIA Document A201–2007 or another Contract Document, the reference refers to that provision as amended or supplemented by other provisions of the Contract Documents.

§ 8.2 Payments due and unpaid under the Contract shall bear interest from the date payment is due at the rate stated below, or in the absence thereof, at the legal rate prevailing from time to time at the place where the Project is located. (*Insert rate of interest agreed upon, if any.*)

« » % « »

§ 8.3 The Owner's representative:
(*Name, address and other information*)

«Sherilyn Dahlberg, General Manager
Sharyland Water Supply Corporation
P.O. Box 1868
Mission, TX 78573
(956) 585-6081»

§ 8.4 The Contractor's representative:
(*Name, address and other information*)

« »
« »
« »
« »
« »
« »

§ 8.5 Neither the Owner's nor the Contractor's representative shall be changed without ten days written notice to the other party.

§ 8.6 Other provisions:

« »

ARTICLE 9 ENUMERATION OF CONTRACT DOCUMENTS

§ 9.1 The Contract Documents, except for Modifications issued after execution of this Agreement, are enumerated in the sections below.

§ 9.1.1 The Agreement is this executed AIA Document A101–2007, Standard Form of Agreement Between Owner and Contractor.

§ 9.1.2 The General Conditions are AIA Document A201–2007, General Conditions of the Contract for Construction.

§ 9.1.3 The Supplementary and other Conditions of the Contract:

Document	Title	Date	Pages

§ 9.1.4 The Specifications:

(Either list the Specifications here or refer to an exhibit attached to this Agreement.)

<< >>

Section	Title	Date	Pages

§ 9.1.5 The Drawings:

(Either list the Drawings here or refer to an exhibit attached to this Agreement.)

<< >>

Number	Title	Date

§ 9.1.6 The Addenda, if any:

Number	Date	Pages

Portions of Addenda relating to bidding requirements are not part of the Contract Documents unless the bidding requirements are also enumerated in this Article 9.

§ 9.1.7 Additional documents, if any, forming part of the Contract Documents:

- .1 AIA Document E201™–2007, Digital Data Protocol Exhibit, if completed by the parties, or the following:

<< >>

- .2 Other documents, if any, listed below:

(List here any additional documents that are intended to form part of the Contract Documents. AIA Document A201–2007 provides that bidding requirements such as advertisement or invitation to bid, Instructions to Bidders, sample forms and the Contractor's bid are not part of the Contract Documents unless enumerated in this Agreement. They should be listed here only if intended to be part of the Contract Documents.)

<< >>

ARTICLE 10 INSURANCE AND BONDS

The Contractor shall purchase and maintain insurance and provide bonds as set forth in Article 11 of AIA Document A201–2007.

(State bonding requirements, if any, and limits of liability for insurance required in Article 11 of AIA Document A201–2007.)

Type of insurance or bond	Limit of liability or bond amount (\$0.00)

ARTICLE 11 ADDITIONAL CONTRACT TERMS

§ 11.1 The Contract shall be governed by and interpreted in accordance with the laws of the State of Texas. Venue for any action brought in connection with the Contract Documents shall be in Brooks County, Texas.

§ 11.2 All notices required to be given under the Contract must be in writing and delivered to the addresses provided on Page 1 of this Contract. Any notice required or permitted under this Contract shall be deemed delivered four (4) days after it is deposited in the U.S. Mail when sent by certified mail, return receipt requested.

§ 11.3 The Contractor must comply with all applicable state and federal laws, including but not limited to laws concerned with labor, equal employment opportunity, safety, minimum wage and prevailing wage rates requirements under Chapter 2258 of the Texas Government Code. Contractor shall require all subcontractors to comply with the provisions of this Article 11 which pertain to subcontractors.

§ 11.4 A Contractor or subcontractor who violates these provisions shall pay to Owner \$60 for each worker employed for each calendar day or part of the day that the worker is paid less than the wage rates stipulated herein.

§ 11.5 The Contractor and each subcontractor shall keep a record showing:

- (1) the name and occupation of each worker employed by the Contractor or subcontractor in the construction of the Work; and
- (2) the actual per diem wages paid to each worker.

The record shall be open at all reasonable hours to inspection by officers and agents of Owner.

§ 11.6 In the event of a complaint of a breach of these requirements by Contractor or subcontractor, Owner shall have the right to make a determination as provided by law, and to retain any amount due under the Contract pending a final determination of the violation.

§ 11.7 Contractor shall provide Owner with a Payment Bond. Contractor shall deliver the Bond to Owner no later than 10 days after the execution of this Agreement by Contractor. The Bond must be in the amount of 100% of the Contract Sum and must be issued by a corporate surety authorized to do business in the State of Texas. The Bond must be in form provided by Owner and must comply with the requirements of Chapter 2253 of the Texas Government Code, and other applicable law, including the requirements of Section 7.19-1 of the Texas Insurance Code regarding reinsurance if the bond exceeds 10% of the Surety's capital and surplus. All sureties must be listed as approved sureties by the U.S. Department of Treasury.

In the event any surety on the bonds becomes insolvent or is otherwise unable to perform its obligations under the bonds, the Contractor shall provide substitute bonds or equivalent security satisfactory to the Owner to protect the interests of Owner and of persons furnishing labor and materials in the prosecution of the Work.

Contractor shall not begin any Work on this Project until the payment and performance bonds and required insurance have been furnished by Contractor and approved by Owner.

§ 11.8 Pursuant to Section 406.096 of the Texas labor Code, by execution of the Contract, Contractor certifies to Owner that it has Worker's Compensation insurance coverage for each employee of the Contractor employed on this Project. Contractor shall obtain from each Subcontractor a certificate which certifies that the Subcontractor has Worker's Compensation insurance coverage for each employee of the Subcontractor employed on this Project and shall promptly provide Owner with all such certificates.

§ 11.9 Contractor shall ensure that subcontracts with Subcontractors for this Project are consistent with and reflective of the terms of the Contract Documents applicable or relevant to Subcontractors, including, but not limited to, the prevailing wage rate requirements and the Labor Code requirements set forth above, as well as Owner's rights and remedies under the Contract Documents.

§ 11.10 All rights and remedies of Owner provided in the Contract Documents are in addition to all other rights and remedies provided by law or equity. All such rights and remedies are cumulative, and not exclusive, and may be exercised concurrently and/or successively.

§11.11 Materials testing shall be performed through a laboratory selected by Owner, and Owner shall bear the cost of such testing except if testing is required due to the fault of Contractor.

By signing this Agreement or providing or causing to be provided a certificate of coverage, the Contractor is certifying to the Owner that all employees of the Contractor who will provide services on the Project will be covered by workers' compensation coverage for the duration of the Project. Contractor is also representing that it will require all subcontractors to provide workers' compensation coverage on all employees who will provide services on the Project for the duration of the Project and to provide written certifications of such coverage to Contractor. Contractor will provide the certification to Owner. Providing false or misleading information may subject the contractor to administrative penalties, criminal penalties, civil penalties, or other civil actions. The Contractor's failure to comply with any of these provision is a breach of contract by the Contractor which entitles the Owner to declare the Contract void if the Contractor does not remedy the breach within ten (10) days after receipt of notice of breach from the Owner.

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

OWNER *(Signature)*

« »« »

(Printed name and title)

CONTRACTOR *(Signature)*

« »« »

(Printed name and title)

DRAFT AIA® Document A201™ – 2007

General Conditions of the Contract for Construction

for the following PROJECT:

(Name and location or address)

Sharyland Water Supply Corp.
New Building
4210 E. Main Ave.
Alton, TX. 78573

THE OWNER:

(Name, legal status and address)

Sharyland Water Supply Corp.
4210 E. Main Ave.
Alton, TX 78573

THE ARCHITECT:

(Name, legal status and address)

Milnet Architectural Services, PLLC
608 S. 12th St.
McAllen, TX 78501

TABLE OF ARTICLES

- | | |
|----|--|
| 1 | GENERAL PROVISIONS |
| 2 | OWNER |
| 3 | CONTRACTOR |
| 4 | ARCHITECT |
| 5 | SUBCONTRACTORS |
| 6 | CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS |
| 7 | CHANGES IN THE WORK |
| 8 | TIME |
| 9 | PAYMENTS AND COMPLETION |
| 10 | PROTECTION OF PERSONS AND PROPERTY |
| 11 | INSURANCE AND BONDS |
| 12 | UNCOVERING AND CORRECTION OF WORK |
| 13 | MISCELLANEOUS PROVISIONS |

ADDITIONS AND DELETIONS:

The author of this document has added information needed for its completion. The author may also have revised the text of the original AIA standard form. An *Additions and Deletions Report* that notes added information as well as revisions to the standard form text is available from the author and should be reviewed.

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

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- 14 TERMINATION OR SUSPENSION OF THE CONTRACT
- 15 CLAIMS AND DISPUTES



INDEX

(Topics and numbers in bold are section headings.)

Acceptance of Nonconforming Work

9.6.6, 9.9.3, **12.3**

Acceptance of Work

9.6.6, 9.8.2, 9.9.3, 9.10.1, 9.10.3, 12.3

Access to Work

3.16, 6.2.1, 12.1

Accident Prevention

10

Acts and Omissions

3.2, 3.3.2, 3.12.8, 3.18, 4.2.3, 8.3.1, 9.5.1, 10.2.5, 10.2.8, 13.4.2, 13.7, 14.1, 15.2

Addenda

1.1.1, 3.11

Additional Costs, Claims for

3.7.4, 3.7.5, 6.1.1, 7.3.7.5, 10.3, 15.1.4

Additional Inspections and Testing

9.4.2, 9.8.3, 12.2.1, **13.5**

Additional Insured

11.1.4

Additional Time, Claims for

3.2.4, 3.7.4, 3.7.5, 3.10.2, 8.3.2, **15.1.5**

Administration of the Contract

3.1.3, **4.2**, 9.4, 9.5

Advertisement or Invitation to Bid

1.1.1

Aesthetic Effect

4.2.13

Allowances

3.8, 7.3.8

All-risk Insurance

11.3.1, 11.3.1.1

Applications for Payment

4.2.5, 7.3.9, 9.2, **9.3**, 9.4, 9.5.1, 9.6.3, 9.7, 9.10, 11.1.3

Approvals

2.1.1, 2.2.2, 2.4, 3.1.3, 3.10.2, 3.12.8, 3.12.9, 3.12.10, 4.2.7, 9.3.2, 13.5.1

Arbitration

8.3.1, 11.3.10, 13.1, 15.3.2, **15.4**

ARCHITECT

4

Architect, Definition of

4.1.1

Architect, Extent of Authority

2.4, 3.12.7, 4.1, 4.2, 5.2, 6.3, 7.1.2, 7.3.7, 7.4, 9.2, 9.3.1, 9.4, 9.5, 9.6.3, 9.8, 9.10.1, 9.10.3, 12.1, 12.2.1, 13.5.1, 13.5.2, 14.2.2, 14.2.4, 15.1.3, 15.2.1

Architect, Limitations of Authority and Responsibility

2.1.1, 3.12.4, 3.12.8, 3.12.10, 4.1.2, 4.2.1, 4.2.2, 4.2.3, 4.2.6, 4.2.7, 4.2.10, 4.2.12, 4.2.13, 5.2.1, 7.4, 9.4.2, 9.5.3, 9.6.4, 15.1.3, 15.2

Architect's Additional Services and Expenses

2.4, 11.3.1.1, 12.2.1, 13.5.2, 13.5.3, 14.2.4

Architect's Administration of the Contract

3.1.3, 4.2, 3.7.4, 15.2, 9.4.1, 9.5

Architect's Approvals

2.4, 3.1.3, 3.5, 3.10.2, 4.2.7

Architect's Authority to Reject Work

3.5, 4.2.6, 12.1.2, 12.2.1

Architect's Copyright

1.1.7, 1.5

Architect's Decisions

3.7.4, 4.2.6, 4.2.7, 4.2.11, 4.2.12, 4.2.13, 4.2.14, 6.3, 7.3.7, 7.3.9, 8.1.3, 8.3.1, 9.2, 9.4.1, 9.5, 9.8.4, 9.9.1, 13.5.2, 15.2, 15.3

Architect's Inspections

3.7.4, 4.2.2, 4.2.9, 9.4.2, 9.8.3, 9.9.2, 9.10.1, 13.5

Architect's Instructions

3.2.4, 3.3.1, 4.2.6, 4.2.7, 13.5.2

Architect's Interpretations

4.2.11, 4.2.12

Architect's Project Representative

4.2.10

Architect's Relationship with Contractor

1.1.2, 1.5, 3.1.3, 3.2.2, 3.2.3, 3.2.4, 3.3.1, 3.4.2, 3.5, 3.7.4, 3.7.5, 3.9.2, 3.9.3, 3.10, 3.11, 3.12, 3.16, 3.18, 4.1.2, 4.1.3, 4.2, 5.2, 6.2.2, 7, 8.3.1, 9.2, 9.3, 9.4, 9.5, 9.7, 9.8, 9.9, 10.2.6, 10.3, 11.3.7, 12, 13.4.2, 13.5, 15.2

Architect's Relationship with Subcontractors

1.1.2, 4.2.3, 4.2.4, 4.2.6, 9.6.3, 9.6.4, 11.3.7

Architect's Representations

9.4.2, 9.5.1, 9.10.1

Architect's Site Visits

3.7.4, 4.2.2, 4.2.9, 9.4.2, 9.5.1, 9.9.2, 9.10.1, 13.5

Asbestos

10.3.1

Attorneys' Fees

3.18.1, 9.10.2, 10.3.3

Award of Separate Contracts

6.1.1, 6.1.2

Award of Subcontracts and Other Contracts for Portions of the Work

5.2

Basic Definitions

1.1

Bidding Requirements

1.1.1, 5.2.1, 11.4.1

Binding Dispute Resolution

9.7, 11.3.9, 11.3.10, 13.1, 15.2.5, 15.2.6.1, 15.3.1, 15.3.2, 15.4.1

Boiler and Machinery Insurance

11.3.2

Bonds, Lien

7.3.7.4, 9.10.2, 9.10.3

Bonds, Performance, and Payment

7.3.7.4, 9.6.7, 9.10.3, 11.3.9, **11.4**

Building Permit

3.7.1

Capitalization

1.3

Certificate of Substantial Completion

9.8.3, 9.8.4, 9.8.5

Certificates for Payment

4.2.1, 4.2.5, 4.2.9, 9.3.3, **9.4**, 9.5, 9.6.1, 9.6.6, 9.7, 9.10.1, 9.10.3, 14.1.1.3, 14.2.4, 15.1.3

Certificates of Inspection, Testing or Approval
13.5.4

Certificates of Insurance

9.10.2, 11.1.3

Change Orders

1.1.1, 2.4, 3.4.2, 3.7.4, 3.8.2.3, 3.11, 3.12.8, 4.2.8, 5.2.3, 7.1.2, 7.1.3, **7.2**, 7.3.2, 7.3.6, 7.3.9, 7.3.10, 8.3.1, 9.3.1.1, 9.10.3, 10.3.2, 11.3.1.2, 11.3.4, 11.3.9, 12.1.2, 15.1.3

Change Orders, Definition of

7.2.1

CHANGES IN THE WORK

2.2.1, 3.11, 4.2.8, **7**, 7.2.1, 7.3.1, 7.4, 8.3.1, 9.3.1.1, 11.3.9

Claims, Definition of

15.1.1

CLAIMS AND DISPUTES

3.2.4, 6.1.1, 6.3, 7.3.9, 9.3.3, 9.10.4, 10.3.3, **15**, 15.4

Claims and Timely Assertion of Claims

15.4.1

Claims for Additional Cost

3.2.4, 3.7.4, 6.1.1, 7.3.9, 10.3.2, **15.1.4**

Claims for Additional Time

3.2.4, 3.7.4, 6.1.1, 8.3.2, 10.3.2, **15.1.5**

Concealed or Unknown Conditions, Claims for
3.7.4

Claims for Damages

3.2.4, 3.18, 6.1.1, 8.3.3, 9.5.1, 9.6.7, 10.3.3, 11.1.1, 11.3.5, 11.3.7, 14.1.3, 14.2.4, 15.1.6

Claims Subject to Arbitration

15.3.1, 15.4.1

Cleaning Up

3.15, 6.3

Commencement of the Work, Conditions Relating to

2.2.1, 3.2.2, 3.4.1, 3.7.1, 3.10.1, 3.12.6, 5.2.1, 5.2.3, 6.2.2, 8.1.2, 8.2.2, 8.3.1, 11.1, 11.3.1, 11.3.6, 11.4.1, 15.1.4

Commencement of the Work, Definition of

8.1.2

Communications Facilitating Contract

Administration

3.9.1, **4.2.4**

Completion, Conditions Relating to

3.4.1, 3.11, 3.15, 4.2.2, 4.2.9, 8.2, 9.4.2, 9.8, 9.9.1, 9.10, 12.2, 13.7, 14.1.2

COMPLETION, PAYMENTS AND

9

Completion, Substantial

4.2.9, 8.1.1, 8.1.3, 8.2.3, 9.4.2, 9.8, 9.9.1, 9.10.3, 12.2, 13.7

Compliance with Laws

1.6, 3.2.3, 3.6, 3.7, 3.12.10, 3.13, 4.1.1, 9.6.4, 10.2.2, 11.1, 11.3, 13.1, 13.4, 13.5.1, 13.5.2, 13.6, 14.1.1, 14.2.1.3, 15.2.8, 15.4.2, 15.4.3

Concealed or Unknown Conditions

3.7.4, 4.2.8, 8.3.1, 10.3

Conditions of the Contract

1.1.1, 6.1.1, 6.1.4

Consent, Written

3.4.2, 3.7.4, 3.12.8, 3.14.2, 4.1.2, 9.3.2, 9.8.5, 9.9.1, 9.10.2, 9.10.3, 11.3.1, 13.2, 13.4.2, 15.4.4.2

Consolidation or Joinder

15.4.4

CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

1.1.4, **6**

Construction Change Directive, Definition of

7.3.1

Construction Change Directives

1.1.1, 3.4.2, 3.12.8, 4.2.8, 7.1.1, 7.1.2, 7.1.3, **7.3**, 9.3.1.1

Construction Schedules, Contractor's

3.10, 3.12.1, 3.12.2, 6.1.3, 15.1.5.2

Contingent Assignment of Subcontracts

5.4, 14.2.2.2

Continuing Contract Performance

15.1.3

Contract, Definition of

1.1.2

CONTRACT, TERMINATION OR SUSPENSION OF THE

5.4.1.1, 11.3.9, **14**

Contract Administration

3.1.3, 4, 9.4, 9.5

Contract Award and Execution, Conditions Relating to

3.7.1, 3.10, 5.2, 6.1, 11.1.3, 11.3.6, 11.4.1

Contract Documents, Copies Furnished and Use of

1.5.2, 2.2.5, 5.3

Contract Documents, Definition of

1.1.1

Contract Sum

3.7.4, 3.8, 5.2.3, 7.2, 7.3, 7.4, **9.1**, 9.4.2, 9.5.1.4, 9.6.7, 9.7, 10.3.2, 11.3.1, 14.2.4, 14.3.2, 15.1.4, 15.2.5

Contract Sum, Definition of

9.1

Contract Time

3.7.4, 3.7.5, 3.10.2, 5.2.3, 7.2.1.3, 7.3.1, 7.3.5, 7.4, 8.1.1, 8.2.1, 8.3.1, 9.5.1, 9.7, 10.3.2, 12.1.1, 14.3.2, 15.1.5.1, 15.2.5

Contract Time, Definition of

8.1.1

CONTRACTOR

3

Contractor, Definition of

3.1, **6.1.2**

Contractor's Construction Schedules

3.10, 3.12.1, 3.12.2, 6.1.3, 15.1.5.2

Contractor's Employees

3.3.2, 3.4.3, 3.8.1, 3.9, 3.18.2, 4.2.3, 4.2.6, 10.2, 10.3, 11.1.1, 11.3.7, 14.1, 14.2.1.1

Contractor's Liability Insurance

11.1

Contractor's Relationship with Separate Contractors and Owner's Forces

3.12.5, 3.14.2, 4.2.4, 6, 11.3.7, 12.1.2, 12.2.4

Contractor's Relationship with Subcontractors

1.2.2, 3.3.2, 3.18.1, 3.18.2, 5, 9.6.2, 9.6.7, 9.10.2, 11.3.1.2, 11.3.7, 11.3.8

Contractor's Relationship with the Architect

1.1.2, 1.5, 3.1.3, 3.2.2, 3.2.3, 3.2.4, 3.3.1, 3.4.2, 3.5, 3.7.4, 3.10, 3.11, 3.12, 3.16, 3.18, 4.1.3, 4.2, 5.2, 6.2.2, 7, 8.3.1, 9.2, 9.3, 9.4, 9.5, 9.7, 9.8, 9.9, 10.2.6, 10.3, 11.3.7, 12, 13.5, 15.1.2, 15.2.1

Contractor's Representations

3.2.1, 3.2.2, 3.5, 3.12.6, 6.2.2, 8.2.1, 9.3.3, 9.8.2

Contractor's Responsibility for Those Performing the Work

3.3.2, 3.18, 5.3, 6.1.3, 6.2, 9.5.1, 10.2.8

Contractor's Review of Contract Documents

3.2

Contractor's Right to Stop the Work

9.7

Contractor's Right to Terminate the Contract

14.1, 15.1.6

Contractor's Submittals

3.10, 3.11, 3.12.4, 4.2.7, 5.2.1, 5.2.3, 9.2, 9.3, 9.8.2, 9.8.3, 9.9.1, 9.10.2, 9.10.3, 11.1.3, 11.4.2

Contractor's Superintendent

3.9, 10.2.6

Contractor's Supervision and Construction

Procedures

1.2.2, 3.3, 3.4, 3.12.10, 4.2.2, 4.2.7, 6.1.3, 6.2.4, 7.1.3, 7.3.5, 7.3.7, 8.2, 10, 12, 14, 15.1.3

Contractual Liability Insurance

11.1.1.8, 11.2

Coordination and Correlation

1.2, 3.2.1, 3.3.1, 3.10, 3.12.6, 6.1.3, 6.2.1

Copies Furnished of Drawings and Specifications

1.5, 2.2.5, 3.11

Copyrights

1.5, **3.17**

Correction of Work

2.3, 2.4, 3.7.3, 9.4.2, 9.8.2, 9.8.3, 9.9.1, 12.1.2, **12.2**

Correlation and Intent of the Contract Documents

1.2

Cost, Definition of

7.3.7

Costs

2.4, 3.2.4, 3.7.3, 3.8.2, 3.15.2, 5.4.2, 6.1.1, 6.2.3, 7.3.3.3, 7.3.7, 7.3.8, 7.3.9, 9.10.2, 10.3.2, 10.3.6, 11.3, 12.1.2, 12.2.1, 12.2.4, 13.5, 14

Cutting and Patching

3.14, 6.2.5

Damage to Construction of Owner or Separate Contractors

3.14.2, 6.2.4, 10.2.1.2, 10.2.5, 10.4, 11.1.1, 11.3, 12.2.4

Damage to the Work

3.14.2, 9.9.1, 10.2.1.2, 10.2.5, 10.4, 11.3.1, 12.2.4

Damages, Claims for

3.2.4, 3.18, 6.1.1, 8.3.3, 9.5.1, 9.6.7, 10.3.3, 11.1.1, 11.3.5, 11.3.7, 14.1.3, 14.2.4, 15.1.6

Damages for Delay

6.1.1, 8.3.3, 9.5.1.6, 9.7, 10.3.2

Date of Commencement of the Work, Definition of **8.1.2**

Date of Substantial Completion, Definition of **8.1.3**

Day, Definition of

8.1.4

Decisions of the Architect

3.7.4, 4.2.6, 4.2.7, 4.2.11, 4.2.12, 4.2.13, 15.2, 6.3, 7.3.7, 7.3.9, 8.1.3, 8.3.1, 9.2, 9.4, 9.5.1, 9.8.4, 9.9.1, 13.5.2, 14.2.2, 14.2.4, 15.1, 15.2

Decisions to Withhold Certification

9.4.1, **9.5**, 9.7, 14.1.1.3

Defective or Nonconforming Work, Acceptance, Rejection and Correction of

2.3, 2.4, 3.5, 4.2.6, 6.2.5, 9.5.1, 9.5.2, 9.6.6, 9.8.2, 9.9.3, 9.10.4, 12.2.1

Definitions

1.1, 2.1.1, 3.1.1, 3.5, 3.12.1, 3.12.2, 3.12.3, 4.1.1, 15.1.1, 5.1, 6.1.2, 7.2.1, 7.3.1, 8.1, 9.1, 9.8.1

Delays and Extensions of Time

3.2, 3.7.4, 5.2.3, 7.2.1, 7.3.1, 7.4, **8.3**, 9.5.1, 9.7, 10.3.2, 10.4, 14.3.2, 15.1.5, 15.2.5

Disputes

6.3, 7.3.9, 15.1, 15.2

Documents and Samples at the Site

3.11

Drawings, Definition of

1.1.5

Drawings and Specifications, Use and Ownership of 3.11

Effective Date of Insurance

8.2.2, 11.1.2

Emergencies

10.4, 14.1.1.2, 15.1.4

Employees, Contractor's

3.3.2, 3.4.3, 3.8.1, 3.9, 3.18.2, 4.2.3, 4.2.6, 10.2, 10.3.3, 11.1.1, 11.3.7, 14.1, 14.2.1.1

Equipment, Labor, Materials or

1.1.3, 1.1.6, 3.4, 3.5, 3.8.2, 3.8.3, 3.12, 3.13, 3.15.1, 4.2.6, 4.2.7, 5.2.1, 6.2.1, 7.3.7, 9.3.2, 9.3.3, 9.5.1.3, 9.10.2, 10.2.1, 10.2.4, 14.2.1.1, 14.2.1.2

Execution and Progress of the Work

1.1.3, 1.2.1, 1.2.2, 2.2.3, 2.2.5, 3.1, 3.3.1, 3.4.1, 3.5, 3.7.1, 3.10.1, 3.12, 3.14, 4.2, 6.2.2, 7.1.3, 7.3.5, 8.2, 9.5.1, 9.9.1, 10.2, 10.3, 12.2, 14.2, 14.3.1, 15.1.3

Extensions of Time
3.2.4, 3.7.4, 5.2.3, 7.2.1, 7.3, 7.4, 9.5.1, 9.7, 10.3.2,
10.4, 14.3, 15.1.5, 15.2.5
Failure of Payment
9.5.1.3, **9.7**, 9.10.2, 13.6, 14.1.1.3, 14.2.1.2
Faulty Work
(See Defective or Nonconforming Work)
Final Completion and Final Payment
4.2.1, 4.2.9, 9.8.2, **9.10**, 11.1.2, 11.1.3, 11.3.1, 11.3.5,
12.3, 14.2.4, 14.4.3
Financial Arrangements, Owner's
2.2.1, 13.2.2, 14.1.1.4
Fire and Extended Coverage Insurance
11.3.1.1
GENERAL PROVISIONS
1
Governing Law
13.1
Guarantees (See Warranty)
Hazardous Materials
10.2.4, **10.3**
Identification of Subcontractors and Suppliers
5.2.1
Indemnification
3.17, **3.18**, 9.10.2, 10.3.3, 10.3.5, 10.3.6, 11.3.1.2,
11.3.7
Information and Services Required of the Owner
2.1.2, **2.2**, 3.2.2, 3.12.4, 3.12.10, 6.1.3, 6.1.4, 6.2.5,
9.6.1, 9.6.4, 9.9.2, 9.10.3, 10.3.3, 11.2, 11.4, 13.5.1,
13.5.2, 14.1.1.4, 14.1.4, 15.1.3
Initial Decision
15.2
Initial Decision Maker, Definition of
1.1.8
Initial Decision Maker, Decisions
14.2.2, 14.2.4, 15.2.1, 15.2.2, 15.2.3, 15.2.4, 15.2.5
Initial Decision Maker, Extent of Authority
14.2.2, 14.2.4, 15.1.3, 15.2.1, 15.2.2, 15.2.3, 15.2.4,
15.2.5
Injury or Damage to Person or Property
10.2.8, 10.4
Inspections
3.1.3, 3.3.3, 3.7.1, 4.2.2, 4.2.6, 4.2.9, 9.4.2, 9.8.3,
9.9.2, 9.10.1, 12.2.1, 13.5
Instructions to Bidders
1.1.1
Instructions to the Contractor
3.2.4, 3.3.1, 3.8.1, 5.2.1, 7, 8.2.2, 12, 13.5.2
Instruments of Service, Definition of
1.1.7
Insurance
3.18.1, 6.1.1, 7.3.7, 9.3.2, 9.8.4, 9.9.1, 9.10.2, **11**
Insurance, Boiler and Machinery
11.3.2
Insurance, Contractor's Liability
11.1
Insurance, Effective Date of
8.2.2, 11.1.2

Insurance, Loss of Use
11.3.3
Insurance, Owner's Liability
11.2
Insurance, Property
10.2.5, **11.3**
Insurance, Stored Materials
9.3.2
INSURANCE AND BONDS
11
Insurance Companies, Consent to Partial Occupancy
9.9.1
Intent of the Contract Documents
1.2.1, 4.2.7, 4.2.12, 4.2.13, 7.4
Interest
13.6
Interpretation
1.2.3, **1.4**, 4.1.1, 5.1, 6.1.2, 15.1.1
Interpretations, Written
4.2.11, 4.2.12, 15.1.4
Judgment on Final Award
15.4.2
Labor and Materials, Equipment
1.1.3, 1.1.6, **3.4**, 3.5, 3.8.2, 3.8.3, 3.12, 3.13, 3.15.1,
4.2.6, 4.2.7, 5.2.1, 6.2.1, 7.3.7, 9.3.2, 9.3.3, 9.5.1.3,
9.10.2, 10.2.1, 10.2.4, 14.2.1.1, 14.2.1.2
Labor Disputes
8.3.1
Laws and Regulations
1.5, 3.2.3, 3.6, 3.7, 3.12.10, 3.13, 4.1.1, 9.6.4, 9.9.1,
10.2.2, 11.1.1, 11.3, 13.1, 13.4, 13.5.1, 13.5.2, 13.6,
14, 15.2.8, 15.4
Liens
2.1.2, 9.3.3, 9.10.2, 9.10.4, 15.2.8
Limitations, Statutes of
12.2.5, 13.7, 15.4.1.1
Limitations of Liability
2.3, 3.2.2, 3.5, 3.12.10, 3.17, 3.18.1, 4.2.6, 4.2.7,
4.2.12, 6.2.2, 9.4.2, 9.6.4, 9.6.7, 10.2.5, 10.3.3,
11.1.2, 11.2, 11.3.7, 12.2.5, 13.4.2
Limitations of Time
2.1.2, 2.2, 2.4, 3.2.2, 3.10, 3.11, 3.12.5, 3.15.1, 4.2.7,
5.2, 5.3, 5.4.1, 6.2.4, 7.3, 7.4, 8.2, 9.2, 9.3.1, 9.3.3,
9.4.1, 9.5, 9.6, 9.7, 9.8, 9.9, 9.10, 11.1.3, 11.3.1.5,
11.3.6, 11.3.10, 12.2, 13.5, 13.7, 14, 15
Loss of Use Insurance
11.3.3
Material Suppliers
1.5, 3.12.1, 4.2.4, 4.2.6, 5.2.1, 9.3, 9.4.2, 9.6, 9.10.5
Materials, Hazardous
10.2.4, **10.3**
Materials, Labor, Equipment and
1.1.3, 1.1.6, 1.5.1, 3.4.1, 3.5, 3.8.2, 3.8.3, 3.12, 3.13,
3.15.1, 4.2.6, 4.2.7, 5.2.1, 6.2.1, 7.3.7, 9.3.2, 9.3.3,
9.5.1.3, 9.10.2, 10.2.1.2, 10.2.4, 14.2.1.1, 14.2.1.2
Means, Methods, Techniques, Sequences and
Procedures of Construction
3.3.1, 3.12.10, 4.2.2, 4.2.7, 9.4.2

Mechanic's Lien

2.1.2, 15.2.8

Mediation

8.3.1, 10.3.5, 10.3.6, 15.2.1, 15.2.5, 15.2.6, **15.3**, 15.4.1

Minor Changes in the Work

1.1.1, 3.12.8, 4.2.8, 7.1, **7.4**

MISCELLANEOUS PROVISIONS

13

Modifications, Definition of

1.1.1

Modifications to the Contract

1.1.1, 1.1.2, 3.11, 4.1.2, 4.2.1, 5.2.3, 7, 8.3.1, 9.7, 10.3.2, 11.3.1

Mutual Responsibility

6.2

Nonconforming Work, Acceptance of

9.6.6, 9.9.3, **12.3**

Nonconforming Work, Rejection and Correction of
2.3, 2.4, 3.5, 4.2.6, 6.2.4, 9.5.1, 9.8.2, 9.9.3, 9.10.4, 12.2.1

Notice

2.2.1, 2.3, 2.4, 3.2.4, 3.3.1, 3.7.2, 3.12.9, 5.2.1, 9.7, 9.10, 10.2.2, 11.1.3, 12.2.2.1, 13.3, 13.5.1, 13.5.2, 14.1, 14.2, 15.2.8, 15.4.1

Notice, Written

2.3, 2.4, 3.3.1, 3.9.2, 3.12.9, 3.12.10, 5.2.1, 9.7, 9.10, 10.2.2, 10.3, 11.1.3, 11.3.6, 12.2.2.1, **13.3**, 14, 15.2.8, 15.4.1

Notice of Claims

3.7.4, 10.2.8, **15.1.2**, 15.4

Notice of Testing and Inspections

13.5.1, 13.5.2

Observations, Contractor's

3.2, 3.7.4

Occupancy

2.2.2, 9.6.6, 9.8, 11.3.1.5

Orders, Written

1.1.1, 2.3, 3.9.2, 7, 8.2.2, 11.3.9, 12.1, 12.2.2.1, 13.5.2, 14.3.1

OWNER

2

Owner, Definition of

2.1.1

Owner, Information and Services Required of the

2.1.2, **2.2**, 3.2.2, 3.12.10, 6.1.3, 6.1.4, 6.2.5, 9.3.2, 9.6.1, 9.6.4, 9.9.2, 9.10.3, 10.3.3, 11.2, 11.3, 13.5.1, 13.5.2, 14.1.1.4, 14.1.4, 15.1.3

Owner's Authority

1.5, 2.1.1, 2.3, 2.4, 3.4.2, 3.8.1, 3.12.10, 3.14.2, 4.1.2, 4.1.3, 4.2.4, 4.2.9, 5.2.1, 5.2.4, 5.4.1, 6.1, 6.3, 7.2.1, 7.3.1, 8.2.2, 8.3.1, 9.3.1, 9.3.2, 9.5.1, 9.6.4, 9.9.1, 9.10.2, 10.3.2, 11.1.3, 11.3.3, 11.3.10, 12.2.2, 12.3, 13.2.2, 14.3, 14.4, 15.2.7

Owner's Financial Capability

2.2.1, 13.2.2, 14.1.1.4

Owner's Liability Insurance

11.2

Owner's Relationship with Subcontractors

1.1.2, 5.2, 5.3, 5.4, 9.6.4, 9.10.2, 14.2.2

Owner's Right to Carry Out the Work

2.4, 14.2.2

Owner's Right to Clean Up

6.3

Owner's Right to Perform Construction and to

Award Separate Contracts

6.1

Owner's Right to Stop the Work

2.3

Owner's Right to Suspend the Work

14.3

Owner's Right to Terminate the Contract

14.2

Ownership and Use of Drawings, Specifications and Other Instruments of Service

1.1.1, 1.1.6, 1.1.7, **1.5**, 2.2.5, 3.2.2, 3.11, 3.17, 4.2.12, 5.3

Partial Occupancy or Use

9.6.6, **9.9**, 11.3.1.5

Patching, Cutting and

3.14, 6.2.5

Patents

3.17

Payment, Applications for

4.2.5, 7.3.9, 9.2, **9.3**, 9.4, 9.5, 9.6.3, 9.7, 9.8.5, 9.10.1, 14.2.3, 14.2.4, 14.4.3

Payment, Certificates for

4.2.5, 4.2.9, 9.3.3, **9.4**, 9.5, 9.6.1, 9.6.6, 9.7, 9.10.1, 9.10.3, 13.7, 14.1.1.3, 14.2.4

Payment, Failure of

9.5.1.3, **9.7**, 9.10.2, 13.6, 14.1.1.3, 14.2.1.2

Payment, Final

4.2.1, 4.2.9, 9.8.2, 9.10, 11.1.2, 11.1.3, 11.4.1, 12.3, 13.7, 14.2.4, 14.4.3

Payment Bond, Performance Bond and

7.3.7.4, 9.6.7, 9.10.3, **11.4**

Payments, Progress

9.3, **9.6**, 9.8.5, 9.10.3, 13.6, 14.2.3, 15.1.3

PAYMENTS AND COMPLETION

9

Payments to Subcontractors

5.4.2, 9.5.1.3, 9.6.2, 9.6.3, 9.6.4, 9.6.7, 14.2.1.2

PCB

10.3.1

Performance Bond and Payment Bond

7.3.7.4, 9.6.7, 9.10.3, **11.4**

Permits, Fees, Notices and Compliance with Laws

2.2.2, **3.7**, 3.13, 7.3.7.4, 10.2.2

PERSONS AND PROPERTY, PROTECTION OF

10

Polychlorinated Biphenyl

10.3.1

Product Data, Definition of

3.12.2

Product Data and Samples, Shop Drawings

3.11, **3.12**, 4.2.7

Progress and Completion

4.2.2, **8.2**, 9.8, 9.9.1, 14.1.4, 15.1.3

Progress Payments

9.3, **9.6**, 9.8.5, 9.10.3, 13.6, 14.2.3, 15.1.3

Project, Definition of

1.1.4

Project Representatives

4.2.10

Property Insurance

10.2.5, **11.3**

PROTECTION OF PERSONS AND PROPERTY **10**

Regulations and Laws

1.5, 3.2.3, 3.6, 3.7, 3.12.10, 3.13, 4.1.1, 9.6.4, 9.9.1, 10.2.2, 11.1, 11.4, 13.1, 13.4, 13.5.1, 13.5.2, 13.6, 14, 15.2.8, 15.4

Rejection of Work

3.5, 4.2.6, 12.2.1

Releases and Waivers of Liens

9.10.2

Representations

3.2.1, 3.5, 3.12.6, 6.2.2, 8.2.1, 9.3.3, 9.4.2, 9.5.1, 9.8.2, 9.10.1

Representatives

2.1.1, 3.1.1, 3.9, 4.1.1, 4.2.1, 4.2.2, 4.2.10, 5.1.1, 5.1.2, 13.2.1

Responsibility for Those Performing the Work

3.3.2, 3.18, 4.2.3, 5.3, 6.1.3, 6.2, 6.3, 9.5.1, 10

Retainage

9.3.1, 9.6.2, 9.8.5, 9.9.1, 9.10.2, 9.10.3

Review of Contract Documents and Field Conditions by Contractor

3.2, 3.12.7, 6.1.3

Review of Contractor's Submittals by Owner and Architect

3.10.1, 3.10.2, 3.11, 3.12, 4.2, 5.2, 6.1.3, 9.2, 9.8.2

Review of Shop Drawings, Product Data and Samples by Contractor

3.12

Rights and Remedies

1.1.2, 2.3, 2.4, 3.5, 3.7.4, 3.15.2, 4.2.6, 5.3, 5.4, 6.1, 6.3, 7.3.1, 8.3, 9.5.1, 9.7, 10.2.5, 10.3, 12.2.2, 12.2.4, **13.4**, 14, 15.4

Royalties, Patents and Copyrights

3.17

Rules and Notices for Arbitration

15.4.1

Safety of Persons and Property

10.2, 10.4

Safety Precautions and Programs

3.3.1, 4.2.2, 4.2.7, 5.3, **10.1**, 10.2, 10.4

Samples, Definition of

3.12.3

Samples, Shop Drawings, Product Data and

3.11, **3.12**, 4.2.7

Samples at the Site, Documents and

3.11

Schedule of Values

9.2, 9.3.1

Schedules, Construction

3.10, 3.12.1, 3.12.2, 6.1.3, 15.1.5.2

Separate Contracts and Contractors

1.1.4, 3.12.5, 3.14.2, 4.2.4, 4.2.7, 6, 8.3.1, 12.1.2

Shop Drawings, Definition of

3.12.1

Shop Drawings, Product Data and Samples

3.11, **3.12**, 4.2.7

Site, Use of

3.13, 6.1.1, 6.2.1

Site Inspections

3.2.2, 3.3.3, 3.7.1, 3.7.4, 4.2, 9.4.2, 9.10.1, 13.5

Site Visits, Architect's

3.7.4, 4.2.2, 4.2.9, 9.4.2, 9.5.1, 9.9.2, 9.10.1, 13.5

Special Inspections and Testing

4.2.6, 12.2.1, 13.5

Specifications, Definition of

1.1.6

Specifications

1.1.1, **1.1.6**, 1.2.2, 1.5, 3.11, 3.12.10, **3.17**, 4.2.14

Statute of Limitations

13.7, 15.4.1.1

Stopping the Work

2.3, 9.7, 10.3, 14.1

Stored Materials

6.2.1, 9.3.2, 10.2.1.2, 10.2.4

Subcontractor, Definition of

5.1.1

SUBCONTRACTORS

5

Subcontractors, Work by

1.2.2, 3.3.2, 3.12.1, 4.2.3, 5.2.3, 5.3, 5.4, 9.3.1.2, 9.6.7

Subcontractual Relations

5.3, 5.4, 9.3.1.2, 9.6, 9.10, 10.2.1, 14.1, 14.2.1

Submittals

3.10, 3.11, 3.12, 4.2.7, 5.2.1, 5.2.3, 7.3.7, 9.2, 9.3, 9.8, 9.9.1, 9.10.2, 9.10.3, 11.1.3

Submittal Schedule

3.10.2, 3.12.5, 4.2.7

Subrogation, Waivers of

6.1.1, **11.3.7**

Substantial Completion

4.2.9, 8.1.1, 8.1.3, 8.2.3, 9.4.2, **9.8**, 9.9.1, 9.10.3, 12.2, 13.7

Substantial Completion, Definition of

9.8.1

Substitution of Subcontractors

5.2.3, 5.2.4

Substitution of Architect

4.1.3

Substitutions of Materials

3.4.2, 3.5, 7.3.8

Sub-subcontractor, Definition of

5.1.2

Subsurface Conditions

3.7.4

Successors and Assigns

13.2

Superintendent

3.9, 10.2.6

Supervision and Construction Procedures

1.2.2, **3.3**, 3.4, 3.12.10, 4.2.2, 4.2.7, 6.1.3, 6.2.4,
7.1.3, 7.3.7, 8.2, 8.3.1, 9.4.2, 10, 12, 14, 15.1.3

Surety

5.4.1.2, 9.8.5, 9.10.2, 9.10.3, 14.2.2, 15.2.7

Surety, Consent of

9.10.2, 9.10.3

Surveys

2.2.3

Suspension by the Owner for Convenience

14.3

Suspension of the Work

5.4.2, 14.3

Suspension or Termination of the Contract

5.4.1.1, 14

Taxes

3.6, 3.8.2.1, 7.3.7.4

Termination by the Contractor

14.1, 15.1.6

Termination by the Owner for Cause

5.4.1.1, **14.2**, 15.1.6

Termination by the Owner for Convenience

14.4

Termination of the Architect

4.1.3

Termination of the Contractor

14.2.2

TERMINATION OR SUSPENSION OF THE CONTRACT

14

Tests and Inspections

3.1.3, 3.3.3, 4.2.2, 4.2.6, 4.2.9, 9.4.2, 9.8.3, 9.9.2,
9.10.1, 10.3.2, 11.4.1, 12.2.1, **13.5**

TIME

8

Time, Delays and Extensions of

3.2.4, 3.7.4, 5.2.3, 7.2.1, 7.3.1, 7.4, **8.3**, 9.5.1, 9.7,
10.3.2, 10.4, 14.3.2, 15.1.5, 15.2.5

Time Limits

2.1.2, 2.2, 2.4, 3.2.2, 3.10, 3.11, 3.12.5, 3.15.1, 4.2,
5.2, 5.3, 5.4, 6.2.4, 7.3, 7.4, 8.2, 9.2, 9.3.1, 9.3.3,
9.4.1, 9.5, 9.6, 9.7, 9.8, 9.9, 9.10, 11.1.3, 12.2, 13.5,
13.7, 14, 15.1.2, 15.4

Time Limits on Claims

3.7.4, 10.2.8, **13.7**, 15.1.2

Title to Work

9.3.2, 9.3.3

Transmission of Data in Digital Form

1.6

UNCOVERING AND CORRECTION OF WORK

12

Uncovering of Work

12.1

Unforeseen Conditions, Concealed or Unknown

3.7.4, 8.3.1, 10.3

Unit Prices

7.3.3.2, 7.3.4

Use of Documents

1.1.1, 1.5, 2.2.5, 3.12.6, 5.3

Use of Site

3.13, 6.1.1, 6.2.1

Values, Schedule of

9.2, 9.3.1

Waiver of Claims by the Architect

13.4.2

Waiver of Claims by the Contractor

9.10.5, 13.4.2, 15.1.6

Waiver of Claims by the Owner

9.9.3, 9.10.3, 9.10.4, 12.2.2.1, 13.4.2, 14.2.4, 15.1.6

Waiver of Consequential Damages

14.2.4, 15.1.6

Waiver of Liens

9.10.2, 9.10.4

Waivers of Subrogation

6.1.1, **11.3.7**

Warranty

3.5, 4.2.9, 9.3.3, 9.8.4, 9.9.1, 9.10.4, 12.2.2, 13.7

Weather Delays

15.1.5.2

Work, Definition of

1.1.3

Written Consent

1.5.2, 3.4.2, 3.7.4, 3.12.8, 3.14.2, 4.1.2, 9.3.2, 9.8.5,
9.9.1, 9.10.2, 9.10.3, 11.4.1, 13.2, 13.4.2, 15.4.4.2

Written Interpretations

4.2.11, 4.2.12

Written Notice

2.3, 2.4, 3.3.1, 3.9, 3.12.9, 3.12.10, 5.2.1, 8.2.2, 9.7,
9.10, 10.2.2, 10.3, 11.1.3, 12.2.2, 12.2.4, **13.3**, 14,
15.4.1

Written Orders

1.1.1, 2.3, 3.9, 7, 8.2.2, 12.1, 12.2, 13.5.2, 14.3.1,
15.1.2

ARTICLE 1 GENERAL PROVISIONS

§ 1.1 BASIC DEFINITIONS

§ 1.1.1 THE CONTRACT DOCUMENTS

The Contract Documents are enumerated in the Agreement between the Owner and Contractor (hereinafter the Agreement) and consist of the Agreement, Conditions of the Contract (General, Supplementary and other Conditions), Drawings, Specifications, Addenda issued prior to execution of the Contract, other documents listed in the Agreement and Modifications issued after execution of the Contract. A Modification is (1) a written amendment to the Contract signed by both parties, (2) a Change Order, (3) a Construction Change Directive or (4) a written order for a minor change in the Work issued by the Architect. Unless specifically enumerated in the Agreement, the Contract Documents do not include the advertisement or invitation to bid, Instructions to Bidders, sample forms, other information furnished by the Owner in anticipation of receiving bids or proposals, the Contractor's bid or proposal, or portions of Addenda relating to bidding requirements.

§ 1.1.2 THE CONTRACT

The Contract Documents form the Contract for Construction. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations or agreements, either written or oral. The Contract may be amended or modified only by a Modification. The Contract Documents shall not be construed to create a contractual relationship of any kind (1) between the Contractor and the Architect or the Architect's consultants, (2) between the Owner and a Subcontractor or a Sub-subcontractor, (3) between the Owner and the Architect or the Architect's consultants or (4) between any persons or entities other than the Owner and the Contractor. The Architect shall, however, be entitled to performance and enforcement of obligations under the Contract intended to facilitate performance of the Architect's duties.

§ 1.1.3 THE WORK

The term "Work" means the construction and services required by the Contract Documents, whether completed or partially completed, and includes all other labor, materials, equipment and services provided or to be provided by the Contractor to fulfill the Contractor's obligations. The Work may constitute the whole or a part of the Project.

§ 1.1.4 THE PROJECT

The Project is the total construction of which the Work performed under the Contract Documents may be the whole or a part and which may include construction by the Owner and by separate contractors.

§ 1.1.5 THE DRAWINGS

The Drawings are the graphic and pictorial portions of the Contract Documents showing the design, location and dimensions of the Work, generally including plans, elevations, sections, details, schedules and diagrams.

§ 1.1.6 THE SPECIFICATIONS

The Specifications are that portion of the Contract Documents consisting of the written requirements for materials, equipment, systems, standards and workmanship for the Work, and performance of related services.

§ 1.1.7 INSTRUMENTS OF SERVICE

Instruments of Service are representations, in any medium of expression now known or later developed, of the tangible and intangible creative work performed by the Architect and the Architect's consultants under their respective professional services agreements. Instruments of Service may include, without limitation, studies, surveys, models, sketches, drawings, specifications, and other similar materials.

§ 1.1.8 INITIAL DECISION MAKER

The Initial Decision Maker is the person identified in the Agreement to render initial decisions on Claims in accordance with Section 15.2 and certify termination of the Agreement under Section 14.2.2.

§ 1.2 CORRELATION AND INTENT OF THE CONTRACT DOCUMENTS

§ 1.2.1 The intent of the Contract Documents is to include all items necessary for the proper execution and completion of the Work by the Contractor. The Contract Documents are complementary, and what is required by one shall be as binding as if required by all; performance by the Contractor shall be required only to the extent consistent with the Contract Documents and reasonably inferable from them as being necessary to produce the indicated results.

§ 1.2.2 Organization of the Specifications into divisions, sections and articles, and arrangement of Drawings shall not control the Contractor in dividing the Work among Subcontractors or in establishing the extent of Work to be performed by any trade.

§ 1.2.3 Unless otherwise stated in the Contract Documents, words that have well-known technical or construction industry meanings are used in the Contract Documents in accordance with such recognized meanings.

§ 1.3 CAPITALIZATION

Terms capitalized in these General Conditions include those that are (1) specifically defined, (2) the titles of numbered articles or (3) the titles of other documents published by the American Institute of Architects.

§ 1.4 INTERPRETATION

In the interest of brevity the Contract Documents frequently omit modifying words such as “all” and “any” and articles such as “the” and “an,” but the fact that a modifier or an article is absent from one statement and appears in another is not intended to affect the interpretation of either statement.

§ 1.5 OWNERSHIP AND USE OF DRAWINGS, SPECIFICATIONS AND OTHER INSTRUMENTS OF SERVICE

§ 1.5.1 The Architect and the Architect’s consultants shall be deemed the authors and owners of their respective Instruments of Service, including the Drawings and Specifications, and will retain all common law, statutory and other reserved rights, including copyrights. The Contractor, Subcontractors, Sub-subcontractors, and material or equipment suppliers shall not own or claim a copyright in the Instruments of Service. Submittal or distribution to meet official regulatory requirements or for other purposes in connection with this Project is not to be construed as publication in derogation of the Architect’s or Architect’s consultants’ reserved rights.

§ 1.5.2 The Contractor, Subcontractors, Sub-subcontractors and material or equipment suppliers are authorized to use and reproduce the Instruments of Service provided to them solely and exclusively for execution of the Work. All copies made under this authorization shall bear the copyright notice, if any, shown on the Instruments of Service. The Contractor, Subcontractors, Sub-subcontractors, and material or equipment suppliers may not use the Instruments of Service on other projects or for additions to this Project outside the scope of the Work without the specific written consent of the Owner, Architect and the Architect’s consultants.

§ 1.6 TRANSMISSION OF DATA IN DIGITAL FORM

If the parties intend to transmit Instruments of Service or any other information or documentation in digital form, they shall endeavor to establish necessary protocols governing such transmissions, unless otherwise already provided in the Agreement or the Contract Documents.

ARTICLE 2 OWNER

§ 2.1 GENERAL

§ 2.1.1 The Owner is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The Owner shall designate in writing a representative who shall have express authority to bind the Owner with respect to all matters requiring the Owner’s approval or authorization. Except as otherwise provided in Section 4.2.1, the Architect does not have such authority. The term “Owner” means the Owner or the Owner’s authorized representative.

§ 2.1.2 The Owner shall furnish to the Contractor within fifteen days after receipt of a written request, information necessary and relevant for the Contractor to evaluate, give notice of or enforce mechanic’s lien rights. Such information shall include a correct statement of the record legal title to the property on which the Project is located, usually referred to as the site, and the Owner’s interest therein.

§ 2.2 INFORMATION AND SERVICES REQUIRED OF THE OWNER

§ 2.2.1 Prior to commencement of the Work, the Contractor may request in writing that the Owner provide reasonable evidence that the Owner has made financial arrangements to fulfill the Owner’s obligations under the Contract. Thereafter, the Contractor may only request such evidence if (1) the Owner fails to make payments to the Contractor as the Contract Documents require; (2) a change in the Work materially changes the Contract Sum; or (3) the Contractor identifies in writing a reasonable concern regarding the Owner’s ability to make payment when due. The Owner shall furnish such evidence as a condition precedent to commencement or continuation of the Work or the portion of the Work affected by a material change. After the Owner furnishes the evidence, the Owner shall not materially vary such financial arrangements without prior notice to the Contractor.

§ 2.2.2 Except for permits and fees that are the responsibility of the Contractor under the Contract Documents, including those required under Section 3.7.1, the Owner shall secure and pay for necessary approvals, easements, assessments and charges required for construction, use or occupancy of permanent structures or for permanent changes in existing facilities.

§ 2.2.3 The Owner shall furnish surveys describing physical characteristics, legal limitations and utility locations for the site of the Project, and a legal description of the site. The Contractor shall be entitled to rely on the accuracy of information furnished by the Owner but shall exercise proper precautions relating to the safe performance of the Work.

§ 2.2.4 The Owner shall furnish information or services required of the Owner by the Contract Documents with reasonable promptness. The Owner shall also furnish any other information or services under the Owner's control and relevant to the Contractor's performance of the Work with reasonable promptness after receiving the Contractor's written request for such information or services.

§ 2.2.5 Unless otherwise provided in the Contract Documents, the Owner shall furnish to the Contractor one copy of the Contract Documents for purposes of making reproductions pursuant to Section 1.5.2.

§ 2.3 OWNER'S RIGHT TO STOP THE WORK

If the Contractor fails to correct Work that is not in accordance with the requirements of the Contract Documents as required by Section 12.2 or repeatedly fails to carry out Work in accordance with the Contract Documents, the Owner may issue a written order to the Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, the right of the Owner to stop the Work shall not give rise to a duty on the part of the Owner to exercise this right for the benefit of the Contractor or any other person or entity, except to the extent required by Section 6.1.3.

§ 2.4 OWNER'S RIGHT TO CARRY OUT THE WORK

If the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents and fails within a ten-day period after receipt of written notice from the Owner to commence and continue correction of such default or neglect with diligence and promptness, the Owner may, without prejudice to other remedies the Owner may have, correct such deficiencies. In such case an appropriate Change Order shall be issued deducting from payments then or thereafter due the Contractor the reasonable cost of correcting such deficiencies, including Owner's expenses and compensation for the Architect's additional services made necessary by such default, neglect or failure. Such action by the Owner and amounts charged to the Contractor are both subject to prior approval of the Architect. If payments then or thereafter due the Contractor are not sufficient to cover such amounts, the Contractor shall pay the difference to the Owner.

ARTICLE 3 CONTRACTOR

§ 3.1 GENERAL

§ 3.1.1 The Contractor is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The Contractor shall be lawfully licensed, if required in the jurisdiction where the Project is located. The Contractor shall designate in writing a representative who shall have express authority to bind the Contractor with respect to all matters under this Contract. The term "Contractor" means the Contractor or the Contractor's authorized representative.

§ 3.1.2 The Contractor shall perform the Work in accordance with the Contract Documents.

§ 3.1.3 The Contractor shall not be relieved of obligations to perform the Work in accordance with the Contract Documents either by activities or duties of the Architect in the Architect's administration of the Contract, or by tests, inspections or approvals required or performed by persons or entities other than the Contractor.

§ 3.2 REVIEW OF CONTRACT DOCUMENTS AND FIELD CONDITIONS BY CONTRACTOR

§ 3.2.1 Execution of the Contract by the Contractor is a representation that the Contractor has visited the site, become generally familiar with local conditions under which the Work is to be performed and correlated personal observations with requirements of the Contract Documents.

§ 3.2.2 Because the Contract Documents are complementary, the Contractor shall, before starting each portion of the Work, carefully study and compare the various Contract Documents relative to that portion of the Work, as well as the information furnished by the Owner pursuant to Section 2.2.3, shall take field measurements of any existing conditions related to that portion of the Work, and shall observe any conditions at the site affecting it. These obligations are for the purpose of facilitating coordination and construction by the Contractor and are not for the purpose of discovering errors, omissions, or inconsistencies in the Contract Documents; however, the Contractor shall promptly report to the Architect any errors, inconsistencies or omissions discovered by or made known to the Contractor as a request for information in such form as the Architect may require. It is recognized that the Contractor's review is made in the Contractor's capacity as a contractor and not as a licensed design professional, unless otherwise specifically provided in the Contract Documents.

§ 3.2.3 The Contractor is not required to ascertain that the Contract Documents are in accordance with applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, but the Contractor shall promptly report to the Architect any nonconformity discovered by or made known to the Contractor as a request for information in such form as the Architect may require.

§ 3.2.4 If the Contractor believes that additional cost or time is involved because of clarifications or instructions the Architect issues in response to the Contractor's notices or requests for information pursuant to Sections 3.2.2 or 3.2.3, the Contractor shall make Claims as provided in Article 15. If the Contractor fails to perform the obligations of Sections 3.2.2 or 3.2.3, the Contractor shall pay such costs and damages to the Owner as would have been avoided if the Contractor had performed such obligations. If the Contractor performs those obligations, the Contractor shall not be liable to the Owner or Architect for damages resulting from errors, inconsistencies or omissions in the Contract Documents, for differences between field measurements or conditions and the Contract Documents, or for nonconformities of the Contract Documents to applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities.

§ 3.3 SUPERVISION AND CONSTRUCTION PROCEDURES

§ 3.3.1 The Contractor shall supervise and direct the Work, using the Contractor's best skill and attention. The Contractor shall be solely responsible for, and have control over, construction means, methods, techniques, sequences and procedures and for coordinating all portions of the Work under the Contract, unless the Contract Documents give other specific instructions concerning these matters. If the Contract Documents give specific instructions concerning construction means, methods, techniques, sequences or procedures, the Contractor shall evaluate the jobsite safety thereof and, except as stated below, shall be fully and solely responsible for the jobsite safety of such means, methods, techniques, sequences or procedures. If the Contractor determines that such means, methods, techniques, sequences or procedures may not be safe, the Contractor shall give timely written notice to the Owner and Architect and shall not proceed with that portion of the Work without further written instructions from the Architect. If the Contractor is then instructed to proceed with the required means, methods, techniques, sequences or procedures without acceptance of changes proposed by the Contractor, the Owner shall be solely responsible for any loss or damage arising solely from those Owner-required means, methods, techniques, sequences or procedures.

§ 3.3.2 The Contractor shall be responsible to the Owner for acts and omissions of the Contractor's employees, Subcontractors and their agents and employees, and other persons or entities performing portions of the Work for, or on behalf of, the Contractor or any of its Subcontractors.

§ 3.3.3 The Contractor shall be responsible for inspection of portions of Work already performed to determine that such portions are in proper condition to receive subsequent Work.

§ 3.4 LABOR AND MATERIALS

§ 3.4.1 Unless otherwise provided in the Contract Documents, the Contractor shall provide and pay for labor, materials, equipment, tools, construction equipment and machinery, water, heat, utilities, transportation, and other facilities and services necessary for proper execution and completion of the Work, whether temporary or permanent and whether or not incorporated or to be incorporated in the Work.

§ 3.4.2 Except in the case of minor changes in the Work authorized by the Architect in accordance with Sections 3.12.8 or 7.4, the Contractor may make substitutions only with the consent of the Owner, after evaluation by the Architect and in accordance with a Change Order or Construction Change Directive.

§ 3.4.3 The Contractor shall enforce strict discipline and good order among the Contractor's employees and other persons carrying out the Work. The Contractor shall not permit employment of unfit persons or persons not properly skilled in tasks assigned to them.

§ 3.5 WARRANTY

The Contractor warrants to the Owner and Architect that materials and equipment furnished under the Contract will be of good quality and new unless the Contract Documents require or permit otherwise. The Contractor further warrants that the Work will conform to the requirements of the Contract Documents and will be free from defects, except for those inherent in the quality of the Work the Contract Documents require or permit. Work, materials, or equipment not conforming to these requirements may be considered defective. The Contractor's warranty excludes remedy for damage or defect caused by abuse, alterations to the Work not executed by the Contractor, improper or insufficient maintenance, improper operation, or normal wear and tear and normal usage. If required by the Architect, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment.

§ 3.6 TAXES

The Contractor shall pay sales, consumer, use and similar taxes for the Work provided by the Contractor that are legally enacted when bids are received or negotiations concluded, whether or not yet effective or merely scheduled to go into effect.

§ 3.7 PERMITS, FEES, NOTICES AND COMPLIANCE WITH LAWS

§ 3.7.1 Unless otherwise provided in the Contract Documents, the Contractor shall secure and pay for the building permit as well as for other permits, fees, licenses, and inspections by government agencies necessary for proper execution and completion of the Work that are customarily secured after execution of the Contract and legally required at the time bids are received or negotiations concluded.

§ 3.7.2 The Contractor shall comply with and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities applicable to performance of the Work.

§ 3.7.3 If the Contractor performs Work knowing it to be contrary to applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, the Contractor shall assume appropriate responsibility for such Work and shall bear the costs attributable to correction.

§ 3.7.4 Concealed or Unknown Conditions. If the Contractor encounters conditions at the site that are (1) subsurface or otherwise concealed physical conditions that differ materially from those indicated in the Contract Documents or (2) unknown physical conditions of an unusual nature, that differ materially from those ordinarily found to exist and generally recognized as inherent in construction activities of the character provided for in the Contract Documents, the Contractor shall promptly provide notice to the Owner and the Architect before conditions are disturbed and in no event later than 21 days after first observance of the conditions. The Architect will promptly investigate such conditions and, if the Architect determines that they differ materially and cause an increase or decrease in the Contractor's cost of, or time required for, performance of any part of the Work, will recommend an equitable adjustment in the Contract Sum or Contract Time, or both. If the Architect determines that the conditions at the site are not materially different from those indicated in the Contract Documents and that no change in the terms of the Contract is justified, the Architect shall promptly notify the Owner and Contractor in writing, stating the reasons. If either party disputes the Architect's determination or recommendation, that party may proceed as provided in Article 15.

§ 3.7.5 If, in the course of the Work, the Contractor encounters human remains or recognizes the existence of burial markers, archaeological sites or wetlands not indicated in the Contract Documents, the Contractor shall immediately suspend any operations that would affect them and shall notify the Owner and Architect. Upon receipt of such notice, the Owner shall promptly take any action necessary to obtain governmental authorization required to resume the operations. The Contractor shall continue to suspend such operations until otherwise instructed by the Owner but shall continue with all other operations that do not affect those remains or features. Requests for adjustments in the Contract Sum and Contract Time arising from the existence of such remains or features may be made as provided in Article 15.

§ 3.8 ALLOWANCES

§ 3.8.1 The Contractor shall include in the Contract Sum all allowances stated in the Contract Documents. Items covered by allowances shall be supplied for such amounts and by such persons or entities as the Owner may direct,

but the Contractor shall not be required to employ persons or entities to whom the Contractor has reasonable objection.

§ 3.8.2 Unless otherwise provided in the Contract Documents,

- .1 Allowances shall cover the cost to the Contractor of materials and equipment delivered at the site and all required taxes, less applicable trade discounts;
- .2 Contractor's costs for unloading and handling at the site, labor, installation costs, overhead, profit and other expenses contemplated for stated allowance amounts shall be included in the Contract Sum but not in the allowances; and
- .3 Whenever costs are more than or less than allowances, the Contract Sum shall be adjusted accordingly by Change Order. The amount of the Change Order shall reflect (1) the difference between actual costs and the allowances under Section 3.8.2.1 and (2) changes in Contractor's costs under Section 3.8.2.2.

§ 3.8.3 Materials and equipment under an allowance shall be selected by the Owner with reasonable promptness.

§ 3.9 SUPERINTENDENT

§ 3.9.1 The Contractor shall employ a competent superintendent and necessary assistants who shall be in attendance at the Project site during performance of the Work. The superintendent shall represent the Contractor, and communications given to the superintendent shall be as binding as if given to the Contractor.

§ 3.9.2 The Contractor, as soon as practicable after award of the Contract, shall furnish in writing to the Owner through the Architect the name and qualifications of a proposed superintendent. The Architect may reply within 14 days to the Contractor in writing stating (1) whether the Owner or the Architect has reasonable objection to the proposed superintendent or (2) that the Architect requires additional time to review. Failure of the Architect to reply within the 14 day period shall constitute notice of no reasonable objection.

§ 3.9.3 The Contractor shall not employ a proposed superintendent to whom the Owner or Architect has made reasonable and timely objection. The Contractor shall not change the superintendent without the Owner's consent, which shall not unreasonably be withheld or delayed.

§ 3.10 CONTRACTOR'S CONSTRUCTION SCHEDULES

§ 3.10.1 The Contractor, promptly after being awarded the Contract, shall prepare and submit for the Owner's and Architect's information a Contractor's construction schedule for the Work. The schedule shall not exceed time limits current under the Contract Documents, shall be revised at appropriate intervals as required by the conditions of the Work and Project, shall be related to the entire Project to the extent required by the Contract Documents, and shall provide for expeditious and practicable execution of the Work.

§ 3.10.2 The Contractor shall prepare a submittal schedule, promptly after being awarded the Contract and thereafter as necessary to maintain a current submittal schedule, and shall submit the schedule(s) for the Architect's approval. The Architect's approval shall not unreasonably be delayed or withheld. The submittal schedule shall (1) be coordinated with the Contractor's construction schedule, and (2) allow the Architect reasonable time to review submittals. If the Contractor fails to submit a submittal schedule, the Contractor shall not be entitled to any increase in Contract Sum or extension of Contract Time based on the time required for review of submittals.

§ 3.10.3 The Contractor shall perform the Work in general accordance with the most recent schedules submitted to the Owner and Architect.

§ 3.11 DOCUMENTS AND SAMPLES AT THE SITE

The Contractor shall maintain at the site for the Owner one copy of the Drawings, Specifications, Addenda, Change Orders and other Modifications, in good order and marked currently to indicate field changes and selections made during construction, and one copy of approved Shop Drawings, Product Data, Samples and similar required submittals. These shall be available to the Architect and shall be delivered to the Architect for submittal to the Owner upon completion of the Work as a record of the Work as constructed.

§ 3.12 SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

§ 3.12.1 Shop Drawings are drawings, diagrams, schedules and other data specially prepared for the Work by the Contractor or a Subcontractor, Sub-subcontractor, manufacturer, supplier or distributor to illustrate some portion of the Work.

§ 3.12.2 Product Data are illustrations, standard schedules, performance charts, instructions, brochures, diagrams and other information furnished by the Contractor to illustrate materials or equipment for some portion of the Work.

§ 3.12.3 Samples are physical examples that illustrate materials, equipment or workmanship and establish standards by which the Work will be judged.

§ 3.12.4 Shop Drawings, Product Data, Samples and similar submittals are not Contract Documents. Their purpose is to demonstrate the way by which the Contractor proposes to conform to the information given and the design concept expressed in the Contract Documents for those portions of the Work for which the Contract Documents require submittals. Review by the Architect is subject to the limitations of Section 4.2.7. Informational submittals upon which the Architect is not expected to take responsive action may be so identified in the Contract Documents. Submittals that are not required by the Contract Documents may be returned by the Architect without action.

§ 3.12.5 The Contractor shall review for compliance with the Contract Documents, approve and submit to the Architect Shop Drawings, Product Data, Samples and similar submittals required by the Contract Documents in accordance with the submittal schedule approved by the Architect or, in the absence of an approved submittal schedule, with reasonable promptness and in such sequence as to cause no delay in the Work or in the activities of the Owner or of separate contractors.

§ 3.12.6 By submitting Shop Drawings, Product Data, Samples and similar submittals, the Contractor represents to the Owner and Architect that the Contractor has (1) reviewed and approved them, (2) determined and verified materials, field measurements and field construction criteria related thereto, or will do so and (3) checked and coordinated the information contained within such submittals with the requirements of the Work and of the Contract Documents.

§ 3.12.7 The Contractor shall perform no portion of the Work for which the Contract Documents require submittal and review of Shop Drawings, Product Data, Samples or similar submittals until the respective submittal has been approved by the Architect.

§ 3.12.8 The Work shall be in accordance with approved submittals except that the Contractor shall not be relieved of responsibility for deviations from requirements of the Contract Documents by the Architect's approval of Shop Drawings, Product Data, Samples or similar submittals unless the Contractor has specifically informed the Architect in writing of such deviation at the time of submittal and (1) the Architect has given written approval to the specific deviation as a minor change in the Work, or (2) a Change Order or Construction Change Directive has been issued authorizing the deviation. The Contractor shall not be relieved of responsibility for errors or omissions in Shop Drawings, Product Data, Samples or similar submittals by the Architect's approval thereof.

§ 3.12.9 The Contractor shall direct specific attention, in writing or on resubmitted Shop Drawings, Product Data, Samples or similar submittals, to revisions other than those requested by the Architect on previous submittals. In the absence of such written notice, the Architect's approval of a resubmission shall not apply to such revisions.

§ 3.12.10 The Contractor shall not be required to provide professional services that constitute the practice of architecture or engineering unless such services are specifically required by the Contract Documents for a portion of the Work or unless the Contractor needs to provide such services in order to carry out the Contractor's responsibilities for construction means, methods, techniques, sequences and procedures. The Contractor shall not be required to provide professional services in violation of applicable law. If professional design services or certifications by a design professional related to systems, materials or equipment are specifically required of the Contractor by the Contract Documents, the Owner and the Architect will specify all performance and design criteria that such services must satisfy. The Contractor shall cause such services or certifications to be provided by a properly licensed design professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, Shop Drawings and other submittals prepared by such professional. Shop Drawings and other submittals related to the Work designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to the Architect. The Owner and the Architect shall be entitled

to rely upon the adequacy, accuracy and completeness of the services, certifications and approvals performed or provided by such design professionals, provided the Owner and Architect have specified to the Contractor all performance and design criteria that such services must satisfy. Pursuant to this Section 3.12.10, the Architect will review, approve or take other appropriate action on submittals only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents. The Contractor shall not be responsible for the adequacy of the performance and design criteria specified in the Contract Documents.

§ 3.13 USE OF SITE

The Contractor shall confine operations at the site to areas permitted by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities and the Contract Documents and shall not unreasonably encumber the site with materials or equipment.

§ 3.14 CUTTING AND PATCHING

§ 3.14.1 The Contractor shall be responsible for cutting, fitting or patching required to complete the Work or to make its parts fit together properly. All areas requiring cutting, fitting and patching shall be restored to the condition existing prior to the cutting, fitting and patching, unless otherwise required by the Contract Documents.

§ 3.14.2 The Contractor shall not damage or endanger a portion of the Work or fully or partially completed construction of the Owner or separate contractors by cutting, patching or otherwise altering such construction, or by excavation. The Contractor shall not cut or otherwise alter such construction by the Owner or a separate contractor except with written consent of the Owner and of such separate contractor; such consent shall not be unreasonably withheld. The Contractor shall not unreasonably withhold from the Owner or a separate contractor the Contractor's consent to cutting or otherwise altering the Work.

§ 3.15 CLEANING UP

§ 3.15.1 The Contractor shall keep the premises and surrounding area free from accumulation of waste materials or rubbish caused by operations under the Contract. At completion of the Work, the Contractor shall remove waste materials, rubbish, the Contractor's tools, construction equipment, machinery and surplus materials from and about the Project.

§ 3.15.2 If the Contractor fails to clean up as provided in the Contract Documents, the Owner may do so and Owner shall be entitled to reimbursement from the Contractor.

§ 3.16 ACCESS TO WORK

The Contractor shall provide the Owner and Architect access to the Work in preparation and progress wherever located.

§ 3.17 ROYALTIES, PATENTS AND COPYRIGHTS

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

§ 3.18 INDEMNIFICATION

§ 3.18.1 To the fullest extent permitted by law the Contractor shall indemnify and hold harmless the Owner, Architect, Architect's consultants, and agents and employees of any of them from and against claims, damages, losses and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the Work, provided that such claim, damage, loss or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), but only to the extent caused by the negligent acts or omissions of the Contractor, a Subcontractor, anyone directly or indirectly employed by them or anyone for whose acts they may be liable, regardless of whether or not such claim, damage, loss or expense is caused in part by a party indemnified hereunder. Such obligation shall not be construed to negate, abridge, or reduce

other rights or obligations of indemnity that would otherwise exist as to a party or person described in this Section 3.18.

§ 3.18.2 In claims against any person or entity indemnified under this Section 3.18 by an employee of the Contractor, a Subcontractor, anyone directly or indirectly employed by them or anyone for whose acts they may be liable, the indemnification obligation under Section 3.18.1 shall not be limited by a limitation on amount or type of damages, compensation or benefits payable by or for the Contractor or a Subcontractor under workers' compensation acts, disability benefit acts or other employee benefit acts.

ARTICLE 4 ARCHITECT

§ 4.1 GENERAL

§ 4.1.1 The Owner shall retain an architect lawfully licensed to practice architecture or an entity lawfully practicing architecture in the jurisdiction where the Project is located. That person or entity is identified as the Architect in the Agreement and is referred to throughout the Contract Documents as if singular in number.

§ 4.1.2 Duties, responsibilities and limitations of authority of the Architect as set forth in the Contract Documents shall not be restricted, modified or extended without written consent of the Owner, Contractor and Architect. Consent shall not be unreasonably withheld.

§ 4.1.3 If the employment of the Architect is terminated, the Owner shall employ a successor architect as to whom the Contractor has no reasonable objection and whose status under the Contract Documents shall be that of the Architect.

§ 4.2 ADMINISTRATION OF THE CONTRACT

§ 4.2.1 The Architect will provide administration of the Contract as described in the Contract Documents and will be an Owner's representative during construction until the date the Architect issues the final Certificate for Payment. The Architect will have authority to act on behalf of the Owner only to the extent provided in the Contract Documents.

§ 4.2.2 The Architect will visit the site at intervals appropriate to the stage of construction, or as otherwise agreed with the Owner, to become generally familiar with the progress and quality of the portion of the Work completed, and to determine in general if the Work observed is being performed in a manner indicating that the Work, when fully completed, will be in accordance with the Contract Documents. However, the Architect will not be required to make exhaustive or continuous on-site inspections to check the quality or quantity of the Work. The Architect will not have control over, charge of, or responsibility for, the construction means, methods, techniques, sequences or procedures, or for the safety precautions and programs in connection with the Work, since these are solely the Contractor's rights and responsibilities under the Contract Documents, except as provided in Section 3.3.1.

§ 4.2.3 On the basis of the site visits, the Architect will keep the Owner reasonably informed about the progress and quality of the portion of the Work completed, and report to the Owner (1) known deviations from the Contract Documents and from the most recent construction schedule submitted by the Contractor, and (2) defects and deficiencies observed in the Work. The Architect will not be responsible for the Contractor's failure to perform the Work in accordance with the requirements of the Contract Documents. The Architect will not have control over or charge of and will not be responsible for acts or omissions of the Contractor, Subcontractors, or their agents or employees, or any other persons or entities performing portions of the Work.

§ 4.2.4 COMMUNICATIONS FACILITATING CONTRACT ADMINISTRATION

Except as otherwise provided in the Contract Documents or when direct communications have been specially authorized, the Owner and Contractor shall endeavor to communicate with each other through the Architect about matters arising out of or relating to the Contract. Communications by and with the Architect's consultants shall be through the Architect. Communications by and with Subcontractors and material suppliers shall be through the Contractor. Communications by and with separate contractors shall be through the Owner.

§ 4.2.5 Based on the Architect's evaluations of the Contractor's Applications for Payment, the Architect will review and certify the amounts due the Contractor and will issue Certificates for Payment in such amounts.

§ 4.2.6 The Architect has authority to reject Work that does not conform to the Contract Documents. Whenever the Architect considers it necessary or advisable, the Architect will have authority to require inspection or testing of the

Work in accordance with Sections 13.5.2 and 13.5.3, whether or not such Work is fabricated, installed or completed. However, neither this authority of the Architect nor a decision made in good faith either to exercise or not to exercise such authority shall give rise to a duty or responsibility of the Architect to the Contractor, Subcontractors, material and equipment suppliers, their agents or employees, or other persons or entities performing portions of the Work.

§ 4.2.7 The Architect will review and approve, or take other appropriate action upon, the Contractor's submittals such as Shop Drawings, Product Data and Samples, but only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents. The Architect's action will be taken in accordance with the submittal schedule approved by the Architect or, in the absence of an approved submittal schedule, with reasonable promptness while allowing sufficient time in the Architect's professional judgment to permit adequate review. Review of such submittals is not conducted for the purpose of determining the accuracy and completeness of other details such as dimensions and quantities, or for substantiating instructions for installation or performance of equipment or systems, all of which remain the responsibility of the Contractor as required by the Contract Documents. The Architect's review of the Contractor's submittals shall not relieve the Contractor of the obligations under Sections 3.3, 3.5 and 3.12. The Architect's review shall not constitute approval of safety precautions or, unless otherwise specifically stated by the Architect, of any construction means, methods, techniques, sequences or procedures. The Architect's approval of a specific item shall not indicate approval of an assembly of which the item is a component.

§ 4.2.8 The Architect will prepare Change Orders and Construction Change Directives, and may authorize minor changes in the Work as provided in Section 7.4. The Architect will investigate and make determinations and recommendations regarding concealed and unknown conditions as provided in Section 3.7.4.

§ 4.2.9 The Architect will conduct inspections to determine the date or dates of Substantial Completion and the date of final completion; issue Certificates of Substantial Completion pursuant to Section 9.8; receive and forward to the Owner, for the Owner's review and records, written warranties and related documents required by the Contract and assembled by the Contractor pursuant to Section 9.10; and issue a final Certificate for Payment pursuant to Section 9.10.

§ 4.2.10 If the Owner and Architect agree, the Architect will provide one or more project representatives to assist in carrying out the Architect's responsibilities at the site. The duties, responsibilities and limitations of authority of such project representatives shall be as set forth in an exhibit to be incorporated in the Contract Documents.

§ 4.2.11 The Architect will interpret and decide matters concerning performance under, and requirements of, the Contract Documents on written request of either the Owner or Contractor. The Architect's response to such requests will be made in writing within any time limits agreed upon or otherwise with reasonable promptness.

§ 4.2.12 Interpretations and decisions of the Architect will be consistent with the intent of, and reasonably inferable from, the Contract Documents and will be in writing or in the form of drawings. When making such interpretations and decisions, the Architect will endeavor to secure faithful performance by both Owner and Contractor, will not show partiality to either and will not be liable for results of interpretations or decisions rendered in good faith.

§ 4.2.13 The Architect's decisions on matters relating to aesthetic effect will be final if consistent with the intent expressed in the Contract Documents.

§ 4.2.14 The Architect will review and respond to requests for information about the Contract Documents. The Architect's response to such requests will be made in writing within any time limits agreed upon or otherwise with reasonable promptness. If appropriate, the Architect will prepare and issue supplemental Drawings and Specifications in response to the requests for information.

ARTICLE 5 SUBCONTRACTORS

§ 5.1 DEFINITIONS

§ 5.1.1 A Subcontractor is a person or entity who has a direct contract with the Contractor to perform a portion of the Work at the site. The term "Subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Subcontractor or an authorized representative of the Subcontractor. The term "Subcontractor" does not include a separate contractor or subcontractors of a separate contractor.

§ 5.1.2 A Sub-subcontractor is a person or entity who has a direct or indirect contract with a Subcontractor to perform a portion of the Work at the site. The term “Sub-subcontractor” is referred to throughout the Contract Documents as if singular in number and means a Sub-subcontractor or an authorized representative of the Sub-subcontractor.

§ 5.2 AWARD OF SUBCONTRACTS AND OTHER CONTRACTS FOR PORTIONS OF THE WORK

§ 5.2.1 Unless otherwise stated in the Contract Documents or the bidding requirements, the Contractor, as soon as practicable after award of the Contract, shall furnish in writing to the Owner through the Architect the names of persons or entities (including those who are to furnish materials or equipment fabricated to a special design) proposed for each principal portion of the Work. The Architect may reply within 14 days to the Contractor in writing stating (1) whether the Owner or the Architect has reasonable objection to any such proposed person or entity or (2) that the Architect requires additional time for review. Failure of the Owner or Architect to reply within the 14-day period shall constitute notice of no reasonable objection.

§ 5.2.2 The Contractor shall not contract with a proposed person or entity to whom the Owner or Architect has made reasonable and timely objection. The Contractor shall not be required to contract with anyone to whom the Contractor has made reasonable objection.

§ 5.2.3 If the Owner or Architect has reasonable objection to a person or entity proposed by the Contractor, the Contractor shall propose another to whom the Owner or Architect has no reasonable objection. If the proposed but rejected Subcontractor was reasonably capable of performing the Work, the Contract Sum and Contract Time shall be increased or decreased by the difference, if any, occasioned by such change, and an appropriate Change Order shall be issued before commencement of the substitute Subcontractor's Work. However, no increase in the Contract Sum or Contract Time shall be allowed for such change unless the Contractor has acted promptly and responsively in submitting names as required.

§ 5.2.4 The Contractor shall not substitute a Subcontractor, person or entity previously selected if the Owner or Architect makes reasonable objection to such substitution.

§ 5.3 SUBCONTRACTUAL RELATIONS

By appropriate agreement, written where legally required for validity, the Contractor shall require each Subcontractor, to the extent of the Work to be performed by the Subcontractor, to be bound to the Contractor by terms of the Contract Documents, and to assume toward the Contractor all the obligations and responsibilities, including the responsibility for safety of the Subcontractor's Work, which the Contractor, by these Documents, assumes toward the Owner and Architect. Each subcontract agreement shall preserve and protect the rights of the Owner and Architect under the Contract Documents with respect to the Work to be performed by the Subcontractor so that subcontracting thereof will not prejudice such rights, and shall allow to the Subcontractor, unless specifically provided otherwise in the subcontract agreement, the benefit of all rights, remedies and redress against the Contractor that the Contractor, by the Contract Documents, has against the Owner. Where appropriate, the Contractor shall require each Subcontractor to enter into similar agreements with Sub-subcontractors. The Contractor shall make available to each proposed Subcontractor, prior to the execution of the subcontract agreement, copies of the Contract Documents to which the Subcontractor will be bound, and, upon written request of the Subcontractor, identify to the Subcontractor terms and conditions of the proposed subcontract agreement that may be at variance with the Contract Documents. Subcontractors will similarly make copies of applicable portions of such documents available to their respective proposed Sub-subcontractors.

§ 5.4 CONTINGENT ASSIGNMENT OF SUBCONTRACTS

§ 5.4.1 Each subcontract agreement for a portion of the Work is assigned by the Contractor to the Owner, provided that

- .1 assignment is effective only after termination of the Contract by the Owner for cause pursuant to Section 14.2 and only for those subcontract agreements that the Owner accepts by notifying the Subcontractor and Contractor in writing; and
- .2 assignment is subject to the prior rights of the surety, if any, obligated under bond relating to the Contract.

When the Owner accepts the assignment of a subcontract agreement, the Owner assumes the Contractor's rights and obligations under the subcontract.

§ 5.4.2 Upon such assignment, if the Work has been suspended for more than 30 days, the Subcontractor's compensation shall be equitably adjusted for increases in cost resulting from the suspension.

§ 5.4.3 Upon such assignment to the Owner under this Section 5.4, the Owner may further assign the subcontract to a successor contractor or other entity. If the Owner assigns the subcontract to a successor contractor or other entity, the Owner shall nevertheless remain legally responsible for all of the successor contractor's obligations under the subcontract.

ARTICLE 6 CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

§ 6.1 OWNER'S RIGHT TO PERFORM CONSTRUCTION AND TO AWARD SEPARATE CONTRACTS

§ 6.1.1 The Owner reserves the right to perform construction or operations related to the Project with the Owner's own forces, and to award separate contracts in connection with other portions of the Project or other construction or operations on the site under Conditions of the Contract identical or substantially similar to these including those portions related to insurance and waiver of subrogation. If the Contractor claims that delay or additional cost is involved because of such action by the Owner, the Contractor shall make such Claim as provided in Article 15.

§ 6.1.2 When separate contracts are awarded for different portions of the Project or other construction or operations on the site, the term "Contractor" in the Contract Documents in each case shall mean the Contractor who executes each separate Owner-Contractor Agreement.

§ 6.1.3 The Owner shall provide for coordination of the activities of the Owner's own forces and of each separate contractor with the Work of the Contractor, who shall cooperate with them. The Contractor shall participate with other separate contractors and the Owner in reviewing their construction schedules. The Contractor shall make any revisions to the construction schedule deemed necessary after a joint review and mutual agreement. The construction schedules shall then constitute the schedules to be used by the Contractor, separate contractors and the Owner until subsequently revised.

§ 6.1.4 Unless otherwise provided in the Contract Documents, when the Owner performs construction or operations related to the Project with the Owner's own forces, the Owner shall be deemed to be subject to the same obligations and to have the same rights that apply to the Contractor under the Conditions of the Contract, including, without excluding others, those stated in Article 3, this Article 6 and Articles 10, 11 and 12.

§ 6.2 MUTUAL RESPONSIBILITY

§ 6.2.1 The Contractor shall afford the Owner and separate contractors reasonable opportunity for introduction and storage of their materials and equipment and performance of their activities, and shall connect and coordinate the Contractor's construction and operations with theirs as required by the Contract Documents.

§ 6.2.2 If part of the Contractor's Work depends for proper execution or results upon construction or operations by the Owner or a separate contractor, the Contractor shall, prior to proceeding with that portion of the Work, promptly report to the Architect apparent discrepancies or defects in such other construction that would render it unsuitable for such proper execution and results. Failure of the Contractor so to report shall constitute an acknowledgment that the Owner's or separate contractor's completed or partially completed construction is fit and proper to receive the Contractor's Work, except as to defects not then reasonably discoverable.

§ 6.2.3 The Contractor shall reimburse the Owner for costs the Owner incurs that are payable to a separate contractor because of the Contractor's delays, improperly timed activities or defective construction. The Owner shall be responsible to the Contractor for costs the Contractor incurs because of a separate contractor's delays, improperly timed activities, damage to the Work or defective construction.

§ 6.2.4 The Contractor shall promptly remedy damage the Contractor wrongfully causes to completed or partially completed construction or to property of the Owner or separate contractors as provided in Section 10.2.5.

§ 6.2.5 The Owner and each separate contractor shall have the same responsibilities for cutting and patching as are described for the Contractor in Section 3.14.

§ 6.3 OWNER'S RIGHT TO CLEAN UP

If a dispute arises among the Contractor, separate contractors and the Owner as to the responsibility under their respective contracts for maintaining the premises and surrounding area free from waste materials and rubbish, the Owner may clean up and the Architect will allocate the cost among those responsible.

ARTICLE 7 CHANGES IN THE WORK

§ 7.1 GENERAL

§ 7.1.1 Changes in the Work may be accomplished after execution of the Contract, and without invalidating the Contract, by Change Order, Construction Change Directive or order for a minor change in the Work, subject to the limitations stated in this Article 7 and elsewhere in the Contract Documents.

§ 7.1.2 A Change Order shall be based upon agreement among the Owner, Contractor and Architect; a Construction Change Directive requires agreement by the Owner and Architect and may or may not be agreed to by the Contractor; an order for a minor change in the Work may be issued by the Architect alone.

§ 7.1.3 Changes in the Work shall be performed under applicable provisions of the Contract Documents, and the Contractor shall proceed promptly, unless otherwise provided in the Change Order, Construction Change Directive or order for a minor change in the Work.

§ 7.2 CHANGE ORDERS

§ 7.2.1 A Change Order is a written instrument prepared by the Architect and signed by the Owner, Contractor and Architect stating their agreement upon all of the following:

- .1 The change in the Work;
- .2 The amount of the adjustment, if any, in the Contract Sum; and
- .3 The extent of the adjustment, if any, in the Contract Time.

§ 7.3 CONSTRUCTION CHANGE DIRECTIVES

§ 7.3.1 A Construction Change Directive is a written order prepared by the Architect and signed by the Owner and Architect, directing a change in the Work prior to agreement on adjustment, if any, in the Contract Sum or Contract Time, or both. The Owner may by Construction Change Directive, without invalidating the Contract, order changes in the Work within the general scope of the Contract consisting of additions, deletions or other revisions, the Contract Sum and Contract Time being adjusted accordingly.

§ 7.3.2 A Construction Change Directive shall be used in the absence of total agreement on the terms of a Change Order.

§ 7.3.3 If the Construction Change Directive provides for an adjustment to the Contract Sum, the adjustment shall be based on one of the following methods:

- .1 Mutual acceptance of a lump sum properly itemized and supported by sufficient substantiating data to permit evaluation;
- .2 Unit prices stated in the Contract Documents or subsequently agreed upon;
- .3 Cost to be determined in a manner agreed upon by the parties and a mutually acceptable fixed or percentage fee; or
- .4 As provided in Section 7.3.7.

§ 7.3.4 If unit prices are stated in the Contract Documents or subsequently agreed upon, and if quantities originally contemplated are materially changed in a proposed Change Order or Construction Change Directive so that application of such unit prices to quantities of Work proposed will cause substantial inequity to the Owner or Contractor, the applicable unit prices shall be equitably adjusted.

§ 7.3.5 Upon receipt of a Construction Change Directive, the Contractor shall promptly proceed with the change in the Work involved and advise the Architect of the Contractor's agreement or disagreement with the method, if any, provided in the Construction Change Directive for determining the proposed adjustment in the Contract Sum or Contract Time.

§ 7.3.6 A Construction Change Directive signed by the Contractor indicates the Contractor's agreement therewith, including adjustment in Contract Sum and Contract Time or the method for determining them. Such agreement shall be effective immediately and shall be recorded as a Change Order.

§ 7.3.7 If the Contractor does not respond promptly or disagrees with the method for adjustment in the Contract Sum, the Architect shall determine the method and the adjustment on the basis of reasonable expenditures and savings of those performing the Work attributable to the change, including, in case of an increase in the Contract Sum, an amount for overhead and profit as set forth in the Agreement, or if no such amount is set forth in the Agreement, a reasonable amount. In such case, and also under Section 7.3.3.3, the Contractor shall keep and present, in such form as the Architect may prescribe, an itemized accounting together with appropriate supporting data. Unless otherwise provided in the Contract Documents, costs for the purposes of this Section 7.3.7 shall be limited to the following:

- .1 Costs of labor, including social security, old age and unemployment insurance, fringe benefits required by agreement or custom, and workers' compensation insurance;
- .2 Costs of materials, supplies and equipment, including cost of transportation, whether incorporated or consumed;
- .3 Rental costs of machinery and equipment, exclusive of hand tools, whether rented from the Contractor or others;
- .4 Costs of premiums for all bonds and insurance, permit fees, and sales, use or similar taxes related to the Work; and
- .5 Additional costs of supervision and field office personnel directly attributable to the change.

§ 7.3.8 The amount of credit to be allowed by the Contractor to the Owner for a deletion or change that results in a net decrease in the Contract Sum shall be actual net cost as confirmed by the Architect. When both additions and credits covering related Work or substitutions are involved in a change, the allowance for overhead and profit shall be figured on the basis of net increase, if any, with respect to that change.

§ 7.3.9 Pending final determination of the total cost of a Construction Change Directive to the Owner, the Contractor may request payment for Work completed under the Construction Change Directive in Applications for Payment. The Architect will make an interim determination for purposes of monthly certification for payment for those costs and certify for payment the amount that the Architect determines, in the Architect's professional judgment, to be reasonably justified. The Architect's interim determination of cost shall adjust the Contract Sum on the same basis as a Change Order, subject to the right of either party to disagree and assert a Claim in accordance with Article 15.

§ 7.3.10 When the Owner and Contractor agree with a determination made by the Architect concerning the adjustments in the Contract Sum and Contract Time, or otherwise reach agreement upon the adjustments, such agreement shall be effective immediately and the Architect will prepare a Change Order. Change Orders may be issued for all or any part of a Construction Change Directive.

§ 7.4 MINOR CHANGES IN THE WORK

The Architect has authority to order minor changes in the Work not involving adjustment in the Contract Sum or extension of the Contract Time and not inconsistent with the intent of the Contract Documents. Such changes will be effected by written order signed by the Architect and shall be binding on the Owner and Contractor.

ARTICLE 8 TIME

§ 8.1 DEFINITIONS

§ 8.1.1 Unless otherwise provided, Contract Time is the period of time, including authorized adjustments, allotted in the Contract Documents for Substantial Completion of the Work.

§ 8.1.2 The date of commencement of the Work is the date established in the Agreement.

§ 8.1.3 The date of Substantial Completion is the date certified by the Architect in accordance with Section 9.8.

§ 8.1.4 The term "day" as used in the Contract Documents shall mean calendar day unless otherwise specifically defined.

§ 8.2 PROGRESS AND COMPLETION

§ 8.2.1 Time limits stated in the Contract Documents are of the essence of the Contract. By executing the Agreement the Contractor confirms that the Contract Time is a reasonable period for performing the Work.

§ 8.2.2 The Contractor shall not knowingly, except by agreement or instruction of the Owner in writing, prematurely commence operations on the site or elsewhere prior to the effective date of insurance required by Article 11 to be

furnished by the Contractor and Owner. The date of commencement of the Work shall not be changed by the effective date of such insurance.

§ 8.2.3 The Contractor shall proceed expeditiously with adequate forces and shall achieve Substantial Completion within the Contract Time.

§ 8.3 DELAYS AND EXTENSIONS OF TIME

§ 8.3.1 If the Contractor is delayed at any time in the commencement or progress of the Work by an act or neglect of the Owner or Architect, or of an employee of either, or of a separate contractor employed by the Owner; or by changes ordered in the Work; or by labor disputes, fire, unusual delay in deliveries, unavoidable casualties or other causes beyond the Contractor's control; or by delay authorized by the Owner pending mediation and arbitration; or by other causes that the Architect determines may justify delay, then the Contract Time shall be extended by Change Order for such reasonable time as the Architect may determine.

§ 8.3.2 Claims relating to time shall be made in accordance with applicable provisions of Article 15.

§ 8.3.3 This Section 8.3 does not preclude recovery of damages for delay by either party under other provisions of the Contract Documents.

ARTICLE 9 PAYMENTS AND COMPLETION

§ 9.1 CONTRACT SUM

The Contract Sum is stated in the Agreement and, including authorized adjustments, is the total amount payable by the Owner to the Contractor for performance of the Work under the Contract Documents.

§ 9.2 SCHEDULE OF VALUES

Where the Contract is based on a stipulated sum or Guaranteed Maximum Price, the Contractor shall submit to the Architect, before the first Application for Payment, a schedule of values allocating the entire Contract Sum to the various portions of the Work and prepared in such form and supported by such data to substantiate its accuracy as the Architect may require. This schedule, unless objected to by the Architect, shall be used as a basis for reviewing the Contractor's Applications for Payment.

§ 9.3 APPLICATIONS FOR PAYMENT

§ 9.3.1 At least ten days before the date established for each progress payment, the Contractor shall submit to the Architect an itemized Application for Payment prepared in accordance with the schedule of values, if required under Section 9.2, for completed portions of the Work. Such application shall be notarized, if required, and supported by such data substantiating the Contractor's right to payment as the Owner or Architect may require, such as copies of requisitions from Subcontractors and material suppliers, and shall reflect retainage if provided for in the Contract Documents.

§ 9.3.1.1 As provided in Section 7.3.9, such applications may include requests for payment on account of changes in the Work that have been properly authorized by Construction Change Directives, or by interim determinations of the Architect, but not yet included in Change Orders.

§ 9.3.1.2 Applications for Payment shall not include requests for payment for portions of the Work for which the Contractor does not intend to pay a Subcontractor or material supplier, unless such Work has been performed by others whom the Contractor intends to pay.

§ 9.3.2 Unless otherwise provided in the Contract Documents, payments shall be made on account of materials and equipment delivered and suitably stored at the site for subsequent incorporation in the Work. If approved in advance by the Owner, payment may similarly be made for materials and equipment suitably stored off the site at a location agreed upon in writing. Payment for materials and equipment stored on or off the site shall be conditioned upon compliance by the Contractor with procedures satisfactory to the Owner to establish the Owner's title to such materials and equipment or otherwise protect the Owner's interest, and shall include the costs of applicable insurance, storage and transportation to the site for such materials and equipment stored off the site.

§ 9.3.3 The Contractor warrants that title to all Work covered by an Application for Payment will pass to the Owner no later than the time of payment. The Contractor further warrants that upon submittal of an Application for Payment all Work for which Certificates for Payment have been previously issued and payments received from the

Owner shall, to the best of the Contractor's knowledge, information and belief, be free and clear of liens, claims, security interests or encumbrances in favor of the Contractor, Subcontractors, material suppliers, or other persons or entities making a claim by reason of having provided labor, materials and equipment relating to the Work.

§ 9.4 CERTIFICATES FOR PAYMENT

§ 9.4.1 The Architect will, within seven days after receipt of the Contractor's Application for Payment, either issue to the Owner a Certificate for Payment, with a copy to the Contractor, for such amount as the Architect determines is properly due, or notify the Contractor and Owner in writing of the Architect's reasons for withholding certification in whole or in part as provided in Section 9.5.1.

§ 9.4.2 The issuance of a Certificate for Payment will constitute a representation by the Architect to the Owner, based on the Architect's evaluation of the Work and the data comprising the Application for Payment, that, to the best of the Architect's knowledge, information and belief, the Work has progressed to the point indicated and that the quality of the Work is in accordance with the Contract Documents. The foregoing representations are subject to an evaluation of the Work for conformance with the Contract Documents upon Substantial Completion, to results of subsequent tests and inspections, to correction of minor deviations from the Contract Documents prior to completion and to specific qualifications expressed by the Architect. The issuance of a Certificate for Payment will further constitute a representation that the Contractor is entitled to payment in the amount certified. However, the issuance of a Certificate for Payment will not be a representation that the Architect has (1) made exhaustive or continuous on-site inspections to check the quality or quantity of the Work, (2) reviewed construction means, methods, techniques, sequences or procedures, (3) reviewed copies of requisitions received from Subcontractors and material suppliers and other data requested by the Owner to substantiate the Contractor's right to payment, or (4) made examination to ascertain how or for what purpose the Contractor has used money previously paid on account of the Contract Sum.

§ 9.5 DECISIONS TO WITHHOLD CERTIFICATION

§ 9.5.1 The Architect may withhold a Certificate for Payment in whole or in part, to the extent reasonably necessary to protect the Owner, if in the Architect's opinion the representations to the Owner required by Section 9.4.2 cannot be made. If the Architect is unable to certify payment in the amount of the Application, the Architect will notify the Contractor and Owner as provided in Section 9.4.1. If the Contractor and Architect cannot agree on a revised amount, the Architect will promptly issue a Certificate for Payment for the amount for which the Architect is able to make such representations to the Owner. The Architect may also withhold a Certificate for Payment or, because of subsequently discovered evidence, may nullify the whole or a part of a Certificate for Payment previously issued, to such extent as may be necessary in the Architect's opinion to protect the Owner from loss for which the Contractor is responsible, including loss resulting from acts and omissions described in Section 3.3.2, because of

- .1 defective Work not remedied;
- .2 third party claims filed or reasonable evidence indicating probable filing of such claims unless security acceptable to the Owner is provided by the Contractor;
- .3 failure of the Contractor to make payments properly to Subcontractors or for labor, materials or equipment;
- .4 reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Sum;
- .5 damage to the Owner or a separate contractor;
- .6 reasonable evidence that the Work will not be completed within the Contract Time, and that the unpaid balance would not be adequate to cover actual or liquidated damages for the anticipated delay; or
- .7 repeated failure to carry out the Work in accordance with the Contract Documents.

§ 9.5.2 When the above reasons for withholding certification are removed, certification will be made for amounts previously withheld.

§ 9.5.3 If the Architect withholds certification for payment under Section 9.5.1.3, the Owner may, at its sole option, issue joint checks to the Contractor and to any Subcontractor or material or equipment suppliers to whom the Contractor failed to make payment for Work properly performed or material or equipment suitably delivered. If the Owner makes payments by joint check, the Owner shall notify the Architect and the Architect will reflect such payment on the next Certificate for Payment.

§ 9.6 PROGRESS PAYMENTS

§ 9.6.1 After the Architect has issued a Certificate for Payment, the Owner shall make payment in the manner and within the time provided in the Contract Documents, and shall so notify the Architect.

§ 9.6.2 The Contractor shall pay each Subcontractor no later than seven days after receipt of payment from the Owner the amount to which the Subcontractor is entitled, reflecting percentages actually retained from payments to the Contractor on account of the Subcontractor's portion of the Work. The Contractor shall, by appropriate agreement with each Subcontractor, require each Subcontractor to make payments to Sub-subcontractors in a similar manner.

§ 9.6.3 The Architect will, on request, furnish to a Subcontractor, if practicable, information regarding percentages of completion or amounts applied for by the Contractor and action taken thereon by the Architect and Owner on account of portions of the Work done by such Subcontractor.

§ 9.6.4 The Owner has the right to request written evidence from the Contractor that the Contractor has properly paid Subcontractors and material and equipment suppliers amounts paid by the Owner to the Contractor for subcontracted Work. If the Contractor fails to furnish such evidence within seven days, the Owner shall have the right to contact Subcontractors to ascertain whether they have been properly paid. Neither the Owner nor Architect shall have an obligation to pay or to see to the payment of money to a Subcontractor, except as may otherwise be required by law.

§ 9.6.5 Contractor payments to material and equipment suppliers shall be treated in a manner similar to that provided in Sections 9.6.2, 9.6.3 and 9.6.4.

§ 9.6.6 A Certificate for Payment, a progress payment, or partial or entire use or occupancy of the Project by the Owner shall not constitute acceptance of Work not in accordance with the Contract Documents.

§ 9.6.7 Unless the Contractor provides the Owner with a payment bond in the full penal sum of the Contract Sum, payments received by the Contractor for Work properly performed by Subcontractors and suppliers shall be held by the Contractor for those Subcontractors or suppliers who performed Work or furnished materials, or both, under contract with the Contractor for which payment was made by the Owner. Nothing contained herein shall require money to be placed in a separate account and not commingled with money of the Contractor, shall create any fiduciary liability or tort liability on the part of the Contractor for breach of trust or shall entitle any person or entity to an award of punitive damages against the Contractor for breach of the requirements of this provision.

§ 9.7 FAILURE OF PAYMENT

If the Architect does not issue a Certificate for Payment, through no fault of the Contractor, within seven days after receipt of the Contractor's Application for Payment, or if the Owner does not pay the Contractor within seven days after the date established in the Contract Documents the amount certified by the Architect or awarded by binding dispute resolution, then the Contractor may, upon seven additional days' written notice to the Owner and Architect, stop the Work until payment of the amount owing has been received. The Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable costs of shut-down, delay and start-up, plus interest as provided for in the Contract Documents.

§ 9.8 SUBSTANTIAL COMPLETION

§ 9.8.1 Substantial Completion is the stage in the progress of the Work when the Work or designated portion thereof is sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work for its intended use.

§ 9.8.2 When the Contractor considers that the Work, or a portion thereof which the Owner agrees to accept separately, is substantially complete, the Contractor shall prepare and submit to the Architect a comprehensive list of items to be completed or corrected prior to final payment. Failure to include an item on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents.

§ 9.8.3 Upon receipt of the Contractor's list, the Architect will make an inspection to determine whether the Work or designated portion thereof is substantially complete. If the Architect's inspection discloses any item, whether or not included on the Contractor's list, which is not sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work or designated portion thereof for its intended use, the Contractor shall, before issuance of the Certificate of Substantial Completion, complete or correct such item upon notification by the Architect. In such case, the Contractor shall then submit a request for another inspection by the Architect to determine Substantial Completion.

§ 9.8.4 When the Work or designated portion thereof is substantially complete, the Architect will prepare a Certificate of Substantial Completion that shall establish the date of Substantial Completion, shall establish responsibilities of the Owner and Contractor for security, maintenance, heat, utilities, damage to the Work and insurance, and shall fix the time within which the Contractor shall finish all items on the list accompanying the Certificate. Warranties required by the Contract Documents shall commence on the date of Substantial Completion of the Work or designated portion thereof unless otherwise provided in the Certificate of Substantial Completion.

§ 9.8.5 The Certificate of Substantial Completion shall be submitted to the Owner and Contractor for their written acceptance of responsibilities assigned to them in such Certificate. Upon such acceptance and consent of surety, if any, the Owner shall make payment of retainage applying to such Work or designated portion thereof. Such payment shall be adjusted for Work that is incomplete or not in accordance with the requirements of the Contract Documents.

§ 9.9 PARTIAL OCCUPANCY OR USE

§ 9.9.1 The Owner may occupy or use any completed or partially completed portion of the Work at any stage when such portion is designated by separate agreement with the Contractor, provided such occupancy or use is consented to by the insurer as required under Section 11.3.1.5 and authorized by public authorities having jurisdiction over the Project. Such partial occupancy or use may commence whether or not the portion is substantially complete, provided the Owner and Contractor have accepted in writing the responsibilities assigned to each of them for payments, retainage, if any, security, maintenance, heat, utilities, damage to the Work and insurance, and have agreed in writing concerning the period for correction of the Work and commencement of warranties required by the Contract Documents. When the Contractor considers a portion substantially complete, the Contractor shall prepare and submit a list to the Architect as provided under Section 9.8.2. Consent of the Contractor to partial occupancy or use shall not be unreasonably withheld. The stage of the progress of the Work shall be determined by written agreement between the Owner and Contractor or, if no agreement is reached, by decision of the Architect.

§ 9.9.2 Immediately prior to such partial occupancy or use, the Owner, Contractor and Architect shall jointly inspect the area to be occupied or portion of the Work to be used in order to determine and record the condition of the Work.

§ 9.9.3 Unless otherwise agreed upon, partial occupancy or use of a portion or portions of the Work shall not constitute acceptance of Work not complying with the requirements of the Contract Documents.

§ 9.10 FINAL COMPLETION AND FINAL PAYMENT

§ 9.10.1 Upon receipt of the Contractor's written notice that the Work is ready for final inspection and acceptance and upon receipt of a final Application for Payment, the Architect will promptly make such inspection and, when the Architect finds the Work acceptable under the Contract Documents and the Contract fully performed, the Architect will promptly issue a final Certificate for Payment stating that to the best of the Architect's knowledge, information and belief, and on the basis of the Architect's on-site visits and inspections, the Work has been completed in accordance with terms and conditions of the Contract Documents and that the entire balance found to be due the Contractor and noted in the final Certificate is due and payable. The Architect's final Certificate for Payment will constitute a further representation that conditions listed in Section 9.10.2 as precedent to the Contractor's being entitled to final payment have been fulfilled.

§ 9.10.2 Neither final payment nor any remaining retained percentage shall become due until the Contractor submits to the Architect (1) an affidavit that payrolls, bills for materials and equipment, and other indebtedness connected with the Work for which the Owner or the Owner's property might be responsible or encumbered (less amounts withheld by Owner) have been paid or otherwise satisfied, (2) a certificate evidencing that insurance required by the Contract Documents to remain in force after final payment is currently in effect and will not be canceled or allowed to expire until at least 30 days' prior written notice has been given to the Owner, (3) a written statement that the Contractor knows of no substantial reason that the insurance will not be renewable to cover the period required by the Contract Documents, (4) consent of surety, if any, to final payment and (5), if required by the Owner, other data establishing payment or satisfaction of obligations, such as receipts, releases and waivers of liens, claims, security interests or encumbrances arising out of the Contract, to the extent and in such form as may be designated by the Owner. If a Subcontractor refuses to furnish a release or waiver required by the Owner, the Contractor may furnish a bond satisfactory to the Owner to indemnify the Owner against such lien. If such lien remains unsatisfied after payments are made, the Contractor shall refund to the Owner all money that the Owner may be compelled to pay in discharging such lien, including all costs and reasonable attorneys' fees.

§ 9.10.3 If, after Substantial Completion of the Work, final completion thereof is materially delayed through no fault of the Contractor or by issuance of Change Orders affecting final completion, and the Architect so confirms, the Owner shall, upon application by the Contractor and certification by the Architect, and without terminating the Contract, make payment of the balance due for that portion of the Work fully completed and accepted. If the remaining balance for Work not fully completed or corrected is less than retainage stipulated in the Contract Documents, and if bonds have been furnished, the written consent of surety to payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by the Contractor to the Architect prior to certification of such payment. Such payment shall be made under terms and conditions governing final payment, except that it shall not constitute a waiver of claims.

§ 9.10.4 The making of final payment shall constitute a waiver of Claims by the Owner except those arising from

- .1 liens, Claims, security interests or encumbrances arising out of the Contract and unsettled;
- .2 failure of the Work to comply with the requirements of the Contract Documents; or
- .3 terms of special warranties required by the Contract Documents.

§ 9.10.5 Acceptance of final payment by the Contractor, a Subcontractor or material supplier shall constitute a waiver of claims by that payee except those previously made in writing and identified by that payee as unsettled at the time of final Application for Payment.

ARTICLE 10 PROTECTION OF PERSONS AND PROPERTY

§ 10.1 SAFETY PRECAUTIONS AND PROGRAMS

The Contractor shall be responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the performance of the Contract.

§ 10.2 SAFETY OF PERSONS AND PROPERTY

§ 10.2.1 The Contractor shall take reasonable precautions for safety of, and shall provide reasonable protection to prevent damage, injury or loss to

- .1 employees on the Work and other persons who may be affected thereby;
- .2 the Work and materials and equipment to be incorporated therein, whether in storage on or off the site, under care, custody or control of the Contractor or the Contractor's Subcontractors or Sub-subcontractors; and
- .3 other property at the site or adjacent thereto, such as trees, shrubs, lawns, walks, pavements, roadways, structures and utilities not designated for removal, relocation or replacement in the course of construction.

§ 10.2.2 The Contractor shall comply with and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities bearing on safety of persons or property or their protection from damage, injury or loss.

§ 10.2.3 The Contractor shall erect and maintain, as required by existing conditions and performance of the Contract, reasonable safeguards for safety and protection, including posting danger signs and other warnings against hazards, promulgating safety regulations and notifying owners and users of adjacent sites and utilities.

§ 10.2.4 When use or storage of explosives or other hazardous materials or equipment or unusual methods are necessary for execution of the Work, the Contractor shall exercise utmost care and carry on such activities under supervision of properly qualified personnel.

§ 10.2.5 The Contractor shall promptly remedy damage and loss (other than damage or loss insured under property insurance required by the Contract Documents) to property referred to in Sections 10.2.1.2 and 10.2.1.3 caused in whole or in part by the Contractor, a Subcontractor, a Sub-subcontractor, or anyone directly or indirectly employed by any of them, or by anyone for whose acts they may be liable and for which the Contractor is responsible under Sections 10.2.1.2 and 10.2.1.3, except damage or loss attributable to acts or omissions of the Owner or Architect or anyone directly or indirectly employed by either of them, or by anyone for whose acts either of them may be liable, and not attributable to the fault or negligence of the Contractor. The foregoing obligations of the Contractor are in addition to the Contractor's obligations under Section 3.18.

§ 10.2.6 The Contractor shall designate a responsible member of the Contractor's organization at the site whose duty shall be the prevention of accidents. This person shall be the Contractor's superintendent unless otherwise designated by the Contractor in writing to the Owner and Architect.

§ 10.2.7 The Contractor shall not permit any part of the construction or site to be loaded so as to cause damage or create an unsafe condition.

§ 10.2.8 INJURY OR DAMAGE TO PERSON OR PROPERTY

If either party suffers injury or damage to person or property because of an act or omission of the other party, or of others for whose acts such party is legally responsible, written notice of such injury or damage, whether or not insured, shall be given to the other party within a reasonable time not exceeding 21 days after discovery. The notice shall provide sufficient detail to enable the other party to investigate the matter.

§ 10.3 HAZARDOUS MATERIALS

§ 10.3.1 The Contractor is responsible for compliance with any requirements included in the Contract Documents regarding hazardous materials. If the Contractor encounters a hazardous material or substance not addressed in the Contract Documents and if reasonable precautions will be inadequate to prevent foreseeable bodily injury or death to persons resulting from a material or substance, including but not limited to asbestos or polychlorinated biphenyl (PCB), encountered on the site by the Contractor, the Contractor shall, upon recognizing the condition, immediately stop Work in the affected area and report the condition to the Owner and Architect in writing.

§ 10.3.2 Upon receipt of the Contractor's written notice, the Owner shall obtain the services of a licensed laboratory to verify the presence or absence of the material or substance reported by the Contractor and, in the event such material or substance is found to be present, to cause it to be rendered harmless. Unless otherwise required by the Contract Documents, the Owner shall furnish in writing to the Contractor and Architect the names and qualifications of persons or entities who are to perform tests verifying the presence or absence of such material or substance or who are to perform the task of removal or safe containment of such material or substance. The Contractor and the Architect will promptly reply to the Owner in writing stating whether or not either has reasonable objection to the persons or entities proposed by the Owner. If either the Contractor or Architect has an objection to a person or entity proposed by the Owner, the Owner shall propose another to whom the Contractor and the Architect have no reasonable objection. When the material or substance has been rendered harmless, Work in the affected area shall resume upon written agreement of the Owner and Contractor. By Change Order, the Contract Time shall be extended appropriately and the Contract Sum shall be increased in the amount of the Contractor's reasonable additional costs of shut-down, delay and start-up.

§ 10.3.3 To the fullest extent permitted by law, the Owner shall indemnify and hold harmless the Contractor, Subcontractors, Architect, Architect's consultants and agents and employees of any of them from and against claims, damages, losses and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the Work in the affected area if in fact the material or substance presents the risk of bodily injury or death as described in Section 10.3.1 and has not been rendered harmless, provided that such claim, damage, loss or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), except to the extent that such damage, loss or expense is due to the fault or negligence of the party seeking indemnity.

§ 10.3.4 The Owner shall not be responsible under this Section 10.3 for materials or substances the Contractor brings to the site unless such materials or substances are required by the Contract Documents. The Owner shall be responsible for materials or substances required by the Contract Documents, except to the extent of the Contractor's fault or negligence in the use and handling of such materials or substances.

§ 10.3.5 The Contractor shall indemnify the Owner for the cost and expense the Owner incurs (1) for remediation of a material or substance the Contractor brings to the site and negligently handles, or (2) where the Contractor fails to perform its obligations under Section 10.3.1, except to the extent that the cost and expense are due to the Owner's fault or negligence.

§ 10.3.6 If, without negligence on the part of the Contractor, the Contractor is held liable by a government agency for the cost of remediation of a hazardous material or substance solely by reason of performing Work as required by the Contract Documents, the Owner shall indemnify the Contractor for all cost and expense thereby incurred.

§ 10.4 EMERGENCIES

In an emergency affecting safety of persons or property, the Contractor shall act, at the Contractor's discretion, to prevent threatened damage, injury or loss. Additional compensation or extension of time claimed by the Contractor on account of an emergency shall be determined as provided in Article 15 and Article 7.

ARTICLE 11 INSURANCE AND BONDS

§ 11.1 CONTRACTOR'S LIABILITY INSURANCE

§ 11.1.1 The Contractor shall purchase from and maintain in a company or companies lawfully authorized to do business in the jurisdiction in which the Project is located such insurance as will protect the Contractor from claims set forth below which may arise out of or result from the Contractor's operations and completed operations under the Contract and for which the Contractor may be legally liable, whether such operations be by the Contractor or by a Subcontractor or by anyone directly or indirectly employed by any of them, or by anyone for whose acts any of them may be liable:

- .1 Claims under workers' compensation, disability benefit and other similar employee benefit acts that are applicable to the Work to be performed;
- .2 Claims for damages because of bodily injury, occupational sickness or disease, or death of the Contractor's employees;
- .3 Claims for damages because of bodily injury, sickness or disease, or death of any person other than the Contractor's employees;
- .4 Claims for damages insured by usual personal injury liability coverage;
- .5 Claims for damages, other than to the Work itself, because of injury to or destruction of tangible property, including loss of use resulting therefrom;
- .6 Claims for damages because of bodily injury, death of a person or property damage arising out of ownership, maintenance or use of a motor vehicle;
- .7 Claims for bodily injury or property damage arising out of completed operations; and
- .8 Claims involving contractual liability insurance applicable to the Contractor's obligations under Section 3.18.

§ 11.1.2 The insurance required by Section 11.1.1 shall be written for not less than limits of liability specified in the Contract Documents or required by law, whichever coverage is greater. Coverages, whether written on an occurrence or claims-made basis, shall be maintained without interruption from the date of commencement of the Work until the date of final payment and termination of any coverage required to be maintained after final payment, and, with respect to the Contractor's completed operations coverage, until the expiration of the period for correction of Work or for such other period for maintenance of completed operations coverage as specified in the Contract Documents.

§ 11.1.3 Certificates of insurance acceptable to the Owner shall be filed with the Owner prior to commencement of the Work and thereafter upon renewal or replacement of each required policy of insurance. These certificates and the insurance policies required by this Section 11.1 shall contain a provision that coverages afforded under the policies will not be canceled or allowed to expire until at least 30 days' prior written notice has been given to the Owner. An additional certificate evidencing continuation of liability coverage, including coverage for completed operations, shall be submitted with the final Application for Payment as required by Section 9.10.2 and thereafter upon renewal or replacement of such coverage until the expiration of the time required by Section 11.1.2. Information concerning reduction of coverage on account of revised limits or claims paid under the General Aggregate, or both, shall be furnished by the Contractor with reasonable promptness.

§ 11.1.4 The Contractor shall cause the commercial liability coverage required by the Contract Documents to include (1) the Owner, the Architect and the Architect's consultants as additional insureds for claims caused in whole or in part by the Contractor's negligent acts or omissions during the Contractor's operations; and (2) the Owner as an additional insured for claims caused in whole or in part by the Contractor's negligent acts or omissions during the Contractor's completed operations.

§ 11.2 OWNER'S LIABILITY INSURANCE

The Owner shall be responsible for purchasing and maintaining the Owner's usual liability insurance.

§ 11.3 PROPERTY INSURANCE

§ 11.3.1 Unless otherwise provided, the Owner shall purchase and maintain, in a company or companies lawfully authorized to do business in the jurisdiction in which the Project is located, property insurance written on a builder's

risk “all-risk” or equivalent policy form in the amount of the initial Contract Sum, plus value of subsequent Contract Modifications and cost of materials supplied or installed by others, comprising total value for the entire Project at the site on a replacement cost basis without optional deductibles. Such property insurance shall be maintained, unless otherwise provided in the Contract Documents or otherwise agreed in writing by all persons and entities who are beneficiaries of such insurance, until final payment has been made as provided in Section 9.10 or until no person or entity other than the Owner has an insurable interest in the property required by this Section 11.3 to be covered, whichever is later. This insurance shall include interests of the Owner, the Contractor, Subcontractors and Sub-subcontractors in the Project.

§ 11.3.1.1 Property insurance shall be on an “all-risk” or equivalent policy form and shall include, without limitation, insurance against the perils of fire (with extended coverage) and physical loss or damage including, without duplication of coverage, theft, vandalism, malicious mischief, collapse, earthquake, flood, windstorm, falsework, testing and startup, temporary buildings and debris removal including demolition occasioned by enforcement of any applicable legal requirements, and shall cover reasonable compensation for Architect’s and Contractor’s services and expenses required as a result of such insured loss.

§ 11.3.1.2 If the Owner does not intend to purchase such property insurance required by the Contract and with all of the coverages in the amount described above, the Owner shall so inform the Contractor in writing prior to commencement of the Work. The Contractor may then effect insurance that will protect the interests of the Contractor, Subcontractors and Sub-subcontractors in the Work, and by appropriate Change Order the cost thereof shall be charged to the Owner. If the Contractor is damaged by the failure or neglect of the Owner to purchase or maintain insurance as described above, without so notifying the Contractor in writing, then the Owner shall bear all reasonable costs properly attributable thereto.

§ 11.3.1.3 If the property insurance requires deductibles, the Owner shall pay costs not covered because of such deductibles.

§ 11.3.1.4 This property insurance shall cover portions of the Work stored off the site, and also portions of the Work in transit.

§ 11.3.1.5 Partial occupancy or use in accordance with Section 9.9 shall not commence until the insurance company or companies providing property insurance have consented to such partial occupancy or use by endorsement or otherwise. The Owner and the Contractor shall take reasonable steps to obtain consent of the insurance company or companies and shall, without mutual written consent, take no action with respect to partial occupancy or use that would cause cancellation, lapse or reduction of insurance.

§ 11.3.2 BOILER AND MACHINERY INSURANCE

The Owner shall purchase and maintain boiler and machinery insurance required by the Contract Documents or by law, which shall specifically cover such insured objects during installation and until final acceptance by the Owner; this insurance shall include interests of the Owner, Contractor, Subcontractors and Sub-subcontractors in the Work, and the Owner and Contractor shall be named insureds.

§ 11.3.3 LOSS OF USE INSURANCE

The Owner, at the Owner’s option, may purchase and maintain such insurance as will insure the Owner against loss of use of the Owner’s property due to fire or other hazards, however caused. The Owner waives all rights of action against the Contractor for loss of use of the Owner’s property, including consequential losses due to fire or other hazards however caused.

§ 11.3.4 If the Contractor requests in writing that insurance for risks other than those described herein or other special causes of loss be included in the property insurance policy, the Owner shall, if possible, include such insurance, and the cost thereof shall be charged to the Contractor by appropriate Change Order.

§ 11.3.5 If during the Project construction period the Owner insures properties, real or personal or both, at or adjacent to the site by property insurance under policies separate from those insuring the Project, or if after final payment property insurance is to be provided on the completed Project through a policy or policies other than those insuring the Project during the construction period, the Owner shall waive all rights in accordance with the terms of Section 11.3.7 for damages caused by fire or other causes of loss covered by this separate property insurance. All separate policies shall provide this waiver of subrogation by endorsement or otherwise.

§ 11.3.6 Before an exposure to loss may occur, the Owner shall file with the Contractor a copy of each policy that includes insurance coverages required by this Section 11.3. Each policy shall contain all generally applicable conditions, definitions, exclusions and endorsements related to this Project. Each policy shall contain a provision that the policy will not be canceled or allowed to expire, and that its limits will not be reduced, until at least 30 days' prior written notice has been given to the Contractor.

§ 11.3.7 WAIVERS OF SUBROGATION

The Owner and Contractor waive all rights against (1) each other and any of their subcontractors, sub-subcontractors, agents and employees, each of the other, and (2) the Architect, Architect's consultants, separate contractors described in Article 6, if any, and any of their subcontractors, sub-subcontractors, agents and employees, for damages caused by fire or other causes of loss to the extent covered by property insurance obtained pursuant to this Section 11.3 or other property insurance applicable to the Work, except such rights as they have to proceeds of such insurance held by the Owner as fiduciary. The Owner or Contractor, as appropriate, shall require of the Architect, Architect's consultants, separate contractors described in Article 6, if any, and the subcontractors, sub-subcontractors, agents and employees of any of them, by appropriate agreements, written where legally required for validity, similar waivers each in favor of other parties enumerated herein. The policies shall provide such waivers of subrogation by endorsement or otherwise. A waiver of subrogation shall be effective as to a person or entity even though that person or entity would otherwise have a duty of indemnification, contractual or otherwise, did not pay the insurance premium directly or indirectly, and whether or not the person or entity had an insurable interest in the property damaged.

§ 11.3.8 A loss insured under the Owner's property insurance shall be adjusted by the Owner as fiduciary and made payable to the Owner as fiduciary for the insureds, as their interests may appear, subject to requirements of any applicable mortgagee clause and of Section 11.3.10. The Contractor shall pay Subcontractors their just shares of insurance proceeds received by the Contractor, and by appropriate agreements, written where legally required for validity, shall require Subcontractors to make payments to their Sub-subcontractors in similar manner.

§ 11.3.9 If required in writing by a party in interest, the Owner as fiduciary shall, upon occurrence of an insured loss, give bond for proper performance of the Owner's duties. The cost of required bonds shall be charged against proceeds received as fiduciary. The Owner shall deposit in a separate account proceeds so received, which the Owner shall distribute in accordance with such agreement as the parties in interest may reach, or as determined in accordance with the method of binding dispute resolution selected in the Agreement between the Owner and Contractor. If after such loss no other special agreement is made and unless the Owner terminates the Contract for convenience, replacement of damaged property shall be performed by the Contractor after notification of a Change in the Work in accordance with Article 7.

§ 11.3.10 The Owner as fiduciary shall have power to adjust and settle a loss with insurers unless one of the parties in interest shall object in writing within five days after occurrence of loss to the Owner's exercise of this power; if such objection is made, the dispute shall be resolved in the manner selected by the Owner and Contractor as the method of binding dispute resolution in the Agreement. If the Owner and Contractor have selected arbitration as the method of binding dispute resolution, the Owner as fiduciary shall make settlement with insurers or, in the case of a dispute over distribution of insurance proceeds, in accordance with the directions of the arbitrators.

§ 11.4 PERFORMANCE BOND AND PAYMENT BOND

§ 11.4.1 The Owner shall have the right to require the Contractor to furnish bonds covering faithful performance of the Contract and payment of obligations arising thereunder as stipulated in bidding requirements or specifically required in the Contract Documents on the date of execution of the Contract.

§ 11.4.2 Upon the request of any person or entity appearing to be a potential beneficiary of bonds covering payment of obligations arising under the Contract, the Contractor shall promptly furnish a copy of the bonds or shall authorize a copy to be furnished.

ARTICLE 12 UNCOVERING AND CORRECTION OF WORK

§ 12.1 UNCOVERING OF WORK

§ 12.1.1 If a portion of the Work is covered contrary to the Architect's request or to requirements specifically expressed in the Contract Documents, it must, if requested in writing by the Architect, be uncovered for the Architect's examination and be replaced at the Contractor's expense without change in the Contract Time.

§ 12.1.2 If a portion of the Work has been covered that the Architect has not specifically requested to examine prior to its being covered, the Architect may request to see such Work and it shall be uncovered by the Contractor. If such Work is in accordance with the Contract Documents, costs of uncovering and replacement shall, by appropriate Change Order, be at the Owner's expense. If such Work is not in accordance with the Contract Documents, such costs and the cost of correction shall be at the Contractor's expense unless the condition was caused by the Owner or a separate contractor in which event the Owner shall be responsible for payment of such costs.

§ 12.2 CORRECTION OF WORK

§ 12.2.1 BEFORE OR AFTER SUBSTANTIAL COMPLETION

The Contractor shall promptly correct Work rejected by the Architect or failing to conform to the requirements of the Contract Documents, whether discovered before or after Substantial Completion and whether or not fabricated, installed or completed. Costs of correcting such rejected Work, including additional testing and inspections, the cost of uncovering and replacement, and compensation for the Architect's services and expenses made necessary thereby, shall be at the Contractor's expense.

§ 12.2.2 AFTER SUBSTANTIAL COMPLETION

§ 12.2.2.1 In addition to the Contractor's obligations under Section 3.5, if, within one year after the date of Substantial Completion of the Work or designated portion thereof or after the date for commencement of warranties established under Section 9.9.1, or by terms of an applicable special warranty required by the Contract Documents, any of the Work is found to be not in accordance with the requirements of the Contract Documents, the Contractor shall correct it promptly after receipt of written notice from the Owner to do so unless the Owner has previously given the Contractor a written acceptance of such condition. The Owner shall give such notice promptly after discovery of the condition. During the one-year period for correction of Work, if the Owner fails to notify the Contractor and give the Contractor an opportunity to make the correction, the Owner waives the rights to require correction by the Contractor and to make a claim for breach of warranty. If the Contractor fails to correct nonconforming Work within a reasonable time during that period after receipt of notice from the Owner or Architect, the Owner may correct it in accordance with Section 2.4.

§ 12.2.2.2 The one-year period for correction of Work shall be extended with respect to portions of Work first performed after Substantial Completion by the period of time between Substantial Completion and the actual completion of that portion of the Work.

§ 12.2.2.3 The one-year period for correction of Work shall not be extended by corrective Work performed by the Contractor pursuant to this Section 12.2.

§ 12.2.3 The Contractor shall remove from the site portions of the Work that are not in accordance with the requirements of the Contract Documents and are neither corrected by the Contractor nor accepted by the Owner.

§ 12.2.4 The Contractor shall bear the cost of correcting destroyed or damaged construction, whether completed or partially completed, of the Owner or separate contractors caused by the Contractor's correction or removal of Work that is not in accordance with the requirements of the Contract Documents.

§ 12.2.5 Nothing contained in this Section 12.2 shall be construed to establish a period of limitation with respect to other obligations the Contractor has under the Contract Documents. Establishment of the one-year period for correction of Work as described in Section 12.2.2 relates only to the specific obligation of the Contractor to correct the Work, and has no relationship to the time within which the obligation to comply with the Contract Documents may be sought to be enforced, nor to the time within which proceedings may be commenced to establish the Contractor's liability with respect to the Contractor's obligations other than specifically to correct the Work.

§ 12.3 ACCEPTANCE OF NONCONFORMING WORK

If the Owner prefers to accept Work that is not in accordance with the requirements of the Contract Documents, the Owner may do so instead of requiring its removal and correction, in which case the Contract Sum will be reduced as appropriate and equitable. Such adjustment shall be effected whether or not final payment has been made.

ARTICLE 13 MISCELLANEOUS PROVISIONS

§ 13.1 GOVERNING LAW

The Contract shall be governed by the law of the place where the Project is located except that, if the parties have selected arbitration as the method of binding dispute resolution, the Federal Arbitration Act shall govern Section 15.4.

§ 13.2 SUCCESSORS AND ASSIGNS

§ 13.2.1 The Owner and Contractor respectively bind themselves, their partners, successors, assigns and legal representatives to covenants, agreements and obligations contained in the Contract Documents. Except as provided in Section 13.2.2, neither party to the Contract shall assign the Contract as a whole without written consent of the other. If either party attempts to make such an assignment without such consent, that party shall nevertheless remain legally responsible for all obligations under the Contract.

§ 13.2.2 The Owner may, without consent of the Contractor, assign the Contract to a lender providing construction financing for the Project, if the lender assumes the Owner's rights and obligations under the Contract Documents. The Contractor shall execute all consents reasonably required to facilitate such assignment.

§ 13.3 WRITTEN NOTICE

Written notice shall be deemed to have been duly served if delivered in person to the individual, to a member of the firm or entity, or to an officer of the corporation for which it was intended; or if delivered at, or sent by registered or certified mail or by courier service providing proof of delivery to, the last business address known to the party giving notice.

§ 13.4 RIGHTS AND REMEDIES

§ 13.4.1 Duties and obligations imposed by the Contract Documents and rights and remedies available thereunder shall be in addition to and not a limitation of duties, obligations, rights and remedies otherwise imposed or available by law.

§ 13.4.2 No action or failure to act by the Owner, Architect or Contractor shall constitute a waiver of a right or duty afforded them under the Contract, nor shall such action or failure to act constitute approval of or acquiescence in a breach there under, except as may be specifically agreed in writing.

§ 13.5 TESTS AND INSPECTIONS

§ 13.5.1 Tests, inspections and approvals of portions of the Work shall be made as required by the Contract Documents and by applicable laws, statutes, ordinances, codes, rules and regulations or lawful orders of public authorities. Unless otherwise provided, the Contractor shall make arrangements for such tests, inspections and approvals with an independent testing laboratory or entity acceptable to the Owner, or with the appropriate public authority, and shall bear all related costs of tests, inspections and approvals. The Contractor shall give the Architect timely notice of when and where tests and inspections are to be made so that the Architect may be present for such procedures. The Owner shall bear costs of (1) tests, inspections or approvals that do not become requirements until after bids are received or negotiations concluded, and (2) tests, inspections or approvals where building codes or applicable laws or regulations prohibit the Owner from delegating their cost to the Contractor.

§ 13.5.2 If the Architect, Owner or public authorities having jurisdiction determine that portions of the Work require additional testing, inspection or approval not included under Section 13.5.1, the Architect will, upon written authorization from the Owner, instruct the Contractor to make arrangements for such additional testing, inspection or approval by an entity acceptable to the Owner, and the Contractor shall give timely notice to the Architect of when and where tests and inspections are to be made so that the Architect may be present for such procedures. Such costs, except as provided in Section 13.5.3, shall be at the Owner's expense.

§ 13.5.3 If such procedures for testing, inspection or approval under Sections 13.5.1 and 13.5.2 reveal failure of the portions of the Work to comply with requirements established by the Contract Documents, all costs made necessary by such failure including those of repeated procedures and compensation for the Architect's services and expenses shall be at the Contractor's expense.

§ 13.5.4 Required certificates of testing, inspection or approval shall, unless otherwise required by the Contract Documents, be secured by the Contractor and promptly delivered to the Architect.

§ 13.5.5 If the Architect is to observe tests, inspections or approvals required by the Contract Documents, the Architect will do so promptly and, where practicable, at the normal place of testing.

§ 13.5.6 Tests or inspections conducted pursuant to the Contract Documents shall be made promptly to avoid unreasonable delay in the Work.

§ 13.6 INTEREST

Payments due and unpaid under the Contract Documents shall bear interest from the date payment is due at such rate as the parties may agree upon in writing or, in the absence thereof, at the legal rate prevailing from time to time at the place where the Project is located.

§ 13.7 TIME LIMITS ON CLAIMS

The Owner and Contractor shall commence all claims and causes of action, whether in contract, tort, breach of warranty or otherwise, against the other arising out of or related to the Contract in accordance with the requirements of the final dispute resolution method selected in the Agreement within the time period specified by applicable law, but in any case not more than 10 years after the date of Substantial Completion of the Work. The Owner and Contractor waive all claims and causes of action not commenced in accordance with this Section 13.7.

ARTICLE 14 TERMINATION OR SUSPENSION OF THE CONTRACT

§ 14.1 TERMINATION BY THE CONTRACTOR

§ 14.1.1 The Contractor may terminate the Contract if the Work is stopped for a period of 30 consecutive days through no act or fault of the Contractor or a Subcontractor, Sub-subcontractor or their agents or employees or any other persons or entities performing portions of the Work under direct or indirect contract with the Contractor, for any of the following reasons:

- .1 Issuance of an order of a court or other public authority having jurisdiction that requires all Work to be stopped;
- .2 An act of government, such as a declaration of national emergency that requires all Work to be stopped;
- .3 Because the Architect has not issued a Certificate for Payment and has not notified the Contractor of the reason for withholding certification as provided in Section 9.4.1, or because the Owner has not made payment on a Certificate for Payment within the time stated in the Contract Documents; or
- .4 The Owner has failed to furnish to the Contractor promptly, upon the Contractor's request, reasonable evidence as required by Section 2.2.1.

§ 14.1.2 The Contractor may terminate the Contract if, through no act or fault of the Contractor or a Subcontractor, Sub-subcontractor or their agents or employees or any other persons or entities performing portions of the Work under direct or indirect contract with the Contractor, repeated suspensions, delays or interruptions of the entire Work by the Owner as described in Section 14.3 constitute in the aggregate more than 100 percent of the total number of days scheduled for completion, or 120 days in any 365-day period, whichever is less.

§ 14.1.3 If one of the reasons described in Section 14.1.1 or 14.1.2 exists, the Contractor may, upon seven days' written notice to the Owner and Architect, terminate the Contract and recover from the Owner payment for Work executed, including reasonable overhead and profit, costs incurred by reason of such termination, and damages.

§ 14.1.4 If the Work is stopped for a period of 60 consecutive days through no act or fault of the Contractor or a Subcontractor or their agents or employees or any other persons performing portions of the Work under contract with the Contractor because the Owner has repeatedly failed to fulfill the Owner's obligations under the Contract Documents with respect to matters important to the progress of the Work, the Contractor may, upon seven additional days' written notice to the Owner and the Architect, terminate the Contract and recover from the Owner as provided in Section 14.1.3.

§ 14.2 TERMINATION BY THE OWNER FOR CAUSE

§ 14.2.1 The Owner may terminate the Contract if the Contractor

- .1 repeatedly refuses or fails to supply enough properly skilled workers or proper materials;
- .2 fails to make payment to Subcontractors for materials or labor in accordance with the respective agreements between the Contractor and the Subcontractors;
- .3 repeatedly disregards applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of a public authority; or

- .4 otherwise is guilty of substantial breach of a provision of the Contract Documents.

§ 14.2.2 When any of the above reasons exist, the Owner, upon certification by the Initial Decision Maker that sufficient cause exists to justify such action, may without prejudice to any other rights or remedies of the Owner and after giving the Contractor and the Contractor's surety, if any, seven days' written notice, terminate employment of the Contractor and may, subject to any prior rights of the surety:

- .1 Exclude the Contractor from the site and take possession of all materials, equipment, tools, and construction equipment and machinery thereon owned by the Contractor;
- .2 Accept assignment of subcontracts pursuant to Section 5.4; and
- .3 Finish the Work by whatever reasonable method the Owner may deem expedient. Upon written request of the Contractor, the Owner shall furnish to the Contractor a detailed accounting of the costs incurred by the Owner in finishing the Work.

§ 14.2.3 When the Owner terminates the Contract for one of the reasons stated in Section 14.2.1, the Contractor shall not be entitled to receive further payment until the Work is finished.

§ 14.2.4 If the unpaid balance of the Contract Sum exceeds costs of finishing the Work, including compensation for the Architect's services and expenses made necessary thereby, and other damages incurred by the Owner and not expressly waived, such excess shall be paid to the Contractor. If such costs and damages exceed the unpaid balance, the Contractor shall pay the difference to the Owner. The amount to be paid to the Contractor or Owner, as the case may be, shall be certified by the Initial Decision Maker, upon application, and this obligation for payment shall survive termination of the Contract.

§ 14.3 SUSPENSION BY THE OWNER FOR CONVENIENCE

§ 14.3.1 The Owner may, without cause, order the Contractor in writing to suspend, delay or interrupt the Work in whole or in part for such period of time as the Owner may determine.

§ 14.3.2 The Contract Sum and Contract Time shall be adjusted for increases in the cost and time caused by suspension, delay or interruption as described in Section 14.3.1. Adjustment of the Contract Sum shall include profit. No adjustment shall be made to the extent

- .1 that performance is, was or would have been so suspended, delayed or interrupted by another cause for which the Contractor is responsible; or
- .2 that an equitable adjustment is made or denied under another provision of the Contract.

§ 14.4 TERMINATION BY THE OWNER FOR CONVENIENCE

§ 14.4.1 The Owner may, at any time, terminate the Contract for the Owner's convenience and without cause.

§ 14.4.2 Upon receipt of written notice from the Owner of such termination for the Owner's convenience, the Contractor shall

- .1 cease operations as directed by the Owner in the notice;
- .2 take actions necessary, or that the Owner may direct, for the protection and preservation of the Work; and
- .3 except for Work directed to be performed prior to the effective date of termination stated in the notice, terminate all existing subcontracts and purchase orders and enter into no further subcontracts and purchase orders.

§ 14.4.3 In case of such termination for the Owner's convenience, the Contractor shall be entitled to receive payment for Work executed, and costs incurred by reason of such termination, along with reasonable overhead and profit on the Work not executed.

ARTICLE 15 CLAIMS AND DISPUTES

§ 15.1 CLAIMS

§ 15.1.1 DEFINITION

A Claim is a demand or assertion by one of the parties seeking, as a matter of right, payment of money, or other relief with respect to the terms of the Contract. The term "Claim" also includes other disputes and matters in question between the Owner and Contractor arising out of or relating to the Contract. The responsibility to substantiate Claims shall rest with the party making the Claim.

§ 15.1.2 NOTICE OF CLAIMS

Claims by either the Owner or Contractor must be initiated by written notice to the other party and to the Initial Decision Maker with a copy sent to the Architect, if the Architect is not serving as the Initial Decision Maker. Claims by either party must be initiated within 21 days after occurrence of the event giving rise to such Claim or within 21 days after the claimant first recognizes the condition giving rise to the Claim, whichever is later.

§ 15.1.3 CONTINUING CONTRACT PERFORMANCE

Pending final resolution of a Claim, except as otherwise agreed in writing or as provided in Section 9.7 and Article 14, the Contractor shall proceed diligently with performance of the Contract and the Owner shall continue to make payments in accordance with the Contract Documents. The Architect will prepare Change Orders and issue Certificates for Payment in accordance with the decisions of the Initial Decision Maker.

§ 15.1.4 CLAIMS FOR ADDITIONAL COST

If the Contractor wishes to make a Claim for an increase in the Contract Sum, written notice as provided herein shall be given before proceeding to execute the Work. Prior notice is not required for Claims relating to an emergency endangering life or property arising under Section 10.4.

§ 15.1.5 CLAIMS FOR ADDITIONAL TIME

§ 15.1.5.1 If the Contractor wishes to make a Claim for an increase in the Contract Time, written notice as provided herein shall be given. The Contractor's Claim shall include an estimate of cost and of probable effect of delay on progress of the Work. In the case of a continuing delay, only one Claim is necessary.

§ 15.1.5.2 If adverse weather conditions are the basis for a Claim for additional time, such Claim shall be documented by data substantiating that weather conditions were abnormal for the period of time, could not have been reasonably anticipated and had an adverse effect on the scheduled construction.

§ 15.1.6 CLAIMS FOR CONSEQUENTIAL DAMAGES

The Contractor and Owner waive Claims against each other for consequential damages arising out of or relating to this Contract. This mutual waiver includes

- .1 damages incurred by the Owner for rental expenses, for losses of use, income, profit, financing, business and reputation, and for loss of management or employee productivity or of the services of such persons; and
- .2 damages incurred by the Contractor for principal office expenses including the compensation of personnel stationed there, for losses of financing, business and reputation, and for loss of profit except anticipated profit arising directly from the Work.

This mutual waiver is applicable, without limitation, to all consequential damages due to either party's termination in accordance with Article 14. Nothing contained in this Section 15.1.6 shall be deemed to preclude an award of liquidated damages, when applicable, in accordance with the requirements of the Contract Documents.

§ 15.2 INITIAL DECISION

§ 15.2.1 Claims, excluding those arising under Sections 10.3, 10.4, 11.3.9, and 11.3.10, shall be referred to the Initial Decision Maker for initial decision. The Architect will serve as the Initial Decision Maker, unless otherwise indicated in the Agreement. Except for those Claims excluded by this Section 15.2.1, an initial decision shall be required as a condition precedent to mediation of any Claim arising prior to the date final payment is due, unless 30 days have passed after the Claim has been referred to the Initial Decision Maker with no decision having been rendered. Unless the Initial Decision Maker and all affected parties agree, the Initial Decision Maker will not decide disputes between the Contractor and persons or entities other than the Owner.

§ 15.2.2 The Initial Decision Maker will review Claims and within ten days of the receipt of a Claim take one or more of the following actions: (1) request additional supporting data from the claimant or a response with supporting data from the other party, (2) reject the Claim in whole or in part, (3) approve the Claim, (4) suggest a compromise, or (5) advise the parties that the Initial Decision Maker is unable to resolve the Claim if the Initial Decision Maker lacks sufficient information to evaluate the merits of the Claim or if the Initial Decision Maker concludes that, in the Initial Decision Maker's sole discretion, it would be inappropriate for the Initial Decision Maker to resolve the Claim.

§ 15.2.3 In evaluating Claims, the Initial Decision Maker may, but shall not be obligated to, consult with or seek information from either party or from persons with special knowledge or expertise who may assist the Initial Decision Maker in rendering a decision. The Initial Decision Maker may request the Owner to authorize retention of such persons at the Owner's expense.

§ 15.2.4 If the Initial Decision Maker requests a party to provide a response to a Claim or to furnish additional supporting data, such party shall respond, within ten days after receipt of such request, and shall either (1) provide a response on the requested supporting data, (2) advise the Initial Decision Maker when the response or supporting data will be furnished or (3) advise the Initial Decision Maker that no supporting data will be furnished. Upon receipt of the response or supporting data, if any, the Initial Decision Maker will either reject or approve the Claim in whole or in part.

§ 15.2.5 The Initial Decision Maker will render an initial decision approving or rejecting the Claim, or indicating that the Initial Decision Maker is unable to resolve the Claim. This initial decision shall (1) be in writing; (2) state the reasons therefor; and (3) notify the parties and the Architect, if the Architect is not serving as the Initial Decision Maker, of any change in the Contract Sum or Contract Time or both. The initial decision shall be final and binding on the parties but subject to mediation and, if the parties fail to resolve their dispute through mediation, to binding dispute resolution.

§ 15.2.6 Either party may file for mediation of an initial decision at any time, subject to the terms of Section 15.2.6.1.

§ 15.2.6.1 Either party may, within 30 days from the date of an initial decision, demand in writing that the other party file for mediation within 60 days of the initial decision. If such a demand is made and the party receiving the demand fails to file for mediation within the time required, then both parties waive their rights to mediate or pursue binding dispute resolution proceedings with respect to the initial decision.

§ 15.2.7 In the event of a Claim against the Contractor, the Owner may, but is not obligated to, notify the surety, if any, of the nature and amount of the Claim. If the Claim relates to a possibility of a Contractor's default, the Owner may, but is not obligated to, notify the surety and request the surety's assistance in resolving the controversy.

§ 15.2.8 If a Claim relates to or is the subject of a mechanic's lien, the party asserting such Claim may proceed in accordance with applicable law to comply with the lien notice or filing deadlines.

§ 15.3 MEDIATION

§ 15.3.1 Claims, disputes, or other matters in controversy arising out of or related to the Contract except those waived as provided for in Sections 9.10.4, 9.10.5, and 15.1.6 shall be subject to mediation as a condition precedent to binding dispute resolution.

§ 15.3.2 The parties shall endeavor to resolve their Claims by mediation which, unless the parties mutually agree otherwise, shall be administered by the American Arbitration Association in accordance with its Construction Industry Mediation Procedures in effect on the date of the Agreement. A request for mediation shall be made in writing, delivered to the other party to the Contract, and filed with the person or entity administering the mediation. The request may be made concurrently with the filing of binding dispute resolution proceedings but, in such event, mediation shall proceed in advance of binding dispute resolution proceedings, which shall be stayed pending mediation for a period of 60 days from the date of filing, unless stayed for a longer period by agreement of the parties or court order. If an arbitration is stayed pursuant to this Section 15.3.2, the parties may nonetheless proceed to the selection of the arbitrator(s) and agree upon a schedule for later proceedings.

§ 15.3.3 The parties shall share the mediator's fee and any filing fees equally. The mediation shall be held in the place where the Project is located, unless another location is mutually agreed upon. Agreements reached in mediation shall be enforceable as settlement agreements in any court having jurisdiction thereof.

§ 15.4.4 CONSOLIDATION OR JOINDER

§ 15.4.4.1 Either party, at its sole discretion, may consolidate an arbitration conducted under this Agreement with any other arbitration to which it is a party provided that (1) the arbitration agreement governing the other arbitration permits consolidation, (2) the arbitrations to be consolidated substantially involve common questions of law or fact, and (3) the arbitrations employ materially similar procedural rules and methods for selecting arbitrator(s).

§ 15.4.4.2 Either party, at its sole discretion, may include by joinder persons or entities substantially involved in a common question of law or fact whose presence is required if complete relief is to be accorded in arbitration, provided that the party sought to be joined consents in writing to such joinder. Consent to arbitration involving an additional person or entity shall not constitute consent to arbitration of any claim, dispute or other matter in question not described in the written consent.

§ 15.4.4.3 The Owner and Contractor grant to any person or entity made a party to an arbitration conducted under this Section 15.4, whether by joinder or consolidation, the same rights of joinder and consolidation as the Owner and Contractor under this Agreement.

DRAFT

SECTION 01 20 00 - PRICE AND PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 COORDINATION

- A. The General Conditions of the Contract for Construction and the Supplementary Conditions to the General Conditions of the Contract for Construction shall be considered as part of this section of the specifications.
- B. Each Bidder shall be responsible for determining during the bidding period the extent that any addenda issued during the bidding period may affect this section of the specifications.
- C. Reference Instructions to Bidders for requirements regarding substitutions of materials and products.
- D. Where conflicts occur between the drawings and specifications, between different drawings, between different portions of this section of the specifications, or between different sections of the specifications, the more stringent requirements and the greater quantity shall apply.

1.2 UNIT PRICES

- A. Changes to the Work incorporating Unit Prices will be made by Change Order.

1.3 CONTRACT MODIFICATION PROCEDURES

- A. On Owner's approval of a proposal from Contractor, Architect will issue a Change Order on AIA Document G701, for all changes to Contract Sum or Contract Time.
- B. When Owner and Contractor disagree on the terms of a proposal, Architect may issue a Construction Change Directive on AIA Document G714, instructing Contractor to proceed with the change. Construction Change Directive will contain a description of the change and designate the method to be followed to determine changes to Contract Sum or Contract Time.

1.4 PAYMENT PROCEDURES

- A. Submit a Schedule of Values **at least 10 days before** the first Application for Payment. In Schedule of Values, break down Contract Sum into at least one line item for each Specification Section. Correlate the Schedule of Values with Contractor's Construction Schedule.
- B. Submit 3 copies of each application for payment on AIA Document G702/703, according to the schedule established in Owner/Contractor Agreement.
 - 1. For the second Application for Payment through the Application for Payment submitted at Substantial Completion, submit partial releases of liens from each subcontractor or supplier for whom amounts were requisitioned in the previous Application for Payment.
 - 2. Submit final Application for Payment after completion of Project closeout procedures with release of liens and supporting documentation. Include consent of surety to final payment and insurance certificates.

Sharyland Water Supply Corp
New Building

MAS Proj. No. 217017

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION

SECTION 01 21 00 — ALLOWANCES

PART 1 - GENERAL

1.1 COORDINATION

- A. The General Conditions of the Contract for Construction and the Supplementary Conditions to the General Conditions of the Contract for Construction shall be considered as part of this section of the specifications.
- B. Each Bidder shall be responsible for determining during the bidding period the extent that any addenda issued during the bidding period may affect this section of the specifications.
- C. Reference Instructions to Bidders for requirements regarding substitutions of materials and products.
- D. Where conflicts occur between the drawings and specifications, between different drawings, between different portions of this section of the specifications, or between different sections of the specifications, the more stringent requirements and the greater quantity shall apply.

1.2 RELATED DOCUMENTS

- A. Section 01 20 00 – Price and Payment Procedures.

1.3 CONTINGENCY ALLOWANCE

- A. Include in the Contract, a stipulated sum of **One Hundred Thousand Dollars, (\$100,000.00)** for use upon Architect's instruction.
- B. Include in the Contract, a stipulated sum of **One Hundred Thousand Dollars, (\$100,000.00)** for use upon Owner's instruction.
- C. Include in the Contract, a stipulated sum of **Twelve Thousand Dollars, (\$12,000.00)** for Landscaping.
- D. Include in the Contract, a stipulated sum of **Twenty Five Thousand Dollars, (\$25,000.00)** for irrigation system.
- E. Include in the Contract, a stipulated sum of **Two Thousand Dollars, (\$2,000.00)** for two sconce light fixtures at main entrance.
- F. Include in the Contract, a stipulated sum of **Thirty Thousand Dollars, (\$30,000.00)** for transformer.
- G. Include in the Contract, a stipulated sum of **Eleven Thousand Dollars, (\$11,000.00)** for 8x8 water feature.

1.4 PROCEDURES FOR MANAGING ALLOWANCES

- A. Contractor's costs for Products, delivery, installation, labor, payroll, taxes, bonding, and equipment rental will be included in Construction Change Directives authorizing expenditure of funds from Allowances.

- B. Funds will be drawn from Allowances only by Construction Change Directives.
- C. At closeout of Contract, funds remaining in Allowances will be credited to Owner by Change Order.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION

SECTION 01 25 00 – SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 COORDINATION

- A. The General Conditions of the Contract for Construction and the Supplementary Conditions to the General Conditions of the Contract for Construction shall be considered as part of this section of the specifications.
- B. Each Bidder shall be responsible for determining during the bidding period the extent that any addenda issued during the bidding period may affect this section of the specifications.
- C. Where conflicts occur between the drawings and specifications, between different drawings, between different portions of this section of the specifications, or between different sections of the specifications, the more stringent requirements and the greater quantity shall apply.

1.2 SUBSTITUTION REQUIREMENTS

- A. When material, article, or method is specified using name of proprietary product manufacturer, vendor, or method followed by phrase "or equal," specific item mentioned establishes basis upon which projects are to be built.
 - 1. Other manufacturers' materials, articles, and methods not named will be considered as substitutions provided required information is submitted on "SUBSTITUTION REQUEST FORM" and will not require substantial revisions of Contract Documents.
 - 2. This applies to specific construction methods when required by Contract Documents.
 - 3. Substitution Requests must be filled out on enclosed "Substitution Request Form".
- B. Whenever material, article, or method is specified or described without phrase "or equal," no substitutions will be allowed.
- C. Costs for redesigns due to substituted items are responsibility of Applicant.
- D. In making request for substitution, Applicant/Contractor represents that he:
 - 1. Has personally investigated proposed product or method and determined that it is equal in all respects to that specified.
 - 2. Will provide same guarantee for substitution as for product or method specified.
 - 3. Will coordinate installation of accepted substitution into work, making design and construction changes to complete work in all respects following the Contract Documents.

1.3 SUBMITTAL OF DATA FOR PROPOSED SUBSTITUTIONS

- A. In order for substitutions that do not change design intent to be considered, submit no later than 10 days prior to bid date deadline, 3 copies of complete data set forth herein to permit complete analysis of proposed substitutions listed on submitted "SUBSTITUTION REQUEST FORM".

1. For Products:
 - a. Identification including manufacturer's name and address.
 - b. Manufacturer's literature, including but not necessarily limited to:
 - 1) Product description, performance, and test data.
 - 2) Reference standards.
 - c. Samples where appropriate.
 - d. Name and address of similar projects on which product was used and dates of installation with contact name and telephone number.
2. For Construction Methods:
 - a. Detailed description of proposed method.
 - b. Drawings illustrating methods.
 - c. Name and address of similar projects on which method was used and dates of use with contact name and telephone number.
3. Comparison of proposed substitution with product or method specified
4. Data relating to impact on construction schedule by proposed substitution.
5. Impact on other contracts.

1.4 APPROVAL OF SUBSTITUTION

- A. Architect's decision regarding evaluation of substitutions will be final and binding.
- B. All approved substitutions will be incorporated into the Contract Documents by Addendum.

PART 2 - PRODUCTS
NOT USED

PART 3 - EXECUTION
NOT USED

SUBSTITUTION REQUEST FORM

Project: _____	Substitution Request Number: _____
_____	From: _____
To: _____	Date: _____
_____	A/E Project Number: _____
Re: _____	Contract For: _____
Specification Title: _____ Description: _____	
Section: _____ Page: _____	Article/Paragraph: _____

Proposed Substitution: _____

Manufacturer: _____ Address: _____ Phone: _____

Trade Name: _____ Model No.: _____

Attached data includes product description, specifications, drawings, photographs, and performance and test data adequate for evaluation of the request; applicable portions of the data are clearly identified.

Attached data also includes a description of changes to the Contract Documents that the proposed substitution will require for its proper installation.

The Undersigned certifies:

- Proposed substitution has been fully investigated and determined to be equal or superior in all respects to specified product.
- Same warranty will be furnished for proposed substitution as for specified product.
- Same maintenance service and source of replacement parts, as applicable, is available.
- Proposed substitution will have no adverse effect on other trades and will not affect or delay progress schedule.
- Proposed substitution does not affect dimensions and functional clearances.
- Payment will be made for changes to building design, including A/E design, detailing, and construction costs caused by the substitution.

Submitted by: _____

Signed by: _____

Firm: _____

Address: _____

Telephone: _____

A/E's REVIEW AND ACTION

- ☐ Substitution approved - Make submittals in accordance with Specification Section 01340 Submittals
- ☐ Substitution approved as noted - Make submittals in accordance with Specification Section 01340 Submittals
- ☐ Substitution rejected - Use specified materials.
- ☐ Substitution Request received too late - Use specified materials.

Signed by: _____ Date: _____

Supporting Data Attached: ☐ Drawings ☐ Product Data ☐ Samples ☐ Tests ☐ Reports ☐ _____

END OF SECTION

SECTION 01 30 00 - ADMINISTRATIVE REQUIREMENTS

PART 1 - GENERAL

1.1 COORDINATION

- A. The General Conditions of the Contract for Construction and the Supplementary Conditions to the General Conditions of the Contract for Construction shall be considered as part of this section of the specifications.
- B. Each Bidder shall be responsible for determining during the bidding period the extent that any addenda issued during the bidding period may affect this section of the specifications.
- C. Reference Instructions to Bidders for requirements regarding substitutions of materials and products.
- D. Where conflicts occur between the drawings and specifications, between different drawings, between different portions of this section of the specifications, or between different sections of the specifications, the more stringent requirements and the greater quantity shall apply.

1.2 PROJECT MANAGEMENT AND COORDINATION

- A. Verify layout information shown on Drawings, in relation to property survey and existing benchmarks, before laying out the Work.
- B. Coordinate construction to ensure efficient and orderly execution of each part of the Work.
- C. Progress meetings will be held at Project site every two weeks. Notify Owner and Architect of meeting dates. Each subcontractor or other entity concerned with current progress or involved with planning or coordination of future activities, shall attend. The Contractor shall:

- 1. Prepare a progress meeting agenda.**
- 2. Prepare a sign in sheet for each progress meeting.**
- 3. Prepare minutes of each meeting and distribute to parties present.**

1.3 CONSTRUCTION SCHEDULE

- A. Prepare a horizontal bar-chart construction schedule. Provide a separate time bar for each activity and a vertical line to identify the first workday of each week. Use same breakdown of Work indicated in the Schedule of Values. As Work progresses, mark each bar to indicate actual completion.
 - 1. Submit within twenty (20) days after date established for Commencement of the Work.
 - 2. Coordinate each element with other activities. Show each activity in proper sequence. Indicate sequences necessary for completion of related Work.
 - 3. Indicate Substantial Completion and allow time for Architect's procedures necessary for certifying Substantial Completion.
 - 4. Schedule Distribution: Distribute copies to Owner, Architect, subcontractors, and parties required to comply with dates.

5. Updating: Revise the schedule after each meeting or activity where revisions have been made. Distribute revised copies to Owner, Architect, subcontractors, and parties required to comply with dates.

1.4 SUBMITTAL PROCEDURES

- A. Coordinate submittal preparation with construction schedule, fabrication lead-times, other submittals, and activities that require sequential operations.
 1. No extension of Contract Time will be authorized due to failure to transmit submittals in time to permit processing sufficiently in advance of when materials are required in the Work.
 2. Architect will not accept submittals from sources other than Contractor.
- B. Prepare submittals by placing a permanent label on each for identification. Provide a 4 by 5 inch space on the label or beside title block to record review and approval markings and action taken. Include the following information on the label:
 1. Project name.
 2. Date.
 3. Name and address of Contractor.
 4. Name and address of subcontractor or supplier.
 5. Number and title of appropriate Specification Section.
 6. Contractor's certification that materials comply with specified requirements.
- C. Coordinate each submittal with other submittals and with work that does not require submittals.
- D. Product Data: Mark each copy to show applicable choices and options. Include the following:
 1. Data indicating compliance with specified standards and requirements.
 2. Notation of coordination requirements.
 3. For equipment data, include rated capacities, dimensions, weights, required clearances, and furnished specialties and accessories.
- E. Shop Drawings: Submit newly prepared information drawn to scale. Do not reproduce Contract Documents or copy standard information. Submit 1 reproducible print and 1 blue- or black-line print on sheets at least 8-1/2 by 11 inches but no larger than 30 by 42 inches. Architect will return the reproducible print. Include the following:
 1. Dimensions, profiles, methods of attachment, coordination with adjoining work, large scale details, and other information, as appropriate for the Work.
 2. Identification of products and materials.
 3. Notation of coordination requirements.
 4. Notation of dimensions established by field measurement.
 5. Identification of deviations from Contract Documents.
- F. Samples: Submit Samples finished as specified and identical with the material proposed. Where variations are inherent in the material, submit sufficient units to show limits of the variations. Include product name or name of the manufacturer.
- G. Architect will review each submittal, mark as appropriate to indicate action taken, and return copies less those retained. Compliance with specified requirements remains Contractor's responsibility.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION

SECTION 01 33 00 - SUBMITTALS

PART 1 - GENERAL

1.1 COORDINATION

- A. The General Conditions of the Contract for Construction and the Supplementary Conditions to the General Conditions of the Contract for Construction shall be considered as part of this section of the specifications.
- B. Each Bidder shall be responsible for determining during the bidding period the extent that any addenda issued during the bidding period may affect this section of the specifications.
- C. Reference Instructions to Bidders for requirements regarding substitutions of materials and products.
- D. Where conflicts occur between the drawings and specifications, between different drawings, between different portions of this section of the specifications, or between different sections of the specifications, the more stringent requirements and the greater quantity shall apply.

1.2 WORK INCLUDED

- A. Provide shop drawings, product data, physical samples and color samples as indicated herein and in each technical section of these specifications.

1.3 RELATED WORK SPECIFIED IN OTHER SECTIONS

- A. Additional submittal requirements specific to the particular section of the specifications.

PART 2 - PRODUCTS

2.1 SHOP DRAWINGS

- A. Prepare shop drawings using competent draftsmen, clearly and precisely showing the following:
 - 1. The size and gage of members.
 - 2. The method of anchoring and securing members of parts together.
 - 3. The quantity and location of each item.
 - 4. Other pertinent data necessary to show the Work to be done and where and how it is to be done.
- B. Prepare Drawings to scale, including full size details as required to fix and illustrate the Work required. Do not use Contract Documents or reproductions thereof as shop drawing submittals.
- C. Each sheet of Drawings shall be 30 x 40 inches maximum size with borders. Provide a title block in the lower right hand corner with the following information:
 - 1. Title of the sheet.
 - 2. Name and location of Project.
 - 3. Names of:
 - a. Architect/Engineer.
 - b. General Contractor.
 - c. Manufacturer of the specified materials and equipment.

4. The date of the Submittal.
 5. The date of each correction or revision.
 6. **Submittal number including Division No.** (such as submittal no. 3 under Division 11 is numbered "11-03").
- D. Fold drawings to 8-1/2x11 inch dimensions with title block exposed to top.
- E. Check the Drawings and add any corrections of field measurements needed. Stamp and sign the Contractor's approval, checker's signature, and date of approval before submitting to the Architect. Shop Drawings which do not bear the Contractor's stamp or have not been reviewed by the Contractor, will be returned by the Architect without review or approval.
- F. Number Shop Drawings consecutively. Indicate working and erection dimensions, arrangements, sectional views, necessary details including complete information for making connections with other Work, kinds of materials, and finishes.
- G. Provide a transmittal letter in duplicate, pointing out any deviations from items, methods or named manufacturers included in the Specifications or on the Drawings. Note submittal file number including Division.
- H. Submit six (6) blue line prints of each Shop Drawing sheet.
- I. Make such corrections, changes, resubmit bound sets of Shop Drawings prints, as required herein, until approved is obtained. Any corrections or changes indicated on Shop Drawings shall not be considered as an extra work order.

2.2 PHYSICAL SAMPLES

- A. Provide duplicate samples of items as specified. Samples shall be 12 inches square or 12 inches long unless noted otherwise. Minimum liquid samples shall be 1 pint. Installed materials shall match approved samples.
- B. For Architect's permanent files provide one (1) 6" x 6" sample of all interior finishes, colors and materials (aluminum finish, glazing, plastic laminate, paint finish flooring materials, ceiling finish, etc.)
- C. Provide a transmittal letter with each sample, listing the following:
1. Specification section title and paragraph specifying the material.
 2. Name and location of Project.
 3. Names of:
 - a. Architect/Engineer.
 - b. General Contractor.
 - c. Manufacturer of the specified materials and equipment.
 4. The date of the Submittal.
 5. Submittal file number including Division.
- D. If samples are not acceptable they will be returned directly to the Contractor for modification and resubmission.
- E. If samples are acceptable, notification will be sent directly to the Contractor, and the sample retained for comparison with the complete Work.

2.3 MANUFACTURER'S PRODUCT DATA

- A. Provide **six (6)** copies of pre-printed Product Data of items as specified. Carefully mark out all items not applicable to the specified item.
- B. Standard catalogs, brochures, etc. including information not applicable to the project and not marked through, will be returned without review or approval.
- C. Provide a transmittal letter with the Product Data from each manufacturer, listing the following information:
 - 1. Name and location of Project.
 - 2. Names of:
 - a. Architect/Engineer.
 - b. General Contractor.
 - c. Manufacturer of the specified materials and equipment.
 - 3. The date of the Submittal.
 - 4. Submittal file number including Division.
- D. If Product Data is not approved, one copy will be marked and returned directly to the Contractor for modification and resubmission.
- E. If Product Data is approved, notification and one copy of the acceptable Product Data will be sent directly to the Contractor.
- F. When requested by the Architect, provide six (6) copies of each ASTM Federal Specification, or other applicable documents referenced in the material Section.

PART 3 - EXECUTION

3.1 REVIEW PROCEDURE

- A. Submittals will be reviewed with reasonable promptness so as to cause no delay, but only for conformance with the design concept of the project and with the information given in the Contract Documents. Architect shall be allowed a maximum review period of **fourteen (14)** calendar days. The review of a separate item shall not indicate a review of an assembly in which the item functions. Submittals that contain excessive errors or that are incomplete will be returned without review and approval and any delay caused thereby shall be the responsibility of the Contractor.
- B. If any submittals are not approved as submitted, all copies will be returned directly to the Contractor for revision. The reviewed submittals will be returned to the Contractor as soon as practicable.
- C. The Contractor shall make all revisions as noted and shall resubmit the required number of corrected copies of submittals, until no exceptions are taken. The Contractor shall direct specific attention, in writing or on resubmitted Shop Drawings, to revisions other than those requested on previous submissions.
- D. The review of submittals shall not relieve the Contractor of responsibility for deviations from the requirements of the Contract Documents unless the Contractor has submitted, in writing, such deviations and written approval has been given to each specific deviation. The review shall not relieve the Contractor from responsibility for errors and omissions in the Shop Drawings and samples.

- E. No portion of the Work requiring a submittal shall commence until the submittal has been approved as designated in the Conditions of the Contract. All such portions of the Work shall be in accordance with the submittal that has been stamped with final "Reviewed Without Exceptions" note, or "Approved" note.
- F. Materials and equipment specified or approved prior to beginning the Work are required to be used on the Project. Any proposed substitution resulting from no availability of specified items must be proven "better than" by the Contractor and approved in writing by the Architect. Substitutions included in submittals shall be so noted and brought to the Architect's attention in the submittal and on the transmittal. Failure to follow this procedure will render the substitution as not acceptable whether or not reviewed by the Architect.
- G. The Contractor shall have the approved shop drawings at the site at all times for use in the construction of the Work. Failure of the Contractor to supply such drawings will be deemed sufficient cause to delay the Work until such drawings are available for field use and reference.
- H. For submittals that will be reviewed by one of the Architect's consultants, these submittals shall be delivered directly to the Architect. The Architect will then be responsible to provide the Consultant with a copy of the submittal.
- I. For submittals that will be reviewed by one of the Architect's consultants, do not send to the Consultant as part of the package any items which will be reviewed by the Architect. As an example, do not provide a single submittal package combining Structural Steel and Miscellaneous Metal Fabrications.

END OF SECTION

SECTION 01 40 00 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 COORDINATION

- A. The General Conditions of the Contract for Construction and the Supplementary Conditions to the General Conditions of the Contract for Construction shall be considered as part of this section of the specifications.
- B. Each Bidder shall be responsible for determining during the bidding period the extent that any addenda issued during the bidding period may affect this section of the specifications.
- C. Reference Instructions to Bidders for requirements regarding substitutions of materials and products.
- D. Where conflicts occur between the drawings and specifications, between different drawings, between different portions of this section of the specifications, or between different sections of the specifications, the more stringent requirements and the greater quantity shall apply.

1.2 SECTION REQUIREMENTS

- A. Quality-control services include inspections, tests, and related actions including reports. Quality-control services are further specified in other Sections of these Specifications and shall be performed by independent testing agencies provided by Contractor or Owner, as specified.
 - 1. Unless otherwise indicated, quality-control services required by authorities having jurisdiction will be provided by Owner.
- B. Contractor is responsible for scheduling inspections and tests.
- C. **Retesting: Contractor shall pay for retesting where results of inspections and tests prove unsatisfactory and indicate noncompliance with requirements.**
- D. Auxiliary Services: Cooperate with agencies performing inspections and tests. Provide auxiliary services as requested. Notify agency in advance of operations requiring tests or inspections, to permit assignment of personnel. Auxiliary services include the following:
 - 1. Access to the Work.
 - 2. Incidental labor and facilities to assist inspections and tests.
 - 3. Adequate quantities of materials that require testing, and assisting in taking samples.
 - 4. Facilities for storage and curing of test samples.
 - 5. Security and protection of samples and test equipment.
- E. Duties of Testing Agency: Testing agency shall cooperate with Architect and Contractor in performing its duties. Agency shall provide qualified personnel to perform inspections and tests.
 - 1. Agency shall promptly notify Architect and Contractor of irregularities or deficiencies observed in the Work during performance of its services.
 - 2. Agency shall not release, revoke, alter, or enlarge requirements of the Contract Documents or approve or accept any portion of the Work.
 - 3. Agency shall not perform duties of Contractor.

- F. Submittals: Testing agency shall submit a certified written report of each inspection and test to the following:
1. Owner.
 2. Architect.
 3. Contractor.
 4. Structural engineer.
 5. Authorities having jurisdiction, when authorities so direct.
- G. Report Data: Reports of each inspection, test, or similar service shall include at least the following:
1. Name, address, and telephone number of testing agency.
 2. Project title and testing agency's project number.
 3. Designation (number) and date of report.
 4. Dates and locations where samples were taken or inspections and field tests made.
 5. Names of individuals taking the sample or making the inspection or test.
 6. Designation of the product and test method.
 7. Complete inspection or test data including an interpretation of test results.
 8. Ambient conditions at the time of sample taking and testing.
 9. Comments or professional opinion on whether inspected or tested Work complies with requirements.
 10. Recommendations on retesting or reinspection.
 11. Name and signature of laboratory inspector.
- H. Testing Agency Qualifications: Engage inspection and testing agencies that are prequalified as complying with the American Council of Independent Laboratories' "Quality Assurance Manual" and that specialize in the types of inspections and tests to be performed.
1. Each testing agency shall be authorized by authorities having jurisdiction to operate in the state where Project is located.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION

SECTION 01 50 00 — TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 COORDINATION

- A. The General Conditions of the Contract for Construction and the Supplementary Conditions to the General Conditions of the Contract for Construction shall be considered as part of this section of the specifications.
- B. Each Bidder shall be responsible for determining during the bidding period the extent that any addenda issued during the bidding period may affect this section of the specifications.
- C. Reference Instructions to Bidders for requirements regarding substitutions of materials and products.
- D. Where conflicts occur between the drawings and specifications, between different drawings, between different portions of this section of the specifications, or between different sections of the specifications, the more stringent requirements and the greater quantity shall apply.

1.2 SECTION INCLUDES

- A. Temporary Utilities: Electricity, lighting, heat, ventilation, telephone and fax service, water, and sanitary facilities.
- B. Temporary Controls: Barriers, enclosures and fencing, protection of the Work, and water control.
- C. Construction Facilities: Access roads, parking, progress cleaning, project signage and temporary buildings.

1.3 TEMPORARY ELECTRICITY

- A. Cost: By General Contractor. Extend temporary outlets in NEC and OSHA approved manner to facilitate construction.
- B. Provide power outlets for construction operations, with branch wiring and distribution boxes located as required. Provide flexible power cords as required.
- C. Provide main service disconnect and over correct protection at convenient location.
- D. Provide sufficient and adequate distribution equipment, wiring, and outlets to ensure unimpeded progress of the Work.
- E. Permanent convenience receptacles may be utilized during construction.

1.4 TEMPORARY LIGHTING

- A. Provide and maintain lighting for construction operations to achieve a minimum lighting level of 2 watt/sq ft.

- B. Provide and maintain 1 watt/sq ft lighting to exterior staging and storage areas after dark for security purposes.
- C. Provide branch wiring from power source to distribution boxes with lighting conductors, pigtails, and lamps as required.
- D. Permanent building lighting may be utilized during construction.
- E. Maintain lighting and provide routine repairs.

1.5 TEMPORARY HEAT

- A. Provide and pay for heating devices and heat as needed to maintain specified conditions for construction operations.
- B. Maintain minimum ambient temperature of 50 degrees F (10 degrees C) in areas where construction is in progress, unless indicated otherwise in product sections.

1.6 TEMPORARY COOLING

- A. If required for the proper installation of particular materials, systems, or equipment, provide and pay for cooling devices and cooling as needed to maintain specified conditions.

1.7 TEMPORARY VENTILATION

- A. Ventilate enclosed areas to assist cure of materials, to dissipate humidify, and to prevent accumulation of dust, fumes, vapors, or gases.
- B. Extend and supplement equipment with temporary fan units as required to maintain clear air for construction operations.

1.8 TELEPHONE SERVICE

- A. Provide, maintain and pay for telephone service to field office.

1.9 FACSIMILE SERVICE

- A. Provide, maintain and pay for separate telephone line to be used solely for fax service to field office.

1.10 TEMPORARY WATER SERVICE

- A. Extend branch piping with outlets located so water is available by hoses with threaded connections. Provide temporary pipe insulation to prevent freezing as required.

1.11 TEMPORARY SANITARY

- A. Provide and maintain required facilities and enclosures. Provide at time of project mobilization.

1.12 BARRIERS

- A. Provide barriers to prevent unauthorized entry to construction areas to protect existing facilities and adjacent properties from damage from construction operations and demolition. Barriers must isolate occupied use from construction activities. If and when needed, barriers must be capable of attenuating sound.
- B. Provide protection for existing plant life and landscaped. Maintain plant life and landscaped areas as necessary during construction operations. Replace damaged plant life.
- C. Protect non-owned vehicular traffic, stored materials, site, and structures from damage.
- D. Barrier plan and method subject to approval by the Architect and the Owner.

1.13 FENCING

- A. Construction: Commercial grade chain link fence.
- B. Provide 6 foot high fence around construction site, equip with vehicular and pedestrian gates with locks. Fence must be capable of restricting entry by on-site facility users.

1.14 WATER CONTROL

- A. Grade site to drain where additions are undertaken. Maintain excavations free of water. Provide, operate, and maintain pumping equipment and/or any other means, methods or techniques necessary to maintain excavation and site free of water.
- B. Protect site from puddling or running water. Provide water barriers as required to protect site from soil erosion.

1.15 EXTERIOR ENCLOSURES

- A. Provide temporary insulated weather tight closure of exterior openings to accommodate acceptable working conditions and protect for products, to allow for temporary heating and maintenance of required ambient temperatures identified in individual specification sections, and to prevent entry of unauthorized persons. Provide access doors with self-closing hardware and locks.
- B. Provide temporary protection of existing wall cavities, substrates, and surfaces exposed to weather during cutting and minor demolition operations to prevent entrapment of moisture and development of mildew.

1.16 PROTECTION OF INSTALLED WORK

- A. Protect installed Work and provide special protection to prohibit damage and where specified in individual specification sections.
- B. Provide temporary and removable protection for installed Products. Control activity in immediate work area to minimize damage.
- C. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.

- D. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.
- E. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.
- F. Prohibit traffic in all landscaped areas.

1.17 SECURITY

- A. Provide security and facilities to protect Work and existing facilities from unauthorized entry, vandalism, or theft.
- B. Coordinate project security program with Owner's existing security operations at project mobilization.
- C. Maintain program throughout construction period until Owner acceptance precludes the need for Contractor security.
- D. Restrict entrance of persons and vehicles into Project site and existing facilities, allowing entrance only to authorized persons and persons identified by the Contract Document and/or the Architect or Owner as authorized to visit Project site.

1.18 ACCESS

- A. Provide and maintain temporary roads accessing public thoroughfares to serve construction area.
- B. Extend and relocate as work progress requires. Provide detours necessary for unimpeded traffic flow.
- C. Provide and maintain access to fire hydrants, free of obstructions.
- D. Provide means of removing mud from vehicle wheels before entering streets.
- E. Existing on-site roads may be used for construction traffic.

1.19 PARKING

- A. Provide temporary surface parking areas to accommodate construction personnel. Existing site areas may be used if approved in advance by the Owner.
- B. Contractor to propose plan for Owner concurrence and approval.

1.20 PROGRESS CLEANING AND WASTE REMOVAL

- A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.
- B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.
- C. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.

- D. Collect and remove waste materials, debris, and rubbish from site weekly and dispose off-site.

1.21 PROJECT IDENTIFICATION

- A. Provide project sign. Refer to drawings for size and content.
- B. Erect on site at location established by Architect.
- C. No other signs are allowed without Owner permission except those required by law.

1.22 FIELD OFFICES AND SHEDS

- A. Office: Weather tight with lighting, electrical outlets, heating, cooling and ventilating equipment, and equipped with sturdy furniture drawing rack, and drawing display table, phone and fax.
- B. Provide space for Project meetings, with table and chairs to accommodate 6 persons.
- C. Provide storage sheds and facilities to accommodate Work. Size to storage requirements for products of individual Sections, allowing for access and orderly provision for maintenance and for inspection of products to requirements of Section 01 25 00.
- D. Designated existing covered and uncovered hard paved areas and facilities may be used for field storage areas. Protect and secure existing areas used for storage. Upon completion of Work, clean, repair, and restore all existing areas used for storage and restore to acceptable condition.

1.23 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

- A. Remove temporary utilities, equipment, facilities, materials prior to Substantial Completion.
- B. Remove underground installation to a minimum depth of 2 feet. Grade site to drain.
- C. Clean and repair damage caused by installation or use of temporary work.
- D. Restore existing and permanent facilities used during construction to original condition. Restore permanent facilities used during construction to specified condition.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION

SECTION 01 77 00 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
 - 1. Substantial Completion procedures.
 - 2. Final completion procedures.
 - 3. Warranties.
 - 4. Final cleaning.
 - 5. Repair of the Work.

1.2 ACTION SUBMITTALS

- A. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.
- B. Certified List of Incomplete Items: Final submittal at Final Completion.

1.3 CLOSEOUT SUBMITTALS

- A. Certificates of Release: From authorities having jurisdiction.
- B. Certificate of Insurance: For continuing coverage.
- C. Field Report: For pest control inspection.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Schedule of Maintenance Material Items: For maintenance material submittal items specified in other Sections.

1.5 SUBSTANTIAL COMPLETION PROCEDURES

- A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's punch list), indicating the value of each item on the list and reasons why the Work is incomplete.
- B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
 - 1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
 - 2. Submit closeout submittals specified in other Division 01 Sections, including project

- record documents, operation and maintenance manuals, final completion construction photographic documentation, damage or settlement surveys, property surveys, and similar final record information.
3. Submit closeout submittals specified in individual Divisions 02 through 33 Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
 4. Submit maintenance material submittals specified in individual Divisions 02 through 33 Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect. Label with manufacturer's name and model number where applicable.
 - a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Architect's signature for receipt of submittals.
 5. Submit test/adjust/balance records.
 6. Submit sustainable design submittals required in Division 01 sustainable design requirements Section and in individual Division 02 through 33 Sections.
 7. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
- C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
1. Advise Owner of pending insurance changeover requirements.
 2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
 3. Complete startup and testing of systems and equipment.
 4. Perform preventive maintenance on equipment used prior to Substantial Completion.
 5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Division 01 Section "Demonstration and Training."
 6. Advise Owner of changeover in heat and other utilities.
 7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
 8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
 9. Complete final cleaning requirements, including touchup painting.
 10. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.
1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
 2. Results of completed inspection will form the basis of requirements for final completion.

1.6 FINAL COMPLETION PROCEDURES

- A. Submittals Prior to Final Completion: Before requesting final inspection for determining final completion, complete the following:
 - 1. Submit a final Application for Payment according to Division 01 Section "Payment Procedures."
 - 2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
 - 3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
 - 4. Submit pest-control final inspection report.
- B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.
 - 1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.7 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

- A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
 - 1. Organize list of spaces in sequential order.
 - 2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
 - 3. Include the following information at the top of each page:
 - a. Project name.
 - b. Date.
 - c. Name of Architect.
 - d. Name of Contractor.
 - e. Page number.
 - 4. Submit list of incomplete items in the following format:
 - a. MS Excel electronic file. Architect will return annotated file.

1.8 SUBMITTAL OF PROJECT WARRANTIES

- A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated, or when delay in submittal of warranties might limit Owner's rights under warranty.
- B. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Owner during

construction period by separate agreement with Contractor.

- C. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.
 - 1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
 - 2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
 - 3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
 - 4. Warranty Electronic File: Scan warranties and bonds and assemble complete warranty and bond submittal package into a single indexed electronic PDF file with links enabling navigation to each item. Provide bookmarked table of contents at beginning of document.
- D. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.
 - 1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

PART 3 - EXECUTION

3.1 FINAL CLEANING

- A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
 - 1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:
 - a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
 - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other

- foreign deposits.
- c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
- d. Remove tools, construction equipment, machinery, and surplus material from Project site.
- e. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
- f. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
- g. Sweep concrete floors broom clean in unoccupied spaces.
- h. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
- i. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
- j. Remove labels that are not permanent.
- k. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
- l. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
- m. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
- n. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.
- 1) Clean HVAC system in compliance with NADCA Standard 1992-01. Provide written report on completion of cleaning.
- o. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.
- p. Leave Project clean and ready for occupancy.
- C. Pest Control: Comply with pest control requirements in Division 01 Section "Temporary Facilities and Controls." Prepare written report.
- D. Construction Waste Disposal: Comply with waste disposal requirements in Division 01 Section "Temporary Facilities and Controls."

3.2 REPAIR OF THE WORK

- A. Complete repair and restoration operations before requesting inspection for determination of Substantial Completion.
- B. Repair or remove and replace defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.
 - 1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.
 - 2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that already show evidence of repair or restoration.

- a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.
3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
4. Replace burned-out bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

END OF SECTION

SECTION 03 30 00 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 COORDINATION

- A. The General Conditions of the Contract for Construction and the Supplementary Conditions to the General Conditions of the Contract for Construction shall be considered as part of this section of the specifications.
- B. Each Bidder shall be responsible for determining during the bidding period the extent that any addenda issued during the bidding period may affect this section of the specifications.
- C. Reference Instructions to Bidders for requirements regarding substitutions of materials and products.
- D. Where conflicts occur between the drawings and specifications, between different drawings, between different portions of this section of the specifications, or between different sections of the specifications, the more stringent requirements and the greater quantity shall apply.

1.2 WORK INCLUDED

- A. All concrete work, including sidewalks, exterior ramps, steps, miscellaneous concrete.
- B. All form work.
- C. Reinforcing steel.
- D. Installation of sleeves which are furnished by plumbing, heating and electrical contractors.
- E. Equipment bases are shown on architectural, mechanical, plumbing and electrical drawings.
- F. Provide and install waterstop material at below grade joints.

1.3 RELATED WORK SPECIFIED IN OTHER SECTIONS

- A. Testing Laboratory services.
- B. Excavation and fill.
- C. Concrete paving, curbs, sidewalks and site concrete.

1.4 DRAWING REFERENCES: See drawings for reinforcing sizes and placement.

1.5 Submittals:

- A. DESIGN MIX: Submit six (6) copies directly to the project Architect the proposed concrete mix(es). Include cement brand and type, aggregate identification, admixtures, proportions and anticipated strengths.

- B. PLASTIC CHAIR SUPPORTS: Submit manufacturer's literature indicating dimensions, configurations and performance data. Submit sample for approval by the Architect. Space at a maximum of 45" centers each way. Provide closer spacing where required to prevent excessive sag, where indicated on the drawings, or to support the weight of concrete pump hose.
- C. ADMIXTURES: Submit manufacturer's product data describing material and mix proportions.
- D. WATERSTOPS: Submit manufacturer's product data describing material and installation procedures.
- E. CURING COMPOUND: Submit Manufacturer's literature indicating composition and recommended application procedures.
- F. Reference Section 01 33 00 SUBMITTALS for additional submittal requirements.

1.6 SAMPLES

- A. Plastic chair support.

1.7 WARRANTY

- A. Provide written warranty against defects in materials and workmanship for the work under this section for a period of one year after the date of Substantial Completion of the project.

1.8 QUALITY ASSURANCE

- A. Cast-in-place concrete shall be installed by technicians specially trained in the proper handling, placing and protection of concrete and reinforcing steel. If required by the Architect, installer shall submit for approval a list of similar installations successfully completed.
- B. Comply with ASTM C 94; ACI 301, "Specification for Structural Concrete"; ACI 117, "Specifications for Tolerances for Concrete Construction and Materials"; and CRSI's "Manual of Standard Practice."
- C. Engage a qualified independent testing agency to design concrete mixes.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. GENERAL: All materials used in the Work shall be stored or handled in a manner that will prevent deterioration; any materials that have been damaged shall be immediately and completely removed from the Work. All manufactured materials, such as cement, shall be delivered and stored in their original packages that show marks or other evidence of damage shall be wholly rejected.
- B. Deformed Reinforcing Bars: ASTM A 615/A 615M, Grade 60.
- C. Plain Steel Wire: ASTM A 82, as drawn.
- D. Steel Welded-Wire Fabric: ASTM A 185, flat sheets not rolls. Use mesh for sidewalks and equipment pads, as indicated on the drawings.

- E. Portland Cement: ASTM C 150, Type I, latest edition.
- F. The use of Fly Ash in the concrete mix is not acceptable.
- G. Aggregates: ASTM C 33, uniformly graded.
- H. Fiber Reinforcement: ASTM C 1116, Type III, synthetic fibers, 1/2 to 1 inch.
- I. Air-Entraining Admixture: ASTM C 260.
- J. Chemical Admixtures:
 - 1. General: All admixtures shall be added only at the plant during mixing and must be prior approved by the Testing Laboratory. Admixtures shall comply with the requirements of ASTM C260 and C-494. Admixtures containing calcium chloride are not acceptable. Do not use admixtures in footings or seal slabs.
- K. Water Stops: Flat dumbbell or center-bulb type, of either rubber (CRD C 513) or PVC (CRD C 572).
- L. **Vapor Barrier: Reference Spec Section 07 26 16 Under Slab Vapor Barrier.**
- M. Liquid Membrane-Forming Curing Compound: ASTM C 309, clear, Type I, Class A or B, solvent borne, wax free.
- N. Liquid Membrane-Forming Curing and Sealing Compound: ASTM C 1315, clear, Type I, Class A, solvent borne.
- O. Slip-Resistive Aggregate: Factory-produced, rustproof, nonglazing, fused aluminum-oxide granules or crushed emery, unaffected by freezing, moisture, and cleaning materials.
- P. Joint-Filler Strips: ASTM D 1751, cellulosic fiber, or ASTM D 1752, cork.
- Q. Repair Underlayment: Factory-packaged, portland or blended hydraulic cement-based, polymer-modified, self-leveling underlayment with minimum 28-day compressive strength of 4100 psi (29 MPa).
- R. Repair Topping: Factory-packaged, portland or blended hydraulic cement-based, polymer-modified, self-leveling traffic-bearing topping with minimum 28-day compressive strength of 5700 psi (39 MPa).

2.2 MIXES

- A. Proportion normal-weight concrete mixes to provide the following properties:
 - 1. Compressive Strength:
 - a. Ramps and sidewalks: 3000 psi at 28 days.
 - 2. Slump Limit: 5 inches at point of placement.
 - 3. Air Content: 5.5 to 7.0 percent for concrete exposed to freezing and thawing, 2 to 4 percent elsewhere.

2.3 FORMWORK

- A. GENERAL: Forms shall conform to the shapes, lines, grade and dimensions of the concrete as indicated in the drawings. Lumber used in forms for exposed surfaces shall be dressed to a uniform thickness and shall be free of loose knots or other defects. Lumber once used in forms shall be thoroughly cleaned before another usage. Form **full depth** of outside face of perimeter grade beams without horizontal joints or

cracks. Forms shall be substantial and sufficiently tight to prevent leakage. They shall be properly shored, braced or otherwise tied or supported to maintain the desired position and shape during and after placement of concrete. Use no formwork which may stain exposed concrete surfaces.

- B. FORM LINING: For exposed concrete the final finish shall be smooth, even and free of defects.
- C. FORM REMOVAL: Forms shall remain in place sufficient time for the concrete to obtain necessary strength to support its own weight and construction load.

PART 3 - EXECUTION

3.1 CONCRETING

- A. Construct formwork and maintain tolerances and surface irregularities within ACI 117 limits of Class A for concrete exposed to view and Class C for other concrete surfaces.
- B. Set water stops where indicated to ensure joint water tightness.
- C. Place vapor retarder on prepared subgrade, with joints lapped 6 inches (150 mm) and sealed.
- D. Accurately position, support, and secure reinforcement.
- E. Install construction, isolation, and contraction joints where indicated. Install full-depth joint-filler strips at isolation joints.
- F. Place concrete in a continuous operation and consolidate using mechanical vibrating equipment.
- G. Protect concrete from physical damage, premature drying, and reduced strength due to hot or cold weather during mixing, placing, and curing.
- H. Formed Surface Finish: Smooth-formed finish for concrete exposed to view, coated, or covered by waterproofing or other direct-applied material; rough-formed finish elsewhere.
- I. Slab Finishes: Float finish for ramps and surfaces to receive waterproofing or other direct-applied material. Trowel and fine-broom finish for surfaces to receive thin-set tile. Nonslip-broom finish to exterior concrete platforms, steps, and ramps.
- J. Uniformly spread 25 lb/100 sq. ft. (12 kg/10 sq. m) of dampened slip-resistive aggregate over initially floated surfaces; tamp and float. Expose nonslip aggregate after curing.
- K. Uniformly spread 100 lb/100 sq. ft. (49 kg/10 sq. m) of mineral dry-shake floor hardener over initially floated surfaces, repeat float finishing to embed each application, and then apply a trowel finish.
- L. Cure formed surfaces by moist curing for at least seven days.
- M. Begin curing concrete slabs after finishing.
- N. Owner will engage a testing agency to perform field tests and to submit test reports.
- O. Protect concrete from damage. Repair surface defects in formed concrete and slabs.
- P. Repair slabs not meeting surface tolerances by grinding high areas and by applying a repair underlayment to low areas receiving floor coverings and a repair topping to low areas to remain exposed.

3.2 CLEANING AND PROTECTION

- A. CLEANING: Slabs are to be kept free of any foreign substances (wax, oil, paint, etc.) or surface irregularities that may affect the final appearance of the completed installation.
- B. Unless otherwise approved by the Architect, no vehicular traffic will be allowed on any concrete until after the 7 day concrete tests have been made by the laboratory indicating that the concrete has attained 3,000 psi compressive strength.
- C. Contractor shall coordinate with Architect and Owner to determine a suitable on-site "wash-out" area for concrete trucks. Contractor shall be responsible for clean-up of the area.
- D. Contractor shall keep clean all adjacent public streets and rights of way. Wash down daily or more often as needed to remove mud and maintain a safe condition at entrances/exits to job site.

END OF SECTION

SECTION 04 05 13 — MORTAR

PART 1 - GENERAL

1.01 COORDINATION

- A. The General Conditions of the Contractor for Construction and the Supplementary Conditions to the General Conditions of the Contract for the Construction shall be considered as part of this section of the specifications.
- B. Each Bidder shall be responsible for determining during the bidding period the extent that any addendum issued during the bidding period may affect this section of the specifications.
- C. Reference Instructions to Bidders for requirements regarding substitutions of materials and products.
- D. Where conflicts occur between the drawings and specifications, between different drawings, between different portions of this section of the specifications, or between different sections of the specifications, the stringent requirements and the greater quantity shall apply.

1.02 SCOPE:

- A. Perform all work required to furnish the Masonry Mortar indicated by the Contract Documents and furnish all supplementary items necessary for its proper installation.
- B. The requirements of Division 0 – “Bidding and Contract Requirements” and Division 1 – “General Requirements” of this Project Manual shall apply to all Work required for this Section.
- C. Application of Mortar used in the installation of masonry units is specified in each respective Unit Masonry Section and is not included in the work required for this Section.

1.03 SUBMITTALS:

- A. Submit product data on all mortar and admixtures.
- B. Submit certification that mortar and grout material meet ASTM standards.

1.04 PRODUCT DELIVERY AND STORAGE:

- A. Delivery: Delivery materials to Project site dry and in unbroken containers.
- B. Storage: Store materials above ground in waterproof shelters.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS:

- A. Material manufactured by any of the following manufacturers is acceptable, provided it complies with the Contract Documents.
 - 1. PORTLAND CEMENT:
 - a. Capitol Lone Star
 - b. Trinity Texas Industries

- c. Universal Atlas Cement
- 2. LIME:
 - a. Gibsonburg Lime Products Co., Tiger Limes
 - b. Texas Lime Company
 - c. United States Gypsum Company
 - d. National Gypsum Company
- 3. WATER PROOFING ADMIXTURE:
 - a. Master Builders-Omicron Mortarproofing
 - b. Sonneborn Building Products-Hydracide
 - c. W.R. Grace-Hydratite Plus
- 4. MORTAR COLOR:
 - a. Gray-
- 5. ***DRY BLOCK-One pound per cubic foot of cementitious material, 1/2 sack per sack of 2 sacks of cement fluted, split –face CMU for warranty purposes***

B. Refer to Section 01 25 00 - Substitutions Procedures for manufacturers not listed above.

2.02 MATERIALS:

- A. Portland Cement: ASTM C150, TYPE I.
- B. Hydrated Lime: ASTM C207, TYPE S.
- C. Fine Aggregate: ASTM C144,
- D. Coarse Aggregate: ASTM C404, Size No. 8
- E. Water: Clean and free of deleterious acids, alkalies, or organic matter.
- F. Waterproofing Admixture: Omicron Mortarproofing, manufactured by Master Builders.
- G. Grout Admixture: “Fluidifier” by Master Builders.
- H. Sealer: “DEFY” Block Water Repellant

2.03 PROPORTIONS AND MIXING:

- A. Meet requirements of ASTM C270 and proportion mortar types as specified.
- B. Meet requirements of ASTM C476 for masonry grout and proportion grout type as specified.
- C. Proportion material accurately and mix thoroughly by machine to a uniform consistency and color. Mix mortars with the maximum amount of water consistent with workability.
- D. Do not use mortar that has begun to set. Retemper mortar by adding water if mortar begins to stiffen from evaporation or absorption of a part of the mixing water. Use and place mortar in final position within 2-1/2 hours after mixing.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. See specific section of Masonry Materials for installation instructions.

3.02 MORTAR SCHEDULE:

- A. Exterior Masonry Walls:
 - 1. Mortar-Type S, ASTM C270.
 - 2. Waterproofing Admixture-*dry block required to provide warranty.*
- B. Interior Masonry Partitions:
 - 1. Mortar-Type N, ASTM C270.
- C. Interior Paving Tile:
 - 1. Mortar-Type S, ASTM C270.
- D. Exterior Paving Tile:
 - 1. Mortar-Type M, ASTM C270.

3.03 GROUT SCHEDULE:

- A. Paving Tile:
 - 1. Portland Cement-one part.
 - 2. Fine Aggregate-three parts.
 - 3. No lime.
 - 4. Sealer

END OF SECTION

SECTION 04 22 00 — CONCRETE MASONRY UNIT

PART 1 - GENERAL

1.01 COORDINATION

- A. The General Conditions of the Contractor for Construction and the Supplementary Conditions to the General Conditions of the Contract for the Construction shall be considered as part of this section of the specifications.
- B. Each Bidder shall be responsible for determining during the bidding period the extent that any addendum issued during the bidding period may affect this section of the specifications.
- C. Reference Instructions to Bidders for requirements regarding substitutions of materials and products.
- D. Where conflicts occur between the drawings and specifications, between different drawings, between different portions of this section of the specifications, or between different sections of the specifications, the stringent requirements and the greater quantity shall apply.

1.02 SCOPE:

- A. Perform all Work required to complete the Concrete Unit Masonry indicated by the Contract Documents and furnish all supplementary items necessary for its proper installation.
- B. The requirements of Division 0 – “Bidding and Contract Requirements” and Division 1 – “General Requirements” of this Project Manual shall apply to all Work required for this Section.

1.03 PRODUCTS INSTALLED UNDER THIS SECTION BUT SPECIFIED ELSEWHERE:

- A. Section 04 05 13 – Mortar.
- B. Section 07 92 00 – Sealants and Caulking.

1.04 SUBMITTALS:

- A. Submit technical data for each type wall reinforcement, anchors and ties.
- B. Submit 12” long sample of control joint filler.
- C. Submit certificate that masonry units conform to ASTM and NBFU standards specified.

1.05 STORAGE AND HANDLING:

- A. Handle materials in a manner to prevent breakage and chipping. Store materials on platforms raised free of ground and protect materials with stainproof tarpaulin covers.

1.06 ENVIRONMENTAL CONDITIONS:

- A. Lay no masonry when the temperature of the air is 40°F. twenty-four (24) hours after laying. Do not build on frozen work.

- B. Store masonry units on the job so that they are kept off the ground and protected from rain.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS:

- A. Material manufactured by any of the following manufacturers is acceptable, provided it complies with the Contract Documents.
 - 1. REINFORCEMENT, ANCHORS AND TIES:

Duro-O-Wal	AA Wire Products Company
Heckman Build Products, Inc.	Hohmann and Barnard, Inc.
Masonry Reinforcing Corp. of America	National Wire Products Corp.
 - 2. SPLIT FACE BLOCK SEALER:
"DEFY" Split Face Block Water Repellant

2.02 MATERIALS:

- A. UNITS:
 - 1. Hollow Concrete Masonry: ASTM C90, medium weight, Grade N-1
- B. REINFORCEMENT:
 - 1. Block Wall Joint Reinforcement:
ASTM A82, AA Wire Products Co., "BLOK-TRUS", AA600 two wire, width 2" less than wall thickness, standard weight galvanized ASTM A116, Class 1.
 - 2. Lintel and Bond Beam Reinforcement: Domestic, ASTM A615, or ASTM A616, deformations ASTM A305. Unless otherwise shown on drawings provide 2-#4 Ø cont. lap 30 dias.
- C. WATER: Clean and free of deleterious acids, alkalies or organic material.
- D. Bullnose edge at all masonry corners for interior walls. Provide sealer for all exterior split face c.m.u.

PART 3 - EXECUTION

3.01 CONDITION OF SURFACES:

- A. Do not commence with masonry work until foundation has properly cured a minimum of seven (7) days and reinforcing steel that is dowelled for masonry units has been approved.
- B. Consult other trades and make provisions to permit installation of their work to avoid cutting and patching. Before closing up any pipe chase, or similar inaccessible spaces, remove all rubbish and sweep out areas to be enclosed.

3.02 PREPARATION:

- A. Provide, install and maintain all scaffolding, staging and forms of protection necessary for execution of the work; substantially constructed, maintained, moved and dismantled as required to properly follow the sequence of operation.

- B. Provide and install all shores and centering for the work, constructed true to require shape, size and form; well-braced and made rigid in all parts, and capable of supporting and sustaining the loads to which subjected.
- C. Leave all shores and centering in place until the masonry has sufficiently set to safely carry its own weight and the added loads of construction. Shore free-standing walls to prevent windstorm damage until walls are protected.
- D. Examine surfaces to receive masonry and report any discrepancies before commencing work. Accept no former measurements, but lay work according to the plans and dimensions thereon.

3.03 LAYING CONCRETE MASONRY UNITS:

- A. Do not dampen units before laying, and do not lay units which have surface water or contain frost. Lay units plumb, level, and true to a line in running bond, or as indicated. Align on exposed face or as indicated.
- B. Lay first course of masonry in full bed of mortar. Lay all other hollow units in a full mortar bed on shell surface and at ends.
- C. Lay hollow units with the thicker edge of the face shell up and make all joints 3/8" thick. Lay corners prior to laying mid-portion of wall. Rock closures into place with the head joints shoved against the two adjacent units in place.
- D. Cut units with power saw through the unit to insure straight, evenly cut edges. Do not use fractional parts of masonry units in the work where whole units can be used.
- E. Avoid over-plumbing and pounding of the corners and jambs to fit stretcher units after setting in place. Remove mortar and replace with fresh mortar where adjustment must be made after initial settings.
- F. Do not use masonry units having cracks, chipped edges, broken corners or other defects in exposed faces. Build walls full thickness as shown. Blocks with open cells exposed will not be permitted.
- G. Provide all special precast lintels, fillers, closers, control joint units, trough tile, etc., required to form all corners, returns, openings, jambs, offsets, etc., to maintain a proper bond throughout all masonry work.
- H. Protect all sills, ledges, off-sets, etc., from droppings of mortar and protect door jambs and corners from damage during construction.
- I. Stop off longitudinal run of masonry only where absolutely necessary by racking one-half block length in each course. Remove loose mortar before new work is started.
- J. Cover tops of walls at end of day's work and when rain is imminent, with waterproof membrane. Overhang two feet on each side of wall and anchor securely. Protect masonry from weather or construction damage.

3.04 JOINTS:

- A. Mortar joints shall be straight, clean and uniform in thickness. Tool joints of all walls to produce a dense surface well bonded to the edges. Joints which are not tight at the time of tooling shall be raked out, pointed, and then tooled.
- B. Tool when the mortar is partially set but still sufficiently plastic to bond. Use a tool which compacts the mortar, pressing the excess mortar out of the joint rather than dragging it out.

- C. Finish joints that will remain exposed with a tool slightly larger than the width of the joint to form a concave surface. Tool vertical joint first. Finish flush, joint that will not remain exposed.
- D. Unless otherwise specified the horizontal and vertical mortar joints shall be 3/8" thick with full mortar coverage on the face shells and on the webs surrounding cells to be filled with grout.
- E. Vertical head joints shall be buttered well for a thickness equal to the face shell of the unit and these joints shall be shoved tightly so that the mortar bonds with both units. Joints shall be solidly filled from the face of the block to at least the depth of the face shell.

3.05 REINFORCING:

- A. Install continuous joint reinforcing 16" on centers for running bond. Install joint reinforcing in the first and second bed joint above and below openings extending 24" beyond each side of opening.
- B. Lap splices a minimum of 6" and install prefabricated corners and tees at such locations. Do not extend reinforcing through expansion joints. Center reinforcing in joint with 5/8" minimum mortar coverage on the exterior face and 1/2" minimum mortar coverage on the interior face.
- C. Do not extend reinforcing through control joints when anchorage is provided on each side of joint. If no anchorage is provided at joint, extend reinforcing through control joint at 48" on center.
- D. Reinforce bond beams and lintels as indicated with continuous bars placed as the work progresses. Maintain 1/2" minimum clear distance between masonry units and reinforcement.

3.06 ANCHORING:

- A. Anchor interior partitions to abutting or intersecting walls by common bond or with prefabricated reinforcing tees.
- B. Anchor interior load bearing partitions laterally a maximum of 12'-0" o.c. by either an intersecting partition or anchorage to foundation with 4-#4Ø dowels and continuous 4 #4Ø bars to top of wall. Grout fill cells to top of wall.
- C. Do not attach construction supports to wall except where specifically permitted by the Architect.
- D. Intersecting load bearing masonry walls and partitions shall be bonded by the use of rigid steel anchors at twenty-four (24) inches o.c. maximum. Corners shall have a standard masonry bond by overlapping units and shall be solid grouted.

3.07 CONTROL JOINTS:

- A. Locate 3/8" wide control joints as indicated but do not exceed 30 feet on centers. Keep vertical joints straight, true and continuous from top to bottom of masonry.
- B. Use sash units to form control joints and install continuous control joint filler with sash units tightly butted to compress neoprene flanges and completely seal joint. Where masonry abuts structural concrete or steel and control joint filler cannot be used, keep joint clean of mortar as work progresses or use expansion joint spacer.
- C. Locate building expansion joints as indicated and install expansion joint spacer properly recessed back from face to allow for sealant.

3.08 EMBEDDED ITEMS:

- A. Build in flashing, sleeves, anchors, clips, mechanical and electrical items, and accessories as work progresses. Accurately cut units to fit all plumbing, ducts, openings and electrical work with all holes neatly patched.
- B. Install loose lintels, as indicated in full beds of mortar. Fill voids at metal frames with mortar and build in frame anchors.

3.09 GROUTING:

- A. Fill with grout, vertical cells, bond beams, lintels and other structural members having reinforcement. Secure in place and inspect reinforcing before grouting. Keep mortar droppings out of grout space and puddle or vibrate all grout in place.
- B. Provide solid bearing under structural members at least 8" vertically and at least 16" horizontally. Bearing shall be hollow units reinforced with 2#4Ø bars U.N.O. and filled with concrete grout.
- C. Build masonry in filled cell construction to preserve the unobstructed vertical continuity of the cells to be filled. Fully bed all walls and cross webs forming such cells to prevent leakage of grout and strike cell joints smooth. Maintain a continuous vertical alignment of cells so the unobstructed cell area is not less than 2"x3".
- D. Grout vertical cells in lifts not to exceed 4'-0". Stop grout where necessary at mid-point but not over openings, when filling trough unit and provide suitable dam to retain grout. Stop grout one and one half inches below the top of the last course when filling vertical cells to form key for next pour.
- E. Grout from inside face of masonry and prevent grout from staining masonry face. Protect projecting surfaces from droppings and clean immediately any grout which comes in contact with face of masonry.

3.010 CLEANING:

- A. Keep face of blockwork free from excess mortar while laying blocks. Clean blockwork that will remain exposed, promptly, with fiber brushes and clear water. Use of wire brushes or acid permitted only with specific approval.
- B. Repair and repoint defective work and pin line holes to match adjacent similar work. Replace broken or damaged blocks.

END OF SECTION

SECTION 04 40 00 - GRANITE

PART 1 – GENERAL

1.00 COORDINATION

- A. The General Conditions of the Contract for Construction and the Supplementary Conditions to the General Conditions of the Contract for Construction shall be considered as part of this section of the specifications.
- B. Each Bidder shall be responsible for determining during the bidding period the extent that any addenda issued during the bidding period may affect this section of the specifications.
- C. Reference Instructions to Bidders for requirements regarding substitutions of materials and products.
- D. Where conflicts occur between the drawings and specifications, between different drawings, between different portions of this section of the specifications, or between different sections of the specifications, the more stringent requirements and the greater quantity shall apply.

1.01 RELATED DOCUMENTS

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

1.02 WORK INCLUDED

- A. The work of this Section consists of providing all equipment and materials and doing all work necessary to fabricate, furnish and install the granite work as indicated on the Contract Drawings and as specified herein.

1.03 RELATED WORK UNDER OTHER SECTIONS

- A. The following items of related work are specified and included in other Sections of the Specifications:
 - 1. Section 03 30 00, Cast-In-Place Concrete; Concrete.
 - 2. Section 04 22 00, Masonry Units.
 - 3. Section 07 90 00, Joint Sealers; Sealants for expansion joints and joints to receive elastomeric sealants.

1.04 REFERENCE STANDARDS

- A. The following standards shall apply to the work in this Section.
 - 1. American Society for Testing and Materials (ASTM):
 - C-97 Test Methods for Absorption and Bulk Specific Gravity of Dimension Stone
 - C-99 Test Methods for Modules of Rupture of Dimension Stone
 - C-170 Test Method for Compressive Strength of Dimension Stone
 - C-241 Test Methods for Abrasion Resistance of Stone Subjected to foot Traffic
 - C-615 Specification for Granite Dimension Stone
 - C-880 Test Method for Flexural Strength of Dimension Stone
 - C-920 Specifications for Elastomeric Joint Sealants
 - 2. National Building Granite Quarries Association, Inc. (NBGQA): Specifications for Architectural Granite

1.05 SUBMITTALS

- A. Shop Drawings: Cutting and setting drawings of granite pieces specified herein shall be submitted. Drawings shall indicate sizes, dimensions, layout, finishes, arrangement and provisions for bedding, bonding, jointing, anchoring, cut-outs and holes, and other necessary details for reception of other work.
 - 1. Drawings shall indicate locations of inserts for stone anchors and supports which are to be built into concrete, and locations and dimensions of cut-outs, holes, openings, and other provisions required for the work of other trades.
 - 2. Shop drawings shall indicate the setting number of each piece shall bear the corresponding number in a non-staining paint.
- B. Samples: Provide samples of each granite type and finish to show texture, finish, and anticipated range of color to be supplied.
 - 1. Granite sample shall fully demonstrate color, shade, veining, texture, range and finish.
- C. Contractor's Review: Before commencing work, submit signed statement that Contract Documents have been reviewed with a qualified representative of granite supplier, and that selected materials and construction are proper, compatible, and adequate for application shown.
- D. Test Report: Submit reports from independent test agency for all granite furnished under this Section indicating compliance with NBGQA Specifications. Testing shall be in accordance with the following:
 - 1. Compressive strength, ps (ASTM C-170).
 - 2. Density, lbs/c.f. (ASTM C-97).
 - 3. Absorption by weight, percent (ASTM C-97).
 - 4. Abrasion resistance (ASTM C-241).
 - 5. Flexural strength, psi (Mpa) (ASTM C-880).
 - 6. Modulus of rupture, average (psi) (ASTM C-99).

1.06 SAMPLE INSTALLATIONS

- A. Provide sample installations as directed conforming to typical project construction. Samples shall show the proposed granite types, colors and finishes, anchorage system, and other pertinent details of installation.
- B. Replace sample installations as many times as necessary until approval of the installation has been obtained. Following approval, construct all subsequent granite work to conform to approved sample installation.

1.07 COORDINATION

- A. Coordinate work with that of other sections affecting, affected by, this work, as necessary to assure the steady progress of the work under the Contract.
- B. Do all cutting and drilling to accommodate work of other sections, as expressly indicated and as reasonably inferred from Contract Documents and Specifications, or required for the proper completion of the Work.

1.08 DELIVERY, HANDLING AND STORAGE

- A. Granite shall be carefully packed and banded by the supplier for shipment. Following shipping, granite shall be stored on wood skids or pallets, covered with non-staining, waterproof membrane and protected from the weather. Skids shall be placed and stacked in such a manner as to evenly distribute the weight of the granite materials and to prevent damage to granite pieces. Granite materials shall be stored in

such a manner as to allow air to circulate around the material. Granite shall not be permitted to be in direct contact with the ground any time during storage.

- B. Granite shall be carefully handled to prevent chipping, breakage, soiling or other damage. Pinch or wrecking bars shall not be used without protecting edges of granite with wood or other rigid materials. Granite units shall be lifted with wide-belt type slings wherever possible; wire rope or ropes containing tar or other substances which might cause staining or damage to granite finish will not be permitted.
- C. If damaged material cannot be repaired to customer satisfaction, it will be replaced at no additional cost.

1.09 PROTECTION OF FINISHED SURFACES

- A. Finished surfaces adjacent to the granite work shall be adequately protected from soiling, staining and other damage.

1.10 QUALITY ASSURANCE

- A. Granite shall conform to the requirements of ASTM C-615, Architectural Grade and NBGQA Specifications, except as modified herein.
- B. Granite shall be standard grade, free of flaws, reeds, rifts, laminations, cracks, seams, starts or other defects which may impair its strength, durability or function. Exposed surfaces shall be free from spots, spalls, chips, stains, discoloration or other defects which are not within the approved sample range and would affect its appearance.
- C. Color, texture and finish of granite shall be within the range of approved samples.
- D. Granite supplier shall be able to demonstrate their capacity and facilities to furnish granite meeting the specified requirements for this project.
- E. The Owner reserves the right to test granite materials supplied for the Project. Tests will be performed by a recognized testing laboratory.

PART 2 – PRODUCTS

2.01 SOURCE OF GRANITE

- A. Source of Granite: Granite shall be supplied by the following:

Fletcher Granite Co., LLC
534 Groton Road, Westford, MA 01863
Telephone: (800) 253-8168 or (978) 251-4031 Fax: (978) 251-8773

2.02 GRANITE

- A. Granite Type: Type of Granite to be selected by Architect.
- B. Granite Properties: Unless otherwise indicated, granite as supplied shall meet or exceed the following:
 - 1. Bulk Density (ASTM C-97): ____ pcf, average.
 - 2. Absorption (ASTM C-97): ____ %, average.
 - 3. Compressive Strength (ASTM C-170): ____ psi, average.
 - 4. Modulus of Rupture (ASTM C-99): ____ psi, average.
- C. Finishes: Unless otherwise indicated provide the following finishes in accordance with NBGQA

Specifications:

1. Unless otherwise indicated, exposed surfaces shall have a polished finish; all other surfaces shall be sawn.

- D. Size and Dimension: Granite shall be of the sizes and dimensions indicated on the Drawings.

2.03 FABRICATION

- A. Fabricate granite in accordance with the tolerances specified in NBGQA Specifications and as indicated.

1. All faces shall be at right angles to the plane of the top.
2. Granite shall be cut accurately to required shapes and dimensions.
3. Holes, cut-outs, sinkages and openings in granite work for anchors, cramps, dowels, supports, and lifting devices shall be accurately cut or drilled to required dimensions, as shown on the approved shop drawings, and as necessary to secure granite in place to ensure correct location and accurate fit of all fixtures. Setting beds shall be shaped to fit supports.
4. Arrises shall be cut sharp and true to square, and continuous with adjoining arrises. Where exposed, arrises shall be eased.

- B. Flatness Tolerance: Variation from true plane, or flat surfaces, shall be determined by use of a 4 ft. long straightedge, applied in any direction on the surface. Such variations on polished, honed and fine rubbed surfaces at the bed and joint arris lines shall not exceed 3/64" or 1/16 of the specified joint, whichever is greater. On surfaces having other finishes, the maximum variation from true plane at the bed and joint arris lines shall not exceed 1/4 of the specified joint width.

- C. Variations from true plane on other parts of the face surfaces shall not exceed the following:

1. Polished, honed or fine rubbed finishes: 3/64 in.
2. Rubbed or fine stippled sandblasted finishes: 1/16 in.
3. Shot ground, 8- and 6-cut finishes: 1/8 in.
4. Thermal and coarse stippled sandblasted finishes: 3/16 in.

- D. Backs of pieces shall be sawn or roughly dressed to approximate true planes. Maximum variation in thickness from the specified shall not exceed the following:

1. 1/4 in. on pieces up to modular 12 in. thick.
2. 1/2 in. on pieces above 12 in. modular thick.

PART 3 – EXECUTION

3.01 ACCEPTABILITY OF BASE TO RECEIVE GRANITE

- A. Contractor shall examine the base to determine its adequacy to receive granite work. Evidence of inadequate base shall be brought to the immediate attention of the Architect or Owner.
- B. Start of work of this Section shall constitute acceptance of base.

3.02 SETTING

- A. All setting shall be done by competent granite setters under adequate supervision and in accordance with the approved shop drawings.
- B. Granite units with chips, cracks, stains, or other defects which might be visible in the finished work shall not be used.

- C. Before setting, granite shall be clean and free of dirt and foreign matter on all sides. Granite shall be dry before setting.
- D. Granite shall be set true to the required lines and grades. Joints shall be uniform in thickness and as indicated on the Drawings. Direct bearing contact between granite pieces shall be prohibited.
- E. Exposed surfaces shall be kept free from mortar at all times. Any mortar smears shall be immediately removed with a clean sponge and clean water before latex-modified mortar can set.
- F. Holes, slots, and other sinkages for anchors and dowels shall be completely filled with mortar during setting of granite.

3.03 CLEANING

- A. After pointing granite, work shall be carefully cleaned, removing all dirt, excess mortar, stains and other defacements.
 - 1. Mild abrasive cleaners that contain no harsh or caustic ingredients may be used, with fiber brooms or brushes and clear water. Wire brushes, steel wool, and acids or other solutions which may cause discoloration are expressly prohibited.
 - 2. Expansion joints and other joints to receive sealant shall be cleaned of all mortar and left ready for sealing of joints under Section 07 90 00, Joint Sealers.
- B. Upon completion of granite work, surfaces shall be left in a clean, unsoiled condition, acceptable to the Architect and Owner.

3.04 PROTECTION

- A. Granite work shall be properly and adequately protected under the responsibility of the Contractor until final acceptance of the Project by Owner.
- B. After the granite work has been installed, it shall be properly and adequately protected from damage. Boxing or other suitable protection shall be provided by Contractor wherever required. However, no lumber which may stain or deface the granite shall be used. Nails shall be high-quality galvanized or non-rusting.

END OF SECTION

SECTION 04 73 00 - MANUFACTURED STONE VENEER

PART 1 – GENERAL

1.00 COORDINATION

- A. The General Conditions of the Contract for Construction and the Supplementary Conditions to the General Conditions of the Contract for Construction shall be considered as part of this section of the specifications.
- B. Each Bidder shall be responsible for determining during the bidding period the extent that any addenda issued during the bidding period may affect this section of the specifications.
- C. Reference Instructions to Bidders for requirements regarding substitutions of materials and products.
- D. Where conflicts occur between the drawings and specifications, between different drawings, between different portions of this section of the specifications, or between different sections of the specifications, the more stringent requirements and the greater quantity shall apply.

1.01 SUMMARY

A. Section Includes: Portland cement based manufactured [stone] [and] [brick] veneer and trim.

B. Related Sections:

- 1. 07 60 00 – Flashing and Sheet Metal.
- 2. 07 92 00 – Joint Sealers.

1.02 REFERENCES

A. Building code applicable to project site.

B. American National Standards Institute (ANSI)

- 1. ANSI A118.4 Specifications for Latex-Portland Cement Mortar

C. American Society for Testing and Materials (ASTM):

- 1. ASTM C 39 – Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
- 2. ASTM C 67-Test Methods for Sampling and Testing Brick and Structural Clay Tile
- 3. ASTM C 144-Specification for Aggregate for Masonry Mortar
- 4. ASTM C 177-Test Method for Steady-State Head Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus
- 5. ASTM C 190 – Method of Test for Tensile Strength of Hydraulic Cement Mortars
- 6. ASTM C 207-Specification for Hydrated Lime for Masonry Purposes
- 7. ASTM C 270-Specification for Mortar for Unit Masonry
- 8. ASTM C 348 – Standard Test Method for Flexural Strength of Hydraulic-Cement Mortars
- 9. ASTM C 482- Standard Test Method for Bond Strength of Ceramic Tile to Portland Cement
- 10. ASTM C 567-Test Method for Unit Weight of Structural Lightweight Concrete
- 11. ASTM C 847-Specification for Metal Lath
- 12. ASTM C 979-Specification for Pigments for Integrally Colored Concrete
- 13. ASTM D 226-Specification for Asphalt-Saturated Organic Felt Used in Roofing and

Waterproofing.

D. Uniform Building Code Standards:

1. UBC Standard 14-1-Kraft Waterproof Building Paper
1. UBC Standard 15-5-Roof Tile

1.03 SUBMITTALS

A. Reference Section 01 33 00 - Submittal Procedures; submit following items:

1. Product Data.
2. Samples:
 - a. Standard sample board consisting of small-scale pieces of veneer units showing full range of textures and colors.
 - b. Full range of mortar colors.
2. Verification samples: Following initial sample selection submit "laid-up" sample board using the selected stone and mortar materials and showing the full range of colors expected in the finished Work; minimum sample size: 3 by 3 feet.
3. Quality Assurance/Control submittals:
 - a. Qualifications:
 - 1) Proof of manufacturer qualifications.
 - 2) Proof of installer qualifications.
 - b. Regulatory Requirements: Evaluation reports
 - c. Veneer manufacturer's installation instructions.
 - d. Installation instructions for other materials.

B. Closeout submittals: Reference Section 01 78 00 – Closeout Submittals; submit following items:

1. Maintenance Instructions.
2. Special Warranties.

1.04 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturer Qualifications: Licensee of Eldorado Stone Corporation.
2. Installer Qualifications: Experienced mason familiar with installation procedures for manufactured veneer.

B. Certifications:

1. ICBO Evaluation Service – Evaluation Report
2. NES Evaluation Service – Evaluation Report
3. LARR – Research Report
4. HUD – Materials Release
5. UL – Classification listing

C. Field Sample:

1. Prepare [4 by 4 foot (1200 by 1200 mm)] sample at a location on the structure as selected by the Architect. Use approved selection sample materials and colors.
2. Obtain Architect's approval.
3. Protect and retain sample as a basis for approval of completed manufactured stone work. Approved sample may be incorporated into completed work.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Reference Section 01 66 00 - Product Storage and Handling Requirements.
- B. Follow manufacturer's instructions.

1.06 PROJECT/SITE CONDITIONS

- A. Environmental Requirements: When air temperature is 40 degrees F (4.5 degrees C) or below, consult local building code for Cold-Weather Construction requirements.

1.07 WARRANTY

- A. Special Warranty: Manufacturer's standard warranty coverage against defects in materials when installed in accordance with manufacturer's installation instructions.

PART 2 – PRODUCTS

2.01 MANUFACTURER

- A. Eldorado Stone, LLC
1370 Grand Ave., Bldg. B
San Marcos, CA 92069
Tel: (800) 925-1491
Fax: (760) 736-8890
E-Mail: customerservice@eldoradostone.com
Website: www.eldoradostone.com
- B. Product: RINCON LIMESTONE.
- C. Substitutions: None Allowed.

2.02 MATERIALS

- A. Veneer Units: Precast veneer units consisting of portland cement, sand, lightweight aggregates, and mineral oxide pigments.
 - 1. Physical Properties:
 - a. Compressive Strength: ASTM C 39, 5 sample ave 1,800psi (12.4 MPa)
 - b. Shear Test: ASTM C 482, 50 psi (345 kPa)
 - c. Water Absorption: UBC Standard 15-5, 22 percent
 - d. Freeze-Thaw Test: ASTM C 67,.....Less than 3%
 - e. Thermal Resistance: ASTM C 177..... R0.60 (0.11)
 - f. Density: ASTM C 567 (Dry density)75 pcf (1200 kg per m3)
- B. Moisture Barrier: [ASTM D 226 No. 15 non-perforated asphalt-saturated organic felt] [UBC Standard 14-1 kraft waterproof building paper].
- C. Reinforcing: [ASTM C 847 galvanized expanded metal lath] [ASTM C 847 painted expanded metal lath] [1 inch galvanized steel, 18 gauge woven wire mesh] complying with code agency requirements for the type of substrate over which stone veneer is installed.
- D. Mortar:
 - 1. Cement: Any cement complying with ASTM C 270.
 - 2. Lime: ASTM C 207.
 - 3. Sand: ASTM C 144, natural or manufactured sand.

4. Pigment: ASTM C 979, mineral oxide pigments.
5. Water: Potable.
6. Pre-Packaged Latex-Portland Cement Mortar: ANSI A118.4.

E. Bonding Agent: Daraweld® as manufactured by Grace Construction, or equal Products

F. Sealer: Water base silane or siloxane masonry sealer, [clear] [semi-gloss]

2.03 MORTAR MIXES

A. Standard Installation (Grouted Joints):

1. Mix mortar in accordance with Eldorado Stone Corp. mortar preparation instructions
 - a. Add color pigment in grout joint mortar in accordance with pigment manufacturer's instructions.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Examine substrates upon which work will be installed.
- B. Coordinate with responsible entity to perform corrective work on unsatisfactory substrates.
- C. Commencement of work by installer is acceptance of substrate.

3.02 PREPARATION

- A. Protection: Protect adjacent work from contact with mortar.
- B. Surface Preparation: Prepare substrate in accordance with manufacturer's installation instructions for the type of substrate being covered.

3.03 INSTALLATION

- A. Install and clean stone in accordance with manufacturer's installation instructions for Standard (Grouted Joint) installation.
- B. Apply sealer in accordance with sealer manufacturer's installation instructions.

3.04 FIELD QUALITY CONTROL

- A. Manufacturer's Field Services: Manufacturer's Field Service Representative shall make periodic site visits for installation consultation and inspection as requested by Owner.

3.05 CLEANING

- A. Remove protective coverings from adjacent work.

B. Cleaning Veneer Units:

1. Wash with soft bristle brush and water/granulated detergent solution.
2. Rinse immediately with clean water.

C. Removing Efflorescence:

1. Allow veneer to dry thoroughly.
2. Scrub with soft bristle brush and clean water.
3. Rinse immediately with clean water; allow to dry.
4. If efflorescence is still visible, repeat above procedure using a solution of 1 part household vinegar and 5 parts water.
5. Rinse immediately with clean water.

END OF SECTION.

SECTION 05 41 00 — LIGHT GAGE METAL FRAMING SYSTEMS AND GYPSUM SHEATHING

PART 1 - GENERAL

1.1 COORDINATION

- A. The General Conditions of the Contract for Construction and the Supplementary Conditions to the General Conditions of the Contract for Construction shall be considered as part of this section of the specifications.
- B. Each Bidder shall be responsible for determining during the bidding period the extent that any addenda issued during the bidding period may affect this section of the specifications.
- C. Reference Instructions to Bidders for requirements regarding substitutions of materials and products.
- D. Where conflicts occur between the drawings and specifications, between different drawings, between different portions of this section of the specifications, or between different sections of the specifications, the more stringent requirements and the greater quantity shall apply.

1.2 WORK INCLUDED

- A. Furnish and install exterior metal stud framing as shown on the drawings and specified herein.
- B. Furnish and install water resistant gypsum board sheathing at exterior face of exterior metal studs.

1.3 RELATED WORK SPECIFIED ELSEWHERE

- A. Masonry.
- B. Interior drywall systems.
- C. Wall Insulation.
- D. Dampproofing and Waterproofing.
- E. Exterior plaster (stucco).

1.4 SUBMITTALS

- A. Submit manufacturer's product data describing all materials.
- B. Submit manufacturer's certification of structural properties, only for products to be used in the project.

1.5 WARRANTY

- A. Provide written warranty against defects in materials and workmanship for the work under this section for a period of one year after the date of Substantial Completion of the project.

1.6 DELIVERY, STORAGE AND HANDLING

- A. All materials shall be delivered in manufacturer's original packaging and stored flat in a covered, dry area providing protection from damage and exposure to the elements.
- B. Damaged or deteriorated materials shall be removed from the premises.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. STUDS AND FRAMING: Unimast, Clark Dietrich, Maverick Steel Co., Dale Industries, Delta Metals, Bostwick, American Studco Inc.
- B. GYPSUM BOARD SHEATHING: United States Gypsum Co., National Gypsum Co., Domtar Gypsum, Inc. Georgia Pacific, Temple Inland.

2.2 MATERIALS

- A. STRUCTURAL STUDS AND RUNNERS: Galvanized "Cee" studs in sizes and gauges as indicated in the drawings. Unless otherwise indicated in the drawings, minimum gauge shall be 16 gauge and the following structural properties shall apply:

SIZE	ABOUT MAJOR AXIS X-X			ABOUT MINOR AXIS Y-Y		
	lx	Sx	rx	ly	Sy	ry
3-5/8"	.906	.500	1.430	.139	.142	.614
4"	1.145	.572	1.566	.147	.143	.615
6"	3.016	1.005	2.262	.180	.149	.595
8"	6.071	1.518	2.923	.201	.152	.565

- B. SHEATHING FASTENERS: Unimast self-drilling screw fasteners (bugle head).
- C. SHEATHING: Fire resistant gypsum board with treated water resistant gypsum core surfaced with water repellant paper both faces -1/2" x 4' x 8' with tongue and groove joint design at long edges. Meet requirements of ASTM C-79. Provide 5/8" thick rated X core where specifically indicated on the drawings.
- D. All metal studs, track, and bridging shall be formed from ASTM A-446 commercial grade steel having a minimum yield of 33,000 psi for 18 gauge and lighter members and 50,000 psi for 16 gauge and heavier members.
- E. All framing components shall be galvanized. Tracks, runners, bridging and bracing shall match grade and gauge of studs.

PART 3 - EXECUTION

3.1 GENERAL

- A. Install studs plumb and in plane, without twist. System installation shall be in accordance with AISI Design Manual for "Light Gauge Cold Formed Steel".
- B. All framing components shall be cut tight against abutting members. Members shall be held firmly in position until properly fastened.
- C. All attachments of axial loaded framing components shall be welded in accordance with the American Welding Society's "Recommended Practices for Resistance Welding" and shall transfer the imposed load into the adjoining member. Use no splices in axial loaded members.
- D. Attachments of framing components not subject to axial loads may be welded or screw fastened.
- E. Members shall be braced as required to resist all wind loads and construction loading for which the system has been designed. System shall be braced as erected and shall not be left overnight without adequate bracing.
- F. Framing components used to frame openings shall be of a size and type to transfer any load imposed on the opening into the members adjacent to the opening. Additional framing shall be provided adjacent to the opening to carry the load imposed.
- G. Welds in galvanized material shall be coated with "ZRC" cold galvanizing after wire brushing.

3.2 ERECTION

- A. TRACK FASTENING: Secure metal floor track to concrete floor slab with Type "A" or "B" fasteners spaced as scheduled in the table below. For determining unbraced wall height, ceiling does not qualify as bracing.
 - 1. Type "A" fastener – minimum 5/32" diameter x 1-1/4" long powder actuated fasteners. Hilti #DS32P10 or Ramset #2335.
 - 2. Type "B" fastener – minimum 1/4" diameter x 2" long drilled sleeve anchor. Hilti sleeve anchor or Ramset "Thunder Nail".
 - 3. Demonstrate to the Architect that fasteners can be driven full length into concrete slab tight to stud track.
 - 4. Use similar fasteners (and spacing) suitable for steel at overhead track or weld track to overhead steel at 12" o.c.
 - 5. At track splices use anchored channel inserts or fully weld.

Spacing Schedule for Type A & B Fasteners

MAX. SPACING OF FASTENERS	*MAX. UNBRACED WALL HEIGHT	
	TYPE A	TYPE B
24"	7.4 FT.	8.3 FT.
16"	11.1 FT.	12.4 FT.
12"	14.8 FT.	16.5 FT.
8"	24.9 FT.	24.9 FT.
6"	29.7 FT.	33.2 FT.

*NOTE: Ceiling at wall does not reduce unbraced wall height.

- B. **STUD FASTENING:** Each stud shall be fastened to top and bottom track (prior to gypsum board sheathing or interior wall finish) using one of the following two methods:
 - 1. **Screw fastening:** One self-drilling screw at the front and back faces of the top and bottom tracks for each stud (4 fasteners per stud.)
 - 2. **Welding:** One weld at the front face of the top and bottom tracks for each stud (2 welds per stud).
 - 3. **Additional:** The above minimum fasteners are required regardless of any additional bracing or intermediate fastening which may be indicated in the drawings or required.

- C. **BRIDGING:** Provide bridging at all exterior stud walls whether or not indicated in the drawings. Unless more stringent requirements are indicated in the drawings provide the following:
 - 1. **Wind loading resistance only:** Provide multiple bridging rows spaced 5'-0" o.c. vertically maximum.
 - 2. **Axial loaded members:** For stud lengths less than 10 feet, provide 2 rows of bridging at third points. For stud lengths 10 feet and greater, provide multiple bridging rows spaced 42" o.c. vertically maximum.

- D. **SHEATHING INSTALLATION:** Apply sheathing panels horizontally with the "v" edge turned up. Install with joints and penetrations tight and neatly fit. Stagger end joints over studs with screws spaced at maximum 12" centers at each stud and at 12" o.c. along top and bottom runners.

END OF SECTION

SECTION 06 10 00 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 COORDINATION

- A. The General Conditions of the Contract for Construction and the Supplementary Conditions to the General Conditions of the Contract for Construction shall be considered as part of this section of the specifications.
- B. Each Bidder shall be responsible for determining during the bidding period the extent that any addenda issued during the bidding period may affect this section of the specifications.
- C. Reference Instructions to Bidders for requirements regarding substitutions of materials and products.
- D. Where conflicts occur between the drawings and specifications, between different drawings, between different portions of this section of the specifications, or between different sections of the specifications, the more stringent requirements and the greater quantity shall apply.

1.2 WORK INCLUDED

- A. Provide and install all rough carpentry, formwork, wood framing, blocking, wood furring, hardboard and related fasteners as indicated in the drawings or as required to complete the indicated construction.
- B. Install all related hardware and fasteners. Provide and install wood furring and/or trim for acoustical panels.

1.3 RELATED WORK SPECIFIED IN OTHER SECTIONS

- A. Cast-in place concrete
- B. Painting
- C. Finish hardware

1.4 SECTION REQUIREMENTS

- A. Submittals manufacturer's printed literature describing wood preservatives treatment system and certifying that system meets all current requirements for applicable Federal, State and local governing agencies.
- B. Submittals manufacturer's printed literature describing fire retardant treatment system, any structural or usage limitations, and certifying that system meets all current requirements for applicable Federal, State and local governing agencies.

1.5 WARRANTY

- A. Provide written warranty against defects in materials and workmanship for the work under this section for a period of one year after the date of Substantial Completion of the project.

1.6 DELIVERY AND STORAGE

- A. Deliver and store lumber, plywood and hardwood on sills and cover for protection.

1.7 QUALITY ASSURANCE

- A. All lumber and plywood shall be grade marked by Southern Pine Inspection Bureau, West Coast Lumber Inspection Bureau, American Plywood Association, or Western Wood Products Association.
- B. All lumber and plywood shall be marked with producing manufacturer's trademark.
- C. Certificate of inspection issued by grading association for bundled lumber and plywood may substitute for individual piece marking.

PART 2 - PRODUCTS

2.1 LUMBER, GENERAL

- A. Dressed lumber, S4S, 15 percent maximum moisture content for 2-inch (38-mm) thickness or less, marked with grade stamp of inspection agency.

2.2 TREATED MATERIALS

- A. Preservative-Treated Materials: AWPAC2 lumber and AWPAC9 plywood, labeled by an inspection agency approved by ALSC's Board of Review. After treatment, kiln-dry lumber and plywood to 19 and 15 percent moisture content, respectively. Treat indicated items and the following:
 - 1. Wood members in connection with roofing, flashing, vapor barriers, and waterproofing.
 - 2. Concealed members in contact with masonry or concrete.
 - 3. Wood framing members less than 18 inches (460 mm) above grade.
 - 4. Wood floor plates installed over concrete slabs directly in contact with earth.
- B. Fire-Retardant-Treated Materials: AWPAC20 lumber and AWPAC27 plywood, interior Type A treatment, labeled by a testing and inspecting agency acceptable to authorities having jurisdiction.
 - 1. Use treated lumber and plywood with bending strength, stiffness, and fastener-holding capacities that are not reduced below values published by manufacturer of chemical formulation under elevated temperature and humidity conditions.

2.3 LUMBER

- A. Miscellaneous Lumber: No. 3 or Standard grade of any species for nailers, blocking, and similar members as indicated on drawings.

2.4 MISCELLANEOUS PRODUCTS

- A. Fasteners: Size and type indicated. Where rough carpentry is exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners with a hot-dip zinc coating per ASTM A 153 or of Type 304 stainless steel.

1. Power-Driven Fasteners: CABO NER-272.
 2. Bolts: Steel bolts complying with ASTM A 307, Grade A (ASTM F 568, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers.
- B. Metal Framing Anchors: Hot-dip galvanized steel of structural capacity, type, and size indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. COORDINATION: Coordinate work with other trades and provide cutting and patching required to accommodate the work. Verify all dimensions by taking field measurements to ensure proper fit. Accurately cut framing and blocking, and fit true to line and level, avoiding shims and wedges.
- B. Fit rough carpentry to other construction; scribe and cope for accurate fit. Correlate location of furring, blocking, and similar supports to allow attachment of other construction.
- C. ANCHORING AND FASTENTING: Use largest practicable fasteners for each type of work. Bolt nailers and blocking to steel, masonry or concrete members using bolts of proportionate strength to members attached. Unless otherwise noted in the drawings use $\frac{3}{4}$ " diameter bolts at maximum 4'-0" centers. Use concealed fasteners in finish work, set nails and use flathead countersunk screws.
- D. WOOD BLOCKING: Install fire-retardant tread wood blocking between metal studs where wall-supported drinking fountains, casework, railings, and other equipment is attached. Install between studs for toilet partitions systems and toilet accessories where anchored to wall. Use minimum 2 x 4 dimension where not indicated otherwise in the drawings.

END OF SECTION

SECTION 06 40 23 - INTERIOR ARCHITECTURAL WOODWORK

PART 1- GENERAL

1.0 COORDINATION

- A. The General Conditions of the Contract for Construction and the Supplementary Conditions to the General Conditions of the Contract for Construction shall be considered as part of this section of the specifications.
- B. Each Bidder shall be responsible for determining during the bidding period the extent that any addenda issued during the bidding period may affect this section of the specifications.
- C. Reference Instructions to Bidders for requirements regarding substitutions of materials and products.
- D. Where conflicts occur between the drawings and specifications, between different drawings, between different portions of this section of the specifications, or between different sections of the specifications, the more stringent requirements and the greater quantity shall apply.

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Interior standing and running trim and rails.
 - 2. Wood cabinets (casework).
 - 3. Laminate clad cabinets (plastic-covered casework).
 - 4. Cabinet tops (countertops) and plastic-covered chair rails.
 - 5. Flush wood paneling.
 - 6. Interior door frames (jambs).
- B. Related Sections: The following sections contain requirements that relate to this section:
 - 1. Division 6 Section 'Rough Carpentry' for furring, blocking, and other carpentry work that is not exposed to view.
 - 2. Division 6 Section 'Finish Carpentry' for carpentry exposed to view that is not specified in this section.
 - 3. Division 6 Section 'Exterior Architectural Woodwork' for exterior woodwork.
 - 4. Division 8 Section "Flush Wood Doors" for doors specified by reference to architectural woodwork standards.
 - 5. Division 9 Section "Painting" for final finishing of installed painted finish architectural woodwork.

1.03 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
- B. Product data for each type of product and process specified in this section and incorporated into items of architectural woodwork during fabrication, finishing, and installation.

- C. Fire-retardant treatment data for material impregnated by pressure process to reduce combustibility. Include certification by treating plant that treated materials comply with requirements.
- D. Shop drawings showing location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
- E. Samples for initial selection purposes of the following in form of manufacturer's color charts consisting of actual units or sections of units showing full range of colors, textures, and patterns available for each type of material indicated.
 - 1. Plastic laminate (standard and premium selections).
- F. Samples for verification purposes of the following:
 - 1. Lumber with or for transparent finish, 50 square inches, for each species and cut, finished on one side and one edge.
 - 2. Veneer leaves representative of and selected from flitches to be used for transparent finished woodwork.
 - 3. Wood veneer faced panel products;, with or for transparent finish, 8-1/2 inches by 11 inches, for each species and cut with one half of exposed surface finished, with separate samples of unfaced panel product used for core.
 - 4. Lumber and panel products with factory-applied opaque finish, 8- 1/2 inches by 11 inches for panels and 50 square inches for lumber, for each finish system and color, with one half of exposed surface finished.
 - 5. Laminate clad panel products, 8-1/2 inches, by 11 inches for each type, color, pattern, and surface finish, with separate samples of unfaced panel product used for core.
 - 6. Corner pieces as follows:
 - a. Cabinet front frame joints between stiles and rail as well as exposed end pieces, 18 inches high by 18 inches wide by 6 inches deep.
 - b. Miter joints for standing trim.
 - 7. Exposed cabinet hardware, one unit of each type and finish.
- G. Product certificates signed by woodwork manufacturer certifying that products comply with specified requirements.
- H. Qualification data for firms and persons specified in "Quality Assurance" article to demonstrate their capabilities and experience. Include list of completed projects with project names, addresses, names of Architects and Owners, and other information specified.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Firm experienced in successfully producing architectural woodwork similar to that indicated for this Project, with sufficient production capacity to produce required units without causing delay in the Work.
- B. Single-Source Responsibility: Arrange for production by a single firm of architectural woodwork with sequence matched wood veneers.
 - 1. Include the veneering of wood doors in the single-firm production, where veneer matching extends across wood doors.
- C. Single-Source Manufacturing and Installation Responsibility: Engage a qualified Manufacturer to assume undivided responsibility for woodwork specified in this section, including fabrication, finishing, and installation.

- D. Installer Qualifications: Arrange for installation of architectural woodwork by a firm that can demonstrate successful experience in installing architectural woodwork items similar in type and quality to those required for this project.
- E. AWI Quality Standard Comply with applicable requirements of “Architectural Woodwork Quality Standards” published by the Architectural Woodwork Institute (AWI) except as otherwise indicated.
- F. Hardware Coordination Distribute copies of approved schedule for cabinet hardware specified in Division 8 Section “Door Hardware” to manufacturer of architectural woodwork; coordinate cabinet shop drawings and fabrication with hardware requirements.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Protect woodwork during transit, delivery, storage, and handling to prevent damage, soilage, and deterioration.
- B. Do not deliver woodwork until painting, wet work, grinding, and similar operations that could damage, soil, or deteriorate woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas whose environmental conditions meet requirements specified in ‘Project Conditions.’

1.06 PROJECT CONDITIONS

- A. Environments¹ Conditions: Obtain and comply with Woodwork Manufacturer’s and Installer’s coordinated advice for optimum temperature and humidity conditions for woodwork during its storage and installation. Do not install woodwork until these conditions have been attained and stabilized so that woodwork is within plus or minus 1.0 percent of optimum moisture content from date of installation through remainder of construction period.
- B. Field Measurements: Where woodwork is indicated to be fitted to other construction, check actual dimensions of other construction by accurate field measurements before manufacturing woodwork; show recorded measurements on final shop drawings. Coordinate manufacturing schedule with construction progress to avoid delay of Work.
 - 1. Where field measurements cannot be made without delaying the Work, guarantee dimensions and proceed with manufacture of woodwork without field measurements. Coordinate other construction to ensure that actual dimensions correspond to guaranteed dimensions.

PART 2- PRODUCTS

2.01 HIGH PRESSURE DECORATIVE LAMINATE MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering high pressure decorative laminates (standard and premium selections) which may be incorporated in the work include:
 - 1. Formica Corp.
 - 2. Nevamar Corp.
 - 3. WilsonArt

2.02 MATERIALS

- A. General: Provide materials that comply with requirements of the AWI woodworking standard for each type of woodwork and quality grade indicated and, where the following products are part of

- woodwork, with requirements of the referenced product standards, that apply to product characteristics indicated:
1. Hardboard ANSI/AHA A135.4
 2. High Pressure Laminate: NEMA LD 3.
 3. Medium Density Fiberboard: ANSI A208.2.
 4. Particleboard ANSI A208.1
 5. Softwood Plywood PS 1.
- B. Formaldehyde Emission Levels: Comply with formaldehyde emission requirements of each voluntary standard referenced below:
1. Particleboard: NPA 8.
 2. Medium Density Fiberboard: NPA 9.
 3. Hardwood Plywood: HPMA FE.
- C. Fire-Retardant Particleboard: Where indicated, provide panels complying with the following requirements that have fire-retardant chemicals bonded to softwood particles at time of panel manufacture to achieve products identical to those tested for flame spread of 20 or less and for smoke developed of 25 or less per ASTM B 84 by UL or other testing and inspecting organization acceptable to authorities having jurisdiction. Identify products with appropriate markings of applicable testing and inspecting organization.
1. For 45-lb-density panels and thicknesses of 3/4 inch and less, comply with ANSI A208.1 for Grade 1-M-1 except that minimums for modulus of elasticity and screw-holding capacity on face and edge shall be 300,000 psi, 250 lb, and 225 lb, respectively.
 2. For 44-lb-density panels and thicknesses of 13/16 inch to 1-1/4 inch, comply with ANSI A208.1 for Grade 1-M-1 except that minimums for modulus of rupture, modulus of elasticity, internal bond, linear expansion, and screw-holding capacity on face and edge shall be 1300 psi, 250,000 psi, 60 psi, 0.50 percent, 250 lb, and 175 lb, respectively.
 3. Product: Subject to compliance with requirements, provide "Duraflake FR" by Duraflake Div.; Willamette Industries, Inc.

2.03 FABRICATION, GENERAL

- A. Wood Moisture Content: Comply with requirements of referenced quality standard for moisture content of lumber in relation to relative humidity conditions existing during time of fabrication and in installation areas.
- B. Fabricate woodwork to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:
1. Corners of cabinets and edges of solid wood (lumber) members less than 1 inch in nominal thickness: 1/16 inch.
 2. Edges of rails and similar members more than 1 inch in nominal thickness: 1/8 inch.
- C. Complete fabrication, including assembly, finishing, and hardware application, before shipment to project site to minimum extent possible. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
- D. Factory-cut openings, to maximum extent possible, to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Smooth edges of cutouts and, where located in countertops and similar exposures, seal edges of cutouts with a water-resistant coating.

2.04 FIRE-RETARDANT-TREATED LUMBER

- A. General: Where indicated, pressure impregnate lumber with fire-retardant chemicals of formulation indicated to produce materials with fire performance characteristics specified.
- B. Fire-Retardant Chemicals: Use chemical formulations specified that do not bleed through or otherwise adversely affect finishes. Do not use colorants in solution to distinguish treated lumber from untreated lumber.
 - 1. Organic Resin-Based Formulation: Exterior type per AWWA C20 consisting of organic-resin solution, relatively insoluble in water, thermally set in wood by kiln drying.
 - 2. Low-Hygroscopic Formulation: Interior Type A per AWWA C20.
- C. Fire Performance Characteristics: Provide materials identical to those tested for the following fire performance characteristics per ASTM test methods indicated by UL or other testing and inspecting organizations acceptable to authorities having jurisdiction. Identify treated lumber with classification marking of inspecting and testing organization in the form of separable paper label or, where required by authorities having jurisdiction, of imprint on lumber surfaces that will be concealed from view after installation.
 - 1. Surface Burning Characteristics: Not exceeding values indicated below, tested per ASTM E 84 for 30 minutes with no evidence of significant combustion.
 - a. Flame Spread: 25.
 - b. Smoke Developed: 50.
- D. Mill lumber after treatment, within limits set for wood removal that does not affect listed fire performance characteristics, using a woodworking plant certified by testing and inspecting organization.
- E. Mill lumber before treatment and implement special procedures during treatment and drying processes that are needed to prevent lumber from warping and developing discolorations from drying sticks or other causes, marring, and other defects affecting appearance of treated woodwork.
- F. Kiln-dry woodwork after treatment to levels required for untreated woodwork. Maintain moisture content required by kiln drying before and after treatment.
- G. Discard treated lumber that does not comply with requirements of referenced woodworking standard. Do not use twisted, warped, bowed, discolored, or otherwise damaged or defective lumber.
- H. Products: Subject to compliance with requirements, provide one of the following:
 - 1. Low-Hygroscopic Formulation (Type A):
 - a. "Flameproof LHC"; Osmose Wood Preserving, Inc.
 - b. "Dricon"; Hickson Corporation.

2.05 STANDING AND RUNNING TRIM AND RAILS FOR TRANSPARENT FINISH

- A. Quality Standard: Comply with AWI Section 300.
- B. Backout or groove backs of flat trim members and kerf backs of other wide flat members, except for members with ends exposed in finished work.
- C. Assemble casings in plant except where limitations of access to place of installation require field assembly.

- D. Grade: Premium.
- E. Lumber Species: Birdseye Maple, half round.

2.06 STANDING AND RUNNING TRIM AND RAILS FOR OPAQUE FINISH

- A. Quality Standard: Comply with AWI Section 300.
- B. Grade: Premium.
- C. Backout or groove backs of flat trim members and kerf backs of other wide flat members, except for members with ends exposed in finished work.
- D. Assemble casing in plant except where limitations of access to place of installation require field assembly.
- E. Lumber Species: Any dosed-grain hardwood listed in referenced woodworking standard.

2.07 WOOD CABINETS (CASEWORK) FOR TRANSPARENT FINISH

- A. Quality Standard: Comply with AWI Section 400 and its Division 400A Wood Cabinets.”
- B. Grade: Premium.
- C. AWI Type of Cabinet Construction: Flush overlay.
- D. Wood Species for Exposed Surfaces: Maple, rotary cut veneer.
 - 1. Grain Matching: Run and match grain vertically for drawer fronts, doors, and fixed panels.
 - 2. Matching of Veneer Leaves: Slip match.
 - 3. Veneer Matching Within Panel Face: Balance match.
- E. Wood Species for Semiexposed Surfaces: Match species and cut indicated for exposed surfaces.

2.08 LAMINATE CLAD CABINETS (PLASTLC.COVERED CASEWORK)

- A. Quality Standard. Comply with AWI Section 400 and its Division 400B ‘Laminate Clad Cabinets.’”
- B. Grade: Premium.
- C. AWI Type of Cabinet Construction: Flush overlay, unless otherwise indicated.
- D. Laminate Cladding High pressure decorative laminate complying with the following requirements:
 - 1. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
 - a. Provide selections made by Architect from laminate manufacturer’s full range of standard and premium colors and finishes in the following categories:
 - (1) Solid colors.
 - (2) Patterns.
 - 2. Laminate Grade for Exposed Surfaces: Provide laminate cladding complying with the following requirements for type of surface and grade.

- a. Horizontal Surfaces Other Than Tops: GP-50 (0.050-inch nominal thickness).
 - b. Vertical Surfaces: GP-50 (0.050-inch nominal thickness).
 - c. Edges: GP-50 (0.050-inch nominal thickness).
3. Semiexposed Surfaces: Provide surface materials indicated below:
 - a. High pressure laminate, GP-28.

2.09 CABINET HARDWARE AND ACCESSORY MATERIAL.8

- A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets, except for items specified in Division 8 Section 'Door Hardware.'
- B. Cabinet Hardware and Miscellaneous Item Schedule:
 1. Adjustable Shelf Standard.
 - a. Manufacturer/Model No.: Knape & Vogt/No. 255.
 - b. Size/Type: 5/8" wide x 3/16" deep, recessed.
 - c. Finish: Bright zinc plate.
 - d. Remarks: 1/2" vertical adjustment.
 2. Adjustable Shelf Support:
 - a. Manufacturer/Model No.: Knape & Vogt/No. 256.
 - b. Finish: Bright zinc plate.
 - c. Remarks: For use with No. 255 standard.
 3. Slotted Shelf Standard:
 - a. Manufacturer/Model No.: Knape & Vogt/No. 51.
 - b. Size/Type: 3/4" x 3/8" x length shown, surface mount, heavy duty.
 - c. Finish: Bright nickel plate.
 - d. Remarks: 1-5/8" vertical adjustment.
 4. Adjustable Shelf Bracket:
 - a. Manufacturer/Model No.: Knape & Vogt/No. 52.
 - b. Size/Type: 1 1/2" wide x shelf depth.
 - c. Finish: Bright nickel plate.
 - d. Remarks: For use with No. 51 standard.
 5. Drawer Slide: (Typical)
 - a. Manufacturer/Model No.: Grant/No. 329.
 - b. Size/Type: Full extension, length to suit drawer.
 - c. Finish: Zinc plate.
 - d. Remarks: 100 lb. rating.
 6. Drawer Slide: (To 4-1/2" drawer depth)
 - a. Manufacturer/Model No.: Grant/No. 328.
 - b. Size/Type: Full extension, length to suit drawer.
 - c. Finish: Zinc plate.
 - d. Remarks: 50 lb. rating.

7. Knobs (at Suites Level):
 - a. Forms + Surfaces Model No. HC430 Series, sizes as selected by Architect from manufacturers standards.
 - b. Finish: Anodized black matte.
 8. Wire Pulls:
 - a. Manufacturer/Model No.: Stanley/No. 4483112
 - b. Size/Type: 3-1/2" center wire pulls.
 - c. Finish: US 28D.
 9. Concealed Hinges:
 - a. Manufacturer/Model No.: Stanley/No. 1510.
 10. Continuous Hinges:
 - a. Manufacturer/Model No.: Stanley/No. STS311-1/4.
 - b. Size/Type: 1-1/2" wide x height of door.
 - c. Finish: US 32.
 - d. Remarks: Provide matching countersunk screws, 2" o.c., both sides.
 11. Door Catch (Magnetic type)
 - a. Manufacturer/Model No.: Stanley/No. SP4L
 - b. Size/Type: 2" x 1-1/4" case size.
 - c. Finish: Aluminum.
 - d. Remarks: One per leaf to 48", two per leaf to 84".
 12. Cabinet Lock
 - a. Manufacturer/Modal No.: National/No. C-8053.
 - b. Size/Type: Disc tumbler cam lock.
 - c. Finish: US 26D or US 32D.
 - d. Remarks: Furnish two keys per lock; keyed to Building Standard.
 13. Sliding Glass Door Locks: K&V 965NP, keyed to building system.
 14. Track, Upper Guide & Sheaves: Stylmark Model No. 810005 Assembly, 204-Ri clear anodized finish.
- C. Hardware Standard Comply with ANSI/BEMA A156.9 "American National Standard for Cabinet Hardware" for items indicated by reference to BIIMA numbers or referenced to this standard.
- D. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with ANSI/BHMA A156.18 for BHMA code number indicated.
1. Dark Oxidized Satin Bronze, Oil Rubbed, on Bronze Base: BHMA 613 and matching Architect's sample.
 2. Satin Chromium Plated, Brass or Bronze Base: BHMA 626.
 3. Satin Chromium Plated, Steel Base: BHMA 652.
 4. Satin Stainless Steel, Stainless Steel Base: BHMA 630.
- E. For concealed hardware provide manufacturer's standard finish that complies with product class requirements of ANSJ/BHMA A156.9.

- F. Clear Tempered Float Glass for Shelves: ASTM C 1048, Condition A, style I, type I, quality q3, class 1, seamed at edges before tempering, 1/4-inch thick unless otherwise indicated.

2.10 ARCHITECTURAL CABINET TOPS (COUNTERTOPS) AND CHAIR RAILS:

- A. Quality Standard: Comply with AWI Section 400 and its Division 400C.
- B. Type of Top and Chair Rail: High pressure decorative laminate complying with the following:
 - 1. Grade: Custom.
 - 2. Laminate Cladding for Horizontal Surface: High pressure decorative laminate as follows:
 - a. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
 - (1) Provide selections made by Architect from manufacturer's full range of standard and premium colors and finishes in the following categories:
 - (a) Solid colors.
 - (b) Patterns.
 - b. Grade: GP-50 (0.050-inch nominal thickness).
 - c. Edge Treatments:
 - (1) Plastic Laminate Edge Treatment: Same as laminate cladding on horizontal surfaces.
 - (2) Wood Edge Treatment: Lumber edge for transparent finish, with matching wood species and cut to be determined.

2.11 FLUSH WOOD PANELING FOR TRANSPARENT FINISH

- A. Quality Standard: Comply with AWI Section 500 and its Division 500A.
- B. Grade: Premium.
- C. Veneer Species: Birdseye Maple half round.
- D. Matching of Adjacent Veneer Leaves: Slip match.
- E. Veneer Matching Within Panel Face: Best match.
- F. Fire Performance Characteristics: Provide paneling composed of panels of wood veneer density and fire-retardant particleboard that are identical in construction to units tested for the following surface burning characteristics per ASTM E 84 by UL or other testing and inspecting organization acceptable to authorities having jurisdiction. Identify panels with appropriate markings of applicable testing and inspecting organization on surfaces that will be concealed from view after installation.
 - 1. Flame Spread: 75 or less.
 - 2. Smoke Developed: 40 or less.

2.12 INTERIOR DOOR FRAMES FOR TRANSPARENT FINISH

- A. Quality Standard: Comply with AWI Section 900B.
- B. Grade: Premium.

- C. Lumber Species: Maple, rotary cut veneer.

2.13 CLOSET AND UTILITY SHELVING:

- A. Quality Standard: Comply with AWI Section 600.
- B. Shelving for Painted Finish (By Section 09 91 00): Comply with the following requirements:
 - 1. Grade: Economy.
 - 2. Shelving Material: Maple faced veneer core plywood.
 - 3. Lumber: Ponderosa Pine or Poplar.

2.14 FASTENERS AND ANCHORS

- A. Screws: Select material, type, size, and finish required for each use. Comply with FS FF-S-111 for applicable requirements.
 - 1. For metal framing supports, provide screws as recommended by metal framing manufacturer.
- B. Nails: Select material, type, size, and finish required for each use. Comply with FS FF-N-105 for applicable requirements.
- C. Anchors: Select material, type, size, and finish required by each substrate for secure anchorage. Provide nonferrous metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed steel or lead expansion bolt devices for drilled-in-place anchors. Furnish inserts and anchors, as required, to be set into concrete or masonry work for subsequent woodwork anchorage.

2.15 FACTORY FINISHING OF INTERIOR ARCHITECTURAL WOODWORK

- A. Quality Standard: Comply with AWI Section 1500 unless otherwise indicated.
- B. General: The entire finish of interior architectural woodwork is specified in this section, regardless of whether factory applied or applied after installation.
 - 1. Factory Finishing: To the greatest extent possible, finish architectural woodwork at factory. Defer only final touch-up, cleaning, and polishing until after installation. Painted finish by Section 09 91 00 except prime coat.
- C. Preparations for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces and similar preparations for finishing of architectural woodwork, as applicable to each unit of work.
- D. Transparent Finish for Closed-Grain Woods: Comply with requirements indicated below for grade, finish system, staining, effect, and sheen.
 - 1. Grade: Premium.
 - 2. AWI Finish System #5: Catalyzed polyurethane.
 - 3. Staining for Cherry Only: Match approved sample for color.
 - 4. Effect: Open grain (not filled).
 - 5. Sheen: Dull satin 15-20 deg.
- E. Opaque Finish: Comply with requirements indicated below for grade, finish system, color, effect, and sheen:
 - 1. Grade: Premium.

2. AWI Finish System #11: Catalyzed polyurethane.
3. Color: Match Architect's sample.
4. Sheen: Medium-gloss rubbed effect 35-45 deg.

2.16 MISCELLANEOUS ACCESSORIES

- A. Steel Countertop Support Bracket: provide prefinished steel bracket supports at locations as shown on drawings. Brackets shall be by A&M Hardware (888) 647-0200 info@aandmhardware.com Other equal products may be provided if and as specifically approved by Architect by substitution request during bidding period.

PART 3- EXECUTION

3.01 PREPARATION

- A. Condition woodwork to average prevailing humidity conditions in installation areas before installing.
- B. Deliver concrete inserts and similar anchoring devices to be built into substrates well in advance of time substrates are to be built.
- C. Before installing architectural woodwork, examine shop-fabricated work for completion and complete work as required, including back priming and removal of packing.

3.02 INSTALLATION

- B. Quality Standard. Install woodwork to comply with AWI Section 1700 for same grade specified in Part 2 of this section for type of woodwork involved.
- C. Install woodwork plumb, level, true, and straight with no distortions. Shim as required with concealed shims. Install to a tolerance of 1/8 inch in 8'-0" for plumb and level (including tops) and with no variations in flushness of adjoining surfaces.
- D. Scribe and cut woodwork to fit adjoining work and refinish cut surfaces or repair damaged finish at cuts.
- E. Fire-Retardant-Treated Wood. Handle, store, and install fire- retardant-treated wood to comply with recommendations of chemical treatment manufacturer including those for adhesives where are used to install woodwork.
- F. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure to grounds, stripping and blocking with countersunk, concealed fasteners and blind nailing as required for a complete installation. Except where prefinished matching fastener heads are required, use fine finishing nails for exposed nailing, countersunk and filled flush with woodwork and matching final finish where transparent finish is indicated.
- G. Standing and Running Trim and Rails: Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to the greatest extent possible. Stagger joints in adjacent and related members. Cope at returns and miter at corners.
- H. Cabinets: Install without distortion so that doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete the installation of hardware and accessory items as indicated. Maintain veneer sequence matching (if any) of cabinets with transparent finish

- I. Tops: Anchor securely to base units and other support systems as indicated.
- J. Paneling: Anchor paneling to supporting substrate with concealed panel-hanger clips and by blind nailing on backup strips, splined-connection strips, and similar associated trim and framing. Do not face nail unless otherwise indicated.
- K. Complete the finishing work specified in this section to whatever extent not completed at shop or before installation of woodwork.
- L. Refer to the Division 9 sections for finishing of painted architectural woodwork.

3.03 ADJUSTMENT AND CLEANING

- A. Repair damaged and defective woodwork where possible to eliminate defects functionally and visually; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.
- B. Clean, lubricate, and adjust hardware.
- C. Clean woodwork on exposed and semiexposed surfaces. Touch up factory-applied finishes to restore damaged or soiled areas.

3.04 PROTECTION

- A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensures that woodwork is being without damage or deterioration at time of Substantial Completion.

END OF SECTION

SECTION 07 10 00 — DAMPPROOFING AND WATERPROOFING

PART 1 - GENERAL

1.1 COORDINATION

- A. The General Conditions of the Contract for Construction and the Supplementary Conditions to the General Conditions of the Contract for Construction shall be considered as part of this section of the specifications.
- B. Each Bidder shall be responsible for determining during the bidding period the extent that any addenda issued during the bidding period may affect this section of the specifications.
- C. Reference Instructions to Bidders for requirements regarding substitutions of materials and products.
- D. Where conflicts occur between the drawings and specifications, between different drawings, between different portions of this section of the specifications, or between different sections of the specifications, the more stringent requirements and the greater quantity shall apply.

1.2 WORK INCLUDED

- A. Provide and install below-grade waterproofing.
- B. Provide and apply dampproofing on weather side of inside wythe of all exterior masonry cavity walls.
- C. Provide and apply dampproofing and joint taping on weather side of gypsum board sheathing.
- D. Provide and install membrane waterproofing (flashing) at exterior walls at door and window openings, and as indicated in the drawings and specified herein.

1.3 RELATED WORK SPECIFIED IN OTHER SECTIONS

- A. Unit masonry.
- B. Gypsum sheathing.
- C. Flashing at roof.
- D. Plastic membrane under slab-on-grade.
- E. Waterstops.
- F. Metal thru-wall flashing.

1.4 SUBMITTALS

- A. Submit manufacturer's printed literature describing each material, restrictions, and manufacturer's recommended procedures. Submit samples of each material.

- B. Reference Section 01 33 00 SUBMITTALS for additional submittal requirements.

1.5 WARRANTY

- A. Provide written warranty against defects in materials and workmanship for the Work under this section for a period of one year after the date of Substantial Completion of the Project.

1.6 QUALITY ASSURANCE

- A. Waterproofing company shall have a minimum of 3 years experience in the dampproofing and waterproofing of building structures of similar size and scope as this project.
- B. Retain at the job site a properly calibrated gauge for use by the Architect to verify applied thickness of materials.

PART 2 - PRODUCTS

2.1 WALL MATERIALS

- A. MEMBRANE FLASHING: 40 mil thick polyethylene backed SBS modified bitumen self-adhering black membrane; "Protecto Flash" as manufactured by Protecto Wrap Co. or "Perm-A-Barrier" as manufactured by W.R. Grace and Co. or "Blueskin SA" as manufactured by Henry Company. Membrane shall comply with the following:
 - 1. Tensile Strength: ASTM D412; 1400 psi.
 - 2. Elongation: ASTM D412; 200% min.
 - 3. Water Absorption: ASTM D570; 0.1% max.
- B. DAMPPROOFING: Non-asbestos emulsion type coating No. 352 over No. 207 adhesive primer, as manufactured by Gulf States Asphalt or approved equivalent by Henry Company, Karnak, W.R. Meadows, Celotex, or Sonneborn. Comply with ASTM D1227, Type 1.
- C. SHEATHING TAPE: 4" wide glass fabric scrim complying with ASTM D1668 or 40 mil thick polyethylene backed SBS modified bitumen self-adhering tape as manufactured by Protecto Wrap Co. or equivalent by W.R. Grace and Co or Henry Company. Verify compatibility of tape with proposed dampproofing.

2.2 BELOW GRADE WATERPROOFING:

- A. WALLS: "Hydrocide Liquid Membrane 5000T", one part cold applied elastomeric, modified urethane. Trowel applied, non-sag, as manufactured by Sonneborn or approved equivalent by Toch Bros. or Tremco or Henry Company.
- B. SLABS: "Hydrocide Liquid Membrane, HLM 5000" Cold Applied Seamless Elastomeric, Modified Urethane for use between concrete seal slab and concrete slab-on-grade as manufactured by Sonneborn or approved equivalent by Toch Bros. or Tremco or Henry Company.
- C. PROTECTION BOARD: Water-resistant, semi-rigid panel composed of a core of asphalt and inorganic mineral filler particles, bottom reinforcing cover of asphalt-saturated felt and top cover of fiber glass mat weather-coated with a bond-breaking film, as manufactured by W.R. Meadows, Inc or Henry Company.

- D. WATERSTOPS: Reference concrete section.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Contractor shall inspect exterior face of all masonry cavity walls to ensure that all penetrations and joints are completely filled prior to dampproofing operations beginning.

3.2 MEMBRANE FLASHING

- A. Prime concrete and masonry surfaces scheduled to receive membrane flashing using flashing manufacturer's recommended primer to ensure good adhesion.
- B. WALL FLASHINGS: Shall be installed above all openings occurring in an exterior wall (doors & windows), at base of exterior wall, and at wall interruptions by columns, beams, slabs, spandrels and other locations as indicated in the drawings. Flashing shall extend to within 1" of outside face of wall, shall be continuous and shall extend through cavity and be turned up to the top first course above finish floor on face of inner wythe, and to extend 1" minimum into back up or inner wythe. End laps to be 9" and side laps 6".
- C. STEEL STRUCTURE: Cover all steel columns or beams in exterior walls not protected by dampproofed concrete block or sheathing. Cover steel completely with membrane flashing lap 6" on to masonry on each side of columns. Conform and adhere to steel shapes not fireproofed. Cover all protruding angles or miscellaneous steel.
- D. FRAMES: Install at exterior window and door frames and other locations as indicated in the drawings.
- E. SHEATHING: Wrap all corners of gypsum board sheathing. See drawings for other details.

3.3 SHEATHING TAPE: Use one of the following systems:

- A. Imbed and cover glass fabric scrim tape in dampproofing mastic at all joints, cracks and penetrations at gypsum board sheathing.
- B. Apply specified self-adhering tape continuously over all joints, cracks and penetrations prior to beginning dampproofing operations.

3.4 DAMPPROOFING

- A. Spray or brush apply dampproofing coating to weather side of all gypsum sheathing and primed concrete block back-up at exterior masonry cavity walls in accordance with the following:
1. Primer: Minimum ½ gallon material per 100 sq. ft. of wall surface.
 2. Coating: Minimum 2/32" (62.5mils) dry film thickness and minimum 5 gallons material per 100 sq. ft.
- B. Cover all corners and work thoroughly into all joints, cracks, or crevices. Finished coating shall be monolithic and free of pin holes or cracks. Seal cracks, voids and joints at dissimilar materials with glass fabric embedded in dampproofing coating.

- C. Seal around penetrations including all masonry anchors.
- D. Dampproofing shall be applied only when temperature is at 50 degrees F. and rising or above, and when no rain is forecast for the 24 hour period following application. No dampproofing shall be covered by masonry prior to observation by the Architect. All dampproofing shall dry for a minimum of 24 hours prior to being covered by finish masonry.

3.5 BELOW GRADE WATERPROOFING

A. LIQUID MEMBRANE:

1. Install liquid membrane systems at earth side of all below grade walls, between sub-slab ("mud-slab") and structural slab, and all outside surfaces of elevator pit. Allow concrete work to cure a minimum of 14 days. All surfaces shall be smooth, dry, sound and free of honeycombs. Concrete shall be free of curing and parting compounds, wax or other foreign materials.
2. Static joints or cracks less than 1/8" wide shall be sealed with "HLM" as manufactured by waterproofing manufacturer. Material shall fill and over-lap the edges of the joint to a width of 4" on both sides and shall have a minimum surface thickness of 55 (+5) mils.
3. Immediately prior to application of membrane, remove all dust and dirt by use of high-pressure air, by brushing with a soft broom or vacuum cleaning.
4. Apply material at a rate of 4 gallons per 100 square feet of surface to produce a membrane of 55 (+5) mil thick. Carefully control application to avoid runs and sags of fresh material.
5. Apply membrane to prestripped areas at cracks, joints, intersections, penetrations, etc., to provide a minimum total thickness of 110 mils over these areas. Mask any membrane edge exposed to view to provide a straight clean edge.
6. Before the membrane attains a final set, verify the applied thickness by use of a mil-thickness gauge. Where readings indicate a thickness less than specified, immediately apply additional membrane to produce required thickness.
7. Following the application of the membrane, place protection boards over the membrane waterproofing at walls receiving backfill. Use membrane material as required to adhere protection boards. Boards shall be firmly in place with joints closely butted and sealed with gusset tape before backfilling is started.
8. Protect membrane during construction. Any punctures or cuts in the membrane shall be patched and sealed in the manner described above for sealing joints in the sheeting.

END OF SECTION

SECTION 07 21 00 - BUILDING INSULATION

PART 1 - GENERAL

1.0 COORDINATION

- A. The General Conditions of the Contract for Construction and the Supplementary Conditions to the General Conditions of the Contract for Construction shall be considered as part of this section of the specifications.
- B. Each Bidder shall be responsible for determining during the bidding period the extent that any addenda issued during the bidding period may affect this section of the specifications.
- C. Reference Instructions to Bidders for requirements regarding substitutions of materials and products.
- D. Where conflicts occur between the drawings and specifications, between different drawings, between different portions of this section of the specifications, or between different sections of the specifications, the more stringent requirements and the greater quantity shall apply.

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Polyencapsulated Batt Insulation
 - 2. Chicken Wire
 - 3. Fiberglass roll or batt insulation
- B. Related Sections include the following:
 - 1. Section 09 21 16.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Verification: Full-size units for each type of exposed insulation indicated.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for insulation products.
- D. Research/Evaluation Reports: For foam-plastic insulation.

1.3 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of building insulation through one source.
- B. Fire-Test-Response Characteristics: Provide insulation and related materials with the fire-test-

response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.

1. Surface-Burning Characteristics: ASTM E 84.
2. Fire-Resistance Ratings: ASTM E 119.
3. Combustion Characteristics: ASTM E 136.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration by moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.
- B. Protect plastic insulation as follows:
 1. Do not expose to sunlight, except to extent necessary for period of installation and concealment.
 2. Protect against ignition at all times. Do not deliver plastic insulating materials to Project site before installation time.
 3. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATING MATERIALS

- A. General: Provide insulating materials that comply with requirements and with referenced standards.
 1. Preformed Units: Sizes to fit applications indicated; selected from manufacturer's standard thicknesses, widths, and lengths.
- B. Polyencapsulated Batt Insulation
 1. Johns Manville
 2. Owens Corning
 3. Certainteed

Encapsulated, Glass-Fiber Blanket Insulation: ASTM C 665, Type II (non-reflective faced), Class A (faced surface with a flame-spread index of 25 or less); Category 1 (membrane is a vapor barrier).

 1. Exterior Walls: R-19
- E. Batt or Roll Insulation:
 1. Johns Manville
 2. Owens Corning

3. Certainteed

General: Insulation shall be fine fiber, flexible, resilient glass fiber blanket. Moisture absorption shall be less than .2% by volume.

1. Interior Stud Walls: 3 5/8" x 16" wide x 96" sound attenuation batts "R" factor 11. Unfaced.
2. Interior Stud Walls: 6" x 16" wide x 96" sound attenuation batts "R" factor 11. Unfaced

AUXILIARY INSULATING MATERIALS

- A. Adhesive for Bonding Insulation: Product with demonstrated capability to bond insulation securely to substrates indicated without damaging insulation and substrates.
- B. Chicken Wire: Provide as support for encapsulated batt insulation attached to the metal building wall 'z' girts.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for Sections in which substrates and related work are specified and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. Review and insure chemical compatibility of cavity wall dampproofing membrane and cavity rigid insulation board prior to installation.

3.2 PREPARATION

- A. Clean substrates of substances harmful to insulations or vapor retarders, including removing projections capable of puncturing vapor retarders or of interfering with insulation attachment.
- B. Close off openings in cavities receiving poured-in-place insulation to prevent escape of insulation. Provide bronze or stainless steel screens (inside) where openings must be maintained for drainage or ventilation.

3.3 INSTALLATION, GENERAL

- A. Comply with insulation manufacturers written instructions applicable to products and application indicated.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed at any time to ice and snow.
- C. Extend insulation in thickness indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with

placement.

- D. Water-Piping Coordination: If water piping is located on inside of insulated exterior walls, coordinate location of piping to ensure that it is placed on warm side of insulation and insulation encapsulates piping.
- E. Apply single layer of insulation to produce thickness indicated, unless multiple layers are required to make up total thickness.

3.4 INSTALLATION OF POLYENCAPSULATED BATTS

- A. Encapsulated batts at vertical wall surfaces are to be attached with self tapping screws where attached at z girts. Batts at metal stud wall shall form fit to cavity.

3.5 INSTALLATION OF GENERAL BUILDING INSULATION

- A. Apply insulation units to substrates by method complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.
- B. Set vapor-retarder-faced units with vapor retarder to warm side of construction. Do not obstruct ventilation spaces, except for firestopping.
 - 1. Tape joints and ruptures in vapor retarder, and seal each continuous area of insulation to surrounding construction to ensure airtight installation.
- C. Apply spray foam insulation in strict compliance with insulation manufacturers' written recommendations by manufacturer approved applicator only. Do not apply insulation until installation of pipes, ducts, conduits, wiring, and electrical outlets in walls is completed and windows, electrical boxes, and other items not indicated to receive insulation are masked. After insulation is applied, make it even with studs by using method recommended by insulation manufacturer.

END OF SECTION

SECTION 07 26 16 - UNDER-SLAB VAPOR BARRIER

PART 1 – GENERAL

1.0 COORDINATION

- A. The General Conditions of the Contract for Construction and the Supplementary Conditions to the General Conditions of the Contract for Construction shall be considered as part of this section of the specifications.
- B. Each Bidder shall be responsible for determining during the bidding period the extent that any addenda issued during the bidding period may affect this section of the specifications.
- C. Reference Instructions to Bidders for requirements regarding substitutions of materials and products.
- D. Where conflicts occur between the drawings and specifications, between different drawings, between different portions of this section of the specifications, or between different sections of the specifications, the more stringent requirements and the greater quantity shall apply.

1.1 SUMMARY

- A. Products supplied under this section:
 - 1. Vapor barrier and installation accessories for installation under concrete slabs.
- B. Related sections:
 - 1. Section 03 30 00 Cast-in-Place Concrete
 - 2. Section 07 26 00 Vapor Retarders

1.2 REFERENCES

- A. American Society for Testing and Materials (ASTM):
 - 1. ASTM E1745- 11Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs.
 - 2. ASTM E1643- 11Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.
- B. Technical Reference - American Concrete Institute (ACI):
 - 1. ACI 302.2R-06 Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials.

1.3 SUBMITTALS

- A. Quality control/assurance:
 - 1. Summary of test results per paragraph 9.3 of ASTM E 1745.
 - 2. Manufacturer's samples and literature.
 - 3. Manufacturer's installation instructions for placement, seaming and penetration repair instructions.
 - 4. All mandatory ASTM E1745 testing must be performed on a single production roll per ASTM E1745 Section 8.1.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Vapor barrier shall have all of the following qualities:
 - 1. Maintain permeance of less than 0.01 Perms [grains/(ft² · hr · inHg)] as tested in accordance with mandatory conditioning tests per ASTM E1745 Section 7.1 (7.1.1-7.1.5).
 - 2. Other performance criteria:
 - a. Strength: ASTM E1745 Class A.
 - b. Thickness: 15 mils minimum
- B. Vapor barrier products:
 - 1. Basis of Design: Stego Wrap Vapor Barrier (15-mil) by Stego Industries LLC., (877) 464-7834 www.stegoindustries.com.
 - 2. Substitutions will be in accordance with Section 01 25 00.

2.2 ACCESSORIES

- A. Seams :
 - 1. Stego Tape by Stego Industries LLC, (877) 464-7834 www.stegoindustries.com.
- B. Penetrations of Vapor barrier:
 - 1. Stego Mastic by Stego Industries LLC, (877) 464-7834 www.stegoindustries.com.
 - 2. Stego Tape by Stego Industries LLC, (877) 464-7834 www.stegoindustries.com.
- C. Perimeter/edge seal:
 - 1. Stego Crete Claw by Stego Industries LLC, (887) 464-7834 www.stegoindustries.com.
 - 2. Stego Term Bar by Stego Industries LLC, (877) 464-7834 www.stegoindustries.com.
 - 3. StegoTack Tape (double sided) by Stego Industries LLC, (877) 464-7834 www.stegoindustries.com.

PART 3 – EXECUTION

3.1 PREPARATION

- A. Ensure that subsoil is approved by Architect or Geotechnical Engineer.
 - 1. Level and compact base material.

3.2 INSTALLATION

- A. Install vapor barrier in accordance ASTM E1643.
 - 1. Unroll vapor barrier with the longest dimension parallel with the direction of the concrete placement and face laps away from the expected direction of the placement whenever possible.
 - 2. Extend vapor barrier over footings and grade beams to a distance acceptable to the structural engineer or stop at impediments such as dowels and waterstops.
 - 3a. Seal vapor barrier to slab perimeter/edge using Stego Crete Claw and remove dirt, debris, and mud from Crete Claw prior to concrete placement.
OR
 - 3b. Seal vapor barrier to footing/grade beam with double sided tape, termination bar, or both.
 - 4. Overlap joints 6 inches and seal with manufacturer's tape.
 - 5. Apply tape/Crete Claw to a clean and dry vapor barrier.
 - 6. Seal all penetrations (including pipes) per manufacturer's instructions.

7. No penetration of the vapor barrier is allowed except for reinforcing steel and permanent utilities.
8. Repair damaged areas by cutting patches of vapor barrier, overlapping damaged area 6 inches and taping all sides with tape.

END OF SECTION

SECTION 07 41 13 - INSULATED METAL ROOF PANEL

PART 1 - GENERAL

1.1 COORDINATION

- A. The General Conditions of the Contract for Construction and the Supplementary Conditions to the General Conditions of the Contract for Construction shall be considered as part of this section of the specifications.
- B. Each Bidder shall be responsible for determining during the bidding period the extent that any addenda issued during the bidding period may affect this section of the specifications.
- C. Reference Instructions to Bidders for requirements regarding substitutions of materials and products.
- D. Where conflicts occur between the drawings and specifications, between different drawings, between different portions of this section of the specifications, or between different sections of the specifications, the more stringent requirements and the greater quantity shall apply.

1.2 SECTION INCLUDES

- A. Foamed-insulation-core standing seam metal roof panels, with related metal trim and accessories.

1.3 RELATED REQUIREMENTS

- A. Division 05 Section "Structural Steel Framing" for steel framing supporting metal panels.
- B. Division 05 Section "Cold-Formed Metal Framing" for cold-formed metal framing supporting metal panels.
- C. Division 07 Section "Metal Wall Panels" for factory-formed metal wall panels.
- D. Division 07 Section "Sheet Metal Flashing and Trim" for sheet metal copings, flashings, reglets, and roof drainage items in addition to items specified in this Section.
- E. Division 07 Section "[Joint Sealants](#)" for field-applied [Joint Sealants](#).
- F. Division 13 Section "Metal Building Systems" for steel framing supporting metal panels.

1.4 REFERENCES

- A. American Society of Civil Engineers (ASCE): www.asce.org/codes-standards:
 - 1. ASCE 7 - Minimum Design Loads for Buildings and Other Structures.
- B. ASTM International (ASTM): www.astm.org:
 - 1. ASTM A 653 - Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - 2. ASTM A 755 - Specification for Steel Sheet, Metallic Coated by the Hot-Dip Process and Prepainted by the Coil-Coating Process for Exterior Exposed Building Products.
 - 3. ASTM A 792 - Standard Specification for Steel Sheet, 55 % Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
 - 4. ASTM C 1363 - Standard Test Method for Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus
 - 5. ASTM D 1621 - Compressive Properties of Rigid Cellular Plastics.

6. ASTM D 1622 – Apparent Density of Rigid Cellular Plastics.
7. ASTM C 518 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
8. ASTM D 2244 - Test Method for Calculation of Color Differences from Instrumentally Measured Color Coordinates.
9. ASTM D 4214 - Test Methods for Evaluating Degree of Chalking of Exterior Paint Films.
10. ASTM D 6226 - Standard Test Method for Open Cell Content of Rigid Cellular Plastics
11. ASTM E 72 - Standard Test Methods of Conducting Strength Tests of Panels for Building Construction.
12. ASTM E 84 - Test Methods for Surface Burning Characteristics of Building Materials.
13. ASTM E 1592 - Standard Test Method for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference.
14. ASTM E 1646 - Standard Test Method for Water Penetration of Exterior Metal Roof Panel Systems by Uniform Static Air Pressure Difference.
15. ASTM E 1680 - Standard Test Method for Rate of Air Leakage Through Exterior Metal Roof Panel Systems.
16. ASTM E 1980 - Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces.

C. FM Global (FM): www.fmglobal.com:

1. ANSI/FM 4471 Approval Standard for Class 1 Panel Roofs.
2. ANSI/FM 4880 American National Standard for Evaluating Insulated Wall and Roof/Ceiling Assemblies.

D. Underwriters Laboratories, Inc. (UL): www.ul.com:

1. UL 580 - Tests for Uplift Resistance of Roof Assemblies

1.5 QUALITY ASSURANCE

- A. Manufacturer/Source: Provide metal roof panel assembly and accessories from a single manufacturer approved under an accredited third-party quality control program.
- B. Manufacturer Qualifications: Approved manufacturer listed in this Section with minimum five years experience in manufacture of similar products in successful use in similar applications.

1.6 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Prior to erection of framing, conduct preinstallation meeting at site attended by Owner, Architect, manufacturer's technical representative, inspection agency and related trade contractors.
 1. Coordinate building framing in relation to metal panel system.
 2. Coordinate openings and penetrations of metal panel system.
 3. Coordinate work of Division 07 Sections "Roof Specialties" and "Roof Accessories" and openings and penetrations and manufacturer's accessories with installation of metal panels.

1.7 ACTION SUBMITTALS

- A. Product Data: Manufacturer's data sheets for specified products.
- B. Shop Drawings: Show layouts of metal panels. Include details of each condition of installation, panel profiles, and attachment to building. Provide details at a minimum scale 1-1/2-inch per foot of edge conditions, joints, fastener and sealant placement, flashings, openings, penetrations, curbs, vents, snow guards, lightning arresting equipment, and special details. Make distinctions between factory and field assembled work.

1. Include data indicating compliance with performance requirements.
 2. Indicate points of supporting structure that must coordinate with metal panel system installation.
 3. Include structural data indicating compliance with performance requirements and requirements of local authorities having jurisdiction.
- C. Samples for Initial Selection: For each exposed product specified including sealants. Provide representative color charts of manufacturer's full range of colors.
- D. Samples for Verification:
1. Provide ~~12-inch-~~ (305 mm-) long section of each metal panel profile.
 2. Provide color chip verifying color selection.
- 1.8 INFORMATIONAL SUBMITTALS
- A. Product Test Reports: Indicating compliance of products with requirements.
- B. Warranty:
1. Submit manufacturer's written two (2) year limited warranty providing panels to be free from defects in materials and workmanship, beginning from the date of substantial completion excluding coil coatings (paint finishes) that are covered under a separate warranty.
 2. The installation contractor shall issue a separate one (1) year warranty against defects in installed materials and workmanship, beginning from the date of substantial completion of the installation.
- 1.9 CLOSEOUT SUBMITTALS
- A. Maintenance data.
- B. Manufacturer's Warranty: Executed copy of manufacturer's standard warranty.
- 1.10 DELIVERY, STORAGE, AND HANDLING
- A. Protect products of metal panel system during shipping, handling, and storage to prevent staining, denting, deterioration of components or other damage. Protect panels and trim bundles during shipping. Protect painted surfaces with a protective covering before shipping.
1. Deliver, unload, store, and erect metal panel system and accessory items without misshaping panels or exposing panels to surface damage from weather or construction operations.
 2. Store in accordance with Manufacturer's written instruction. Provide wood collars for stacking and handling in the field.
 3. Shield foam insulated metal panels from direct sunlight until installation.
- 1.11 WARRANTY
- A. Special Manufacturer's Warranty: On manufacturer's standard form, in which manufacturer agrees to repair or replace metal panel assemblies that fail in materials and workmanship within two years from date of Substantial Completion.
- B. The installation contractor shall issue a separate one (1) year warranty against defects in installed materials and workmanship, beginning from the date of substantial completion of the installation.
- C. Manufacturer's Weathertight Warranty: On manufacturer's standard form, in which manufacturer agrees to repair or replace metal panel assemblies that fail to remain weathertight, including leaks, without monetary limitation within 20 years from date of Substantial Completion.
- D. Special Panel Finish Warranty: Submit Manufacturer's twenty-five (25) year limited warranty on the exterior paint finish for adhesion to the metal substrate and twenty-five (25) year limited warranty on the exterior paint finish for chalk and fade.

1. Fluoropolymer Two- Coat System:
 - a. Color fading in excess of 5 Hunter units per ASTM D 2244.
 - b. Chalking in excess of No. 6 rating per ASTM D 4214.
 - c. Failure of adhesion, peeling, checking, or cracking.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Basis of Design Manufacturer: MBCI Metal Roof and Wall Systems, Division of NCI Group, Inc.; Houston TX. Tel: (877)713-6224; Email: info@ecoficientseries.com; Web: www.mbc.com.
 1. Provide basis of design product , or comparable product in accordance with Section 01 25 00 substitution Procedures.

2.2 PERFORMANCE REQUIREMENTS

- A. General: Provide metal roof panel system meeting performance requirements as determined by application of specified tests by a qualified testing facility on manufacturer's standard assemblies.
- B. Structural Performance: Provide metal panel assemblies capable of withstanding the effects of indicated loads and stresses within limits and under conditions indicated, as determined by ASTM E 72 or ASTM E 1592 applied in accordance with IES AC 04, Section 4, Panel Load Test Option or Section 5, Panel Analysis Option:
 1. Wind Loads: Determine loads based on uniform pressure, importance factor, exposure category, and basic wind speed indicated on drawings.
 - a. Wind Uplift Testing: Certify capacity of metal panels by testing of proposed assembly per ASTM E 72 or ASTM E 1592.
 2. Deflection Limits: Withstand inward and outward wind-load design pressures in accordance with applicable building code with maximum deflection of 1/240 of the span with no evidence of failure. Reference structural drawings for addt. information.
 3. Seismic Performance: Comply with ASCE 7, Section 9, "Earthquake Loads."
- C. Wind Uplift Resistance: Comply with UL 580 for wind-uplift class UL-90.
- D. FM Approvals Listing: Comply with FM Approvals 4471 as part of a panel roofing system, and that are listed in FM Approvals' "RoofNav" for Class 1 construction. Identify materials with FM Approvals markings.
 1. Fire/Windstorm Classification: Class 1A-120.
 2. Hail Resistance Rating: Class 1-SH.
- E. Fire Performance Characteristics: Provide metal panel systems with the following fire-test characteristics determined by indicated test standard as applied by UL or other testing and inspection agency acceptable to authorities having jurisdiction.
 1. Surface-Burning Characteristics: Provide metal panel systems with the following characteristics when tested per ASTM E 84. The core shall have:
 - a. Flame spread index: 25 or less.
 - b. Smoke developed index: 450 or less.
 2. Fire Performance of Insulated Roof: Class 1 roof panel per ANSI/FM 4880.
- F. Air Infiltration, ASTM E 1680:

1. Maximum 0.06 cfm/sq. ft. (0.30 L/s per sq. m) at static-air-pressure difference of 6.24 lbf/sq. ft. (300 Pa).
- G. Water Penetration Static Pressure, ASTM E 1646: No uncontrolled water penetration at a static pressure of 6.24 lbf/sq. ft. (300 Pa).
- H. Thermal Movements: Allow for thermal movements from variations in both ambient and internal temperatures. Accommodate movement of support structure caused by thermal expansion and contraction. Allow for deflection and design for thermal stresses caused by temperature differences from one side of the panel to the other.
- I. Thermal Performance: When tested in accordance with ASTM C 518, "measurement of steady state thermal transmission," the panels shall provide a K-factor of 0.14 btu/sf/hr/deg F at a 75° F (24 C) mean temperature.

2.3 INSULATED METAL ROOF PANELS

- A. Mechanically Seamed, Concealed Fastener, Foamed-Insulation-Core Metal Roof Panels: Structural metal roof panel consisting of ribbed exterior metal sheet and interior metal sheet, with factory foamed-in-place polyurethane core in thermally-separated profile, with tongue-and-groove panel edges, mechanically seamed, attached to supports using concealed clips and fasteners.
 1. Basis of Design: MBCI, Insulated BattenLok.
 2. ASTM A 792/A 792M, structural quality, Grade 50, Coating Class AZ50 (Grade 340, Coating Class AZM150), prepainted by the coil-coating process per ASTM A 755/A 755M.
 - a. Exterior Face Sheet: 22 gauge with stucco embossed surface and planked pan profile.
 - 1) Finish: Fluoropolymer two-coat system.
 - 2) Color: As selected by Architect from manufacturer's standard colors.
 - b. Interior Face Sheet: 24 gauge with stucco embossed surface and planked profile.
 - 1) Finish: Exposed Galvalume Plus coating.
 - 2) Color: As selected by Architect from manufacturer's standard colors.
 3. Panel Width: 36 inches (914 mm).
 4. Panel Thickness: 4 inch (102 mm).
 5. Insulating Core: Polyurethane with zero ozone depletion potential blowing agent
 - a. Closed Cell Content: 95% or more as determined by ASTM D 6226
 - b. Compressive Strength: As required to meet structural performance requirements and with a minimum of 15 psi as determined by ASTM D 1621
 - c. Minimum Density: 2.0 pcf (32 kg/m3) as determined by ASTM D 1622
 - d. Thermal Resistance (R-Value): 8 per inch of panel thickness. Minimum required R-Value of 30 as determined by ASTM C 518 at 75 degrees Fahrenheit mean temperature.

2.4 METAL ROOF PANEL ACCESSORIES

- A. General: Provide complete metal roof panel assembly incorporating trim, copings, fasciae, gutters and downspouts, and miscellaneous flashings. Provide required fasteners, closure strips, and sealants as indicated in manufacturer's written instructions.
- B. Flashing and Trim: Match material, thickness, and finish of metal panel face sheet.

- C. Panel Clips: ASTM C 645, with ASTM A 653/A 653M, **G90 (Z180)** hot-dip galvanized zinc coating, two-piece, configured for concealment in panel joints, and identical to clips utilized in tests demonstrating compliance with performance requirements.
- D. Panel Fasteners: Self-tapping screws and other acceptable fasteners recommended by roof panel manufacturer. Where exposed fasteners cannot be avoided, supply corrosion-resistant fasteners with heads matching color of metal panels by means of factory-applied coating.
- E. Joint Sealers: Provide Tape Mastic Sealants, Concealed Joint Sealant, and Urethane [Joint Sealants](#) per Section 07 92 00, "[Joint Sealants](#)".
- F. Steel Sheet Miscellaneous Framing Components: ASTM C 645, with ASTM A 653/A 653M, **G60 (Z180)** hot-dip galvanized zinc coating.
- G. Roof Accessories: Approved by metal roof panel manufacturer. Refer to Section 07 72 00 "Roof Accessories" for requirements for curbs, equipment supports, roof hatches, heat and smoke vents, ventilators, and preformed flashing sleeves.

2.5 FABRICATION

- A. General: Provide factory fabricated and finished metal panels and accessories meeting performance requirements, indicated profiles, and structural requirements.
- B. Fabricate metal panel joints configured to accept sealant tape providing weathertight seal and preventing metal-to-metal contact and minimizing noise resulting from thermal movement.
- C. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's written instructions, approved shop drawings, and project drawings.

2.6 FINISHES

- A. Finishes, General: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
- B. Exterior Face Sheet Coil-Coated Finish System
 - 1. Fluoropolymer Two-Coat System: 0.2 – 0.3 mil primer with 0.7 - 0.8 mil 70 percent PVDF fluoropolymer color coat, AAMA 621, meeting solar reflectance index requirements.
 - a. Basis of Design: MBCI, Signature 300.
- C. Interior Face Sheet Coil-Coated Finish System:
 - 1. Polyester Two-Coat System: 0.20 – 0.25 mil primer with 0.7 – 0.8 mil color coat.
 - a. Basis of Design: MBCI, Igloo White.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine metal panel system substrate with Installer present. Inspect for erection tolerances and other conditions that would adversely affect installation of metal panel installation.
 - 1. Inspect framing that will support insulated metal panels to determine if support components are installed as indicated on approved shop drawings and are within tolerances acceptable to metal panel manufacturer and installer. Confirm presence of acceptable framing members at recommended spacing to match installation requirements of insulated metal panels.

2. Panel Support Tolerances: Confirm that panel supports are within tolerances acceptable to insulated metal panel system manufacturer but not greater than the following:
 - a. 1/8 inch (3 mm) in 5 foot (152 cm) in any direction.
 - b. 1/4 inch (6 mm) in 20 foot (610 cm) in any direction.
 - c. 1/2 inch (9 mm) over any single roof plane.
- B. Correct out-of-tolerance work and other deficient conditions prior to proceeding with insulated metal roof panel system installation.

3.2 METAL PANEL INSTALLATION

- A. Mechanically-Seamed, Foamed-Insulation-Core Metal Roof Panels: Install insulated metal panel system in accordance with manufacturer's written instructions, approved shop drawings, and project drawings. Install insulated metal roof panels in orientation, sizes, and locations indicated. Anchor panels and other components securely in place. Provide for thermal and structural movement.
- B. Attach panels to metal framing using clips, screws, fasteners, sealants, and adhesives recommended by manufacturer and indicated on approved shop drawings.
 1. Fasten metal panels to supports with concealed clips at each location indicated on approved shop drawings, with spacing and fasteners recommended by manufacturer.
 2. Provide weatherproof jacks for pipe and conduit penetrating metal panels.
 3. Dissimilar Materials: Where elements of metal panel system will come into contact with dissimilar materials, treat faces and edges in contact with dissimilar materials as recommended by manufacturer.
- C. Attach panel flashing trim pieces to supports using recommended fasteners and joint sealers.
- D. Joint Sealers: Install tape sealers and liquid sealants where indicated and where required for weatherproof performance of metal panel assemblies.
 1. Seal panels in accordance with insulated panel manufacturer's instructions, and project design drawings.
 2. Seal panel joints utilizing tape sealer and vapor seal bead of non-curing butyl; apply continuously without gaps in accordance with manufacturer's written instructions, approved shop drawings, and project drawings.
 3. Prepare joints and apply sealants per requirements of Division 07 Section "[Joint Sealants](#)."

3.3 ACCESSORY INSTALLATION

- A. General: Install metal panel accessories with positive anchorage to building and weather tight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.
 1. Install components required for a complete metal panel assembly, including trim, copings, flashings, sealants, closure strips, and similar items.
 2. Comply with details of assemblies utilized to establish compliance with performance requirements and manufacturer's written installation instructions.
 3. Provide concealed fasteners except where noted on approved shop drawings.
 4. Set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently weather resistant.

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Engage an independent testing and inspecting agency acceptable to Architect to perform field tests and inspections and to prepare test reports.
- B. Water-Spray Test: After completing portion of metal roof panel assembly including accessories and trim, test 2-bay area selected by Architect for water penetration, according to AAMA 501.2.

3.5 CLEANING AND PROTECTION

- A. Remove temporary protective films immediately in accordance with metal roof panel manufacturer's instructions. Clean finished surfaces as recommended by metal roof panel manufacturer.
- B. Replace damaged panels and accessories that cannot be repaired to the satisfaction of the Architect.

END OF SECTION

SECTION 07 92 00 - JOINT SEALANTS

PART 1 - GENERAL

1.1 COORDINATION

- A. The General Conditions of the Contract for Construction and the Supplementary Conditions to the General Conditions of the Contract for Construction shall be considered as part of this section of the specifications.
- B. Each Bidder shall be responsible for determining during the bidding period the extent that any addenda issued during the bidding period may affect this section of the specifications.
- C. Reference Instructions to Bidders for requirements regarding substitutions of materials and products.
- D. Where conflicts occur between the drawings and specifications, between different drawings, between different portions of this section of the specifications, or between different sections of the specifications, the more stringent requirements and the greater quantity shall apply.

1.2 SECTION REQUIREMENTS

- A. Submittals: Product Data and color Samples.

PART 2 - PRODUCTS

2.1 JOINT SEALANTS

- A. Compatibility: Provide joint sealants, joint fillers, and other related materials that are compatible with one another and with joint substrates under service and application conditions.
- B. Elastomeric Sealants: Comply with ASTM C 920.
 - 1. Single-component, neutral-curing silicone sealant, Type S; Grade NS; Class 25; Uses T, M, and O, with the additional capability to withstand [50 percent movement in both extension and compression for a total of 100 percent movement] [100 percent movement in extension and 50 percent movement in compression for a total of 150 percent movement]. Use for building expansion joints.
 - 2. Single-component, nonsag polysulfide sealant, Type S; Grade NS; Class 12-1/2; Uses NT, M, G, A, and O. For general exterior use.
 - 3. Single-component, neutral-curing silicone sealant, Type S; Grade NS; Class 25; Uses T, NT, M, G, A, and O. For general exterior use.
 - 4. Single-component, nonsag urethane sealant, Type S; Grade NS; Class 25; and Uses NT, M, A, and O. For general exterior use.
 - 5. Single-component, nonsag urethane sealant, Type S; Grade NS; Class 25; Uses T, NT, M, G, A, and O. Use for exterior traffic-bearing joints, where slope precludes use of pourable sealant.
 - 6. Single-component, pourable urethane sealant, Type S; Grade P; Class 25; Uses T, M, G, A, and O. Use for exterior traffic-bearing joints.
 - 7. Single-component, mildew-resistant silicone sealant, Type S; Grade NS; Class 25; Uses NT, G, A, and O; formulated with fungicide. Use for interior sealant joints in ceramic tile, stone, and other hard surfaces in kitchens and toilet rooms and around plumbing fixtures.

- C. Latex Sealant: Single-component, nonsag, mildew-resistant, paintable, acrylic-emulsion sealant complying with ASTM C 834. For interior use only at perimeters of door and window frames.
- D. Acoustical Sealant for Exposed Joints: Nonsag, paintable, nonstaining, latex sealant complying with ASTM C 834. For interior use only at acoustical assemblies.
- E. Acoustical Sealant for Concealed Joints: Nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber sealant recommended for sealing interior concealed joints to reduce transmission of air-borne sound. For interior use only at acoustical assemblies.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with ASTM C 1193.
- B. Comply with ASTM C 919 for use of joint sealants in acoustical applications.

END OF SECTION

SECTION 08 11 13 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 COORDINATION

- A. The General Conditions of the Contract for Construction and the Supplementary Conditions to the General Conditions of the Contract for Construction shall be considered as part of this section of the specifications.
- B. Each Bidder shall be responsible for determining during the bidding period the extent that any addenda issued during the bidding period may affect this section of the specifications.
- C. Reference Instructions to Bidders for requirements regarding substitutions of materials and products.
- D. Where conflicts occur between the drawings and specifications, between different drawings, between different portions of this section of the specifications, or between different sections of the specifications, the more stringent requirements and the greater quantity shall apply.

1.2 RELATED DOCUMENTS

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

1.3 SUMMARY

- A. Section Includes:
 - 1. Standard and custom hollow metal doors and frames.
 - 2. Steel sidelight, borrowed lite and transom frames.
 - 3. Louvers installed in hollow metal doors.
 - 4. Light frames and glazing installed in hollow metal doors.
- B. Related Sections:
 - 1. Division 04 Section "Unit Masonry" for embedding anchors for hollow metal work into masonry construction.
 - 2. Division 08 Section "Flush Wood Doors".
 - 3. Division 08 Section "Glazing" for glass view panels in hollow metal doors.
 - 4. Division 08 Section "Door Hardware".
 - 5. Division 09 Sections "Exterior Painting" and "Interior Painting" for field painting hollow metal doors and frames.
- C. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.
 - 1. ANSI/SDI A250.8 - Recommended Specifications for Standard Steel Doors and Frames.
 - 2. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames, Frames Anchors and Hardware Reinforcing.
 - 3. ANSI/SDI A250.6 - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames.
 - 4. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames.

5. ANSI/SDI A250.11 - Recommended Erection Instructions for Steel Frames.
6. ASTM A1008 - Standard Specification for Steel Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
7. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
8. ASTM A924 - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
9. ASTM C 1363 - Standard Test Method for Thermal Performance of Building Assemblies by Means of a Hot Box Apparatus.
10. ANSI/BHMA A156.115 - Hardware Preparation in Steel Doors and Frames.
11. ANSI/SDI 122 - Installation and Troubleshooting Guide for Standard Steel Doors and Frames.
12. ANSI/NFPA 80 - Standard for Fire Doors and Fire Windows; National Fire Protection Association.
13. ANSI/NFPA 105: Standard for the Installation of Smoke Door Assemblies.
14. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; National Fire Protection Association.
15. UL 10C - Positive Pressure Fire Tests of Door Assemblies.
16. UL 1784 - Standard for Air Leakage Tests of Door Assemblies.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, core descriptions, hardware reinforcements, profiles, anchors, fire-resistance rating, and finishes.
- B. Door hardware supplier is to furnish templates, template reference number and/or physical hardware to the steel door and frame supplier in order to prepare the doors and frames to receive the finish hardware items.
- C. 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 anchorages, joints, field splices, and connections.
 6. Details of accessories.
 7. Details of moldings, removable stops, and glazing.
 8. Details of conduit and preparations for power, signal, and control systems.
- D. Samples for Verification:
 1. Samples are only required by request of the architect and for manufacturers that are not current members of the Steel Door Institute.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain hollow metal doors and frames through one source from a single manufacturer wherever possible.
- B. Quality Standard: In addition to requirements specified, furnish SDI-Certified manufacturer products that comply with ANSI/SDI A250.8, latest edition, "Recommended Specifications for Standard Steel Doors and Frames".

- C. 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 UL10C (neutral pressure at 40" above sill) or UL 10C.
 - 1. Oversize Fire-Rated Door Assemblies Construction: For units exceeding sizes of tested assemblies, attach construction label certifying doors are built to standard construction requirements for tested and labeled fire rated door assemblies except for size.
 - 2. Temperature-Rise Limit: Where indicated and at vertical exit enclosures (stairwell openings) and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire-test exposure.
 - 3. Smoke Control Door Assemblies: Comply with NFPA 105.
 - a. Smoke "S" Label: Doors to bear "S" label, and include smoke and draft control gasketing applied to frame and on meeting stiles of pair doors.
- D. 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. Provide labeled glazing material.
- E. Pre-Submittal Conference: Conduct conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier, Installer, and Contractor to review proper methods and procedures for installing hollow metal doors and frames and to verify installation of electrical knockout boxes and conduit at frames with electrified or access control hardware.

1.6 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 non-vented plastic.
- 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 space between each stacked door to permit air circulation. Door and frames to be stacked in a vertical upright position.

1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.8 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.

1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.

- B. Warranty includes installation and finishing that may be required due to repair or replacement of defective doors.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide steel doors and frames from a SDI Certified manufacturer:
 - 1. CECO Door Products (C).
 - 2. Curries Company (CU).
 - 3. Steelcraft (S).

2.2 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.
- C. Frame Anchors: ASTM A 653/A 653M, Commercial Steel (CS), Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.

2.3 HOLLOW METAL DOORS

- A. General: Provide 1-3/4 inch 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 and ANSI/NAAMM HMMA 867.
- B. Exterior Doors: Face sheets fabricated of commercial quality hot-dipped zinc coated steel that complies with ASTM A 653/A 653M, Coating Designation A60. 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. Design: Flush panel.
 - 2. Level/Model: Level 2 and Physical Performance Level B (Heavy Duty), Minimum 18 gauge (0.042-inch - 1.0-mm) thick steel, Model 2.
 - 3. Top and Bottom Edges: Reinforce tops and bottoms of doors with a continuous steel channel not less than 16 gauge, extending the full width of the door and welded to the face sheet. Doors with an inverted top channel to include a steel closure channel, screw attached, with the web of the channel flush with the face sheets of the door. Plastic or composite channel fillers are not acceptable.
 - 4. Hinge Reinforcement: Minimum 7 gauge (3/16") plate 1-1/4" x 9" or minimum 14 gauge continuous channel with pierced holes, drilled and tapped.
 - 5. Hardware Reinforcements: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.
- C. Manufacturers Basis of Design:
 - 1. Curries Company (CU) - Energy Efficient - 797 Mercury Series.

2.4 HOLLOW METAL FRAMES

- A. General: Comply with ANSI/SDI A250.8 and with details indicated for type and profile.
- B. Thermal Break Frames: Subject to the same compliance standards and requirements as standard hollow metal frames. Tested for thermal performance in accordance with NFRC 102, and resistance to air infiltration in accordance with NFRC 400. Where indicated provide thermally broken frame profiles available for use in both masonry and drywall construction. Fabricate with 1/16" positive thermal break and integral vinyl weatherstripping.
- C. Exterior Frames: Fabricated of hot-dipped zinc coated steel that complies with ASTM A 653/A 653M, Coating Designation A60.
 - 1. Fabricate frames with mitered or coped corners. Profile as indicated on drawings.
 - 2. Frames: Minimum 16 gauge (0.053-inch -1.3-mm) thick steel sheet.
 - 3. Manufacturers Basis of Design:
 - a. CECO Door Products (C) – SQ SU SR Series.
 - b. Curries Company (CU) – M Series.
- D. Interior Frames: Fabricated from cold-rolled steel sheet that complies with ASTM A 1008/A 1008M.
 - 1. Fabricate frames with mitered or coped corners. Profile as indicated on drawings.
 - 2. Frames: Minimum 16 gauge (0.053-inch -1.3-mm) thick steel sheet.
 - 3. Manufacturers Basis of Design:
 - a. CECO Door Products (C) - SQ SU Series.
 - b. Curries Company (CU) - M Series.
- E. Fire rated frames: Fabricate frames in accordance with NFPA 80, listed and labeled by a qualified testing agency, for fire-protection ratings indicated.
- F. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 Table 4 with reinforcement plates from same material as frames.

2.5 FRAME ANCHORS

- A. Jamb Anchors:
 - 1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, formed from A60 metallic coated material, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
 - 2. Stud Wall Type: Designed to engage stud and not less than 0.042 inch thick.
 - 3. Compression Type for Drywall Slip-on (Knock-Down) Frames: Adjustable compression anchors.
- B. Floor Anchors: Floor anchors to be provided at each jamb, formed from A60 metallic coated material, not less than 0.042 inches thick.
- C. Mortar Guards: Formed from same material as frames, not less than 0.016 inches thick.

2.6 LOUVERS

- A. Metal Louvers: Door manufacturer's standard metal louvers unless otherwise indicated.

1. Blade Type: Vision proof inverted V or inverted Y.
 2. Metal and Finish: Galvanized steel, 0.040 inch thick, factory primed for paint finish with baked enamel or powder coated finish. Match pre-finished door paint color where applicable.
- B. Louvers for Fire Rated Doors: Metal louvers with fusible link and closing device, listed and labeled for use in doors with fire protection rating of 1-1/2 hours and less.
1. Manufacturers: Subject to compliance with requirements, provide door manufacturers standard louver to meet rating indicated.
 2. Metal and Finish: Galvanized steel, 0.040 inch thick, factory primed for paint finish with baked enamel or powder coated finish. Match pre-finished door paint color where applicable.

2.7 LIGHT OPENINGS AND GLAZING

- A. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints at fabricator's shop. Fixed and removable stops to allow multiple glazed lites each to be removed independently. Coordinate frame rabbet widths between fixed and removable stops with the type of glazing and installation indicated.
- B. Moldings for Glazed Lites in Doors and Loose Stops for Glazed Lites in Frames: Minimum 20 gauge thick, fabricated from same material as door face sheet in which they are installed.
- C. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch (16 mm) high unless otherwise indicated. Provide fixed frame moldings and stops on outside of exterior and on secure side of interior doors and frames.
- D. Preformed Metal Frames for Light Openings: Manufacturer's standard frame formed of 0.048-inch-thick, cold rolled steel sheet; with baked enamel or powder coated finish; and approved for use in doors of fire protection rating indicated. Match pre-finished door paint color where applicable.

2.8 ACCESSORIES

- A. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.
- B. Grout Guards: Formed from same material as frames, not less than 0.016 inches thick.

2.9 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. When shipping limitations so dictate, frames for large openings are to be fabricated in sections for splicing or splining in the field by others.
- B. Tolerances: Fabricate hollow metal work to tolerances indicated in ANSI/SDI A250.8.
- C. Hollow Metal Doors:
1. Exterior Doors: Provide optional weep-hole openings in bottom of exterior doors to permit moisture to escape where specified.
 2. Glazed Lites: Factory cut openings in doors with applied trim or kits to fit. Factory install glazing where indicated.
 3. Astragals: Provide overlapping astragals as noted in door hardware sets in Division 08 Section "Door Hardware" 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.

4. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge strap for continuous hinges specified in hardware sets in Division 08 Section "Door Hardware".

D. Hollow Metal Frames:

1. Shipping Limitations: 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.
2. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
 - a. Welded frames are to be provided with two steel spreaders temporarily attached to the bottom of both jambs to serve as a brace during shipping and handling. Spreader bars are for bracing only and are not to be used to size the frame opening.
3. Sidelight and Transom Bar 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.
4. High Frequency Hinge Reinforcement: Provide high frequency hinge reinforcements at door openings 48-inches and wider with mortise butt type hinges at top hinge locations.
5. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge straps for continuous hinges specified in hardware sets in Division 08 Section "Door Hardware".
6. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated for removable stops, provide security screws at exterior locations.
7. Mortar Guards: Provide guard boxes at back of hardware mortises in frames at all hinges and strike preps regardless of grouting requirements.
8. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
9. 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 high.
 - 2) Three anchors per jamb from 60 to 90 inches high.
 - 3) Four anchors per jamb from 90 to 120 inches high.
 - 4) Four anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 120 inches 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 high.
 - 2) Four anchors per jamb from 60 to 90 inches high.
 - 3) Five anchors per jamb from 90 to 96 inches high.
 - 4) Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.
 - 5) Two anchors per head for frames above 42 inches wide and mounted in metal stud partitions.
10. Door Silencers: Except on weatherstripped or gasketed doors, drill stops to receive door silencers. Silencers to be supplied by frame manufacturer regardless if specified in Division 08 Section "Door Hardware".

- E. Hardware Preparation: Factory prepare hollow metal work to receive template 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. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
 - 2. Reinforce doors and frames to receive non-template, mortised and surface mounted door hardware.
 - 3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
 - 4. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 Sections.

2.10 STEEL FINISHES

- A. Prime Finishes: Doors and frames to be cleaned, and chemically treated to insure maximum finish paint adhesion. Surfaces of the door and frame exposed to view to receive a factory applied coat of rust inhibiting shop primer.
 - 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; and compatible with substrate and field-applied coatings.

PART 3 - EXECUTION

3.1 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. General Contractor to verify the accuracy of dimensions given to the steel door and frame manufacturer for existing openings or existing frames (strike height, hinge spacing, hinge back set, etc.).
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 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 square, level, twist, and plumb condition.
- C. Tolerances shall comply with SDI-117 "Manufacturing Tolerances Standard Steel Doors and Frames."
- D. Drill and tap doors and frames to receive non-template, mortised, and surface-mounted door hardware.

3.3 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 and NFPA 80 at fire rated openings.
 - 1. Set frames accurately in position, plumbed, leveled, aligned, and braced securely until permanent anchors are set. After wall construction is complete and frames properly set and secured, remove temporary braces, leaving surfaces smooth and undamaged. Shim as necessary to comply with installation tolerances.
 - 2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with post-installed expansion anchors.
 - 3. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with mortar.
 - 4. Grout Requirements: Do not grout head of frames unless reinforcing has been installed in head of frame. Do not grout vertical or horizontal closed mullion members.
- 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 plus or minus 1/16 inch.
 - b. Between Edges of Pairs of Doors: 1/8 inch plus or minus 1/16 inch.
 - c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.
 - d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch.
 - 2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
- D. Field Glazing: Comply with installation requirements in Division 08 Section "Glazing" and with hollow metal manufacturer's written instructions.

3.4 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.
- C. Prime-Coat and Painted Finish Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat, or painted finishes, and apply touchup of compatible air drying, rust-inhibitive primer, zinc rich primer (exterior and galvanized openings) or finish paint.

END OF SECTION

SECTION 08 14 16 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 COORDINATION

- A. The General Conditions of the Contract for Construction and the Supplementary Conditions to the General Conditions of the Contract for Construction shall be considered as part of this section of the specifications.
- B. Each Bidder shall be responsible for determining during the bidding period the extent that any addenda issued during the bidding period may affect this section of the specifications.
- C. Reference Instructions to Bidders for requirements regarding substitutions of materials and products.
- D. Where conflicts occur between the drawings and specifications, between different drawings, between different portions of this section of the specifications, or between different sections of the specifications, the more stringent requirements and the greater quantity shall apply.

1.2 RELATED DOCUMENTS

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

1.3 SUMMARY

- A. Section Includes:
 - 1. Solid core doors with wood veneer faces.
 - 2. Factory finishing wood doors.
 - 3. Factory fitting wood doors to frames and factory machining for hardware.
 - 4. Louvers installed in flush wood doors.
 - 5. Light frames and glazing installed in wood doors.
- B. Related Sections:
 - 1. Division 08 Section "Door Schedule".
 - 2. Division 08 Section "Hollow Metal Doors and Frames".
 - 3. Division 08 Section "Glazing".
 - 4. Division 08 Section "Door Hardware".
- C. Standards and References: Comply with the version year adopted by the Authority Having Jurisdiction.
 - 1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
 - 2. ANSI A208.1 - Wood Particleboard.
 - 3. Intertek Testing Service (ITS Warnock Hersey) - Certification Listings for Fire Doors.
 - 4. NFPA 80 - Standard for Fire Doors and Fire Windows; National Fire Protection Association.
 - 5. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; National Fire Protection Association.
 - 6. UL 10C - Positive Pressure Fire Tests of Door Assemblies; UL 1784 - Standard for Air Leakage Tests of Door Assemblies.
 - 7. Window and Door Manufacturers Association - WDMA I.S.1-A Architectural Wood Flush Doors.

1.4 SUBMITTALS

- A. Product Data: For each type of door indicated. Include details of core and edge construction, louvers, trim for openings, and WDMA I.S.1-A classifications. Include factory finishing specifications.
- B. Shop Drawings shall include:
 - 1. Indicate location, size, and hand of each door.
 - 2. Indicate dimensions and locations of mortises and holes for hardware.
 - 3. Indicate dimensions and locations of cutouts.
 - 4. Indicate requirements for veneer matching.
 - 5. Indicate location and extent of hardware blocking.
 - 6. Indicate construction details not covered in Product Data.
 - 7. Indicate doors to be factory finished and finish requirements.
 - 8. Indicate fire protection ratings for fire rated doors.
- C. Samples for Initial Selection: For factory finished doors.
 - 1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches, for each material and finish. For each wood species and transparent finish, provide set of three samples showing typical range of color and grain to be expected in the finished work.
 - 2. Corner sections of doors, 8 by 10 inches, with door faces and edges representing actual materials to be used.
 - a. Provide samples for each species of veneer and core material.
 - b. Finish veneer faced door samples with same materials proposed for factory finished doors.
 - 3. Frames for light openings, 6 inches long, for each material, type, and finish required.
- D. Warranty: Provide sample of manufacturer's warranty.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain flush wood doors through one source from a single manufacturer wherever possible.
- B. Quality Standard: In addition to requirements specified, comply with WDMA I.S.1-A, latest edition, "Industry Standard for Architectural Wood Flush Doors".
- C. Fire Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing at positive pressure according to NFPA 252 (neutral pressure at 40" above sill) or UL10C.
 - 1. Oversize Fire Rated Door Assemblies: For units exceeding sizes of tested assemblies provide manufacturer's construction label, indicating compliance to independent 3rd party certification agency's procedure, except for size.
 - 2. Temperature Rise Limit: Where required and at vertical exit enclosures (stairwell openings) and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire test exposure.

3. Smoke Control Door Assemblies: Comply with NFPA 105.

- 1) Smoke "S" Label: Doors to bear "S" label, and include smoke and draft control gasketing applied to frame and on meeting stiles of pair doors.

- D. Pre-Submittal Conference: Conduct conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier, Installer, and Contractor to review proper methods and procedures for receiving, handling, and installing flush wood doors.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Comply with requirements of referenced standard and manufacturer's written instructions.
- B. Package pre-finished doors individually in plastic bags and wrap bundles of doors in plastic sheeting.
- C. Mark each door on top rail with opening number used on Shop Drawings.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weather tight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.8 WARRANTY

- A. Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
 - a. Warping (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section.
 - b. Telegraphing of core construction in wood face veneers exceeding 0.01 inch in a 3-inch span.
 2. Warranty includes installation and finishing that may be required due to repair or replacement of defective doors.
 3. Warranty Period for Solid Core Interior Doors: Life of installation.

PART 2 - PRODUCTS

2.1 DOOR CONSTRUCTION – GENERAL

- A. WDMA I.S.1-A Performance Grade: Extra Heavy Duty; Aesthetic Grade: Premium.

2.2 CORE CONSTRUCTION

- A. Particleboard Core Doors:

1. Particleboard: Wood fiber based materials complying with ANSI A208.1 Particleboard standard. Grade LD-2.
2. Adhesive: Fully bonded construction using Polyurethane (PUR) glue.
3. Blocking: As indicated under article "Blocking".

2.3 BLOCKING

A. Non-Fire-Rated Doors:

1. Provide blocking as indicated below:
 - a. HB3: 5 inch top and bottom rail blocking, in doors indicated to have closers and kick plates.

B. Fire Rated Doors:

1. Provide blocking as indicated below:
 - a. HB1: 5 inch in doors indicated to have closers and overhead stops.

2.4 VENEERED DOORS FOR TRANSPARENT FINISH

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ASSA ABLOY Wood Doors (GR): GPD Series.
2. Eggers Industries (EG): Premium Series.
3. Marshfield-Algoma (MF): Signature Series.
4. VT Industries (VT): Artistry Series.

B. Interior Solid Core Doors:

1. Grade: Premium.
2. Faces: Veneer grades as noted below; veneer minimum 1/50-inch (0.5mm) thickness at moisture content of 12% or less.
 - a. Plain Sliced Select White Maple, A grade faces.
3. Match between Veneer Leaves: Book match.
4. Assembly of Veneer Leaves on Door Faces:
 - a. Running Match.
5. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.
6. Transom Match: Continuous match.

7. Vertical Edges: Matching same species as faces. Wood or composite material, one piece, laminated, or veneered. Minimum requirements per WDMA section P-1, Performance Standards for Architectural Wood Flush Doors.
8. Horizontal Edges: Solid wood or structural composite material meeting the minimum requirements per WDMA section P-1, Performance Standards for Architectural Wood Flush Doors
9. Construction: Five plies. Stiles and rails are bonded to core, then entire unit sanded before applying face veneers.
10. At doors over 40% of the face cut-out for lights and or louvers, furnish engineered composite lumber core.

2.5 LOUVERS

- A. Metal Louvers: Door manufacturer's standard metal louvers unless otherwise indicated.
1. Blade Type: Vision proof inverted V or inverted Y.
 2. Metal and Finish: Galvanized steel, 0.040 inch thick, factory primed for paint finish with baked enamel or powder coated finish.

2.6 LIGHT FRAMES AND GLAZING

- A. Metal Frames for Light Openings in wood doors and up to and including 20-minute Rating: Manufacturer's standard frame formed of 0.048-inch-thick, cold rolled steel sheet; with baked enamel or powder coated finish; and approved for use in doors of fire protection rating indicated.
1. Manufacturers:
 - a. Air Louver (LV).
 - b. All Metal Stamping (AP).
 - c. Anemostat (AN).
 - d. Pemko (PE).
- B. Glazing: Comply with installation requirements in Division 08 Section "Glazing" and with the flush wood door manufacturer's written instructions.

2.7 FABRICATION

- A. Factory fit doors to suit frame opening sizes indicated.
1. Comply with requirements in NFPA 80 for fire rated doors.
 2. Undercut: As required per manufacturer's templates and sill condition.
- B. Factory machine doors for hardware that is not surface applied. Comply with final hardware schedules, door frame Shop Drawings, DHI A115-W series standards, and hardware templates.
1. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.
 2. Metal Astragals: Factory machine astragals and formed steel edges for hardware for pairs of fire rated doors.

- C. Openings: Cut and trim openings through doors in factory.
 - 1. Light Openings: Trim openings with moldings of material and profile indicated.
 - 2. Glazing: Comply with applicable requirements in Division 08 Section "Glazing."
 - 3. Louvers: Factory install louvers in prepared openings.
- D. Electrical Raceways: Provide flush wood doors receiving electrified hardware with concealed wiring harness and standardized Molex™ plug connectors on both ends to accommodate up to twelve wires. Coordinate connectors on end of the wiring harness to plug directly into the electrified hardware and the through wire transfer hardware or wiring harness specified in hardware sets in Division 08 "Door Hardware". Wire nut connections are not acceptable.

2.8 FACTORY FINISHING

- A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
 - 1. Finish faces, all four edges, edges of cutouts, and mortises. Stains and fillers may be omitted on top and bottom edges, edges of cutouts, and mortises.
- B. Transparent Finish: Provide a clear protective coating over the wood veneer allowing the natural color and grain of the selected wood species to provide the appearance specified. Stain is applied to the wood surface underneath the transparent finish to add color and design flexibility.
 - 1. Finish: Meet or exceed WDMA I.S. 1A TR8 UV Cured Acrylated Polyester finish performance requirements.
 - 2. Staining:
 - a. Custom stain to match architect's sample.
 - 3. Sheen: Satin.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine doors and installed door frames before hanging doors.
 - 1. Verify that frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
 - 2. Reject doors with defects.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Hardware: For installation, see Division 8 Section "Door Hardware."
- B. Installation Instructions: Install doors and frames to comply with manufacturer's written instructions and the referenced quality standard, and as indicated.

1. Install fire rated doors in corresponding fire rated frames according to NFPA 80.

C. Factory Fitted Doors: Align in frames for uniform clearance at each edge.

D. Factory Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

E. Field modifications to doors shall not be permitted, except those specifically allowed by manufacturer or fire rating requirements.

3.3 ADJUSTING

A. Operation: Re-hang or replace doors that do not swing or operate freely.

B. Finished Doors: Replace doors that do not comply with requirements. Doors may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION

SECTION 08 33 23 - OVERHEAD COILING SERVICE DOORS

PART 1 GENERAL

1.0 COORDINATION

- A. The General Conditions of the Contract for Construction and the Supplementary Conditions to the General Conditions of the Contract for Construction shall be considered as part of this section of the specifications.
- B. Each Bidder shall be responsible for determining during the bidding period the extent that any addenda issued during the bidding period may affect this section of the specifications.
- C. Reference Instructions to Bidders for requirements regarding substitutions of materials and products.
- D. Where conflicts occur between the drawings and specifications, between different drawings, between different portions of this section of the specifications, or between different sections of the specifications, the more stringent requirements and the greater quantity shall apply.

1.1 SECTION INCLUDES

- A. Overhead coiling service doors.

1.2 RELATED SECTIONS

- A. Section 05 50 00 - Metal Fabrications: Support framing and framed opening.
- B. Section 06 20 00 - Finish Carpentry: Wood jamb and head trim.
- C. Section 08 71 00 - Door Hardware: Product Requirements for cylinder core and keys.
- D. Section 09 91 00 - Painting: Field applied finish.
- E. Section 26 05 33 - Raceway and Boxes: Conduit from electric circuit to door operator and from door operator to control station.
- F. Section 26 05 83 - Wiring Connections: Power to disconnect.

1.3 REFERENCES

- A. [ASTM A 653](#) - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- B. [ASTM A 666](#) - Standard Specification for Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
- C. [ASTM A 924](#) - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
- D. [ASTM B 221](#) - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
- E. [NEMA 250](#) - Enclosures for Electrical Equipment (1000 Volts Maximum).

- F. [NEMA MG 1](#) - Motors and Generators.

1.4 DESIGN / PERFORMANCE REQUIREMENTS

- A. Overhead coiling service doors:
1. Wind Loads: Design door assembly to withstand wind/suction load of 20 psf (958 Pa) without damage to door or assembly components.
 2. Operation: Design door assembly, including operator, to operate for not less than 20,000 cycles.
- B. Single-Source Responsibility: Provide doors, tracks, motors, and accessories from one manufacturer for each type of door. Provide secondary components from source acceptable to manufacturer of primary components.
- C. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories, Inc. acceptable to authority having jurisdiction as suitable for purpose specified.

1.5 SUBMITTALS

- A. Submit under provisions of Section 01 33 00.
- 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. Details of construction and fabrication.
 4. Installation instructions.
- C. Shop Drawings: Include detailed plans, elevations, details of framing members, anchoring methods, required clearances, hardware, and accessories. Include relationship with adjacent construction.
- D. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.
- E. Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) long, representing actual product, color, and patterns.
- F. Manufacturer's Certificates: Certify products meet or exceed specified requirements.
- G. Operation and Maintenance Data: Submit lubrication requirements and frequency, and periodic adjustments required.

1.6 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 closures.
- B. Installer Qualifications: Installer Qualifications: Company specializing in performing Work of this section with minimum three years and approved by manufacturer.
- C. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
1. Finish areas designated by Architect.
 2. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.
 3. Refinish mock-up area as required to produce acceptable work.

1.7 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.

1.8 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.

1.9 COORDINATION

- A. Coordinate Work with other operations and installation of adjacent materials to avoid damage to installed materials.

1.10 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 warranty for 2 years for all parts and components.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturer: Overhead Door Corp., 2501 S. State Hwy. 121, Suite 200, Lewisville, TX 75067. ASD. Tel. Toll Free: (800) 275-3290. Phone: (469) 549-7100. Fax: (972) 906-1499. Web Site: www.overheaddoor.com. E-mail: info@overheaddoor.com.
- B. Requests for substitutions will be considered in accordance with provisions of Section 01 25 00.

2.2 OVERHEAD COILING SERVICE DOORS

- A. Industrial Doors: Overhead Door Corporation Model 610 Service Door.
 - 1. Curtain: Interlocking roll-formed slats as specified following. Endlocks shall be attached to each end of alternate slats to prevent lateral movement.
 - a. Curved profile type C-187 for doors up to 15 feet 4 inches (4.67 m) wide, fabricated of:
 - 1) 22 gauge galvanized steel.
 - 2. Finish:
 - a. Galvanized Steel: Slats and hood galvanized in accordance with ASTM A 653 and receive rust-inhibitive, roll coating process, including 0.2 mils thick baked-on prime paint, and 0.6 mils thick baked-on polyester top coat.

- 1) Powder coat: PowderGuard
 - (a) PowderGuard Weathered Finish: Industrial textured powder coat provides a thicker, more scratch resistant coat. Applied to entire door system including slats, guides, bottom bar and head plate.
3. Weatherseals:
 - a. Vinyl bottom seal.
4. Bottom Bar:
 - a. Two galvanized steel angles.
5. Guides: Three structural steel angles.
 - a. Finish: PowderGuard Weathered finish with iron/black powder.
6. Brackets:
 - a. Galvanized steel to support counterbalance, curtain and hood.
7. 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.
8. Hood:
 - a. 24 gauge galvanized steel with intermediate supports as required.
9. Electric Motor Operation: 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.
 - a. Sensing Edge Protection:
Pneumatic sensing edge.
 - b. Operator Controls:
Push-button operated control stations with open, close, and stop buttons.
 - c. Motor Voltage: 115/230 single phase, 60 Hz.
10. Windload Design:
 - a. Standard windload shall be 20 PSF.
11. Locking:
 - a. Interior slide bolt lock for electric operation with interlock switch.
12. Wall Mounting Condition:
 - a. Face-of-wall mounting.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify opening sizes, tolerances and conditions are acceptable.
- B. Examine conditions of substrates, supports, and other conditions under which this work is to be performed.
- C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.
- C. Securely and rigidly brace components suspended from structure. Secure guides to structural members only.
- D. Fit and align assembly including hardware; level and plumb, to provide smooth operation.
- E. Coordinate installation of electrical service with Section 16150. Complete wiring from disconnect to unit components.
- F. Coordinate installation of sealants and backing materials at frame perimeter as specified in Section 07900.
- G. Install perimeter trim and closures.
- H. Instruct Owner's personnel in proper operating procedures and maintenance schedule.

3.4 ADJUSTING

- A. Test for proper operation and adjust as necessary to provide proper operation without binding or distortion.
- B. Adjust hardware and operating assemblies for smooth and noiseless operation.

3.5 CLEANING

- A. Clean curtain and components using non-abrasive materials and methods recommended by manufacturer.
- B. Remove labels and visible markings.
- C. Touch-up, repair or replace damaged products before Substantial Completion.

3.6 PROTECTION

- A. Protect installed products until completion of project.

END OF SECTION

SECTION 08 41 13 – ALUMINUM STOREFRONT

PART 1 - GENERAL

1.0 COORDINATION

- A. The General Conditions of the Contract for Construction and the Supplementary Conditions to the General Conditions of the Contract for Construction shall be considered as part of this section of the specifications.
- B. Each Bidder shall be responsible for determining during the bidding period the extent that any addenda issued during the bidding period may affect this section of the specifications.
- C. Reference Instructions to Bidders for requirements regarding substitutions of materials and products.
- D. Where conflicts occur between the drawings and specifications, between different drawings, between different portions of this section of the specifications, or between different sections of the specifications, the more stringent requirements and the greater quantity shall apply.

1.1 SUMMARY

- A. Related Documents: Conditions of the Contract, Division 1 - General Requirements, and Drawings apply to Work of this Section.
- B. Section Includes:
 - 1. Entrance and storefront systems, complete with reinforcing, fasteners, anchors and attachment devices.
 - 2. Aluminum doors complete with hardware.
 - 3. Accessories necessary to complete work.
- C. Related Sections:
 - 1. Section 01 40 00 - Quality Requirements.
 - 2. Section 05 50 00 - Metal Fabrications.
 - 3. Section 06 10 00 - Rough Carpentry.
 - 4. Section 07 92 00 - Joint Sealants.
 - 5. Section 08 71 00 - Door Hardware.
 - 6. Section 08 81 00 - Glass and Glazing.

1.2 REFERENCES

- A. Aluminum Association (AA):
 - 1. DAF-45 Designation System for Aluminum Finishes.
- B. American Architectural Manufacturers Association (AAMA):
 - 1. 503.1 Test Method for Condensation Resistance of Windows, Doors and Glazed Wall Systems.
 - 2. 701.2 Specifications for Pile Weatherstripping.
 - 3. Manual #10 Care and Handling of Architectural Aluminum From Shop to Site.
 - 4. SFM-1 Aluminum Storefront and Entrance Manual.
- C. American National Standards Institute (ANSI):
 - 1. A117.1 Safety Standards for the Handicapped.

- D. American Society for Testing and Materials (ASTM):
 - 1. A36 Structural Steel.
 - 2. B209 Aluminum and Aluminum - Alloy Sheet and Plate.
 - 3. B221 Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes and Tubes.
 - 4. B308 Aluminum-Alloy 6061-T6 Standard Structural Shapes, Rolled or Extruded.
 - 5. C509 Cellular Elastomeric Pre-formed Gasket and Sealing Material.
 - 6. C864 Dense Elastomeric Compression Seal Gaskets, Setting Blocks and Spacers.
 - 7. E283 Test Method for Rate of Air Leakage Through Exterior Windows, Curtain Walls and Doors.
 - 8. E330 Test Method for Structural Performance of Exterior Windows, Curtain Walls and Doors by Uniform Static Air Pressure Difference.
 - 9. E331 Test Method for Water Penetration of Exterior Windows, Curtain Walls and Doors by Uniform Static Air Pressure Difference.
- E. Federal Specifications (FS):
 - 1. TT-P-645A Primer, Paint, Zinc Chromate, Alkyd Type.
- F. Steel Structures Painting Council (SSPC):
 - 1. Paint 12 Cold-Applied Asphalt Mastic (Extra Thick Film).

1.3 SYSTEM REQUIREMENTS

- A. Design Requirements:
 - 1. Drawings are diagrammatic and do not purport to identify nor solve problems of thermal or structural movement, glazing, anchorage or moisture disposal.
 - 2. Requirements shown by details are intended to establish basic dimension of units, sight lines and profiles of members.
 - 3. Provide concealed fastening.
 - 4. Provide entrance and storefront systems, including necessary modifications, to meet specified requirements and maintaining visual design concepts.
 - 5. Attachment considerations are to take into account site peculiarities and expansion and contraction movements so there is no possibility of loosening, weakening or fracturing connection between units and building structure or between units themselves.
 - 6. Anchors, fasteners and braces shall be structurally stressed not more than 50% of allowable stress when maximum loads are applied.
 - 7. Provide for expansion and contraction without detriment to appearance or performance.
 - 8. Assemblies shall be free from rattles, wind whistles and noise due to thermal and structural movement and wind pressure.
- B. Performance Requirements:
 - 1. Air infiltration: Air leakage through fixed light areas of storefront shall not exceed 0.06 cfm per square foot (0.0003 m3/sm2) of surface area when tested in accordance with ASTM E283 at differential static pressure of 6.24 psf (300 Pa).
 - 2. Water infiltration: No uncontrolled water penetration when tested in accordance with ASTM E 331 at test pressure of 8.0 psf 380 Pa.

- C. Thermal Requirements:
 - 1. Framing systems shall accommodate expansion and contraction movement due to surface temperature differentials of 180 degrees Fahrenheit (82 degrees Celsius) without causing buckling, stress on glass, failure of joint seals, excessive stress on structural elements, reduction of performance, or other detrimental effects.
 - 2. Ensure doors function normally within limits of specified temperature range.
- D. Structural Requirements, as measured in accordance with ANSI/ASTM E330:
 - 1. Wind loads for exterior assemblies:
 - a. Basic loading:
 - 1) [] psf acting inward.
 - 2) [] psf acting outward.
 - 2. Deflection: Maximum calculated deflection of any framing member in direction normal to plane of wall when subjected to specified design pressures shall not exceed 1/175 of its clear span.
- E. Testing Requirements: Provide components that have been previously tested by an independent testing laboratory.

1.4 SUBMITTALS

- A. General: Submit in accordance with Section 01 33 00.
- B. Product Data:
 - 1. Submit manufacturer's descriptive literature and product specifications.
 - 2. Include information for factory finishes, hardware, accessories and other required components.
 - 3. Include color charts for finish indicating manufacturer's standard colors available for selection.
- C. Shop Drawings:
 - 1. Submit shop drawings covering fabrication, installation and finish of specified systems.
 - 2. Include following:
 - a. Fully dimensioned plans and elevations with detail coordination keys.
 - b. Locations of exposed fasteners and joints.
 - 3. Provide detailed drawings of:
 - a. Composite members.
 - b. Joint connections for framing systems and for entrance doors.
 - c. Anchorage.
 - d. System reinforcements.
 - e. Expansion and contraction provisions.
 - f. Hardware, including locations, mounting heights, reinforcements and special installation provisions.
 - g. Glazing methods and accessories.
 - h. Internal sealant requirements as recommended by sealant manufacturer.
 - 4. Schedule of finishes.
- D. Samples:
 - 1. Submit samples indicating quality of finish, in required colors, on alloys used for work, in sizes as standard with manufacturer.
 - 2. Where normal texture or color variations are expected, include additional samples illustrating range of variation.

E. Test Reports:

1. Standard Systems: Submit certified copies of previous test reports substantiating performance of system in lieu of re-testing. Include other supportive data as necessary.

F. Certificates:

1. Submit manufacturer's certification stating that systems are in compliance with specified requirements.

G. Qualification Data:

1. Submit installer qualifications verifying years of experience.
2. Include list of projects having similar scope of work identified by name, location, date, reference name and phone number.

H. Manufacturer's Instructions: Submit manufacturer's printed installation instructions.

1.5 QUALITY ASSURANCE

A. Single Source Responsibility:

1. To ensure quality of appearance and performance, obtain materials for each system from either a single manufacturer or from manufacturer approved by each system manufacturer.

B. Installer Qualifications: Certified in writing by Contractor as qualified for installation of specified systems.

C. Perform Work in accordance with AAMA SFM-1 and manufacturer's written instructions.

D. Conform to requirements of ANSI A117.1 and local amendments.

1.6 DELIVERY, STORAGE AND HANDLING

A. Comply with requirements of Section 01 60 00.

B. Protect finished surfaces as necessary to prevent damage.

C. Do not use adhesive papers or sprayed coatings which become firmly bonded when exposed to sun.

D. Do not leave coating residue on any surfaces.

E. Replace damaged units.

1.7 WARRANTY

A. Provide warranties in accordance with the Contract General Conditions.

B. Provide written manufacturer's warranty, executed by company official, warranting against defects in materials and products for two (2) years from date of Substantial Completion.

C. Provide written installer's warranty, warranting work to be watertight, free from defective materials, defective workmanship, glass breakage due to defective design, and agreeing to replace components which fail within 1 year from date of Substantial Completion.

1. Warranty shall cover following:

- a. Complete watertight and airtight system installation within specified tolerances.
- b. Completed installation will remain free from rattles, wind whistles and noise due to

thermal and structural movement and wind pressure.

- c. System is structurally sound and free from distortion.
- d. Glass and glazing gaskets will not break or "pop" from frames due to design wind, expansion or contraction movement.
- e. Glazing sealants and gaskets will remain free from abnormal deterioration or dislocation due to sunlight, weather or oxidation.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Manufacturers

- 1. YKK AP America, Inc.
- 2. Vista Wall Architectural Products
- 3. Kawneer
- 4. Oldcastle Building Envelope

B. Substitutions: Submit under provisions of Section 01 25 00, a minimum of 10 days prior to bid date.

C. Acceptable Entrance Doors:

- 1. Standard Duty Doors: Model 35D Medium Stile Door YKK AP with Mid-panel panic device system or equivalent by specified manufacturer.

D. Acceptable Storefront Framing Systems:

- 1. Framing System: YES 45 FI (2" x 4-1/2") YKK AP or equivalent by specified manufacturer.

2.2 FRAMING MATERIALS AND ACCESSORIES

A. Aluminum:

- 1. ASTM B221, alloy 6063-T5 for extrusions; ASTM B209, alloy 5005-H34 for sheets; or other alloys and temper recommended by manufacturer appropriate for specified finish.

B. Internal Reinforcing:

- 1. ASTM A36 for carbon steel; or ASTM B308 for structural aluminum.
- 2. Shapes and sizes to suit installation.
- 3. Shop coat steel components after fabrication with alkyd type zinc chromate primer complying with FS TT-P-645.

C. Anchorage Devices:

- 1. Manufacturer's standard formed or fabricated steel or aluminum assemblies of shapes, plates, bars or tubes.

D. Fasteners:

- 1. Aluminum, non-magnetic stainless steel or other materials warranted by manufacturer to be non-corrosive and compatible with components being fastened.
- 2. Do not use exposed fasteners, except where unavoidable for application of hardware.
- 3. For exposed locations, provide countersunk Phillips head screws with finish matching items

- fastened.
- 4. For concealed locations, provide manufacturer's standard fasteners.
- 5. Provide nuts or washers of design having means to prevent disengagement; deforming of fastener threads is unacceptable.
- E. Expansion Anchor Devices: Lead-shield or toothed-steel, drilled-in, expansion bolt anchors.
- F. Protective Coatings: Cold-applied asphalt mastic complying with SSPC-Paint 12, compounded for 30 mil (0.77 mm) thickness for each coat; or alkyd type zinc chromate primer complying with FS TT-P-645.
- G. Glazing Gaskets:
 - 1. Compression type design, replaceable, molded or extruded, of neoprene, or ethylene propylene diene monomer (EPDM).
 - 2. Conform to ASTM C509 or C864.
 - 3. Profile and hardness as required to maintain uniform pressure for watertight seal.
 - 4. Provide in manufacturer's standard black color.
- H. Weatherstripping:
 - 1. Wool pile conforming to AAMA 701.2; or extruded EPDM elastomeric conforming to ASTM C509 or C864.
 - 2. Provide EPDM or vinyl-blade gasket weatherstripping in bottom door rail, adjustable for contact with threshold.
- I. Internal Sealants: Types recommended by sealant manufacturer.
- J. "Anti-Walk" Edge Blocking: "W" shaped EPDM blocks for use in keeping glazing material stationary under vibration or seismic loading.
- K. Baffles (at weep holes): Type as recommended by system manufacturer and shown in published installation instructions.

2.3 GLASS AND GLAZING ACCESSORIES

- A. Refer to Section 08 81 00.

2.4 FABRICATION

- A. Coordination of Fabrication:
 - 1. Check actual frame or door openings required in construction work by accurate field measurements before fabrication.
 - 2. Fabricate units to withstand loads which will be applied when system is in place.
- B. General:
 - 1. Conceal fasteners wherever possible.
 - 2. Reinforce work as necessary for performance requirements and for support to structure.
 - 3. Separate dissimilar metals and aluminum in contact with concrete utilizing protective coating or pre-formed separators which will prevent contact and corrosion.
 - 4. Comply with Section 08 81 00 for glazing requirements.
- C. Aluminum Framing:
 - 1. Provide members of size, shape and profile indicated, designed to provide for glazing from interior.
 - 2. Fabricate frame assemblies with joints straight and tight fitting.
 - 3. Reinforce internally with structural members as necessary to support design loads.
 - 4. Maintain accurate relation of planes and angles, with hairline fit of contacting members.

5. Seal horizontals and direct moisture accumulation to exterior.
6. Provide flashings and other materials used internally or externally that are corrosive resistant, non-staining, non-bleeding and compatible with adjoining materials.
7. Provide manufacturer's extrusions and accessories to accommodate expansion and contraction due to temperature changes without being detrimental to appearance or performance.
8. Make provisions in framing for minimum edge clearance, nominal edge cover and nominal pocket width for thickness and type of glazing or infill used in accordance with recommendations of manufacturer and FGMA Glazing Manual.
9. Provide tight fitting, injection molded, plastic water deflectors at all intermediate horizontals.

D. Entrance Doors:

1. Fabricate with mechanical joints using internal reinforcing plates and shear blocks attached with fasteners and by welding.
2. Provide extruded aluminum glazing stops of [square] [beveled and mitered (for single glazing only)] design, [permanently anchored on security side and removable on opposite side.]

E. Hardware:

1. Receive hardware supplied in accordance with Section 08 71 00 and install in accordance with requirements of this Section.
2. Cut, reinforce, drill and tap frames and doors as required to receive hardware.
3. Comply with hardware manufacturer's templates and instructions.
4. Use concealed fasteners wherever possible.
5. Coordinate mid-panel panic device system with hardware at storefront doors to ensure compatibility.

F. Welding:

1. Comply with recommendations of the American Welding Society.
2. Use recommended electrodes and methods to avoid distortion and discoloration.
3. Grind exposed welds smooth and flush with adjacent surfaces; restore mechanical finish.

G. Flashings:

1. Form from sheet aluminum with same finish as extruded sections. Apply finish after fabrication. Material thickness as required to suit condition without deflection or "oil-canning".

2.5 FINISH

- A. Manufacturer's standard colors as selected by Architect.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions and proceed with Work in accordance with Section 01 40 00.
- B. Verify dimensions, tolerances and method of attachment with other Work.

3.2 INSTALLATION

- A. Erection Tolerances:

1. Limit variations from plumb and level:
 - a. 1/8 inch (3 mm) in 10 feet (3 M) vertically.
 - b. 1/8 inch (3 mm) in 20 feet (6 M) horizontally.
 2. Limit variations from theoretical locations: 1/4 inch (6 mm) for any member at any location.
 3. Limit offsets in theoretical end-to-end and edge-to-edge alignment: 1/16 inch (2 mm) from flush surfaces not more than 2 inches (51 mm) apart or out-of-flush by more than 1/4 inch (6 mm).
- B. Install doors and hardware in accordance with manufacturer's printed instructions.
- C. Set units plumb, level and true to line, without warp or rack of frame.
- D. Anchor securely in place, allowing for required movement, including expansion and contraction.
- E. Separate dissimilar materials at contact points, including metal in contact with masonry or concrete surfaces, with bituminous paint or pre-formed separators to prevent contact and corrosion.
- F. Seal perimeter members as shown on manufacturer's installation instructions or as required for unique job conditions. Set other members with internal sealants and baffles as called for in manufacturer's installation instructions. Use sealants as recommended by sealant manufacturer.
- G. Coordinate installation of perimeter sealant and backing materials between assemblies and adjacent construction in accordance with requirements of Section 07 92 00.
- H. Glazing: Refer to requirements of Section 08 81 00. Utilize "anti-walk" edge blocking on all vertical edges of glazing.
- 3.3 ADJUSTING
- A. Test door operating functions. Adjust closing and latching speeds and other hardware in accordance with manufacturer's instructions to ensure smooth operation.
- 3.4 CLEANING
- A. Clean surfaces in compliance with manufacturer's recommendations; remove excess mastic, mastic smears, foreign materials and other unsightly marks.
- B. Clean metal surfaces exercising care to avoid damage.

END OF SECTION

SECTION 08 71 00

FINISH HARDWARE

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. Work under this section comprises of furnishing hardware specified herein and noted on drawings for a complete and operational system, including any electrified hardware components, systems, controls and hardware for aluminum entrance doors. Any door shown on the drawing and not specifically referenced in the hardware sets shall be provided with identical hardware as specified on other similar openings and shall be included in the General Contractor's base bid. All fire rated door shall be provided with fire rated hardware as required by local code Authority as part of the General Contractor's base bid. The hardware supplier shall verify all cylinder types specified for locking devices supplied as part of the door system with the door manufacturer and/or door supplies.
- B. The General Contractor shall notify the Architect in writing of any discrepancies (five (5) days prior to bid date) that could and/or would result in hardware being supplied that is none functional, hardware specified and/or hardware that has not been specified that will result in any code violations and any door that is not covered in this specification. Failure of the General Contractor to address any such issue could be considered acceptance of the hardware specified and all discrepancies could be corrected at the General Contractor's expense.
- C. Items include but are not limited to the following:
 - 1. Hinges - Pivots
 - 2. Flush Bolts
 - 3. Exit Devices
 - 4. Locksets and Cylinders
 - 5. Push Plates - Pulls
 - 6. Coordinators
 - 7. Closers
 - 8. Kick, Mop and Protection Plates
 - 9. Stops, Wall Bumpers, Overhead Controls
 - 10. Electrified Hold Open Devices
 - 11. Thresholds, Seals and Door Bottoms
 - 12. Silencers
 - 13. Miscellaneous Trim and Accessories

1.02 RELATED DOCUMENTS, drawings and general provisions of contract, including General and Supplementary Conditions, and Division 1 Specification sections, apply to this section.

1.03 RELATED WORK specified elsewhere that should be examined for its effect upon this section:

- A. Section 06 20 00 - Finish Carpentry
- B. Section 08 11 13 – Steel Doors and Frames
- C. Section 08 14 16 – Flush Wood Doors
- D. Sections within 08 31 13 – Access Doors
- E. Section within 08 41 13 – Aluminum Entrances, Storefront and Window Framing
- F. Sections within 08 80 00 – Glass and Glazing

- G. Sections within 09 91 00 - Painting
- H. Division 26 – Electrical
- I. Division 28 – Access Control

1.04 REFERENCES SPECIFIED in this section subject to compliance as directed:

- A. NFPA-80 - Standard for Fire Doors and Windows
- B. NFPA-101 - Life Safety Code
- C. ADA - The Americans with Disabilities Act - Title III - Public Accommodations
- D. ANSI-A 117.1 - American National Standards Institute - Accessible and Usable Buildings and Facilities
- E. ANSI-A 156.5 - American National Standards institute -Auxiliary Locks and Associated Products
- F. UFAS - Uniform Federal Accessibility Standards
- G. UL - Underwriter's Laboratories
- H. WHI - Warnock Hersey International, Testing Services
- I. State and Local Codes including Authority Having Jurisdiction
- J. UL10C – Positive Pressure
- K. IBC-2015 – International Building Code
- L. NFPA-70 – International Electrical Code

1.05 SUBMITTALS

- A. **HARDWARE SCHEDULES** submit copies of schedule in accordance with Division 1, General Requirements. Schedule to be in vertical format, listing each door opening, including: handing of opening, all hardware scheduled for opening or otherwise required to allow for proper function of door opening as intended, and finish of hardware. At doors with door closers or door controls include degree of door opening. Supply the schedules all Finish Hardware within two (2) weeks from date purchase order is received by the hardware supplier.
- B. Submit manufacturer's cut/catalog sheets on all hardware items and any required special mounting instructions with the hardware schedule.
- C. Certification of Compliance:
 - 1. Submit any information necessary to indicate compliance to these specifications as required.
 - 2. Submit a statement from the manufacturer that electronic hardware and systems being supplied comply with the operational descriptions exactly as specified.
- D. Submit any samples necessary as required by the Architect.
- E. Templates for finish hardware items to be sent to related door and frame suppliers within three (3) working days of receipt of approved hardware schedule.
- F. Doors and Frames used in positive pressure opening assemblies shall meet UL10C in areas where this specification includes Seals for smoke door.

1.06 QUALITY ASSURANCE

- A. Hardware supplier to be a qualified, Factory Authorized, direct distributor of the products to be furnished. In addition, the supplier to have in their regular employment an AHC or AHC /CDC and/or a person of equivalent experience (minimum fifteen (15) years in the industry) who will be made available at

reasonable times to consult with the Architect/Contractor and/or the Building Owner regarding any matters affecting the finish hardware on this project.

- B. All hardware used in labeled fire or smoke rated openings to be listed for those types of openings and bear the identifying label or mark indicating UL. (Underwriter's Laboratories) approved for fire. Exit devices in non-labeled openings to be listed for panic.

1.07 DELIVERY, HANDLING AND PACKAGING

- A. Furnish all hardware with each unit clearly marked and numbered in accordance with the hardware schedule. Include door and item number for each.
- B. Pack each item of hardware completes with all necessary parts and fasteners.
- C. Properly wrap and cushion each item to prevent scratches and dents during delivery and storage.

1.08 SEQUENCING AND SCHEDULING

Any part of the finish hardware required by the frame or door manufacturers or other suppliers that is needed to produce doors or frames is to be sent to those suppliers in a timely manner, so as not to interrupt job progress.

1.09 WARRANTY

All finish hardware shall be supplied with a One- (1) year warranty against defects in materials and workmanship, commencing with substantial completion of the project except as follows:

- 1. All Closers are to have a thirty- (30) year written warranty.
- 2. All Exit Devices (Grade 1) are to have a three- (3) year written warranty.
- 3. All ND Series Locksets are to have a ten- (10) year written warranty.
- 4. All L9000 Series Locksets Locks are to have a three- (3) year written warranty.
- 5. All Continuous Hinges are to have a ten- (10) year written warranty.

PART 2 – PRODUCTS

2.01 FASTENERS

- A. Furnish with finish hardware all necessary screws, bolts and other fasteners of suitable size and type to anchor the hardware in position for a long life under hard use.
- B. Furnish fastenings where necessary with expansion shields, toggle bolts and other anchors designated by the Architect according to the material to which the hardware is to be applied and the recommendations of the hardware manufacturer. All closers and exit devices on labeled wood doors shall be through-bolted if required by the door manufacturer. All thresholds shall be fastened with wood screws and plastic anchors. Where specified in the hardware sets, security type fasteners of the type called for are to be supplied.
- C. Design of all fastenings shall harmonize with the hardware as to material and finish.

- D. All hardware shall be installed with the Manufacturers standard screws as provided. The use of any other type of fasteners shall not be permitted. The general contractor shall provide wood blocking in all stud walls specified and/or scheduled to receive wall stops, No Exception.

2.02 ENVIRONMENTAL CONCERN FOR PACKAGING

The hardware shall ship to the job site is to be packaged in biodegradable packs such as paper or cardboard boxes and wrapping.

2.03 HINGES

- A. All hinges to be of one manufacturer as hereafter listed for continuity and consideration of warranty. Provide one of the following manufacturers Ives, ABH, Select or Stanley.
- B. Unless otherwise specified provide five-knuckle, heavy-duty, button tip, full mortise template type hinges with non-rising loose pins. Provide non-removable pins for out swinging doors at secured areas or as called for in this specification (Refer to 3.02 Hardware Sets).
- C. Furnish three (3) hinges up to 90 inches high and one (1) additional hinge for every 30 inches or fraction thereof.
- D. Provide size 4½" x 4½" for all 1¾" thick doors up to and including 36 inches wide. Doors over 1¾" through 2¼" thick, use 5" x 5" hinges. Doors over 36 inches use 5" x 4½" unless otherwise noted in 3.02 Hardware Sets.
- E. Were required to clear the trim and/or to permit the doors to swing 180 degrees furnish hinges of sufficient throw.
- F. Provide heavy weight hinges on all doors over 36 inches in width.
- G. At labeled door's steel or stainless steel, bearing-type hinges shall be provided. For all doors equipped with closers provide bearing-type hinges.

2.04 LOCK AND LOCK TRIM

- A. All the locksets, latch sets, and trim to be of one manufacturer as hereafter listed for continuity of design and consideration of warranty. Locksets specified are Schlage "ND" series with the Rhodes lever and L9000 with 06A levers as specified.
- B. Provide metal wrought box strike boxes and curved lip strikes with proper lip length to protect trim of the frame, but not to project more than 1/8 inch beyond frame trim or the inactive leaf of a pair of doors.
- C. Mechanical Locks shall meet ANSI Operational Grade 1, Series 1000 & 4000 as specified.
 - 1. Hand of lock is to be field reversible or non-handed.
 - 2. All lever trim is to be through-bolted through the door.
 - 3. Provide all pairs of doors with a ¾" latch bolt throw.
 - 4. Provide all doors specified with sound seal with a 3-3/4" extended back-set.

2.05 CYLINDERS AND KEYING

- A. Provide all exterior and interior locks or exit devices requiring cylinders keyed to a New Schlage LFIC Everest Master Key System or to the Existing Schlage Everest Master Key System as instructed by the facility representative. All cylinders shall comply with performance requirements of ANSI A156.5. All keys shall be of nickel silver material only. The hardware supplier shall meet with the General Contractor, the Architect and the Facility Owners Representative at the project jobsite to determine all permanent keying requirements. The hardware supplier shall provide One (1) Knox Box 3200 as required by the local Fire Marshall. The contractor shall, as required by the local Fire Marshall and the Facility Owner mount the Knox Box.
- B. Cylinders shall be factory keyed and factory maintained as directed by the Building Owner and the Architect. Provide three- (3) keys per cylinder and six- (6) master keys per master used.
- C. Factory stamp all keys "Do not duplicate" and with key symbol as directed by the Building Owner. Visual key control shall be provided on all permanent keys and cylinders.
- D. Provide all locks with construction master keyed cores for the complete duration of construction.

2.06 EXIT DEVICES

- A. All exit devices and trim, including electrified items, to be of one manufacturer as hereafter listed and in the hardware sets for continuity of design and consideration of warranty; electrified devices and trim to be the same series and design as mechanical devices and trim.
- B. Exit Devices to be "UL" listed for life safety. All exit devices for labeled doors shall have "UL" label for "Fire Exit Hardware". All devices mounted on labeled wood doors are to be through-bolted or per the manufacturer's listing requirements. All devices shall conform to NFPA 80 and NFPA 101 requirements.
- C. All exit devices to be of a heavy duty, chassis mounted design, with a one-piece removable cover, eliminating necessity of removing the device from the door for standard maintenance and keying requirements.
- D. All trims to be through-bolted to the lock stile case. Lever design to be the same as specified with the lock sets ("Rhodes" #06 lever design).
- E. Exit Devices shall be the modern push rail design. All exit devices shall be mounted with sex bolts.
- F. All devices shall carry a three- (3) year warranty against manufacturing defects and workmanship. Exit devices shall be certified by an independent testing lab for a minimum of 1,000,000 cycles.
- G. Furnish roller strikes for all rim and surface vertical rod exit devices. Internal springs shall be coil compression type. Furnish security dead latching for all active latch bolts. Latch bolts to have self lubricating coating to reduce friction and wear. Plated latch bolts not accepted.

- H. All Exit Devices shall be field modifiable as incorporate an Electric Latch Retraction Feature without the purchase of new Panic Exit Hardware.
- J. Exit Devices shall be the Von Duprin "3349, 9949, 9950 & 99" series as specified.

2.07 SURFACE MOUNTED DOOR CLOSERS

- A. All closers for this project shall be the products of a single manufacturer for continuity of design and consideration of warranty. All door closers shall be mounted as to achieve the maximum degree of opening (trim permitting).
- B. All closers to be heavy duty, surface-mounted, fully hydraulic, rack and pinion action with high strength cast iron cylinder to provide control throughout the entire door opening cycle.
- C. Size all closers in accordance with the manufacturer's recommendations at the factory.
- D. All closers to have adjustable spring power sizes 1 or 2 through 4 or 6 and separate tamper resistant, brass, non-critical regulating screw valves for closing speed, latching speed and back-check control as a standard feature unless specified other wise.
- E. All closer covers to be rectangular, full cover type of non-ferrous, non-corrosive material painted to match closer. Provide closer covers only if provided as a standard part of the door closer package.
- F. Closers shall have heavy-duty arms. All closer arms shall be of sufficient length to accommodate the reveal depth and to insure proper installation. The hardware supplier shall provide all required brackets, spacers or filler plates as required by the manufacture for a proper and functional installation as part of their base bid.
- G. Supply appropriate arm assembly for each closer so that closer body and arm are mounted on non-public side of door opening and on the interior side of exterior openings, except where required otherwise in the hardware sets.
 - 1. All parallel arm mounted closers to be factory indexed to insure proper installation.
 - 2. Furnish heavy-duty cold forged parallel arms for all parallel arm mounted closers.
- H. Provide closers with special application and heavy-duty arms as specified in the hardware sets or as otherwise called for to insure a proper operating, long lasting opening. Drop plates and any additional mounting brackets required for the proper installation of the door closer shall be included in the hardware supplier's base bid.
- I. Finish: Baked on Powder Coated finish shall match other hardware.
- J. Provide and mount all door closers with sex bolts as provided by the manufacturer.
- K. Closers shall be 1460 series as specified or acceptable products manufactured by Sargent 281 series.

2.08 DOOR STOPS AND HOLDERS

- A. Door stops are to be furnished for every door leaf. Every door is to have a floor, wall, or an overhead stop.
 - B. Place doorstops in such a position that they permit maximum door swing, but do not present a hazard of obstruction. Furnish floor strikes for floor holders of proper height to engage holders of doors.
 - C. Where overhead stops and holders are specified, or otherwise required for proper door operation, they are to be heavy duty and of extruded brass, bronze or stainless steel with no plastic parts as specified. The General Contractor shall provide wood blocking in all stud walls specified and scheduled to receive wall stops.
 - D. Finish: Shall match other hardware where available.
 - E. Acceptable Products
 - 1. Floor and wall stops as listed in hardware sets. Equivalent products as manufactured by Ives, ABH, Glynn Johnson and Trimco are acceptable.
- 2.09 PUSH PLATES, DOOR PULLS, AND KICKPLATES
- A. All push plates, door pull, kick plates and other miscellaneous hardware as listed in hardware sets. Equivalent products as manufactured by Ives, ABH, Glynn Johnson and Trimco are acceptable.
 - B. Kick plates to be 10 inches high and Mop plates to be 6 inches high, both by 1-1/2 inches or 1 inch less than door width (LDW) as specified. They are to be of 16-gauge thick base metal. For door with louvers or narrow bottom rails, kick plate height to be 1 inch less dimension shown from the bottom of the door to the bottom of the louver or glass.
 - C. Where required armor plates, edge guards and other protective hardware shall be supplied in sizes as scheduled in the hardware sets.
 - D. Finish: Same as other hardware where available.
- 2.10 FLUSH BOLTS AND COORDINATORS
- A. Provide Flush bolts with Dust Proof Strikes as indicated in the individual hardware sets by Ives, ABH, Glynn Johnson and Trimco are acceptable. Finish shall match the adjacent hardware.
- 2.11 THRESHOLDS AND SEALS
- A. Provide materials and finishes as listed in hardware sets. National Guard Products has been specified to set a high level of quality, equivalent product by manufactured by Zero, and Pemko shall be acceptable. All thresholds must be in accordance with the requirements of the ADA and ANSI A117.1.
 - B. Provide thresholds with wood screws and plastic anchors. Supply all necessary anchoring devices for weather strip and sound seal.

- C. Seals shall comply with requirements of UL10C. All thresholds, door bottoms and weather strip inserts shall be a silicone-based product as specified in 3.02 Hardware Sets. Other materials used shall be rejected, unless originally specified.
- D. Seals shall comply with the requirements of the Wood Door Manufacturer's certification requirements.
- E. All thresholds shall be provided with none slip coating as specified in the hardware sets.

2.12 FINISHES

- A. Finishes for all hardware are as required in this specification and the hardware sets.
- B. Special care is to be taken to make uniform the finish of all various manufactured items.

2.13 DOOR SILENCERS

- A. Provide door silencers at all openings without gasket. Provide two- (2) each at pair of doors and three- (3) or four- (4) each for each single door (coordinate with the frame manufacturer).

2.14 KEY CABINET

- A. Provide a key cabinet Lund 1200 series (two tag system) for installation by the contractor as instructed by the Architect and Owners Representative. Key Cabinet shall be of such size as to hold 150% of the total number of keys supplied for this project.
- B. The hardware supplier shall assist Owners Representative in the tagging of all keys and instruct the Owners staff as to the proper use of the key cabinet system at the project site. Training shall include industry standard procedures for maintaining a key system. The hardware supplier shall provide Owners Representative two- (2) complete full-size copies of the floor plans complete with the door number and key symbol shown at each door opening. One- (1) copy shall be placed in the key cabinet and one- (1) copy shall be turned over to the Owners Representative. Training shall be based on eight- (8) hours maximum. The hardware supplier shall send a list of all staff members trained in the proper use of the key cabinet to the Owners Representative and the Architect.

2.15 PROPRIETARY PRODUCTS

- A. References to specific products are used to establish quality standards of utility and performance. Unless otherwise approved provide only the specified product.
- B. All other materials, not specifically described, but required for a complete and proper finish hardware installation, are to be selected by the Contractor, subject to the approval of the Architect and the Building Owner.
- C. Architect and the Building Owner reserve the right to approve all the substitutions proposed for this specification. All requests for substitution to be made prior to bid in accordance with Division 1, General Requirements, and are to be in writing, hand delivered to the Architect. Two (2) copies of the manufacturer's brochures

and a physical sample of each item in the appropriate design and finish shall accompany requests for substitution.

PART 3 - EXECUTION

3.01 INSTALLATION AND SERVICE ITEMS OF FINISH HARDWARE

- A. All finish hardware shall be installed by an experienced finish hardware installer with at least ten (10) years experience after a pre-installation meeting between the contractor, hardware Manufacturers representative, the hardware supplier, the hollow metal supplier and the wood door supplier. The finish hardware installer shall be responsible for the proper installation and function of all doors and hardware.
- B. The hardware supplier's office and/or warehouse shall be located within a one hundred twenty-five (125) mile radius of the project site as to better service the general contractor and the Facility Owner during this project.
- C. Check hardware against the reviewed hardware schedule upon delivery. Store the hardware in a dry and secure location to protect against loss and damage.
- D. Install finish hardware in accordance with approved hardware schedule and manufacturers' printed instructions. Pre-fit hardware before finish is applied to door; remove and reinstall after finish is complete and dry. Install and adjust hardware so that parts operate smoothly, close tightly, and do not rattle.
- E. Mortise and cutting to be done neatly, and evidence of cutting to be concealed in the finished work. Protect all Finish hardware from scratching or other damage.

3.02 HARDWARE SETS

SPEXTRA: 433020

HARDWARE GROUP NO. 001

FOR USE ON MARK/DOOR #(S):

200A 200B 200C

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CYLINDER	20-059/20-079 AS REQUIRED	626	SCH
1	EA	FSIC CORE	23-030	626	SCH
1	EA	FSIC CORE	23-030 ICX	622	SCH

HARDWARE GROUP NO. 101

FOR USE ON MARK/DOOR #(S):

204

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	ENTRANCE LOCK	ND53TD RHO	626	SCH
1	EA	FSIC CORE	23-030	626	SCH
1	EA	SURFACE CLOSER	1461 HD FC TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 1 1/2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE

3 EA SILENCER SR64 GRY IVE

HARDWARE GROUP NO. 101A

FOR USE ON MARK/DOOR #(S):
202

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	ENTRANCE LOCK	ND53TD RHO	626	SCH
1	EA	FSIC CORE	23-030	626	SCH
1	EA	SURFACE CLOSER	1461 HD FC TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 1 1/2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	GASKETING	8303AA-HEAD & JAMBS	AA	ZER
1	EA	DOOR SWEEP	50MAA-DOOR WIDTH	AA	ZER
1	EA	THRESHOLD	655A-223-FRAME WIDTH	A	ZER

HARDWARE GROUP NO. 101G

FOR USE ON MARK/DOOR #(S):
208

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	ENTRANCE LOCK	ND53TD RHO	626	SCH
1	EA	FSIC CORE	23-030	626	SCH
1	EA	SURFACE CLOSER	1461 HD FC WMS	689	LCN
1	EA	KICK PLATE	8400 10" X 1 1/2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	GASKETING	8303AA-HEAD & JAMBS	AA	ZER
1	EA	DOOR SWEEP	50MAA-DOOR WIDTH	AA	ZER
1	EA	THRESHOLD	655A-223-FRAME WIDTH	A	ZER

HARDWARE GROUP NO. 101GN

FOR USE ON MARK/DOOR #(S):
200

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	PANIC HARDWARE	99-L-BE-06-SNB	626/628	VON
1	EA	SURFACE CLOSER	1461 HD FC TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 1 1/2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	GASKETING	8303AA-HEAD & JAMBS	AA	ZER

1	EA	DOOR SWEEP	50MAA-DOOR WIDTH	AA	ZER
1	EA	THRESHOLD	655A-223-FRAME WIDTH	A	ZER

HARDWARE GROUP NO. 103

FOR USE ON MARK/DOOR #(S):

107	110	111	120	120B	121
122	123	125	126	127	128
129	130	131	137	203	209
210	211	213	214		

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	ENTRANCE LOCK	ND53TD RHO	626	SCH
1	EA	FSIC CORE	23-030	626	SCH
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

HARDWARE GROUP NO. 103A

FOR USE ON MARK/DOOR #(S):

116

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	ENTRANCE LOCK	ND53TD RHO	626	SCH
1	EA	FSIC CORE	23-030	626	SCH
1	EA	FLOOR STOP	FS410	626	IVE
3	EA	SILENCER	SR64	GRY	IVE

HARDWARE GROUP NO. 105

FOR USE ON MARK/DOOR #(S):

201

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	652	IVE
1	EA	PANIC HARDWARE	99-L-06-SNB	626/628	VON
1	EA	RIM CYLINDER HOUSING	20-079	626	SCH
1	EA	FSIC CORE	23-030	626	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH TBSRT	689	LCN
1	EA	PA MOUNTING PLATE	4040XP-18PA	689	LCN
1	EA	CUSH SHOE SUPPORT	4040XP-30	689	LCN
1	EA	KICK PLATE	8400 10" X 1 1/2" LDW B-CS	630	IVE
1	EA	RAIN DRIP	142AA-FRAME WIDTH PLUS 4"	AA	ZER
1	EA	GASKETING	8303AA-HEAD & JAMBS	AA	ZER

1	EA	DOOR SWEEP	50MAA-DOOR WIDTH	AA	ZER
1	EA	THRESHOLD	65A-223-FRAME WIDTH	A	ZER

HARDWARE GROUP NO. 201

FOR USE ON MARK/DOOR #(S):
132

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	CLASSROOM LOCK	ND70TD RHO	626	SCH
1	EA	FSIC CORE	23-030	626	SCH
1	EA	SURFACE CLOSER	1461 HD FC TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 1 1/2" LDW B-CS	630	IVE
1	EA	FLOOR STOP	FS410	626	IVE
3	EA	SILENCER	SR64	GRY	IVE

HARDWARE GROUP NO. 203

FOR USE ON MARK/DOOR #(S):
112

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	ND80TD RHO	626	SCH
1	EA	FSIC CORE	23-030	626	SCH
1	EA	SURFACE CLOSER	1461 HD FC TBSRT	689	LCN
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

HARDWARE GROUP NO. 203N

FOR USE ON MARK/DOOR #(S):
113

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	STOREROOM LOCK	ND80TD RHO	626	SCH
1	EA	FSIC CORE	23-030	626	SCH
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

HARDWARE GROUP NO. 210

FOR USE ON MARK/DOOR #(S):
119

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
6	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
2	EA	MANUAL FLUSH BOLT	FB458	626	IVE
1	EA	DUST PROOF STRIKE	DP2	626	IVE
1	EA	STOREROOM LOCK	ND80TD RHO	626	SCH
1	EA	FSIC CORE	23-030	626	SCH
1	EA	SURFACE CLOSER	1461 HD FC TBSRT	689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS	630	IVE
2	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	FLAT ASTRAGAL	905A	A	ZER
2	EA	SILENCER	SR64	GRY	IVE

HARDWARE GROUP NO. 303

FOR USE ON MARK/DOOR #(S):
124

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PRIVACY LOCK	ND40S RHO	626	SCH
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

HARDWARE GROUP NO. 341

FOR USE ON MARK/DOOR #(S):
103 212

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PRIVACY LOCK	L9040 06A L583-363 L283-721	626	SCH
1	EA	SURFACE CLOSER	1461 HD FC TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 1 1/2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

HARDWARE GROUP NO. 401

FOR USE ON MARK/DOOR #(S):
114 114A 215

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
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3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PASSAGE SET	ND10S RHO	626	SCH
1	EA	SURFACE CLOSER	1461 HD FC TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 1 1/2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

HARDWARE GROUP NO. 401A

FOR USE ON MARK/DOOR #(S):
114B

EACH TO HAVE:

QTY	DESCRIPTION	CATALOG NUMBER	FINISH	MFR
	ALL HARDWARE	PROVIDED BY THE DOOR MFG		

HARDWARE GROUP NO. 403

FOR USE ON MARK/DOOR #(S):
104

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PASSAGE SET	ND10S RHO	626	SCH
1	EA	SURFACE CLOSER	1461 HD FC TBSRT	689	LCN
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

HARDWARE GROUP NO. 403A

FOR USE ON MARK/DOOR #(S):
105 106

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PASSAGE SET	ND10S RHO	626	SCH
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

HARDWARE GROUP NO. 403B

FOR USE ON MARK/DOOR #(S):
115

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	ND80TD RHO	626	SCH
1	EA	FSIC CORE	23-030	626	SCH
1	EA	KICK PLATE	8400 10" X 1 1/2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

HARDWARE GROUP NO. 503

FOR USE ON MARK/DOOR #(S):
205

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	ND80TD RHO	626	SCH
1	EA	FSIC CORE	23-030	626	SCH
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

HARDWARE GROUP NO. 701

FOR USE ON MARK/DOOR #(S):
102A

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	652	IVE
1	EA	PANIC HARDWARE	99-L-06	626	VON
1	EA	RIM CYLINDER HOUSING	20-079	626	SCH
1	EA	FSIC CORE	23-030	626	SCH
1	EA	FSIC CORE	23-030 ICX	622	SCH
1	EA	SURFACE CLOSER	1461 SCUSH FC TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 1 1/2" LDW B-CS	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

HARDWARE GROUP NO. 801

FOR USE ON MARK/DOOR #(S):
117 118 206 207

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	PUSH PLATE	8200 8" X 16"	630	IVE
1	EA	PULL PLATE	8305 8" 3.5" X 15"	630	IVE
1	EA	SURFACE CLOSER	1461 HD FC TBSRT	689	LCN

1	EA	KICK PLATE	8400 10" X 1 1/2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

HARDWARE GROUP NO. C201

FOR USE ON MARK/DOOR #(S):
108

EACH TO HAVE:

QTY	DESCRIPTION	CATALOG NUMBER	FINISH	MFR
	ALL HARDWARE	PROVIDED BY THE VAULT DOOR MFG		

VAULT DOOR

HARDWARE GROUP NO. C201I

FOR USE ON MARK/DOOR #(S):
105A 106A

EACH TO HAVE:

QTY	DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3 EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1 EA	ELECTRIC STRIKE	8300-2001M-2006M	630	HES
1 EA	STOREROOM LOCK	ND80TD RHO	626	SCH
1 EA	FSIC CORE	23-030	626	SCH
1 EA	SURFACE CLOSER	1461 HD FC TBSRT	689	LCN
1 EA	KICK PLATE	8400 10" X 1 1/2" LDW B-CS	630	IVE
1 EA	WALL STOP	WS406/407CCV	630	IVE
3 EA	SILENCER	SR64	GRY	IVE
	CARD READER	PROVIDED BY OTHER		
	POWER SOURCE	PROVIDED BY OTHER		
	DOOR POSITION SWITCH	PROVIDED BY OTHER		

-ENTRANCE BY CARD READER OR OUTSIDE KEY.

-FREE EGRESS BY INSIDE LEVER AT ALL TIMES.

HARDWARE GROUP NO. C201N

FOR USE ON MARK/DOOR #(S):
136

EACH TO HAVE:

QTY	DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3 EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1 EA	ELECTRIC STRIKE	8300-2001M-2006M	630	HES
1 EA	STOREROOM LOCK	ND80TD RHO	626	SCH
1 EA	FSIC CORE	23-030	626	SCH

1	EA	SURFACE CLOSER	1461 HDPA FC TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 1 1/2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE
		CARD READER	PROVIDED BY OTHER		
		POWER SOURCE	PROVIDED BY OTHER		
		DOOR POSITION SWITCH	PROVIDED BY OTHER		

-ENTRANCE BY CARD READER OR OUTSIDE KEY.
-FREE EGRESS BY INSIDE LEVER AT ALL TIMES.

HARDWARE GROUP NO. C202I

FOR USE ON MARK/DOOR #(S):
120C

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	ELECTRIC STRIKE	8300-2001M-2006M	630	HES
1	EA	STOREROOM LOCK	ND80TD RHO	626	SCH
1	EA	FSIC CORE	23-030	626	SCH
1	EA	SURFACE CLOSER	1461 HD FC TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 1 1/2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	DOOR SCOPE	DS2200-2 1/8"	BLK	DSI
3	EA	SILENCER	SR64	GRY	IVE
		CARD READER	PROVIDED BY OTHER		
		POWER SOURCE	PROVIDED BY OTHER		
		DOOR POSITION SWITCH	PROVIDED BY OTHER		

-ENTRANCE BY CARD READER OR OUTSIDE KEY.
-FREE EGRESS BY INSIDE LEVER AT ALL TIMES.

HARDWARE GROUP NO. C205

FOR USE ON MARK/DOOR #(S):
134

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	652	IVE
1	EA	ELECTRIC HINGE	5BB1HW 4.5 X 4.5 TW8	652	IVE
1	EA	STOREROOM LOCK	ND80TDEU RHO RX	626	SCH
1	EA	FSIC CORE	23-030	626	SCH
1	EA	LOCK GUARD	LG12	630	IVE
1	EA	OH STOP	100S	630	GLY
1	EA	KICK PLATE	8400 10" X 1 1/2" LDW B-CS	630	IVE
1	EA	RAIN DRIP	142AA-FRAME WIDTH PLUS 4"	AA	ZER
1	EA	GASKETING	8303AA-HEAD & JAMBS	AA	ZER

1	EA	DOOR SWEEP	50MAA-DOOR WIDTH	AA	ZER
1	EA	THRESHOLD	65A-223-FRAME WIDTH	A	ZER
		CARD READER	PROVIDED BY OTHER		
		POWER SOURCE	PROVIDED BY OTHER		
		DOOR POSITION	PROVIDED BY OTHER		
		SWITCH			

-ENTRANCE BY CARD READER OR OUTSIDE KEY.
-FREE EGRESS BY INSIDE LEVER AT ALL TIMES.

HARDWARE GROUP NO. C710

FOR USE ON MARK/DOOR #(S):
102

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	EA	CONTINUOUS HINGE	A110HD R TW12-DOOR HEIGHT	628	ABH
1	EA	ELEC PANIC HARDWARE	RX-QEL-3350AWDC-DT	626/628	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-3350AWDC-NL	626/628	VON
1	EA	RIM CYLINDER HOUSING	20-079	626	SCH
1	EA	FSIC CORE	23-030	626	SCH
1	EA	FSIC CORE	23-030 ICX	622	SCH
2	EA	SURFACE CLOSER	1461 SCUSH FC TBSRT	689	LCN
2	EA	PA MOUNTING PLATE	1460-18PAFC	689	LCN
2	EA	CUSH SHOE SUPPORT	1460-30	689	LCN
		CARD READER	PROVIDED BY OTHER		
		POWER SOURCE	PROVIDED BY OTHER		
		DOOR POSITION	PROVIDED BY OTHER		
		SWITCH			

-ENTRANCE BY CARD READER OR OUTSIDE KEY.
-FREE EGRESS BY EXIT DEVICE AT ALL TIMES.

HARDWARE GROUP NO. C710A

FOR USE ON MARK/DOOR #(S):
100A

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	EA	CONTINUOUS HINGE	A110HD R TW12-DOOR HEIGHT	628	ABH
1	EA	ELEC PANIC HARDWARE	RX-QEL-3350AWDC-DT	626/628	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-3350AWDC-NL	626/628	VON
1	EA	RIM CYLINDER HOUSING	20-079	626	SCH
1	EA	FSIC CORE	23-030	626	SCH

1	EA	FSIC CORE	23-030 ICX	622	SCH
2	EA	SURFACE CLOSER	1461 SCUSH FC WMS	689	LCN
2	EA	PA MOUNTING PLATE	1460-18PAFC	689	LCN
2	EA	CUSH SHOE SUPPORT	1460-30	689	LCN
		CARD READER	PROVIDED BY OTHER		
		POWER SOURCE	PROVIDED BY OTHER		
		DOOR POSITION SWITCH	PROVIDED BY OTHER		
		SEALS	PROVIDED BY THE ALUMINUM FRAME MFG		

-ENTRANCE BY CARD READER OR OUTSIDE KEY.
-FREE EGRESS BY EXIT DEVICE AT ALL TIMES.

HARDWARE GROUP NO. C714

FOR USE ON MARK/DOOR #(S):
133A

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	EA	CONTINUOUS HINGE	A110HD R TW12-DOOR HEIGHT	628	ABH
1	EA	ELEC PANIC HARDWARE	RX-QEL-9949-DT	628	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-9949-NL	628	VON
1	EA	RIM CYLINDER HOUSING	20-079	626	SCH
1	EA	FSIC CORE	23-030	626	SCH
1	EA	FSIC CORE	23-030 ICX	622	SCH
2	EA	SURFACE CLOSER	4040XP SCUSH TBSRT	689	LCN
1	EA	RAIN DRIP	142AA-FRAME WIDTH PLUS 4"	AA	ZER
1	EA	MEETING STILE	328AA-S X 2PCS.	AA	ZER
1	EA	GASKETING	8303AA-HEAD & JAMBS	AA	ZER
2	EA	DOOR SWEEP	50MAA-DOOR WIDTH	AA	ZER
1	EA	THRESHOLD	65A-223-FRAME WIDTH	A	ZER
		CARD READER	PROVIDED BY OTHER		
		POWER SOURCE	PROVIDED BY OTHER		
		DOOR POSITION SWITCH	PROVIDED BY OTHER		

-ENTRANCE BY CARD READER OR OUTSIDE KEY.
-FREE EGRESS BY EXIT DEVICE AT ALL TIMES.

HARDWARE GROUP NO. C714A

FOR USE ON MARK/DOOR #(S):
100

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	EA	CONTINUOUS HINGE	A110HD R TW12-DOOR HEIGHT	628	ABH

1	EA	ELEC PANIC HARDWARE	RX-QEL-3350AWDC-DT	626/628	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-3350AWDC-NL	626/628	VON
1	EA	RIM CYLINDER HOUSING	20-079	626	SCH
1	EA	FSIC CORE	23-030	626	SCH
1	EA	FSIC CORE	23-030 ICX	622	SCH
2	EA	SURFACE CLOSER	4040XP SCUSH TBSRT	689	LCN
2	EA	PA MOUNTING PLATE	4040XP-18PA	689	LCN
2	EA	CUSH SHOE SUPPORT	4040XP-30	689	LCN
2	EA	DOOR SWEEP	50MAA-DOOR WIDTH	AA	ZER
1	EA	THRESHOLD	655A-223-FRAME WIDTH	A	ZER
		CARD READER	PROVIDED BY OTHER		
		POWER SOURCE	PROVIDED BY OTHER		
		DOOR POSITION	PROVIDED BY OTHER		
		SWITCH			
		SEALS	PROVIDED BY THE ALUMINUM FRAME MFG		

-ENTRANCE BY CARD READER OR OUTSIDE KEY.
-FREE EGRESS BY EXIT DEVICE AT ALL TIMES.

HARDWARE GROUP NO. C715

FOR USE ON MARK/DOOR #(S):

133 133B

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONTINUOUS HINGE	A110HD R TW12-DOOR HEIGHT	628	ABH
1	EA	ELEC PANIC HARDWARE	RX-QEL-99-NL-SNB	628	VON
1	EA	RIM CYLINDER HOUSING	20-079	626	SCH
1	EA	FSIC CORE	23-030	626	SCH
1	EA	FSIC CORE	23-030 ICX	622	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 1 1/2" LDW B-CS	630	IVE
1	EA	RAIN DRIP	142AA-FRAME WIDTH PLUS 4"	AA	ZER
1	EA	GASKETING	8303AA-HEAD & JAMBS	AA	ZER
1	EA	DOOR SWEEP	50MAA-DOOR WIDTH	AA	ZER
1	EA	THRESHOLD	65A-223-FRAME WIDTH	A	ZER
1	EA	DOOR SCOPE	DS2200-2 1/8"	BLK	DSI
		CARD READER	PROVIDED BY OTHER		
		POWER SOURCE	PROVIDED BY OTHER		
		DOOR POSITION	PROVIDED BY OTHER		
		SWITCH			

-ENTRANCE BY CARD READER OR OUTSIDE KEY.
-FREE EGRESS BY EXIT DEVICE AT ALL TIMES.

END OF SECTION

SECTION 08 81 00 — GLASS AND GLAZING

PART 1 - GENERAL

1.1 COORDINATION

- A. The General Conditions of the Contract for Construction and the Supplementary Conditions to the General Conditions of the Contract for Construction shall be considered as part of this section of the specifications.
- B. Each Bidder shall be responsible for determining during the bidding period the extent that any addenda issued during the bidding period may affect this section of the specifications.
- C. Reference Instructions to Bidders for requirements regarding substitutions of materials and products.
- D. Where conflicts occur between the drawings and specifications, between different drawings, between different portions of this section of the specifications, or between different sections of the specifications, the more stringent requirements and the greater quantity shall apply.

1.2 WORK INCLUDED

- A. Glazing for hollow metal doors and frames.
- B. Glazing for aluminum frames.

1.3 RELATED WORK SPECIFIED IN OTHER SECTIONS

- A. Hollow metal doors and frames.
- B. Aluminum entrances and storefronts.
- C. Aluminum window systems.

1.4 SUBMITTALS

- A. Submit manufacturer's literature with material and performance descriptions for each type of glass, sealant and glazing accessories.
- B. Submit detailed shop drawings indicating locations, installation and sealing methods.
- C. Submit 12" x 12" physical samples of each type of tinted or wire glass and panel.
- D. Obtain approved shop drawings from hollow metal supplier, aluminum frame supplier, plastic laminate door supplier.
- E. Reference Section 01 33 00 SUBMITTALS for additional submittal requirements.

1.5 WARRANTY

- A. Provide written warranty against defects in materials and workmanship for the work under this section for a period of one year after the date of Substantial Completion of the project.
- B. Warranted defects shall include but not necessarily be limited to water infiltration, air infiltration, glass failure due to improper sizing or installation, sealant failure.

1.6 QUALITY ASSURANCE

- A. Glazing contractor shall have a minimum of 3 years experience in the installation of glazing products for projects of similar size and scope as this project.
- B. Each piece of glass shall bear manufacturer's label indicating type.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Do not deliver glass or panels to the jobsite until openings are ready for glazing.
- B. Deliver glass and panels in manufacturer's original protective packaging. Store in a dry, well ventilated area and take care to prevent condensation on the materials. Keep glass faces separated.

1.8 MINIMUM COMPLIANCE STANDARDS

- A. **SAFETY:** Contractor shall be responsible for meeting all Federal and applicable code requirements for types and locations of glazing regardless of drawing indications. Comply with the current standards of the Consumer Products Safety Commission and Federal Standard 16 CFR 1201 Federal Architectural Glazing Materials Safety Standard.
- B. **INSTALLATION:** Comply with recommendations of Flat Glass Marketing Association – FGMA Glazing Manual.

PART 2 - PRODUCTS

2.1 GENERAL

- A. **GLAZING SHEETS:** Glazing materials shall conform to the highest qualities as specified in the following standards:
 - 1. Float glass: FS DD-G-451d and ASTM C1036.
 - 2. Float glass, heat strengthened: ASTM C1036 and ASTM C1048.
 - 3. Float glass, tempered: FS DD-G-1403B and ASTM C1036, ASTM C1048, ANSI Z97.1, and Consumer Product Safety Commission 16 CFR 1201.
 - 4. Wired glass: FS DD-G-451, ASTM C1036 and ANSI Z97.1. Misco diamond pattern.
 - 5. Insulating glass: ASTM C1036. Meet industry standards set by the Sealed Insulating Glass Manufacturers Association (SIGMA).
- B. **MISCELLANEOUS**
 - 1. Glazing sealants: FS TT-S-1543A (silicone rubber); FS TT-S-230 (synthetic rubber); FS TT-S-001657 (butyl rubber).
 - 2. Glazing tape: Architectural Aluminum Manufacturer's Association.

2.2 MANUFACTURERS

- A. GLASS:
 - 1. Guardian
 - 2. PPG Industries
 - 3. Pilkington.
- B. TEMPERING, LAMINATING AND HEAT STRENGTHENING:
 - 1. Oldcastle
 - 2. Trulite
- C. WIRE GLASS:
 - 1. Pilkington
 - 2. PPG Industries
- D. GLAZING TAPE:
 - 1. TREMCO – tape, shims, setting blocks, edge blocking.
- E. GLAZING SEALANT:
 - 1. TREMCO,
 - 2. General Electric.

2.3 MATERIALS: Types as indicated in the drawings.

- A. TEMPERED GLASS: 1/4" clear and solar tint float glass tempered by the vertical or horizontal process and meeting requirements of FS DD-G-1403B.
- B. WIRE GLASS: Shall be 1/4" thick. Polish plate glass reinforced with diamond pattern wire mesh No. 24 gauge minimum, with a mesh not larger than 1".
- C. HOLLOW METAL FRAME AND DOOR GLAZING SYSTEM:
 - 1. Glazing: 1/4" Tempered.
 - 2. Glazing tape: 1/8" x 3/8" x continuous preshimmied butyl tape; Tremco 440.
 - 3. Setting blocks: Neoprene or EPDM in minimum 4" lengths.
 - 4. Edge blocking: Neoprene or EPDM in minimum 4" lengths and sized to allow for 1/8" clear expansion at both vertical edges.
 - 5. Add sealant at exterior glazing.

2.4 INSULATING GLASS

- A. Solar Control Tinted Insulated Units
 - 1. Conformance: ASTM C 1172 and complying with testing requirements in CPSC 16CFR-1201 for Category II materials.
 - 2. Overall Thickness: 1 inch (25 mm)
 - 3. Outboard Lite: Bronze float glass.
 - a. Tinted Float Glass: ASTM C 1036, Type I, Class 2, Quality q3.
 - b. Glass Thickness: 1/4 inch (6 mm).
 - c. Heat Treatment: Fully Tempered, ASTM C 1048, Kind FT
 - 4. Interspace: 1/2 inch (12 mm) hermetically sealed air
 - 5. Inboard Lite: Clear float glass.
 - a. Clear Float Glass: ASTM C 1036, Type I, Class 1, Quality q3.
 - b. Glass Thickness: 1/4 inch (6 mm).
 - c. Heat Treatment: Fully Tempered, ASTM C 1048, Kind FT
 - 6. Sealant: Approved by glass manufacturer.

7. Nominal shading coefficient: 0.53

PART 3 - EXECUTION

3.1 INSTALLATION

- A. **GENERAL:** Install glass without warping, binding or stress. Allow for expansion and contraction of glass due to temperature changes. Do not install sealant with surfaces or ambient temperature below 40 degrees F.
- B. **HOLOW METAL FRAMES AND DOORS:**
 1. Ensure that finish painting of doors and frames is complete.
 2. Cut glazing tape to length and install against permanent stop, flush with face of stop.
 3. Place setting blocks at 1/4 points.
 4. Rest glass on setting blocks and press against stop for full contact and adhesion at perimeter.
 5. Place continuous glazing tape on opposite-face perimeter of glass in same manner described above. Install removable stop; avoid displacement of tape; and exert pressure on tape for full continuous contact.
 6. Knife trim excess of protruding tape (leave recessed for sealant at exterior glazing).
 7. Do not touch glass to metal.
- C. **PLASTIC LAMINATE DOORS:**
 1. Follow procedures specified above for non-rated doors. Metal stops provided by door manufacturer.
 2. Follow recommendations of door manufacturer for rated doors. Metal stops provided by door manufacturer.
- D. **ALUMINUM FRAMES:** Follow door and frame manufacturer's printed instructions for glazing gasketed systems. Provide watertight installation at exterior systems.

3.2 CLEANING AND PROTECTION

- A. During glazing operations, provide sufficient stick-on safety labels or hang streamers on new glazing.
- B. Prior to project closeout, thoroughly clean all glazing inside and out with commercial glass cleaner.
- C. Reglaze any openings where glass is chipped, broken, scratched, pitted or stained.

END OF SECTION

SECTION 08 91 00 - LOUVERS AND VENTS

PART 1 – GENERAL

1.0 COORDINATION

- A. The General Conditions of the Contract for Construction and the Supplementary Conditions to the General Conditions of the Contract for Construction shall be considered as part of this section of the specifications.
- B. Each Bidder shall be responsible for determining during the bidding period the extent that any addenda issued during the bidding period may affect this section of the specifications.
- C. Reference Instructions to Bidders for requirements regarding substitutions of materials and products.
- D. Where conflicts occur between the drawings and specifications, between different drawings, between different portions of this section of the specifications, or between different sections of the specifications, the more stringent requirements and the greater quantity shall apply.

1.1 SUMMARY

- A. Section Includes:
 - 1. Fixed, prefinished formed-metal louvers.
- B. Related Sections:
 - 1. Division 04 Section "Unit Masonry" for building wall vents (brick vents) into masonry.
 - 2. Division 09 Section "Exterior Painting."

1.2 DEFINITIONS

- A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section unless otherwise defined in this Section or in referenced standards.
- B. Horizontal Louver: Louver with horizontal blades; i.e., the axes of the blades are horizontal.
- C. Vertical Louver: Louver with vertical blades; i.e., the axes of the blades are vertical.
- D. Drainable-Blade Louver: Louver with blades having gutters that collect water and drain it to channels in jambs and mullions, which carry it to bottom of unit and away from opening.
- E. Storm-Resistant Louver: Louver that provides specified wind-driven rain performance, as determined by testing according to AMCA 500-L.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design louvers, including comprehensive engineering analysis by a qualified professional engineer, using structural performance requirements and design criteria indicated.

- B. Structural Performance: Louvers shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building.
 - 1. Wind Loads: Design to withstand TDI requirements for Inland I conditions.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes, without buckling, opening of joints, overstressing of components, failure of connections, or other detrimental effects.
 - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
- D. Louver Performance Ratings: Provide louvers complying with requirements specified, as demonstrated by testing manufacturer's stock units identical to those provided, except for length and width according to AMCA 500-L.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.
- B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.
 - 1. Show weep paths, gaskets, flashing, sealant, and other means of preventing water intrusion.
 - 2. Show mullion profiles and locations.
- C. Samples for Initial Selection: For units with factory-applied color finishes.

1.5 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: Based on evaluation of comprehensive tests performed according to AMCA 500-L by a qualified testing agency or by manufacturer and witnessed by a qualified testing agency, for each type of louver and showing compliance with performance requirements specified. Include testing information for TDI impact requirements.

1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain louvers and vents from single source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.
- B. Welding: Qualify procedures and personnel according to the following:
 - 1. AWS D1.3, "Structural Welding Code - Sheet Steel."

- C. SMACNA Standard: Comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for fabrication, construction details, and installation procedures.

1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Aluminum Extrusions: ASTM B 221 , Alloy 6063-T5, T-52, or T6.
- B. Aluminum Sheet: ASTM B 209, Alloy 3003 or 5005 with temper as required for forming, or as otherwise recommended by metal producer for required finish.
- C. Aluminum Castings: ASTM B 26/B 26M, Alloy 319.
- D. Fasteners: Use types and sizes to suit unit installation conditions.
 - 1. Use Phillips flat-head screws for exposed fasteners unless otherwise indicated.
 - 2. For color-finished louvers, use fasteners with heads that match color of louvers.
- E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.2 FABRICATION, GENERAL

- A. Assemble louvers in factory to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- B. Maintain equal louver blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.
- C. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.
 - 1. Frame Type: Interior flange unless otherwise indicated.
- D. Include supports, anchorages, and accessories required for complete assembly.
- E. Provide vertical mullions of type and at spacings indicated, but not more than recommended by manufacturer, or 72 inches o.c., whichever is less.

1. Exposed Mullions: Where indicated, provide units with exposed mullions of same width and depth as louver frame. Where length of louver exceeds fabrication and handling limitations, provide interlocking split mullions designed to permit expansion and contraction.
- F. Provide subsills made of same material as louvers.
- G. Join frame members to each other and to fixed louver blades with fillet welds, threaded fasteners, or both, as standard with louver manufacturer unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

2.3 STATIONARY, EXTRUDED-ALUMINUM LOUVERS

- A. Louver Construction and Operation: Provide louvers with extruded-aluminum frames and blades not less than 0.080-inch nominal thickness.
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. Air Balance Inc.; a Mestek company.
 - b. Air Flow Company, Inc.
 - c. Airolite Company, LLC (The).
 - d. All-Lite Architectural Products.
 - e. American Warming and Ventilating, Inc.; a Mestek company.
 - f. Arrow United Industries; a division of Mestek, Inc.
 - g. Carnes Company, Inc.
 - h. Cesco Products; a division of Mestek, Inc.
 - i. Construction Specialties, Inc.
 - j. Dowco Products Group; Safe-Air of Illinois, Inc.
 - k. Greenheck Fan Corporation.
 - l. Industrial Louvers, Inc.
 - m. Louvers & Dampers, Inc.; a division of Mestek, Inc.
 - n. NCA Manufacturing, Inc.
 - o. Metal Form Manufacturing Inc.
 - p. Reliable Products, Inc.
 - q. Ruskin Company; Tomkins PLC.
 - r. United Enertech Corp.
 - s. Vent Products Company, Inc.
 2. Louver Depth: 4 inches, overall.

2.4 LOUVER SCREENS

- A. General: Provide screen at each exterior louver.
1. Screen Location for Fixed Louvers: Interior face.
 2. Screening Type: Insect screening.
- B. Secure screen frames to louver frames with machine screws with heads finished to match louver,

spaced a maximum of 6 inches (150 mm) from each corner and at 12 inches (300 mm) o.c.

2.5 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Provide factory applied finish from manufacturer's complete selection of available colors.

2.6 ALUMINUM FINISHES

- A. Finish louvers after assembly.
- B. High-Performance Organic Finish: 3-coat fluoropolymer finish complying with AAMA 2605 and 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.
 - 1. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and openings, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

3.3 INSTALLATION

- A. Locate and place louvers and vents level, plumb, and at indicated alignment with adjacent work.
- B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.
- C. Form closely fitted joints with exposed connections accurately located and secured.
- D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
- E. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory,

make required alterations, and refinish entire unit or provide new units.

- F. Protect unpainted galvanized and nonferrous-metal surfaces that will be in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.
- G. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Division 07 Section "Joint Sealants" for sealants applied during louver installation.

3.4 ADJUSTING AND CLEANING

- A. Test operation of adjustable louvers and adjust as needed to produce fully functioning units that comply with requirements.
- B. Clean exposed surfaces of louvers and vents that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.
- C. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.
- D. Restore louvers and vents damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.
 - 1. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

END OF SECTION

SECTION 09 20 00 — LATH AND PLASTER

PART 1 - GENERAL

1.1 COORDINATION

- A. The General Conditions of the Contract for Construction and the Supplementary Conditions to the General Conditions of the Contract for Construction shall be considered as part of this section of the specifications.
- B. Each Bidder shall be responsible for determining during the bidding period the extent that any addenda issued during the bidding period may affect this section of the specifications.
- C. Reference Instructions to Bidders for requirements regarding substitutions of materials and products.
- D. Where conflicts occur between the drawings and specifications, between different drawings, between different portions of this section of the specifications, or between different sections of the specifications, the more stringent requirements and the greater quantity shall apply.

1.2 WORK INCLUDED

- A. Provide and install plaster lathing and accessories, three coat stucco system with floated finish as indicated in the drawings and specified herein.

1.3 RELATED WORK SPECIFIED IN OTHER SECTIONS

- A. Metal studs and gypsum sheathing.
- B. Insulation
- C. Dampproofing and waterproofing.
- D. Painting

1.4 SUBMITTALS

- A. Submit manufacturer's product data describing masonry mix, waterproofing additive, oriental stucco, lath and metal accessories.
- B. Submit mix design.
- C. Submit a 12" x 12" lath and plaster, metal edged sample for each type of plaster and each finish texture for Architect's approval.
- D. Reference Section 01 33 00 SUBMITTALS for additional submittal requirements.

1.5 WARRANTY

- A. Provide written warranty against defects in materials and workmanship for the work under this section for a period of one year after the date of Substantial Completion of the project.
- B. Warranted defects shall include but not necessarily be limited to cracking, water infiltration, loss of adhesion, spalling or discoloration.

1.6 QUALITY ASSURANCE

- A. Plaster contractor shall have a minimum of 3 years experience in the installation of plaster systems for projects of similar size and scope as this project.

PART 2 - PRODUCTS

2.1 LATHING MATERIALS

- A. CHANNELS: 16 gauge, cold rolled pressed steel, galvanized. Flanges minimum 7/16" wide. Minimum weight shall be 475 pounds per 1000 lineal feet for 1-1/2" channels and 300 pounds per 1000 lineal feet for 3/4" channels.
- B. METAL LATH: Copper - alloy steel as follows: 1. Interior dry areas: Flat expanded diamond mesh at ceilings and soffits. Self-furring type at sheathed walls. Galvanized or painted finish. Minimum 3.4 lbs. per square yard. 2. Exterior and interior wet areas: Flat expanded diamond mesh at ceilings and soffits. Self-furring type at sheathed walls. Galvanized finish meeting requirements of FS QQ-Z-325C, Type 1. Minimum 3.4 lbs. per square yard.
- C. WIRE: Annealed galvanized metal wire. Minimum 18 gauge tie wire; minimum 8 gauge hanger wire.
- D. LATHING ACCESSORIES: Galvanized for interior dry areas; solid zinc alloy for exterior work.
 - 1. Casino Beads: MUCor #66 with expanded metal flange, 26 gauge.
 - 2. Corner Beads: U.S.G. NO. 4-R, or approved equal, 26 gauge expansion type.
 - 3. Control Joints: No. 75 per U.S.G.
 - 4. Expansion Joints: No. 40 zinc expansion flange type per Keene.
- E. Wire clips for attachment of furring channels to runner channels shall be formed hairpin clips, 8 gauge galvanized soft steel wire.
- F. METAL STUDS: Provided and installed under another section of these specifications

2.2 PLASTERING MATERIALS

- A. REINFORCING: Alkaline resistant fiberglass strands, 1/2".
- B. PORTLAND CEMENT: ASTM C-150, Type I, white for finish coat.
- C. SAND: ASTM C-144, red torpedo sand for scratch and brown coats.
- D. MASONRY MIX: Pre-mixed dry masonry mortar mix meeting requirements of A.S.T.M. C-91, Type N, as manufactured by Trinity, Ideal, TXI or Lonestar.

- E. FINISH: "Oriental Exterior" stucco as manufactured by United States Gypsum Company, or approved equal. Colors shall be as selected by the Architect. Deliver to job in manufacturer's original packages, with labels intact, seals unbroken. Prepare stucco finish coat for application by mixing with water only.
- F. WATERPROOFING: "Hvdrocide" as manufactured by Sonneborn.
- G. WATER: Clean, potable and free from any amounts of mineral and organic substances that would affect set of Plaster.
- H. No asbestos or admixtures.

2.3 MIXES

- A. SCRATCH COAT:
 - 1. 1 sack Portland cement.
 - 2. 2 sacks masonry mix.
 - 3. 9 cu. ft. sharp sand
 - 4. 1-1/2 lbs. fiberglass strands.
- B. BROWN COAT:
 - 1. 1 sack Portland cement.
 - 2. 2 sacks masonry mix.
 - 3. 10 cu. ft. sharp sand.
 - 4. 1-1/2 lbs. fiberglass strands
 - 5. Integral waterproofing per manufacturer's recommendations
- C. Plaster mixes shall comply with ASTM C926.

PART 3 - EXECUTION

3.1 GENERAL

- A. Install furring, lathing, and all plaster work level and plumb, true and rigid. Ensure that all work to be concealed by plaster has been completed and inspected prior to beginning plaster work.
- B. Obtain access panels, frames, or other built-in items from the appropriate trades before beginning plaster work.
- C. Exercise precautions to prevent damage to work of other crafts. Plaster droppings on glass or aluminum surfaces shall be immediately removed with clean water and soft cloths.

3.2 EXTERIOR PLASTER (STUCCO)

- A. All exterior work and interior wet areas to have Portland Cement Finish "Oriental Exterior" sand finish 3/16" to 1/4" thick finished coat, texture as approved by Architect. Color and texture shall be uniform.
- B. Exterior plaster and interior wet areas to include integral waterproofing, galvanized lath, and pure zinc accessories.

3.3 SUSPENDED CEILING & SOFFIT INSTALLATION

- A. Install suspended ceilings or exterior soffits in indicated locations. Unless otherwise indicated, suspension system shall consist of 1-1/2" runner channels, 3/4" furring channels, suspended from structure above by galvanized hanger wires.
- B. Space hanger wire 48" maximum in either direction for interior ceilings. Maximum 36" in either direction for stucco soffits.
- C. Space runner channels 48" on center maximum for interior plaster ceilings, supported from resilient hangers; space 36" on center maximum for plaster soffits
- D. Wrap each hanger wire twice around channels; secure by at least 3 turns around itself. Space furring channels 12-1/2" on center maximum and at right angles to runners.
- E. Secure to runner channels with wire clips or saddle tied with 2 strands of 16 gauge tie wire giving wire ends 3 twists.
- F. Isolate penetrations (such as light fixtures) with control joints and reinforce with furring channels

3.4 METAL LATH & ACCESSORIES

- A. Apply metal lath to form true surfaces, straight, without sags or buckles, with long dimension at right angles to direction of supports. Secure lath to supports at 6" intervals. Secure side laps on ceilings to supports; tie at 6" intervals between supports. Lap lath at sides at least 1/2". Lap lath at ends at least 1", stagger laps; and locate only over supports. Break end joints of lath on alternate sheets of lath. Lath ties shall have a minimum of three complete turns.
- B. Provide corner beads on external plaster corners and where indicated. Corner beads shall be single lengths where length of corner does not exceed standard stock lengths. Miter or cope beads at corners; fasten securely with tie wire spaced 8" maximum; stagger on two wings.
- C. Install casing beads (stops) where plaster abuts other surfaces, at edges of plaster panels, and elsewhere as indicated. Set casing beads level, true to line. Install casing beads in lengths as long as practicable, with joints in straight runs aligned with suitable formed splices. Secure casing beads to metal lath with tie wire spaced 8" maximum.
- D. Provide expansion joints in exterior and interior plaster as shown. Expansion joints shall be in single lengths where possible. Secure expansion joints to metal lath with tie wire; space ties or nail anchors not over 8" apart.
- E. Provide control joints in exterior and interior plaster between expansion joints so that no panel dimension exceeds 12' or 120 square feet of area.

3.5 APPLICATION

- A. Maintain temperature of at least 40 degrees F. in building prior to plaster application, until it is dry. Plaster shall be three coat work on all bases. Plaster thickness from plaster base to finished plaster surface shall be as noted on drawings but shall be a minimum thickness of 3/4" at its thinnest point. Do not combine scratch and brown coats. No irregularities shall show in finished surface, such as "cat faces", streaks, waviness, trowel, float or brush marks. Finished surfaces shall be true, uniform in texture and finish.

- B. Apply scratch coat with sufficient pressure to force mortar through mesh and key firmly to lath. Scratch to form rough surfaces. Apply brown coat 48 hours after scratch coat has set; bring out to grounds; straighten to true surface with rod, darby; leave rough, and ready for finish coat.
- C. Apply finish over base coat which has been wetted evenly by brushing or spraying. Apply finish coat not sooner than seven (7) days after brown coat. Provide light sand finish per approved sample.
- D. Keep plaster moist for the curing period between coats. Limit thickness of scratch, and brown coat to maximum 3/8" each.

3.6 PLASTER CUTTING & PATCHING

- A. Execute after other work is in place, and after painter has applied priming coat. Thoroughly rake out, or cut out, moisten and fill with finishing material. Float finish with adjoining work. Point up around fixtures, outlet boxes, switch plates, fittings, piping and other appliances abutting or extending into plastering.

3.7 FINISH PLASTER PROTECTION

- A. Provide protection against damage for finished plaster work. Protect plastering from freezing or premature drying. Execute no plastering work in cold weather, except where work is adequately protected and proper temperatures are maintained to prevent freezing.

END OF SECTION

SECTION 09 21 16 — INTERIOR DRYWALL SYSTEMS

PART 1 - GENERAL

1.1 COORDINATION

- A. The General Conditions of the Contract for Construction and the Supplementary Conditions to the General Conditions of the Contract for Construction shall be considered as part of this section of the specifications.
- B. Each Bidder shall be responsible for determining during the bidding period the extent that any addenda issued during the bidding period may affect this section of the specifications.
- C. Reference Instructions to Bidders for requirements regarding substitutions of materials and products.
- D. Where conflicts occur between the drawings and specifications, between different drawings, between different portions of this section of the specifications, or between different sections of the specifications, the more stringent requirements and the greater quantity shall apply.

1.2 WORK INCLUDED

- A. Provide and install acoustical batt insulation within interior drywall partitions.
- B. Provide and install all interior drywall systems including light gauge metal studs and tracks, gypsum wall board and finishing systems, suspended gypsum board ceilings and soffits, furred gypsum board.
- C. Provide and install troweled firestopping system at drywall ceiling and wall penetrations at rated walls.
- D. Provide and install specified corner guards at each wall corner.

1.3 RELATED WORK SPECIFIED IN OTHER SECTIONS

- A. Painting
- B. Door frames
- C. Carpentry (wood blocking)
- D. Plaster on metal studs
- E. Mechanical, electrical and plumbing penetrations in rated drywall systems.

1.4 SUBMITTALS

- A. Submit manufacturer's product data describing all materials.
- B. Submit gypsum board finish schedule indicating level of finish proposed per each area. Finish levels shall be levels 1 through 4 as specified herein and defined by "Recommended Specification: Levels of Gypsum Board Finish" as jointly published by AWCI, CISA, GA, and PDCA. Submit copy of publication with finish schedule.

- C. Submit manufacturers detail drawings and detailed installation methods for fire rated penetrations and filling of voids with specified firestopping system. Submit only those systems applicable to this project.
- D. Reference Section 01 33 00 SUBMITTALS for additional submittal requirements.

1.5 WARRANTY

- A. Provide written warranty against defects in materials and workmanship for the work under this section for a period of one year after the date of Substantial Completion of the project.
- B. Warranted defects shall include but not necessarily be limited to cracking, joint tape delamination or tearing, dimpling at fastener heads, bowing or warping of wall board, cracking at metal accessories, acoustical sealant failure.

1.6 DELIVERY, STORAGE AND HANDLING

- A. All materials shall be delivered in manufacturer's original packaging and stored flat in a covered, dry area providing protection from damage and exposure to the elements.
- B. Damaged or deteriorated materials shall be removed from the premises.
- C. During cold weather installation of gypsum panels and joint finishing, temperatures within the building shall be maintained within the range of 50 degrees to 80 degrees F. Adequate ventilation shall be provided to carry off excess moisture.
- D. Steel framing and related accessories shall be stored and handled in accordance with AISI's "Code of Standard Practice"

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- | | |
|---|---|
| <ul style="list-style-type: none">A. <u>Drywall Framing:</u><ul style="list-style-type: none">1. ClarkDietrich Building SystemsB. <u>Gypsum Board and Related Accessories:</u><ul style="list-style-type: none">1. United States Gypsum Co.2. National Gypsum Co.3. Georgia Pacific4. Temple Inland5. James HardieC. <u>Acoustical Batts:</u><ul style="list-style-type: none">1. Owens-Corning2. Certaineed3. Manville | <ul style="list-style-type: none">D. <u>Acoustical Sealant:</u><ul style="list-style-type: none">1. TREMCO2. Ohio Sealants, Inc.E. <u>Specialty Trims:</u><ul style="list-style-type: none">1. Fry Reglet Corp.2. MM Systems Corp.F. <u>Corner Guards:</u><ul style="list-style-type: none">1. WallProtex, (877) 880-8115 |
|---|---|

2.2 FRAMING: Comply with ASTM C645-09 for conditions indicated.

- 1. Steel Sheet Components: Comply with ASTM C645-09 requirements for metal unless otherwise indicated.

2. Protective coating: Comply with ASTM C645-09; roll formed from hot dipped galvanized steel; complying with ASTM A1003/A1003M and ASTM A653/A653M G40 (Z120) or having a coating that provides equivalent corrosion resistance. A40 galvanized products are not acceptable.
- A. METAL STUDS: 25 gauge (22 gauge where shown on drawings) galvanized roll formed, screw channel type studs with minimum 5/16 inch flanges and 1-1/4 inch legs. Provide widths of 1-5/8 inch, 2-1/2 inch, 3-5/8 inch, 4 inches and 6 inches as indicated in the drawings. Provide conduit punchouts at 24" o.c.
1. "EQ" (Equivalent Gauge Thickness) Steel Studs and Runners: Members that can show certified third party testing with gypsum board in accordance with ICC ES AC86-2010 (approved February 2010 Effective March 1, 2010) need not meet the minimum thickness limitation or minimum section properties set forth in ASTM C645-09.
 2. Non-structural Studs: Cold-formed galvanized steel C-studs, ClarkDietrich Building Systems Pro STUD drywall studs as per ASTM C645-09 for conditions indicated below:
 - a. Flange Size: 1 1/4 inch (32mm)
 - b. Web Depth: As specified on drawings, 1-5/8 inches (41 mm) 2-1/2 inches (64 mm) 3-5/8 inches (92 mm) 4 inches (102 mm) 6 inches (152 mm).
 - c. Member Description: ProSTUD 25 (25ga equivalent drywall stud) 70ksi Minimum Thickness: 0.0150 inches (0.3810mm) Minimum Design Thickness: 0.0158 inches (0.4013mm)
 - d. Member Description: ProSTUD 22 (22ga equivalent drywall stud) 70ksi Minimum Thickness: 0.0179 inches (0.4547mm) Minimum Design Thickness: 0.0188 inches (0.4775mm)
- B. RUNNER CHANNELS: Provide 25 gauge (22 gauge where shown on drawings) galvanized channels with minimum 1-1/4 inch flanges with hemmed edges, in widths to accommodate stud sizes.
1. Non structural Track: Cold-Formed galvanized steel runner tracks, ClarkDietrich Building Systems ProTRAK drywall track in conformance with ASTM C645-09 for conditions indicated below:
 - a. Flange Size: 1 1/4 inch (32mm)
 - b. Web Depth: Track web to match stud web size.
 - c. Minimum Material Thickness: Track thickness to match wall stud thickness or as per design.
- C. FURRING CHANNELS: Provide 20 gauge galvanized "hat" channels with face width of 1-1/4 inches, depth of 7/8 inches, and back Width of 2-9/16 inches minimum, hemmed edges.
- D. CEILING SUSPENSION: Provide 16 gauge galvanized channels, 3/4" x 1/2" and 11/2" or 2" x 17/32".
1. Firestop tracks: Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
 - a. Basis of Design Product: Subject to compliance with requirements, provide ClarkDietrich Building Systems; MaxTrak or an equivalent product.

2.3 ACCESSORIES

- A. CORNER BEADS: 26 gauge galvanized beaded angle with 1-1/4" legs.
- B. EDGE TRIM: 26 gauge galvanized steel "J" mould and angle with continuous bead. ClarkDietrich Building Systems 200.A and 200.B.
 - 1. Channel Bridging and Bracing: Steel, 0.0538-inch (1.37mm) minimum base metal thickness, with minimum 1/2 inch (13mm) wide flanges.
 - a. Basis of Design Product: Subject to compliance with requirements, provide ClarkDietrich Building Systems; Spazzer 9200 Bridging and Spacing Bar, or an equivalent product.
 - b. Depth: As indicated on drawings, 7/8 inch by 7/8 inch by 50 inches.
 - 2. Backing Plate: Proprietary fire-resistance treated blocking and bracing in width indicated.
 - a. Basis of Design Product: Subject to compliance with requirements, provide ClarkDietrich Building Systems; Danback Fire-treated wood backing plate or an equivalent product.
- C. WIRE: 9 gauge galvanized hanger wire and 16 gauge galvanized be wire.
- D. SCREWS: Bugel head Type "S" self tapping drywall screws in lengths recommended by wallboard manufacturer. USG "Super-Tite".
- E. CONTROL JOINTS: Roll formed zinc with 1/4" open joint, and perforated flanges. Provide with fireseal backing at rated systems. ClarkDietrich Building Systems No. 093.
- F. JOINT ADHESIVE: Premixed water based compound. USG taping joint compound.
- G. LAMINATING ADHESIVE: Durabond sheetrock setting-type for double-layer application and column fireproofing.
- H. JOINT REINFORCING: Center creased paper tape equal to "Perf-A-Tape".
- I. TROWELED FIRESTOPPING
 - 1. System Type: A combination of glass fiber or mineral wool insulation packing material with troweled-on application of sealing compound.
 - 2. Sealing Compound: Red tinted compound job mixed with water providing protection from heat (to temperatures of 1850 degrees F), smoke, toxic gas, fire and water. "Sta-Smooth FS 90 Fire-Shield Compound Fire and Smoke Stop" as manufactured by National Gypsum Co. or approved equivalent by Domtar Gypsum, Inc.
 - 3. Approvals:
 - a. Rated as noncombustible as defined by NFPA Standard 220 when tested in accordance with ASTM E 136 at Underwriters Laboratories.
 - b. Meet all requirements of ASTM E 814 and UL 1479: Fire tests of through penetration fire stops.
- J. CORNER GUARDS: Textured Vinyl Corner Guards 3" by WallProtex. 4' lengths, taped. Color as selected by Architect.

2.4 WALLBOARD

- A. TYPICAL: 5/8" thick x 48" wide paper-faced gypsum panels, tapered long edges, lengths as required. U.L. listed and conforming to ASTM C-1396/C1396M-09a Standard Specification for Gypsum Board, Type X. USG fire code.

- B. WATER RESISTANT: 5/8" thick x 48" wide U.L. listed, Type X board with chemically treated face paper and water resistant gypsum core. Comply with ASTM C-1396/C1396M-09a Standard Specification for Gypsum Board.
- C. HIGH IMPACT: 5/8" thick x 48" wide, length as required. U.L. listed, "Fiberock Interior Panel Abuse Resistant" by USG or equal.

2.5 TILE BACKER BOARD

- A. 5/8" thick cement board formed of aggregated Portland cement slurry with polymer-coated, glass-fiber mesh. "Durock" as manufactured by United States Gypsum Co or approved equivalent.

PART 3 - EXECUTION

3.1 PARTITION INSTALLATION

- A. STUD SYSTEM ERECTION: Attach metal runners at floor and to structural elements with suitable fasteners spaced maximum 24" o.c. Position studs vertically, engaging floor track and runner at ceiling or structure. Place studs in direct contact with all door frame jambs, abutting partitions, partition corners and existing construction elements.
- B. Anchor all studs adjacent to door and window frames, partition intersections, and corners to ceiling and floor runner flanges. Securely anchor studs to jamb and head anchor clips of door or side-light frames by screw attachment. Over door and side-light frames, install horizontal runner with a web-flange bend at each end, and secure with one positive attachment per flange.
- C. Install diagonal stud bracing above ceiling at strike side of door jambs and at other locations as indicated in the drawings. Secure to structure.
- D. Follow stud manufacturer's recommendations for all framing construction and fastening.

3.2 WALL PANEL ERECTION

- A. Apply gypsum panels vertically or horizontally. Position all edges over studs for vertical application; all ends over studs for horizontal application. Use maximum practical lengths to eliminate end joints. Fit ends and edges closely together. Stagger joints on opposite side of partition.
- B. For single-layer vertical application of gypsum panels, space screws 12" o.c. in field of panels and 8" o.c. staggered along vertical abutting edges. For horizontal panel application, space screws 12" o.c. in field and along abutting end joints.
- C. For double-layer screw attachment, space screws 16" o.c. for both layers. Apply both layers of gypsum panels vertically with joints in face layer offset from base layer joints. For 5/8" panels, use 1" screws for base layer and 1-5/8" screws for face layers. For 1/2" panels, use 7/8" screws for base layer and 1-5/16" screws for face layer.

3.3 CHASE WALL ERECTION

- A. Align two parallel rows of floor and ceiling runners spaced as indicated in the drawings. Attach to concrete slabs with powder actuated anchors 24" o.c. and to suspended ceiling tees or structure with suitable fasteners 24" o.c.
- B. Position metal studs vertically in runners, 16" o.c., with flanges in the same direction and with studs on opposite sides of chase directly across from each other. Anchor all studs to floor and ceiling runner flanges with U.S.G. Metal Lock Fastener tool.
- C. Cut gypsum panel bracing to be placed between rows of studs, 12" high by chase wall width. Space braces 48" o.c. vertically and attach to stud webs with screw fasteners. 2-1/2" metal studs may be used in lieu of gypsum panels. Anchor web at each end of metal brace to stud web with two 3/8" pan head screws.

3.4 CEILING FRAMING

- A. GRILLAGE ERECTION: Space 8 gauge hanger wires 48" o.c. along carrying channels and within 6" of ends of carrying-channel runs. Wrap hanger around and through beams or joists. Install 1-1/2" carrying channels at 24" o.c. Position channels for proper ceiling height, level and secure with hanger wire saddle-bed along channel. Provide 1" clearance between runners and abutting walls and partitions. Secure furring to carrying channels with clips or saddle-tie to support. Overlap splices at least 8" and securely wire-tie each end with double-strand 16 gauge tie wire.
- B. Erect metal furring channels at right angles to 1-1/2" carrying channels or main support members Space furring (16") o.c. and within 6" of walls. Provide 1" clearance between furring ends and abutting walls and partitions. Secure furring to carrying channels with clips or saddle-tie to supports with double strand 16 gauge tie wire. Overlap splices at least 8" and securely wire-tie each end with double-strand 16 gauge tie wire.
- C. At light troffers or any openings that interrupt the carrying or furring channels, install additional cross reinforcing to restore lateral stability of grillage.
- D. At rated ceilings meet all requirements of selected U.L. Design No.
- E. METAL STUD CEILING FRAMING OPTION: Attach runners at ceiling height through gypsum panels to each partition stud with two screws. Insert metal studs in runners and attach each end with one 3/8" pan head screw. Install 1-5/8" stud cross-bracing over stud framing, space 48" o.c. and attach to each framing stud with two 3/8" pan head screws. At hangers, install 12" long stud section for box reinforcing or lap studs 12" and secure each end with two 3/8" pan head screws. At light troffers or any openings that interrupt the ceiling, install additional cross reinforcing to maintain structural integrity of framing.
- F. GYPSUM PANEL ERECTION: Apply gypsum panels of maximum practical length with long dimension at right angles to furring channels. Position end joints over channel web and stagger in adjacent rows. Fit ends and edges closely. Fasten panels to channels with 1", Type S screws, spaced 8" o.c. in field of panels and 8" along ends and edges.

3.5 EXTERIOR WALLS: Reference Section 05 41 00.

3.6 ACOUSTICAL BATTS

- A. Install unfaced full thickness acoustical fiberglass batts between studs at partitions as scheduled on the drawings. Fit batts tight to studs, tight to floor and head tracks and tight to one another. Batt shall run full height of partition unless indicated otherwise in the drawings.

3.7 ACOUSTICAL SEALANT

- A. Install continuous bead of sealant at bottom tracks at drywall partitions.
- B. Install vinyl foam double stick tape and sealant where head track terminates at ceiling.
- C. See drawings for additional locations.

3.8 ACCESSORY APPLICATION

- A. JOINT SYSTEM: Finish all face panel joints and corners with U.S.G. Joint System installed according to manufacturer's directions.
 - 1. Mix joint cement in strict accordance with manufacturers directions.
 - 2. Butter cement into joints filling them evenly and fully.
 - 3. Center tape and press down into cement leaving sufficient cement under tape for proper bond. Cover with thin coat of cement to fill recess between tape and board to bring material flush with surface.
 - 4. Face panels shall be cut fit around all wall outlets and switch boxes, utility lines, etc. All voids and cracks, occurring around all openings in board shall be taped and covered with joint cement.
- B. LAMINATING ADHESIVE: Spread to provide 1/2" adhesive beads 4-1/2" o.c. for full sheet lamination. For strip lamination, apply adhesive in vertical strips of four 1/2" beads, 1-1/2" to 2" o.c. Space strips 24" o.c.
- C. CORNER BEAD: Reinforce all vertical and horizontal exterior corners with corner bead fastened with 9/16" rosin-coated staples 9" o.c. on both flanges along entire length of bead.
- D. METAL TRIM: At exposed edges of board or where board terminates against other materials, apply metal trim over panel edge and fasten with screws.
- E. SCREWS: Power-drive at least 3/8" from edges or ends of panel to provide uniform dimple of 1/32" deep.
- F. CONTROL JOINTS: Cut panel at joint and back with double framing members. Attach control joint to face layer with 9/16" rosin-coated staples spaced 6" o.c. on both flanges along entire length of joint. At rated walls, provide fireseal behind joint. Provide joints at 25' maximum or as otherwise indicated in the drawings.
- G. CORNER GUARDS: Install as per manufacturer's recommendations. Double sided adhesive tape factory applied to corner guard.

3.9 TROWELED FIRESTOPPING:

- A. General: Install systems in complete accordance with manufacturers printed instructions and approved submittal for the required fire rating of the particular condition. Install firestopping systems at all penetrations and voids in all rated drywall ceilings and walls.
- B. Through-penetrations. Ensure that pipe, conduit, duct, cables or other penetration element is rigidly supported by drywall framing on both sides of wall or ceiling assembly. Oversize opening in wall board to allow for required opening size and thickness of packing material in accordance with system and rating requirements. Install packing material in accordance with system requirements and compressed to allow for required thickness of sealing material. Trowel red-tint sealing material into void (same thickness as

gypsum board) and smooth flush with both faces of drywall. Provide additional layer(s) of gypsum board around penetration where necessary to achieve required minimum thickness of sealing material.

- C. Void-filling: For voids such as intersection of walls and smooth or corrugated deck, pack void with compressed packing material and trowel red-tint sealing material into void (same thickness as gypsum board) and smooth flush with both faces of drywall. Provide additional layer(s) of gypsum board around penetration where necessary to achieve required minimum thickness of sealing material.

3.10 WOOD BLOCKING: Coordinate with project carpenter to ensure installation of fire retardant wood blocking between studs for mounting casework, millwork, toilet partitions, drinking fountains and other equipment.

3.11 FINISHING SCHEDULE: Follow published "Recommended Specification: Levels of Gypsum Board Finish" as follows:

- A. LEVEL 1 FINISH: At concealed areas above ceiling.
- B. LEVEL 2 FINISH: At gypsum backing board to be covered with file or panels thicker than 1/4".
- C. LEVEL 3 FINISH: At mechanical rooms, storage rooms, custodial and maintenance rooms, electrical and telephone closets.
- D. LEVEL 4 FINISH: All other drywall areas scheduled for paint, fabric or vinyl wall covering.

END SECTION

SECTION 09 30 00 — WALL AND FLOOR TILE

PART 1 - GENERAL

1.1 COORDINATION

- A. The General Conditions of the Contract for Construction and the Supplementary Conditions to the General Conditions of the Contract for Construction shall be considered as part of this section of the specifications.
- B. Each Bidder shall be responsible for determining during the bidding period the extent that any addenda issued during the bidding period may affect this section of the specifications.
- C. Reference Instructions to Bidders for requirements regarding substitutions of materials and products.
- D. Where conflicts occur between the drawings and specifications, between different drawings, between different portions of this section of the specifications, or between different sections of the specifications, the more stringent requirements and the greater quantity shall apply.

1.2 WORK INCLUDED

- A. Provide and install all ceramic wall and floor tile and base as indicated in the drawings and specified herein.

1.3 RELATED WORK SPECIFIED IN OTHER SECTIONS

- A. Cast-in-place concrete.
- B. Drywall systems.
- C. Masonry.
- D. Waterproofing and dampproofing.

1.4 SUBMITTALS

- A. Per SUPPLEMENTARY GENERAL CONDITIONS, submit samples, type of tile and color for Architect's approval. Mark with manufacturer's name and space where tile is to be installed.
- B. Submit manufacturer's printed literature describing products.
- C. Submit (2) boxes of tile chips showing full range of available colors.
- D. Submit (2) boxes of grout color samples.
- E. Submit 12" x 12" grouted sample board for each tile/grout combination selected.
- F. Reference Section 01 33 00 SUBMITTALS for additional submittal requirements.

1.5 WARRANTY

- A. Provide written warranty against defects in materials and workmanship for the work under this section for a period of one year after the date of Substantial Completion of the project.
- B. Warranted defects shall include but not necessarily be limited to cracking, crazing, staining, joint spalling or cracking, loosening of bond.

1.6 QUALITY ASSURANCE

- A. Tile Contractor shall have a minimum of 3 years experience in tile installation for projects of similar size and scope as this project.
- B. Conform with all applicable requirements of the American Standards Association Specifications (A-108 Series) and the "Tile Handbook" of the Tile Council of America. Tile shall bear the seal of Tile Council of America, Inc., and be equal to or exceed Standard Grade.

1.7 DELIVERY & STORAGE

- A. Deliver all manufactured materials in original, unbroken containers bearing name of manufacturer, brand and grade seal. Keep materials dry, clean and protected against deterioration in any form and at room temperature.
- B. Maintain room temperature between 70 and 80 degrees F. 24 hours prior, during and a minimum of 48 hours after installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. CERAMIC TILE:
 - 1. American Olean
 - 2. Dal-Tile
 - 3. United States Ceramic Tile Co.
- B. GROUT:
 - 1. American Olean
 - 2. Laticrete
 - 3. Tex Rite

2.2 MATERIALS

- A. RESTROOMS:
 - 1. Floor Tile: Unglazed porcelain ceramic with cushioned edges and sheet backing.
 - a. Water absorption: Classified "Impervious" per A.S.T.M. C-373. Less than 1/2 of 1% absorption.
 - b. Size: Nominal 6" x 6" x 1/4" thick.
 - c. Base: 4" high base. Bottom tile with integral cove.
 - d. Type: Porcelain Tile in **group 4 & 5** as selected by the Architect from one of the specified manufacturers.

- e. Color(s): Bidders shall assume a different color scheme for each room unless colors and patterns are indicated in the drawings.
- 2. Wall Tile: Glazed ceramic with cushion edges.
 - a. Size: Nominal 6" x 6" x 1/4" thick.
 - b. Base: See floor base.
 - c. Type: **Group 4 & 5** for field tile and for accent banding as selected by the Architect from one of the specified manufacturers.
 - d. Color(s): Bidders shall assume a different color scheme for each room unless colors and patterns are indicated in the drawings.
- 3. Trim: Terminate tile with bullnose edges and rounded outside corners. Provide square inside corners and at ceiling/wall joints.
- B. THINSET BOND COAT: Latex/Portland Cement mortar mix meeting requirements of ANSI A118.4. Provide Portland cement and sand in a 1 to 1 mixture gauged with Laticrete 4237 latex additive. Use on dry cured mortar bed at slab recesses, where thinset on concrete slab, and where thinset on wall substrates.
- C. SEALANT: One part silicone rubber meeting requirements of FS TT-S-001543, as manufactured by Dow Corning or General Electric.
- D. GROUT:
 - 1. Walls: Portland Cement waterproof, dry set grout as manufactured by American Olean. Color(s) as selected by Architect.
 - 2. Floor and base: Interior grout shall be epoxy type as manufactured by American Olean. Color(s) as selected by Architect.
- E. SEALANT: One part silicone rubber meeting requirements of FS TT-S-001543, as manufactured by Dow Corning or General Electric.

PART 3 - EXECUTION

3.1 INSPECTION AND PREPARATION

- A. Examine surfaces to receive tile and do not start work until defects that will adversely affect tile work have been corrected.
- B. Inspect all surfaces to see that they are dry, clean, free of oily or waxy film, firm, level and plumb. Report any unsatisfactory conditions to the Architect. Starting installation shall be deemed as acceptance of surfaces.
- C. Do not start until work of other trades, which goes through or in the space behind tile has been completed. Do not proceed with installation until adjoining work is satisfactory protected. Close off spaces in which tile is being set to traffic and other work during installation and for at least 48 hours after completion of tile work.
- D. Do not apply mortar and adhesives to surfaces covered by frost. Maintain minimum temperature-for installation of tile above 50 Deg. F. Prevent rapid evaporation of moisture from mortar bed. Do not set tile on dry bed.
- E. Install specified mortar bed at slab depressions. Slope mortar bed uniformly to drain(s).

3.2 INSTALLATION

- A. GENERAL: Tile shall be installed in accordance with current Tile Council of America's "Handbook for Ceramic Tile Installation", design numbers as indicated below.
- B. Center fields and patterns on applied areas so that no tile is less than half size. For heights stated in feet and inches, maintain full courses to nearest attainable height without cutting tile.
- C. Except where otherwise shown or specified, make joints in wall tile vertical and horizontal and joints in floor tile perpendicular and parallel to walls. Control joint widths of glazed tile by lugs on the sides of tile. Control joints widths between sheets of ceramic mosaic tile by supporting boards with metal spacing strips.
- D. Grind and fit tile carefully at intersections, against trim finish and at built-in fixtures and accessories. Fit tile closely around outlets, pipes, fixtures and fittings so that plates, escutcheons and collars will overlap cuts. Cut and drill tile and trim shapes accurately without damage. Rub all exposed cut edges smooth with abrasive stone.
- E. Coat trim with 1/32 to 1/16" pure coat paste. Set in same mortar mix as is recommended for setting flat tile on walls. Do not use pure coat as mortar to set trim and angles.
- F. FLOORS:
 - 1. Interior thinset on concrete floor slab:
 - a. Tile bonded with minimum 3/32" thick latex-Portland cement bond coat over cleavage membrane adhered to floor slab (**modified TCA F113**).
 - b. Adhere cleavage membrane to slab in strict accordance with manufacturer's recommendations using specified latex-Portland cement bond coat. Increase typical curing time of bond coat by 50%.
 - 2. Interior thin-set on recessed mortar bed (where required at existing kitchens): Tile bonded with minimum 3/32" thick Latex-Portland Cement bond coat to reinforced mortar bed over loose bond breaker membrane over floor slab (**TCA F111**).
- G. WALLS:
 - 1. Ceramic Tile at Drywall Toilets: Thinset to water resistant gypsum wallboard.
 - 2. Ceramic Tile at Drywall Showers: Thinset to tile backer board.
 - 3. Ceramic Tile at Masonry: Bonded to mortar bed at masonry. No. **W211**.
 - 4. 12" x 12" Porcelain – Up to 3 ft. High Wainscot: Install with mastic over drywall.
 - 5. 12" x 12" Porcelain – Over 3 ft. High Wainscot: Thinset over tile backer board.
- H. EXPANSION JOINTS:
 - 1. At floor tile provide 1/4" sealant expansion joints in accordance with TCA recommendations where tile abuts walls, curbs, columns and other restraining surfaces, where substrate material changes, at floor slab construction joints (cold joints), and each way in pattern approved by the Owner.
 - 2. At walls install sealant expansion joints at inside corners, at maximum 30', and at other conditions subject to cracking or movement. Install specified sealant at expansion and control joints, at doorframe perimeters and similar conditions.

3.3 LAYOUT

- A. Layout all work so that no tiles less than half size occur. Align all joints vertically and horizontally.

- B. Cut and drill neatly without marring tile. Rub smooth any necessary cuts with a fine stone and set no cut edge against any fixture, cabinet, or other tile without a joint at least 1/16" wide.
- C. Maximum plane variation shall be 1/8" + or - in 10' when a straight edge is laid on the surface in any direction.

3.4 GROUTING AND SEALING:

- A. Follow grout manufacturer's recommendations for grouting procedures and precautions. Damp cure non-epoxy grout in accordance with manufacturer's recommendations.
- B. Grout Haze Removal:
 - 1. Unglazed Tile: For cement grout remove all grout haze following grout manufacturer's recommendations for use of acid and chemical cleaners. Rinse tilework thoroughly with clean water before and after chemical cleaners. Polish surface of tilework with soft cheesecloth.
 - 2. Glazed Tile: For cement grout remove all grout haze with cheesecloth rub.
 - 3. Take special care with epoxy grout to keep tiles clean as work progresses.

3.5 PROTECTION

- A. Protect tiled floors from foot and wheel traffic for at least 7 days after installation.
- B. Place plywood panels over traffic floors.
- C. In non-traffic areas, cover floors with heavy paper taped in place.
- D. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Furnish quantity not less than 5 percent for each color, pattern, and type of tile installed.

END OF SECTION

SECTION 09 51 00 - ACOUSTICAL TILE CEILINGS

PART 1 - GENERAL

1.1 COORDINATION

- A. The General Conditions of the Contract for Construction and the Supplementary Conditions to the General Conditions of the Contract for Construction shall be considered as part of this section of the specifications.
- B. Each Bidder shall be responsible for determining during the bidding period the extent that any addenda issued during the bidding period may affect this section of the specifications.
- C. Reference Instructions to Bidders for requirements regarding substitutions of materials and products.
- D. Where conflicts occur between the drawings and specifications, between different drawings, between different portions of this section of the specifications, or between different sections of the specifications, the more stringent requirements and the greater quantity shall apply.

1.2 WORK INCLUDED

- A. Provide and install all lay-in acoustical ceiling panels and suspended grid system in accordance with the drawings and as specified herein.
- B. Provide and install light fixture protection at all rated ceilings.
- C. Provide and install hold-down clips where required for rated system.

1.3 RELATED WORK SPECIFIED IN OTHER SECTIONS

- A. Mechanical (air devices)
- B. Electrical (lighting fixtures)

1.4 DRAWING REFERENCES

- A. See drawings, finish schedule and Section 2.2 for ceiling types and ratings.

1.5 SUBMITTALS

- A. Submit manufacturer's product data describing all materials, finishes, ratings and installation requirements.
- B. Submit physical samples for each type of acoustical tile proposed.
- C. Submit physical samples for each type of grid proposed.
- D. Submit tile manufacturer's certification for whether hold-down clips are required for the selected tile(s) and rated system(s).
- E. Reference Section 01 33 00 SUBMITTALS for additional submittal requirements.

1.6 WARRANTY

- A. Provide written warranty against defects in materials and workmanship for the work under this section for a period of one year after the date of Substantial Completion of the project.
- B. Warranted defects shall include but not necessarily be limited to rusting or deflection of grid, deterioration or deflection of acoustical tiles.

1.7 QUALITY ASSURANCE

- A. Suspended acoustical ceiling contractor shall have a minimum of 3 years experience in the installation of specified systems for projects of similar size and scope of this project.
- B. Installation of acoustical tile and panels shall not begin until residual moisture from plaster, drywall, concrete or terrazzo work is dissipated. Before installation, the building shall be enclosed and permanent heating and cooling equipment in operation.

1.8 DELIVERY AND STORAGE OF MATERIALS

- A. Do not deliver materials to jobsite until spaces are ready for ceiling installation.
- B. All materials shall be delivered in manufacturer's original packaging and stored in an enclosed shelter providing protection from damage and exposure to the elements.
- C. Damaged, rusted or deteriorated materials shall be removed from the premises.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. TYPICAL CEILING PANELS:
 - 1. Armstrong World Industries, Inc.
 - 2. USG Interiors, Inc.
- B. GRID SYSTEMS:
 - 1. Armstrong World Industries, Inc.
 - 2. USG Interiors, Inc.
 - 3. Chicago Metallic Corp.

2.2 MATERIALS:

- A. TYPICAL CEILING PANELS:
 - 1. 24" x 24" x 5/8" white **“Cortega Square Lay-in” No. 770**, square-edged as manufactured by Armstrong or equivalent (color, pattern, texture) by specified manufacturer. **Non-rated system.**
- B. SUSPENSION SYSTEM:
 - 1. Components shall be formed from commercial quality cold-rolled steel, electro-galvanized, 2' x 2' module.

2. The suspension system shall support the ceiling assembly with a maximum deflection of 1/360 of the span per A.S.T.M. C-635-69.
3. Main tee with double web design 1-1/2" high and rectangular bulb; 15/16" exposed flange with rolled cap; cross tee holes at 6" o.c.
4. Four foot cross tee 1-1/2" high with double web design. Rectangular bulb joining main runners at 2' on center.
5. Two foot cross tees perpendicular to 4' cross tees. Two foot cross tees minimum of 1-1/2" high, No. CMC 222-41 or equivalent by specified manufacturer.
6. Wall molding - hemmed edge, electro-galvanized cold rolled steel with equal leg width, finish to match grid.
7. Finish: Typical finish, factory white painted steel. At high humidity areas including kitchens, dressing rooms, toilet rooms provide factory white painted aluminum cap.
8. Rating: Provide U.L. listed grid for scheduled system rating.

PART 3 – EXECUTION

3.1 COORDINATION

- A. Verify that above ceiling work, including fire dampers, ductwork, piping, wiring and insulation is complete and approved prior to beginning ceiling work.

3.2 INSTALLATION

- A. Ceiling systems shall be suspended from structural members by 12 gauge annealed wire; spacing as recommended by manufacturer. Provide additional support for light fixtures and grilles at each corner. Provide secondary support framing ("Unistrut") where spacing of structural members exceeds suspension system manufacturer's recommendations.
- B. Acoustical lay-in panels shall be installed in strict accordance with the manufacturer's instructions. Tile shall be installed with fissures or pattern all in same direction.
- C. Provide additional hangers at ceiling suspended items including projection screens, speakers, exit lights, air supply and return grilles.
- D. Space main runner hangers a maximum of 6 inches from wall. Do not support systems from wall.
- E. Adjust hangers to ensure level ceiling in plane.

3.3 RATED CEILINGS

- A. Provide specified ceilings in fire rated assembly. Protect light fixture protection in accordance with approved U.L. Design to meet required assembly rating. Provide additional hangers to meet the requirements of the particular U.L. rating.

- B. Ceiling system manufacturers not listed in the required U.L. design number (reference drawings) shall be responsible for determining whether their rated system is acceptable to the particular local code authority.
- C. For ceiling tiles weighing 1 lb. per square foot or more, verify no requirement for hold-down clips at rated systems.

3.4 CLEANING AND REPLACEMENT

- A. At completion, replace file unit and grid systems that are damaged. Clean or replace tile and grid systems that cannot be cleaned.
- B. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Furnish quantity not less than 5 percent for each color, pattern, and type of ceiling tile installed.

END OF SECTION

SECTION 09 65 19 - RESILIENT FLOOR TILE

PART 1 – GENERAL

1.1 COORDINATION

- A. The General Conditions of the Contract for Construction and the Supplementary Conditions to the General Conditions of the Contract for Construction shall be considered as part of this section of the specifications.
- B. Each Bidder shall be responsible for determining during the bidding period the extent that any addenda issued during the bidding period may affect this section of the specifications.
- C. Reference Instructions to Bidders for requirements regarding substitutions of materials and products.
- D. Where conflicts occur between the drawings and specifications, between different drawings, between different portions of this section of the specifications, or between different sections of the specifications, the more stringent requirements and the greater quantity shall apply.

1.2 SUMMARY

- A. Section Includes:
 - 1. Luxury vinyl tile (LVT).
- 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.

1.3 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 Initial Selection: For each type of floor tile indicated.
- D. Product Schedule: For floor tile. Use same designations indicated on Drawings.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of floor tile to include in maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
 - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

1.6 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.

1.7 PROJECT CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), 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

2.1 LUXURY VINYL TILE (LVT) as scheduled on plans

- A. Products: Subject to compliance with requirements, provide one of the following:
1. Mohawk Group – Global Entry- Strong Step Wood series (Basis of Design)
 2. Mannington Mills, Inc.
 3. Bolyu
- B. Tile Standard: ASTM 1700, Class III, Type A
- C. Gauge: 0.10" (2.5mm)
- D. Wear layer: 20 mil (0.5mm)
- E. Size: The following sizes are basis of design. **Variations to these shall be submitted for review and approval 10 calendar days PRIOR to bid date.** To be considered as equal to basis of design, substitute products must approximate pattern and color line of the LVT specified above. Requests for substitutions that do not submit complete, straightforward, and referenced information for product comparison will be considered non-responsive and rejected without further notice. Basis of Design as follows:
1. **Field: 16" X 16" & 18" X 18"**

2.2 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.
 2. LVT Adhesive shall be from manufacturer's products as required and installed in accordance with manufacturer's requirements.
- C. Floor Polish: Provide protective liquid floor polish products as recommended by manufacturer.

PART 3 – EXECUTION

3.1 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.

3.2 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 and as follows. Proceed with installation only after substrates pass testing.
 - a. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75% relative humidity level measurement.
- C. 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. Floorstone as required to achieve working conditions.
- D. 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.
- E. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.3 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 square with room axis 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 with grain direction alternating in adjacent tiles (basket-weave pattern) and 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. 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.

3.4 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protection of floor tile.
- B. 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.
- C. 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.
- D. Floor Polish: Remove soil, visible adhesive, and surface blemishes from floor tile surfaces before applying liquid floor polish.
 1. Apply five coats.
- E. Cover floor tile until Substantial Completion.

END OF SECTION

SECTION 09 68 00 – CARPET

PART 1 – GENERAL

1.1 COORDINATION

- A. The General Conditions of the Contract for Construction and the Supplementary Conditions to the General Conditions of the Contract for Construction shall be considered as part of this section of the specifications.
- B. Each Bidder shall be responsible for determining during the bidding period the extent that any addenda issued during the bidding period may affect this section of the specifications.
- C. Reference Instructions to Bidders for requirements regarding substitutions of materials and products.
- D. Where conflicts occur between the drawings and specifications, between different drawings, between different portions of this section of the specifications, or between different sections of the specifications, the more stringent requirements and the greater quantity shall apply.

1.2 SUMMARY

- A. Section Includes:
 - 1. 24x24 Carpet Tiles.
 - 2. Accessories.
- B. Related Documents: The Contract Documents, as defined in Section 01 11 00 - Summary of Work, apply to the Work of this Section. Additional requirements and information necessary to complete the Work of this Section may be found in other documents.
- C. Related Sections:
 - 1. Section 09 65 00 - Resilient Flooring: Tile and base.

1.3 REFERENCES

- A. American Society for Testing and Materials (ASTM):
 - 1. ASTM E 684 - Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source.
- B. BOCA:
 - 1. FF-1-70.
- C. Carpet and Rug Institute (CRI):
 - 1. CRI 104 - Standard for Installation of Commercial Textile Floorcovering Materials.
 - 2. Green label certification.
- D. HUD:
 - 1. UM44d Standards.
- E. National Fire Protection Association (NFPA):
 - 1. NFPA 253 - Test for Critical Radiant Flux of Floor Covering Systems.
 - 2. NFPA 258 - Standard Research Test Method for Determining Smoke Generation of Solid Materials.

1.4 SYSTEM DESCRIPTION

- A. Recycled content: minimum 50% total recycled content, with not less than 10% post consumer recycled materials and the balance post-industrial recycled materials.
- B. Materials: all materials shall be high quality and of the type generally accepted for use in the industry. When used as intended, the materials shall be non-toxic, non-allergenic and free of similar health hazards. These materials include, but are not limited to, adhesives, cleaners, solvents, etc.
- C. Recyclability: The carpet must be 100% recyclable.
- D. Carpet shall inhibit the growth of fungi, gram-positive and gram-negative bacteria, in accordance with AATCC 138 or AATCC 174, parts 2 and 3. (Provide 3000 ppm of zinc OMADINE® bactericidefungicide.)

1.5 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Procedures for submittals.
 - 1. Product Data: Data on specified products, describing physical characteristics and method of installation.
 - 2. Shop Drawings: Indicate seaming plan, method of joining seams, and direction of carpet.
 - 3. Samples: Submit two samples 13-1/2 inch x 18 inch in size illustrating color and texture.
- B. Procedures for Closeout Submittals:
 - 1. Include the following certifications:
 - a. Stain proof certificate.
 - b. No zippering certificate.
 - c. Carpet and Rug Institute green label certification.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in installing work of this Section with minimum 5 years documented experience.
- B. Regulatory Requirements:
 - 1. NFPA 253 Critical Radiant Flux in Accordance with ASTM E 684: Class 1.
 - 2. NFPA 258 NBS Smoke Chamber: Less than 450 flaming mode.
 - 3. BCA flame spread classification: DOC FF-1(use group R-2 sprinklered).
 - 3. HUD: UM44d Standards.

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Adhesives: No adhesives to be used.
- B. CRI "green label".

1.8 DELIVERY, STORAGE AND HANDLING

- A. Section 01 60 00 - Product Requirements: Transport, handle, store, and protect products.
- B. Deliver carpet in original mill wrappings with register number marked on each bale.
- C. Storage areas shall be secure and dry with temperatures maintained above 65 degrees F at all times.

- D. Remove carpet from its packaging and allow to acclimatize to area of installation 24 hours before application.

1.9 PROJECT CONDITIONS OR SITE CONDITIONS

- A. Environmental Requirements: Do not install carpet unless a constant temperature of at least 65 degrees F. is maintained for 72 hours before, during and 48 hours after application in all areas to receive carpeting.

1.10 WARRANTY

- A. Carpet Manufacturer's Warranty:

Submit a written Warranty, signed by carpet manufacturer and carpet installer agreeing to repair or replace carpet that does not meet requirements or that fails in materials or workmanship, including but not limited to the following:

- A. Delamination.
- B. Edge ravel.
- C. Wear.
- D. Tuft bind.

- 2. Warranty Period: 10 years.

1.11 MAINTENANCE

- A. Maintenance Data: Maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with Project requirements, manufacturers offering Products which may be incorporated in the Work include the following:

CARPET TILES AND CARPET:

- 1. Mannington Commercial, Calhoun, GA. (800) 241-2262
- 2. Interface, LaGrange, GA. 800-336-0225
- 3. Mohawk Group, Marietta, GA. (800) 554-6637
- 4. Substitutions: Refer to Section 01600 – Substitution Procedures.

2.2 CARPET ACCESSORIES

- A. Subfloor Filler: Latex underlayment, mixed with undiluted latex liquid furnished by the selected manufacturer. Use one of the following products.

- 1. Levelayer I, by Dayton Superior Corporation, Miamisburg, OH (800) 745-3700.
- 2. No. 345, by W.W. Henry Company, Orange, CA (800) 447-0216.

3. Approved Substitutions: Refer to Section 01 25 00 – Products and Substitutions.

- B. Tackless Strip: Carpet gripper, of type recommended by carpet manufacturer to suit application, with attachment devices.
- C. Base Gripper: Tackless strip type with special lipped edge; color to match carpet.
- D. Seam Adhesive: Recommended by manufacturer.
- E. Rubber Transition and termination strips: Equal to Johnsonite Specialty Flooring Accessories, color to be selected by Architect
- F. Adhesives: Materials must comply with the toxicity and emission limits specified in Article 1.3 above.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Section 01 70 00 - Execution Requirements: Verification of existing conditions before starting work.
- B. Verification of Conditions: Verify that field measurements, surfaces, substrates and conditions are as required, and ready to receive Work.
- C. Report in writing to Architect prevailing conditions that will adversely affect satisfactory execution of the Work of this Section. Do not proceed with Work until unsatisfactory conditions have been corrected.
- D. By beginning Work, Contractor accepts conditions and assumes responsibility for correcting unsuitable conditions encountered at no additional cost to the Owner.

3.2 PREPARATION

- A. Prepare substrate for product installation in accordance with manufacturer's published instructions.
- B. Subfloor ridges, bumps, and other irregularities. Fill cracks, contraction joints, holes, and depressions with subfloor filler as recommended by manufacturer to achieve smooth, flat hard surface.
- C. Where carpet is installed on existing wood floors, carpet shall be installed directly on existing floors without underlayment.
- D. If carpet is installed on concrete floors, apply subfloor filler and leveler to provide finished concrete surface smooth, with no more than 1/8 inch variation from plane within 10 feet in any direction. Prohibit traffic until subfloor filler is cured.
- E. Remove old adhesive, paint, oils, waxes, sealers and curing compounds not compatible with adhesive to be used. Avoid organic solvents.
- F. Vacuum clean substrate.

3.3 INSTALLATION

- A. General Installation:
 - 1. Install carpet and cushion in accordance with manufacturers instruction and CRI 104.

2. Verify carpet match before cutting to ensure minimal variation between dye lots.
 3. Lay out carpet.
 - A. Locate seams in area of least traffic, out of areas of pivoting traffic, and parallel to main traffic.
 - B. Do not locate seams perpendicular through door openings.
 - C. Align run of pile in same direction as anticipated traffic and in same direction on adjacent pieces.
 - D. Locate change of color or pattern between rooms under door centerline.
 - E. Provide monolithic color, pattern, and texture match within any one area.
 - F. Extend carpet under removable flanges and furnishings and into alcoves and closets of each space.
 - G. Provide cut outs where required and bind cut edges where not concealed by protective edge guards or overlapping flanges.
 - H. Install with pattern parallel to walls and borders.
 4. Install carpet tight and flat on subfloor, well fastened at edges, with a uniform appearance. Use power stretcher where carpet is greater in length than 20 feet.
 5. Install carpet edge guard where edge of carpet is exposed and anchor guards.
 6. Install carpet by trimming edges, butting cuts with seaming cement, and taping and/or sewing seams to provide sufficient strength for stretching and continued stresses during life of carpet.
 7. Trim edges and butt cuts with seam cement.
 8. Carpet shall be installed directly on floor slab or wood floor with reusable hook/loop tape method using 3M TacFast or approved equal. Double sided tape is not acceptable.
- B. Installation on Interior Steel Stairs:
1. Install tackless strips at back of treads, with pins facing riser, and at bottom of riser, with pins facing tread.
 2. Install cushion on stair treads and lap over nosing.
 3. Install carpet on stairs with the run of the pile in opposite direction of anticipated traffic to avoid peaking of backing at nosings.
 4. Stretch carpet over stair treads, full width in one piece as indicated on plans. Fold carpet under 1 1/2 inches (4 cm) on each side.
- 3.4 FIELD QUALITY CONTROL
- A. Section 01 45 00 - Quality Control: Field inspection.
 - B. Inspect carpet and base installation, seaming, pattern, layout, and attachment to substrate.
- 3.5 CLEANING AND PROTECTION
- A. Comply with CRI 104, Section 15 - Protection of Indoor Installation, and manufacturer's recommended cleaning procedures and as follows.

- B. Section 01 70 00 - Execution Requirements: Cleaning and protection of installed work.
- C. Vacuum carpet using commercial machine with face-beater element. Remove spots, according to manufacturer's recommendations, and replace carpet where spots cannot be removed. Remove any protruding face yarn using sharp scissors. Final cleaning with HEPA vacuum as required by Section 01 35 00.
- D. Remove and recycle excess material as required by the Construction Waste Management Program, Section 01 56 50.

3.6 SITE ENVIRONMENTAL PROCEDURES

A. Indoor Air Quality:

- 1. Temporary ventilation: As specified in Section 01 15 00 - Environmental Procedures.

- A. Ventilate products prior to installation. Remove from packaging and ventilate in a secure, dry, well-ventilated space free from strong contaminant sources and residues. Provide a temperature range of minimum 60 degrees F to maximum 90 degree F continuously for minimum 72 hours. Do not ventilate within limits of Work unless otherwise approved by Owner and Architect.

3.7 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Furnish quantity not less than 5 percent for each color, pattern, and type of carpet installed.

END OF SECTION

SECTION 10 14 00 — GRAPHICS AND SIGNAGE

PART 1 - GENERAL

1.1 COORDINATION:

- A. The General Conditions of the Contractor for Construction and the Supplementary Conditions to the General Conditions of the Contract for the Construction shall be considered as part of this section of the specifications.
- B. Each Bidder shall be responsible for determining during the bidding period the extent that any addendum issued during the bidding period may affect this section of the specifications.
- C. Reference Instructions to Bidders for requirements regarding substitutions of materials and products.
- D. Where conflicts occur between the drawings and specifications, between different drawings, between different portions of this section of the specifications, or between different sections of the specifications, the stringent requirements and the greater quantity shall apply.

1.2 WORK INCLUDED

- A. Material and installation for the Plastic Room Identification Plaques.
- B. Material and Installation for Exterior/Interior Building Identification Letters.
- C. Material and Installation For Building Dedication Plaque with logos (including but not limited to conversion of architectural drawings into useable vector line art format).

1.3 RELATED WORK SPECIFIED IN OTHER SECTIONS

- A. Interior wall materials and finishes.
- B. Exterior wall materials and finishes.
- C. Typical handicapped site signage.

1.4 SUBMITTALS

- A. Submit manufacturer's product data describing materials, and mounting methods for Room Identification Plaques, Exterior/Interior Building Identification Letters, and Building Dedication Plaque.
- B. Submit color samples of actual material for color and finish selection by Architect.
- C. Submit finished sample of room identification plaque(s) with any required symbols other than text.
- D. Submit paper "rubbing" of final layout of Building Dedication Plaque for Architect's approval.
- E. Submit full size paper layout of Exterior Building Identification Letters for each line of text.
- F. Reference Section 01 33 00 SUBMITTALS for additional submittal requirements.

1.5 WARRANTY

- A. Provide written warranty against defects in materials and workmanship for the work under this section for a period of one year after the date of Substantial Completion of the project.
- B. Warranted defects shall include but not necessarily be limited to color fading, delamination, failure of anchoring or fastening, cracking, breaking or tarnishing.
- C. Exterior signage or building letters contributing to streaking or staining of building shall be a defect to be corrected by the Contractor, with building materials cleaned or replaced as required.

1.6 QUALITY ASSURANCE

- A. Fabrication and installation company shall have a minimum of 3 years experience in the installation of similar systems for projects of similar size and scope.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Do not deliver materials to the jobsite until surfaces are ready for installation of graphics.
- B. Store materials in covered, dry, temperature and humidity controlled space.

2 PART TWO – PRODUCTS

2.1 MANUFACTURERS

- A. ROOM IDENTIFICATION PLAQUES:
 - 1. South Texas Graphic Specialties, Inc.
 - 2. The Southwell Co.
 - 3. Cantrell Industries.
- B. EXTERIOR BUILDING IDENTIFICATION LETTERS:
 - 1. A.R.K. Ramos
 - 2. Gemini Inc.
 - 3. Matthews Bronze Div. – Architectural Products
 - 4. Metal Arts
- C. BUILDING DEDICATION PLAQUE:
 - 1. A.R.K. Ramos
 - 2. Matthews Bronze Div. – Architectural Products
 - 3. Metal Arts
 - 4. OMC Industries, Inc.

2.2 MATERIALS

- A. ROOM IDENTIFICATION PLAQUES:
 - 1. 6" X 9" X 1/4" thick two tone series:
 - 2. Fabrication: Constructed of Wilson Art face laminate (as selected by the Architect from manufacturer's standard selections) laminated to a solid acrylic core. The raised 1/32" acrylic copy shall be cut through the laminate face color and chemically welded to the acrylic core to assure permanent attachment, including the symbols. Any lower and secondary copy shall be 5/8" high Helvetica Medium (all caps) incised copy paint filled. Colors as selected by the Architect. Any secondary copy shall be 8-stroke computer engraved. Rounded corner letters will not be

acceptable. The edge of the signs shall be finished to match the face laminate color-to-color as selected by the Architect.

3. At toilet rooms also provide with 2" high raised gender and wheelchair symbols when handicapped equipped noted on schedule. Symbols shall be chemically welded through the face laminate to the acrylic core. Edges painted a color as selected.
4. The raised copy shall be accompanied with grade 2 Braille by means of Visi Touch DuraDot Braille manufacturing system. The clear Glass DuraDot shall have a 0.059 surface diameter and raised 1/32" above the face laminate and shall be unitized to the acrylic core through the face laminate. The edges of the sign shall be finished to match the face laminate color-to color as selected by the Architect. Any secondary copy shall be 8-stroke computer engraved. Rounded corner letters will not be acceptable.
5. Installed plaques shall comply with all state, local, and federal requirements for compliance.

B. EXTERIOR/INTERIOR BUILDING IDENTIFICATION LETTERS

1. Scope: The project shall include a cast letters as described below, to be provided and installed by contractor. Letterstyle, finish and mounting to be selected by Architect.
2. Fabrication of Letters: Fabricate letters to comply with requirements indicated below and as indicated on drawings.

A. Cut letters : Form letters by cutting from solid sheet material of thickness specified. Produce characters with smooth flat faces, sharp corners, precisely formed lines and profiles, free from pits, scale, sand holes and other defects. Supply anchoring devices on reverse side of individual letters as required.

3. Characteristics:
 - A. Metal: Aluminum
 - B. Size: 8" and 6" as indicated on drawings.
 - C. Thickness: 1 1/2 inches.
 - D. Letterstyle: Sans Serif
 - E. Finish: As selected by Architect from manufacturer's finish options (submit samples).
 - F. Mounting: Concealed (refer to drawings for wall type).
 - G. Text: "BRUSH COUNTRY G.C.D."
"BRUSH COUNTRY GROUNDWATER CONSERVATION DISTRICT"
4. Template: Provide full size paper mounting template showing hole placement and location of mounting holes.
5. Finishes: Colors and surface textures for exposed letters as selected by the architect from the manufacturer's standard and premium selections.

C. BUILDING IDENTIFICATION PLAQUE:

1. 18" wide X 24" high cast bronze alloy plaque. Borders and raised text shall have satin finish. Background shall receive a dark oxidized leatherette finish. Faces and edges to be chemically cleaned and sprayed with two coats of clear acrylic lacquer.
2. Provide threaded stainless steel or brass studs on back for concealed mounting with epoxy. Letter style "Helvetica Medium" per A.R. Ramos or equivalent by specified manufacturer.
3. Layout, logos and letter sizes to be provided by the Architect. General contractor shall perform all conversions of architectural drawings & logos into useable vector line art format or any other type of format as required in order to produce the building plaque layout as provided by the Architect.

3 PART THREE- EXECUTION

3.1 INSPECTION AND PREPARATION

- A. Ensure that wall surfaces are completed and accepted by the Architect prior to installing wall-mounted items or painted wall graphics.
- B. Obtain approved location schedule for Room Identification Plaques prior to delivery of plaques to the jobsite.

3.2 INSTALLATION

A. ROOM IDENTIFICATION PLAQUES:

- 1. Apply top and bottom strips of 1/8" thick double stick vinyl foam tape and backs of each plaque. Apply liberal amount of clear silicone rubber adhesive to a minimum of 50% coverage of back of plaque.
- 2. Plaques shall be mounted to the strike side of the door on the wall within 5' of the floor and 6" max. from the jamb; when location is on a glass side light or window, mount with a solid color back-up plate to cover reverse side of the glass. Attachment shall be with foam tape and silicone.

B. BUILDING DIRECTIONALS SIGNS:

- 1. Apply top and bottom strips 1/8" thick double stick vinyl foam tape on backs of each sign. Apply liberal amount of clear silicone rubber adhesive to a minimum of 50% coverage of back of sign.
- 2. Signs shall be mounted to the strike side of the door on the wall within 5' of the floor and 6" max. from the jamb; when location is a glass sidelight or window, mount with a solid color back-up plate to cover reverse side of the glass. Attachment shall be with foam tape and silicone.

C. EXTERIOR/INTERIOR BUILDING IDENTIFICATION LETTERS.

- 1. Pre-drill holes into masonry and insert threaded stud on back of letters into epoxy adhesive filled holes. Provide stainless steel spacers to set letters off wall 1/2" minimum 2 studs per letter. Refer to drawings for wall finish type.

D. BUILDING IDENTIFICATION PLAQUE:

- 1. Masonry Wall: Pre-drill holes into masonry walls and insert threaded studs on back of letters into epoxy adhesive filled holes. Mount plaque tight against wall.
- 2. Drywall: Mount plaque using a minimum of 4 moly type expansion screws and silicone adhesive. Mount plaque tight against wall.

END OF SECTION

SECTION 10 14 53 — TRAFFIC STRIPING AND PARKING SIGNAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The General Conditions of the Contractor for Construction and the Supplementary Conditions to the General Conditions of the Contract for the Construction shall be considered as part of this section of the specifications.
- B. Each Bidder shall be responsible for determining during the bidding period the extent that any addendum issued during the bidding period may affect this section of the specifications.
- C. Reference Instructions to Bidders for requirements regarding substitutions of materials and products.
- D. Where conflicts occur between the drawings and specifications, between different drawings, between different portions of this section of the specifications, or between different sections of the specifications, the stringent requirements and the greater quantity shall apply.

1.2 WORK INCLUDED

- A. Provide traffic line, parking stripe and symbol painting on concrete/asphalt paving as indicated in the drawings.
- B. Provide and install pipe-mounted parking signs at handicapped parking spaces meeting requirements of ADA.

1.3 RELATED WORK SPECIFIED IN OTHER SECTIONS

- A. Reinforced concrete paving.

1.4 SUBMITTALS

- A. PAINT: Submit manufacturer's product literature indicating Federal specification numbers and manufacturer's recommended use and application techniques.
- B. Reference Section 01 33 00 SUBMITTALS for additional submittal requirements.
- C. Provide full size template for handicapped stall symbol.

1.5 WARRANTY

- A. Provide written warranty against defects in material and workmanship for a period of one year after date of Substantial Completion.
- B. Warranted defects for paint striping shall include but not necessarily be limited to fading, bleed-thru, spalling, excessive wear or delamination.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. PAINT: "Traffic-Line" alkyd base marking paint meeting Federal Specifications TTP-85 and TTP-115 Type 1 as manufactured by Devoe or equivalent.
 - 1. Width: Typically 4 inches unless indicated otherwise in the drawings.
 - 2. Colors:
 - a. White: Traffic lines, directional symbols, symbols for the handicapped.
 - b. Yellow: Striping for parking stalls.
- B. HANDICAPPED PARKING SIGNS:
 - 1. Provide sign size, colors and copy meeting state, local and federal requirements for handicapped parking signage.
 - 2. Sign blank shall be 1/8" aluminum sheet with Dupont "Emron" glass paint background, graphics and copy.
 - 3. Graphics and copy shall be photo silk screened.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Ensure that paving operations are complete and surfaces thoroughly dry, clean, and free of oil or grease stains or other contaminants.
- B. Clean with high pressure wash or brush if necessary for proper adhesion.

3.2 PAINT

- A. Spray apply two coats of marking paint in patterns indicated on the drawings after weathering of asphalt or concrete paving for a minimum of 30 days. Edges shall be sharply defined.
- B. Provide minimum dry thickness of 2.5 mils. Provide additional coats if required for complete hiding.

- 3.3 HANDICAPPED PARKING SIGNS: Set 2" galvanized pipe sign support in minimum 6" diameter x 24" deep concrete footing.

END OF SECTION

SECTION 10 21 13 - TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 COORDINATION

- A. The General Conditions of the Contract for Construction and the Supplementary Conditions to the General Conditions of the Contract for Construction shall be considered as part of this section of the specifications.
- B. Each Bidder shall be responsible for determining during the bidding period the extent that any addenda issued during the bidding period may affect this section of the specifications.
- C. Reference Instructions to Bidders for requirements regarding substitutions of materials and products.
- D. Where conflicts occur between the drawings and specifications, between different drawings, between different portions of this section of the specifications, or between different sections of the specifications, the more stringent requirements and the greater quantity shall apply.

1.2 WORK INCLUDED

- A. Provide and install **solid phenolic toilet partition system and urinal screens** as indicated in the drawings, the approved shop drawings and as specified herein.
- B. Provide and install all toilet room accessories as indicated in the drawings and as specified herein.

1.3 RELATED WORK SPECIFIED IN OTHER SECTIONS

- A. Wood blocking between studs.
- B. Wall and floor finishes.
- C. Electrical power provided.

1.4 SUBMITTALS

- A. **SOLID PHENOLIC PARTITION SYSTEMS:**
 - 1. Submit shop drawings for solid phenolic partition system indicating plan and elevation dimensions and mounting details. Submit hardware samples and full chain of melamine samples for partition doors.
 - 2. Shop drawings indicating handicapped stall layouts not meeting State and Federal requirements will be returned and rejected without review.
- B. **ACCESSORIES:**
 - 1. Submit manufacturer's product data describing size, type, finish and installation requirements for each item.
 - 2. Indicate mounting heights for each item. Meet State and Federal requirements for the handicapped.
- C. Reference Section 01 33 00 SUBMITTALS for additional submittal requirements.

1.5 WARRANTY

- A. Provide written warranty against defects in materials and workmanship for the work under this section for a period of one year after the date of Substantial Completion of the project.
- B. Warranted defects shall include but not necessarily be limited to delamination of facing or edging, swelling of core, change in alignment of parts, failure of anchorage or fasteners.
- C. Provide manufacturer's extended written warranty for systems and accessories where available.

1.6 QUALITY ASSURANCE

- A. Partition system installation company shall have a minimum of 5 years experience in the installation of similar system for projects of similar size and scope.
- B. Partition system installation company shall be authorized by the system manufacturer for this installation.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Deliver partition system materials to the job site in manufacturer's original packaging.
- B. Store materials in covered, dry, temperature and humidity controlled space.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. SOLID PHENOLIC PARTITION SYSTEMS:
 - 1. Bobrick Washroom Equipment
 - 2. American Specialties, Inc.
 - 3. Ampco
 - 4. General Partitions
- B. ACCESSORY MANUFACTURERS:
 - 1. Bobrick Washroom Equipment
 - 2. Bradley Wash Fountain Co.
- C. PAPER TOWEL DISPENSERS:
 - 1. Bobrick Washroom Equipment

2.2 TOILET ROOM ACCESSORIES:

- 1. Grab bars: Furnish and install grab bars at each handicapped toilet stall. Bars shall be Bobrick No. B-6806 series, 1-1/2" outside diameter, satin finish stainless steel, configuration as indicated on the drawings, 1-1/2" clear to wall. **Where bars are mounted over back of toilet, General Contractor shall hold flush valve low.**
- 2. Mirrors: Mirrors shall be 1/4" plate glass, mirror quality, with copper backs. Provide polished stainless steel or brass chrome plated frames in sizes indicated on the drawings.
 - a. Tilted mirrors shall be Bobrick No. B-293 or equivalent by specified manufacturer.
 - b. Flat mirrors shall be Bobrick No. B-290 or equivalent by specified manufacturer.
- 3. Mop Holder: Bobrick B223X24 stainless steel. Furnished and installed by Contractor.
- 4. Soap dispensers: Bobrick Contura Series Surface Mounted Soap Dispenser Model B-4112. Furnished and installed by Contractor.

5. Tissue dispensers: ClassicSeries Surface-Mounted Toilet Tissue Dispenser for Two Rolls Model B-265 of Bobrick Washroom Equipment, Inc. Furnished and installed by Contractor.
6. Paper Towel Dispensers: Recessed Paper Towel Dispenser and Waster Receptacle shall be Model B-369 of Bobrick Washroom Equipment, Inc. Furnished and installed by Contractor.
7. Clothes hooks: Surface mounted clothes hooks Model B-981 of Bobrick Washroom Equipment, Inc.

2.3 SOLID PHENOLIC PARTITION SYSTEMS:

A. STILES, PANELS, DOORS, SCREENS, BENCHES

1. Solid phenolic material constructed of solidly fused plastic laminate with matte-finish melamine surfaces, colored face sheets, and black phenolic-resin core that are integrally bonded. Edges shall be black. Brown edges shall not be acceptable. Color and pattern as selected by architect from manufacturer's standard colors.
2. Solid phenolic material shall meet National Fire Protection Association and International Building Code Interior Wall and Ceiling Finish Class A, Uniform Building Code Class I, ASTM E-84 Fire Resistance Standards; flame spread 20, smoke density 95.
3. Finish Thickness
 - a. Stiles and doors shall be 3/4" (19mm).
 - b. Panels and benches shall be 1/2" (13mm).

B. HARDWARE

1. All hardware to be 18-8, type-304 stainless steel with satin-finish.
2. All hardware shall be concealed inside compartments with the exception of outswing doors.
3. Hardware of chrome-plated "Zamak" is unacceptable.

C. LATCH

1. Sliding door latch shall be 16-gauge (1.6mm).
2. Sliding door latch shall require less than 5-lb force to operate. Twisting latch operation will not be acceptable.
3. Latch track shall be attached to door by flathead machine screws into factory installed threaded brass inserts.
4. Latch handle shall have rubber bumper to act as door stop.
5. Latch shall allow door to be lifted over 16-gauge (1.6mm) keeper for emergency access.
6. Metal-to-metal connection shall withstand a direct pull of over 1,500 lb. per screw.

D. HINGES

1. Cam shall be adjustable in the field to permit door to be fully closed or partially open when compartment is unoccupied.

2. Hinges shall be attached to door and stile by theft-resistant, one-way stainless steel machine screws into factory-installed metal inserts. Fasteners secured directly into the core are not acceptable.
 3. Metal-to-metal connection shall withstand a direct pull of over 1,500 lb. per screw.
- E. Clothes Hook shall be constructed of stainless steel and shall project no more than 1-1/8" (29mm) from face of door. Clothes hook shall be secured by theft-resistant, one-way stainless steel screws.
- F. Mounting Brackets shall be constructed of stainless steel and shall be mounted inside compartment. Mounting brackets exposed on the exterior of the compartment will not be acceptable. Wall mounted urinal screen brackets shall be 11-gauge (3mm) double thickness.
- G. Leveling Device shall be 3/16" (5mm) hot rolled steel bar; chromate-treated and zinc-plated; through bolted to base of solid phenolic stile.
- H. Stile Shoe shall be one-piece, 4" (102mm) high, type-304, 22-gauge (0.8mm) stainless steel with satinfinish. Top shall have 90° return to stile. Patented one-piece shoe capable of adapting to 3/4" or 1" stile thickness and capable of being fastened (by clip) to stiles starting at wall line.
- I. Headrail (Overhead-Braced) shall be satin finish, extruded anodized aluminum (.065" / 1.65mm thick) with anti-grip profile. Type: Floor mounted, overhead braced continuously over entire system.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Ensure that Contractor has properly installed solid wood blocking between studs at all mounting points.

3.2 INSTALLATION

- A. Install accessories and partition systems in accordance with the project drawings, approved shop drawings and as specified herein. Use tamper proof stainless steel fasteners for all items.
- B. ACCESSORIES:
1. Install through finished stud walls into solid wood blocking with stainless steel one-way screws. No plastic anchors.
 2. Attach to masonry walls using stainless steel machine screws in lead shield anchors.
- C. PARTITION SYSTEMS AND URINAL SCREENS:
1. Mount channels using stainless steel one-way screws through finished stud walls into solid wood blocking.
 2. Mount channels to masonry walls using stainless steel machine screws in lead shield anchors.
 3. Job measure for proper fit and to ensure that the maximum space between edge of any pilaster or panel and its adjacent surface is one inch.
 4. Install pilaster, doors and panels plumb and square. Adjust doors for gravity closing.
- D. FRAMED MIRRORS:

1. Mirrors shall be installed with theft-proof anchors at height shown on drawings. Furnish tilted mirrors where shown.
2. Install mirrors at other locations in addition to toilet rooms as indicated in the drawings.
3. Unframed mirrors are provided and installed under another section of these specifications.

END OF SECTION

SECTION 10 44 00 - FIRE EXTINGUISHERS AND CABINETS

PART 1 GENERAL

1.0 COORDINATION

- A. The General Conditions of the Contract for Construction and the Supplementary Conditions to the General Conditions of the Contract for Construction shall be considered as part of this section of the specifications.
- B. Each Bidder shall be responsible for determining during the bidding period the extent that any addenda issued during the bidding period may affect this section of the specifications.
- C. Reference Instructions to Bidders for requirements regarding substitutions of materials and products.
- D. Where conflicts occur between the drawings and specifications, between different drawings, between different portions of this section of the specifications, or between different sections of the specifications, the more stringent requirements and the greater quantity shall apply.

1.01 SECTION INCLUDES

- A. Fire extinguishers.
- B. Fire extinguisher cabinets.
- C. Accessories.

1.02 RELATED SECTIONS

- A. Section 04 22 00 – Concrete Masonry Units; CMU walls to receive bracket mounted fire extinguisher.
- B. Section 06 10 00 – Rough Carpentry: Wood blocking and framing to receive semi-recessed fire extinguisher cabinets.
- C. Section 09 21 16 – Gypsum Drywall Assemblies: Finished openings in walls for semi-recessed fire extinguisher cabinets.

1.03 REFERENCES

- A. NFPA 10 – Standard for Portable Fire Extinguishers; National Fire Protection Association; 2002.
- B. UL (FPED) – Fire Protection Equipment Directory; Underwriters Laboratories Inc.; current edition.

1.04 PERFORMANCE REQUIREMENTS

- A. Conform to NFPA 10.
- B. Provide extinguishers classified and labeled by Underwriters Laboratories Inc. for the purpose specified and indicated.

1.05 SUBMITTALS

- A. See Section 01 33 00 – Submittals, procedures and requirements for shop drawings, product data and submittal requirements.
- B. Shop Drawings: Indicate cabinet physical dimensions.
- C. Product Data: Provide extinguisher operational features.
- D. Manufacturer's Installation Instructions: Indicate special criteria and wall opening coordination requirements.
- E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- F. Maintenance Data: Include test, refill or recharge schedules and re-certification requirements.

1.06 ENVIRONMENTAL REQUIREMENTS

- A. Do not install extinguishers when ambient temperature may cause freezing of extinguisher ingredients.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Fire Extinguishers, Cabinets and Accessories:
 - 1. JL Industries, Inc; Product 1037B20 with Extinguisher: www.jlindustries.com.
 - 2. Larsen's Manufacturing Co: www.larsensmfg.com.
 - 3. Potter-Roemer: www.potterroemer.com.
 - 4. Substitutions: See Section 01 25 00 – Product Requirements.

2.02 FIRE EXTINGUISHERS

- A. Basis of Design: JL Industries, "Cosmic 10E".
- B. Type: Multipurpose dry chemical.
- C. Rating: Sized for project requirements.
- D. Mounting: Refer to floor plans for locations, annotated FEC for cabinets and FE extinguishers alone.
- E. Dry Chemical Type: Stainless steel tank, with pressure gage.
 - 1. Class A:B:C.
 - 2. Size 10.
 - 3. Finish: Baked enamel, Red color.
- G. ALL fire extinguishers shall be inspected and certified by the local authority having jurisdiction that they are charged and ready for use and shall be "tagged" identifying such.

2.03 FIRE EXTINGUISHER CABINETS

- A. Basis of Design:
 - 1. JL Industries, "Cosmopolitan – 1035B20 ADAC with Saf-T-Loc, TAS compliant.
 - 2. Designations: Refer to the floor plans, FEC for Extinguishers in cabinets and FE for surface mounted extinguishers secured to walls.

- B. Surface Mounted (Non-Cabinet, FE Type) – Bracket and Extinguisher (non-cabinet): Manufacturer's standard stainless steel strap with enamel finished bracket with locking band retainer.
 - 1. Bracket shall match the extinguisher type.
- C. Metal for Cabinets: Formed stainless steel sheet; 0.036 inch thick base metal; #4 finish stainless steel.
- D. Cabinet Configuration: Recessed type.
 - 1. Sized to accommodate accessories.
 - 2. Exterior nominal dimensions of 13 7/8 inch wide x 27 3/8 inch high x 6 inch deep.
 - 3. Trim: Returned to wall surface, with 3 inch projection, 1 1/2 inch wide face.
 - 4. Form cabinet enclosure with right angle inside corners and seams. Form perimeters trim and door stiles.
- E. Door: 0.036 inch thick, reinforced for flatness and rigidity; lock with full glass access. Hinge doors for 180 degree opening with two butt hinge. Provide nylon catch.
- F. Door Glazing: Glass, clear, 1/8 inch thick float. Set in resilient channel gasket glazing.
- G. Cabinet Mounting Hardware: Appropriate to cabinet. Pre-drill for anchors.
- H. Weld, fill, and grind components smooth.
- I. Finish of Cabinet Interior: Enamel, color to select from manufacturer's full color line.

2.04 ACCESSORIES

- A. Extinguisher Brackets: Formed steel, chrome-plated.
- B. Cabinet Signage: FIRE EXTINGUISHER, vertical up face of cabinet to one side.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify rough openings for cabinet are correctly sized and located.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install cabinets plumb and level in wall openings, 30 inches from finished floor to inside bottom of cabinet.
- C. Secure rigidly in place.
- D. Place extinguishers in cabinets.

END OF SECTION

SECTION 10 75 00 - FLAGPOLES

PART 1 GENERAL

1.0 COORDINATION

- A. The General Conditions of the Contract for Construction and the Supplementary Conditions to the General Conditions of the Contract for Construction shall be considered as part of this section of the specifications.
- B. Each Bidder shall be responsible for determining during the bidding period the extent that any addenda issued during the bidding period may affect this section of the specifications.
- C. Reference Instructions to Bidders for requirements regarding substitutions of materials and products.
- D. Where conflicts occur between the drawings and specifications, between different drawings, between different portions of this section of the specifications, or between different sections of the specifications, the more stringent requirements and the greater quantity shall apply.

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division-1 specification section, apply to work of this section.

1.2 SESSION INCLUDES:

- 1.3 Aluminum flagpoles, ground mounted.

1.4 REFERENCES

- A. AASHTO M246/M246M Standard Specification for steel sheet, metallic-coated and polymer pre-coated for corrugated steel pipes.
- B. ASTM A53/A53M-02 Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.
- C. ASTM A123/A123M-02 - Zinc (Hot Dipped Galvanized) Coatings on Iron and Steel Products.
- D. ASTM A790/A790M-02 Standard Specification for Seamless and Welded Ferrite/Austenitic Stainless Steel Pipe
- E. ASTM B221-02 Aluminum Alloy Extruded Bar, Rod, Wire, Shape, and Tube.
- F. ASTM B241/B241M-02 Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube
- G. CDA (Copper Development Association) - Handbook.

1.5 PERFORMANCE REQUIREMENTS

- A. The General Contractor shall furnish and install a tapered aluminum flagpole, complete with a 50-star U.S. Flag, a State of Texas flag and a Mexico Flag, and all fittings, top ornament, lighting, ground spike with plate, foundation, grounding facilities, and all appurtenant work, all in accordance with the requirements of the Contract Documents.

1.6 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Shop Drawings: Indicate detailed dimensions, base details, anchor requirements and imposed loads.

- C. Product Data: Provide product data on pole, accessories and configurations.

1.7 OPERATION AND MAINTENANCE DATA

- A. Maintenance Data: Provide lubrication and periodic maintenance requirement schedules.

1.8 QUALIFICATIONS

- A. Design flagpole foundation under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State of Texas. Provide calculations.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of Section 01 60 00.
- B. Spiral wrap flagpole with protective covering and pack in protective shipping tubes or containers.
- C. Protect flagpole and accessories on site from damage or moisture.

PART 2 PRODUCTS

2.1 POLE MATERIALS

- A. Aluminum: ASTM B241; 6063 alloy, T6 temper.

2.2 POLE CONFIGURATION

- A. Nominal Height: 25 ft measured from nominal ground elevation.
- B. Flagpole: Ground mounted type.
- C. Flagpole Design: Cone tapered, seamless.
- D. Halyard: External type.

2.3 COMPONENTS AND ACCESSORIES

- A. Finial Ball: 6" diameter, spun aluminum.
- B. Truck Assembly: Cast aluminum; revolving, stainless steel ball-bearings, non-fouling.
- C. Flags: (1) U.S.A. design, 8 x 5 feet size, nylon fabric, brass grommets, hemmed edges.
(1) Texas design, 8 x 5 feet size, nylon fabric, brass grommets, hemmed edges.
- D. Cleats: Aluminum with stainless steel fastenings, two per halyard.
- E. Cleat Box: Aluminum with built-in hinge and hasp assembly, attached to pole with tamper proof screws inside box.
- F. Halyard: 3/8" diameter polypropylene, braided, white.

2.4 MOUNTING COMPONENTS

- A. Foundation Tube Sleeve: AASHTO M-246, corrugated 16-gage steel, galvanized.
- B. Pole Base Attachment: Flush, aluminum base with base cover.
- C. Lightning Ground Rod: Copper rod, 3/4" diameter; design length.

2.5 FINISHES

- A. Metal Surfaces in Contact with Concrete: Asphaltic paint.

- B. Concealed Steel Surfaces: Galvanized to ASTM A123 1.25 oz/sq ft.
- C. Aluminum: Anodized to color as selected.
- D. Finial: Spun and Lacquered.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify site conditions under provisions of Section 01 03 90.
- B. Verify that concrete foundation is ready to receive work and dimensions are as indicated on shop drawings.

3.2 PREPARATION

- A. Coat metal sleeve surfaces below grade and surfaces in contact with dissimilar materials with asphaltic paint.

3.3 INSTALLATION

- A. Install flagpole, base assembly, and fittings in accordance with manufacturer's instructions.
- B. Electrically ground flagpole installation.
- C. Fill foundation tube sleeve with sand specified in Section 02 22 30 and compact.
- D. Install foundation plate and centering wedges, welded base assembly for flagpoles base set on concrete base and fasten.

3.4 ERECTION TOLERANCES

- A. Maximum Variation From Plumb: One inch

3.5 ADJUSTING

- A. Adjust work under provisions of Section 01 70 00.
- B. Adjust operating devices so that halyard and flag function smoothly.

END OF SECTION

SECTION 12 21 13 - HORIZONTAL LOUVER BLINDS

PART 1 – GENERAL

1.00 COORDINATION

- A. The General Conditions of the Contract for Construction and the Supplementary Conditions to the General Conditions of the Contract for Construction shall be considered as part of this section of the specifications.
- B. Each Bidder shall be responsible for determining during the bidding period the extent that any addenda issued during the bidding period may affect this section of the specifications.
- C. Reference Instructions to Bidders for requirements regarding substitutions of materials and products.
- D. Where conflicts occur between the drawings and specifications, between different drawings, between different portions of this section of the specifications, or between different sections of the specifications, the more stringent requirements and the greater quantity shall apply.

1.01 DESCRIPTION

- A. Material and installation of 2" Horizontal Louver Blinds With Aluminum Slats at each window location.

1.02 SUBMITTALS

- A. Manufacturer's complete CSI 3- part specification sheet.
- B. Submit working hand sample or mock up blind as required.
- C. Submit two 6" samples of aluminum slat indicating color and dimensions.
- D. Approval of submittals by Architect shall not relieve contractor from installing blinds with adequate clearance to permit smooth operation of the blinds and demonstrating blinds to be in smooth, uniform working order. Contractor must field verify all dimensions.

1.03 DELIVERY, STORAGE AND HANDLING

- A. Product to be delivered in manufacturer's original packaging.
- B. Products to be handled and stored to prevent damage to materials, finishes and operating mechanisms. Store in a clean, dry area, laid flat to prevent sagging and twisting of packaging.

1.04 EXTRA STOCK

- A. Describe extra attic stock as required: One (1) additional horizontal louver blind.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Springs Window Fashions LLC or approved architect equivalent.
- B. Substitutions Request: Submit for approval under provisions of section 01 25 00.

2.02 HORIZONTAL BLINDS

- A. Product: Bali® 2" Aluminum School Blinds

- B. Color Name: As Selected by Architect; Color Number: As Selected by Architect.
- C. SureClose® Headrail shall be 1 5/8" high x 2 1/4" wide x .022" thick U-shaped steel with 1/8" light blocking lip on the bottom centerline. The steel finishing process includes phosphate treatment for corrosion resistance, a chrome-free sealer, a low HAP urethane primer and a topcoat with low HAP polyester baked enamel.
- D. Cord tilter shall be a snap-in component incorporating a worm and pulley of low-friction thermoplastic and a nylon gear. Standard tilt cords shall measure 2.2 mm in diameter.
Select One:
☒ Cord tilter (standard)
☐ Wand tilter
☐ Ring tilter
- E. Cord lock shall be metal of a snap-in design incorporating a floating, shaft-type locking pin and shall incorporate a crash proof safety feature that will lock blind automatically upon release of cord
Options:
☐ Ring pull provides a single plated steel ring in lieu of tassels with a nominal 4" cord length.
- F. Lift cord shall be made of braided polyester measuring 2.2mm in diameter.
- G. Vinyl ladder tape shall be 1 1/2" wide reinforced vinyl. Standard ladder spacing shall be 42mm.
Select One Vinyl Tape Color:
☐ 005 White
☐ 670 Creamy Beige
☐ 904 Lamplight
☐ 983 Gray Haze
☐ 062 Char Brown
- H. Slats shall be 5000 series cold-rolled aluminum containing the maximum allowable recycled content to produce a high strength and corrosion resistant flexible product. Slats shall be nominally 2" wide x .008" thick and treated with Advanced Finishing Technology (AFT), providing a smooth, hard, less porous surface. AFT delivers anti-static performance to repel dust and anti-microbial qualities to resist fungal and bacterial growth. Slats shall be treated with a chrome-free sealer and a topcoat of low HAP polyester baked enamel.
- I. Bottomrail shall be "C" shaped 9/16" high x 2" wide x .040 thick anodized aluminum. It is fully enclosed with a dust cover slat and finished with a polyester baked enamel to match headrail.

2.03 FABRICATION

- A. Blinds shall be fabricated according to specifications and accurate to tolerance established by SWF engineering standards

PART 3 – EXECUTION

3.01 INSPECTION

- A. Installer shall be responsible for inspection of jobsite, approval of mounting surfaces, verification of field measurements and installation conditions. Installation shall commence when satisfactory conditions are met.

- B. Do not dimension the drawings. Any questions concerning dimensions should be directed to the Architect for clarification.

3.02 INSTALLATION

- A. Install blinds in accordance with manufacturer's instructions including recommended support brackets and fasteners.
- B. Install blinds with adequate clearance to permit smooth operation of the blinds. Demonstrate blinds to be in smooth, uniform working order.

3.03 MAINTENANCE AND CLEANING

- A. Maintain and clean blinds in accordance with manufacturer's instructions.

END OF SECTION

SECTION 13 34 19 — PRE-ENGINEERED METAL BUILDINGS

PART 1 - GENERAL

1.00 COORDINATION

- A. The General Conditions of the Contract for Construction and the Supplementary Conditions to the General Conditions of the Contract for Construction shall be considered as part of this section of the specifications.
- B. Each Bidder shall be responsible for determining during the bidding period the extent that any addenda issued during the bidding period may affect this section of the specifications.
- C. Reference Instructions to Bidders for requirements regarding substitutions of materials and products.
- D. Where conflicts occur between the drawings and specifications, between different drawings, between different portions of this section of the specifications, or between different sections of the specifications, the more stringent requirements and the greater quantity shall apply.

1.01 SCOPE:

- A. Provide all pre-engineered metal buildings, complete, as shown on the Drawings, specified herein, or needed for a complete and proper installation and not specifically called for under other Sections of these specifications.
- B. The requirements of Division 0 – “Bidding and Contract Requirements” and Division 1 – “General Requirements” of this Project Manual apply to all work required for this section.

PART 2 - PRE ENGINEERED METAL BUILDING SYSTEM:

2.01 GENERAL:

- A. The intent of these specifications and drawings is to establish a quality and performance level for structural design, material, durability, and workmanship.
- B. All bidders must conform strictly to these specifications in their bid.
- C. The building shall be the design of a manufacturer who is regularly engaged in the fabrication of pre-engineered structures. All materials shall be new, unused, free from defects and of American manufacture.
- D. The following standards and criteria (of most recent issue) shall be used where applicable in the structural design of the building covered by this specification:

“MANUAL OF STEEL CONSTRUCTION”- American Institute of Steel Construction
“COLD FORMED STEEL DESIGN MANUAL” - American Iron and Steel Institute
“ALUMINUM CONSTRUCTION MANUAL” - The Aluminum Association
“CODE FOR WELDING IN BUILDING CONSTRUCTION” -American Welding Society

The following criteria shall also be applicable in other phases of design: latest edition of the INTERNATIONAL BUILDING CODE.

E. Listing by:

*Underwriters' Laboratories Inc.
Factory Mutual System or other recognized testing laboratories*

2.02 DESIGN LOADS:

A. GENERAL:

1. The basic design loads shall include live and wind, in addition to dead load. All other design loads, whether they be of static or dynamic nature, shall be considered as auxiliary loads.

B. VERTICAL LIVE LOAD:

1. Roof covering shall be designed for either 50 psf uniformly distributed or a 200-pound concentrated (point) load (over a 1' x 1' area) located at center of maximum roof (panel) span. The most severe conditions shall govern.
2. Purlins shall be designed for 20 psf uniformly distributed over the roof area which they support.
3. Primary framing (frames) shall be designed for 20 psf uniformly distributed over the roof area which it supports.
4. All the above loads to be in addition to the applicable dead loads and shall be applied to the horizontal projection of the roof.

C. WIND LOADS:

1. The wind load on the structure shall be proportioned and applied as horizontal and uplift forces according to and as recommended by the latest edition of the INTERNATIONAL BUILDING CODE.
2. The roof construction shall carry a U.L. Construction (Uplift) Listing of not less than Class 90.
3. Wind load may be proportioned as allowed by the latest edition of the INTERNATIONAL BUILDING CODE. However, such proportioning shall not compromise the UL-Class 90 listing.

D. AUXILIARY (ADDITIONAL COLLATERAL) LOADS:

1. Other superimposed dynamic and/or static loads shall be considered as part of the design requirements and combined with normal design (live and/or wind) loads as prescribed hereafter:

DYNAMIC LOADS: VARIOUS HVAC EQUIPMENT (REFER TO DRAWINGS FOR LOCATIONS).

STATIC LOADS: THE ROOF FRAMING AT 1:12 PITCH SHALL BE DESIGNED FOR AN AUXILIAR LOAD OF 5 PSI.

E. COMBINATION OF LOADS:

1. The combining of normal loads and auxiliary loads for design purposes shall be as prescribed and recommended by the latest edition of the INTERNATIONAL BUILDING CODE.

F. CERTIFICATION:

1. After the awarding of the Contract, complete structural analysis shall be submitted by the Metal Building Manufacturer to the Architect. Structural design must be sealed by a Texas Registered Professional Structural Engineer.

2.03 DESCRIPTION:

- A. The pre-engineered metal buildings covered in this specification are to be rigid frame structure of steel (frames) rafter beams.
- B. The roof slope shall be not less than 1"; 12" as indicated on the drawings.
- C. Column spacing shall be as indicated on the drawings.
- D. Nominal eave height shall be as indicated on the drawings.

2.04 ROOF COVERING AND SUPPORTS:

- A. ROOF PANELS – Refer to Section 07 41 13 Insulated Metal Roof Panel.
- B. PURLINS (ROOF COVER SUPPORT MEMBERS):
 1. The configuration, thickness and spacing of the purlins shall be the Building Manufacturer's standard. The allowance design capacity of cold-formed purlin members shall be calculated in accordance with the provisions of the AISI Specification for the Design of Cold-Formed Steel Structural Members.
 2. The deflection of the purlin or secondary member shall not exceed L/180 of its span when supporting the applicable vertical live loads previously prescribed and any collateral loads required.
 3. The standing seam roof does not provide a diaphragm or purlin bracing function. Brace purlins as required to conform with A.I.S.C. and A.I.S.I. specifications.
- C. ROOF JACKS AND CURBS:
 1. At roof penetrations for plumbing vents, install roof jacks (rubber) DEKTITE type where standing seam roofing is installed.
 2. At roof penetrations for mechanical equipment skylights requires curbs; provide custom fabricated roof curbs as manufactured by CUSTOM CURB, INC., LCM INC.

2.05 RAKE, TRIM, GUTTERS, ROOF DOWNSPOUTS, TRIMS AND SOFFIT LINERS:

- A. The closures, flashings, fascias, gutters, and trim shall be the Building Manufacturer's standard, compatible with the material furnished as roof panels.
- B. Buildings shall have continuous gutters with downspouts where shown on the drawings.
- C. Gutters, downspouts, rake trim, ridge panels, and trim associated with standing seam roof panels shall be a color to be selected by Architect from manufacturer's KYNAR 500 custom and to be part of base bid colors.
- D. WARRANTY:

1. The exterior color finish for the metal panels shall be warranted by the Material Manufacturer and General Contractor for twenty (20) years against blistering, peeling, cracking, flaking, checking, and chipping. Excessive color change and chalking shall be warranted for twenty (20) years. Color change shall not exceed 5 N.B.S. units (per ASTM D-2244.64T) and chalking shall not be less than a rating of 8 per ASTM D-659.

E. GIRTS:

1. The girt's configuration and thickness shall be the Building Manufacturer's standard provided all design criteria, including deflection and girt spacing is met.
2. Based on a simple span, the deflection of the girts (supporting the wall covering) shall be proportioned with due regard to that produced by the previously prescribed design (wind) load.

2.06 STRUCTURAL STEEL PRIMER:

- A. All uncoated structural steel shall be given one (1) coat of rust inhibitive (primer) paint which meets or exceeds Federal Specifications TT-P-664, or certification shall be submitted that it conforms to a recognized authoritative specification, such as from a Federal or Military authority or the Structural Steel Painting Council.
- B. Exposed pre-engineered metal building must be painted with at least one (1) coat of primer and two (2) coats of finish paint.

2.07 INSULATION AND INTERIOR FINISH:

- A. ROOF - Refer to Section 07 41 13 Insulated Metal Roof Panel.

PART 3 - EXECUTION

3.01 ERECTION:

- A. Erection of metal building, accessories, and insulation shall be performed by one of the following:
 1. Authorized systems contractors or builders of the manufacturer.
 2. Building manufacturer's crews.
 3. Other erectors authorized by the manufacturer as trained and qualified to erect that manufacturer's product. In this case, the manufacturer shall inspect the work and certify its correctness.

END OF SECTION

SECTION 31 10 00 — SITE CLEARING, GRADING AND FILLING

PART 1 - GENERAL

1.1 COORDINATION

- A. The General Conditions of the Contract for Construction and the Supplementary Conditions to the General Conditions of the Contract for Construction shall be considered as part of this section of the specifications.
- B. Each Bidder shall be responsible for determining during the bidding period the extent that any addenda issued during the bidding period may affect this section of the specifications.
- C. Reference Instructions to Bidders for requirements regarding substitutions of materials and products.
- D. Where conflicts occur between the drawings and specifications, between different drawings, between different portions of this section of the specifications, or between different sections of the specifications, the more stringent requirements and the greater quantity shall apply.

1.2 WORK INCLUDED

- A. Clearing, filling and grading of the affected areas of the site.
- B. Top Soil removal and reuse.
- C. Disposal of debris and surplus materials.
- D. Protection of trees and vegetation to remain, coordinate with the Architect.

1.3 RELATED WORK SPECIFIED IN OTHER SECTIONS:

- A. Excavation and backfilling for underground site utilities.
- B. Paving and sidewalks.
- C. Site drainage systems.

1.4 QUALITY ASSURANCE

- A. Testing Laboratory Services: Installed materials shall meet specified requirements as determined by the Owner's Testing Laboratory.
- B. Proposed sitework contractor shall be able to provide documentation that he has a minimum of three years of satisfactory experience in the performance of similar operations.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Existing top soil to be stockpiled and reused.
- B. Existing and off-site earth fill as required.
- C. TOPSOIL:
 - 1. Rich sandy loam, low in silt, free of trash, rocks, debris and other foreign materials.
 - 2. Topsoil stripped at the site and stockpiled may be used if material meets the above requirements and quantities are sufficient to meet all topsoil needs of the site. Otherwise topsoil meeting specified requirements and approved by the testing laboratory shall be provided from an approved off site source.
- D. FERTILIZER AND GRASSING: Provide grass to replace any disturbed areas during regarding.

PART 3 - EXECUTION

3.1 PROTECTION OF EXISTING TREES AND VEGETATION

- A. GENERAL: In addition to any temporary construction fencing provided under Section 01 50 00 Temporary Facilities, provide temporary chain link fencing around existing shrubs, grasses, ground cover and tress indicated to remain. Locate fencing around drip lines of individual trees or groups of trees.
- B. REPLACEMENT: Replace damaged existing trees and vegetation indicated to remain with materials of like kind, size and maturity as approved by the architect. Follow supplier's recommended procedures of planting.

3.2 TOPSOIL REMOVAL AND EXCAVATION

- A. Strip topsoil to a depth of 4" to 6" under all new site paving, sidewalks, within new building lines and at all site areas which will receive earth fill for grading adjustments.
- B. Temporarily store removed topsoil at an on-site location designated by the Architect. Stored topsoil shall be kept free of trash and construction debris.
- C. Remove additional existing soil as required to achieve any finish paving grades which may be at or near natural grade elevation.

3.3 EXCAVATING, GRADING AND FILLING

- A. GRADE ELEVATIONS: Establish finish grades as indicated on the drawings. Set and maintain grade stakes.
- B. ROUGH GRADING:
 - 1. Provide clean earth fill meeting specified requirements from off-site should additional earth fill be required.
 - 2. Provide temporary and permanent drainage swales, pumps, gutters and trenches necessary to dry existing soil and carry off water during construction. As indicated on drawings shape the site around structures to drain away from the building(s) at all times. Do not allow water to stand around trees scheduled to remain.

3. All site fill at unpaved and typical sidewalks areas shall be thoroughly compacted in lifts as specified below. Each layer and subgrade shall be wetted or dried as required to achieve optimum moisture content and then compacted to minimum ninety (90%) percent Proctor density per ASTM D1557. The subgrade shall be thoroughly and completely scarified before wetting and rolling.

C. COMPACTION: Compaction may be obtained by any of the following methods:

1. By sheepsfoot rollers having a unit weight on the contact feet of not less than 300 pounds per square inch with the soil being compacted in layers not exceeding 8" in depth (loose measurement).
2. By pneumatic tired rollers having a minimum compression of 325 pounds per inch of width of tire tread, with the soil being compacted in layers not exceeding 8" in depth (loose measurement).
3. For those portions of fill which cannot be reached with the sheepsfoot roller, such as corners and areas adjacent to columns, beams, etc., mechanical tampers shall be employed to obtain specified compaction.

D. EXISTING UTILITIES:

1. Arrange with utility companies for removal or relocation of any existing utilities.
2. Remove abandoned utilities up to the property line and provide permanent watertight cap.
3. If unknown or uncharted utilities are encountered during excavation, promptly notify the Architect before proceeding. Damage to existing utilities by continuing work without notifying the Architect shall be repaired by the Contractor at no additional cost to the Owner.

E. FINISH GRADING;

1. After rough grading and proof rolling operations are complete, install 2" of topsoil over unpaved open area (within the limits of grading) and fine grade to finish contours and make ready to receive grass planting (whether or not grass planting is required under this contract).
2. Open areas shall be raked smooth and left free of clumps, trash, debris and vegetation. Finish grading shall be uniform in planarity, meeting elevations and slopes as indicated on the drawings, and as required to ensure proper drainage.

3.4 DISPOSAL:

1. Adhere to Federal, State, County and local regulations regarding disposal of removed trees, shrubs, vegetation, soil, and rubble. It is the sole responsibility of the Contractor to determine the regulations regarding on-site burning of removed trees and vegetation.
2. Upon completion of fine grading operations, any excess soil shall be removed from the site, stockpiled at the site, or relocated to any property controlled by the Owner within five miles of the site. The above options shall be as determined by the Owner at no additional cost to the Owner.

END OF SECTION

SECTION 31 31 16 - TERMITE CONTROL

PART 1 - GENERAL

1.1 COORDINATION

- A. The General Conditions of the Contractor for Construction and the Supplementary Conditions to the General Conditions of the Contract for the Construction shall be considered as part of this section of the specifications.
- B. Each Bidder shall be responsible for determining during the bidding period the extent that any addendum issued during the bidding period may affect this section of the specifications.
- C. Reference Instructions to Bidders for requirements regarding substitutions of materials and products.
- D. Where conflicts occur between the drawings and specifications, between different drawings, between different portions of this section of the specifications, or between different sections of the specifications, the stringent requirements and the greater quantity shall apply.

1.2 SECTION REQUIREMENTS

- A. Submittals: Product Data and product certificates signed by manufacturer certifying that products used comply with U.S. EPA regulations for termiticides. Include application instructions and EPA-Registered Label.
- B. Engage a licensed professional pest control operator to apply termite control solution.

PART 2 - PRODUCTS

2.1 TERMITICIDES

- A. Provide an EPA-registered termiticide (5 year) complying with requirements of authorities having jurisdiction, in a soluble or emulsible, concentrated formulation that dilutes with water or foaming agent. Use only soil treatment solutions that are not harmful to plants. Provide quantity required for application at the label volume and rate for the maximum termiticide concentration allowed for each specific use, according to the product's EPA-Registered Label.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Prepare surfaces and apply treatment at rates and concentrations recommended in manufacturer's written instructions.
- B. Apply termite control to the following:
 - 1. At foundations. (Piers, mid-span supports)
 - 2. Under sub-floors and flooring materials.

3. Under basement floor slabs.
 4. At hollow masonry.
 5. At expansion and control joints and slab penetrations.
 6. At crawlspaces; treat soil under and adjacent to foundation supports. Treat adjacent areas including around entrance platform, porches, and equipment bases. Apply overall treatment.
- C. Post warning signs in areas of application.
- D. Reapply soil termiticide treatment solution to areas disturbed by subsequent excavation or other construction activities following application.

END OF SECTION

SECTION 32 11 00 — FLEXIBLE BASE

PART 1 - GENERAL

1.00 COORDINATION

- A. The General Conditions of the Contractor for Construction and the Supplementary Conditions to the General Conditions of the Contract for the Construction shall be considered as part of this section of the specifications.
- B. Each Bidder shall be responsible for determining during the bidding period the extent that any addendum issued during the bidding period may affect this section of the specifications.
- C. Reference Instructions to Bidders for requirements regarding substitutions of materials and products.
- D. Where conflicts occur between the drawings and specifications, between different drawings, between different portions of this section of the specifications, or between different sections of the specifications, the stringent requirements and the greater quantity shall apply.

1.01 GENERAL DESCRIPTION OF WORK:

- 1. This work shall consist of furnishing and placing a foundation course for surface courses or for other base courses.
- 2. Flexible base shall be composed of either caliche (argillaceous limestone, calcareous or calcareous clay particles, with or without stone, conglomerate, gravel, sand or other granular materials), crushed stone, gravel, iron, or topsoil, shell, or crushed slag.
- 3. Flexible base shall be constructed as specified herein in one or more courses in conformance with details, lines and grades shown on the plans, and as established by the ENGINEER.

PART 2 - PRODUCTS

2.01 MATERIALS

- 1. Materials for flexible base shall be crushed or uncrushed as necessary to comply with the requirements hereinafter specified.
- 2. Materials shall consist of durable course aggregate particles mixed with approved binding materials.

2.02 LIME STABILIZATION:

- 1. The material for flexible base shall be lime stabilized.

2.03 TYPES:

- 1. Type A - Crushed or broken aggregate (excluding gravel aggregate).
- 2. Type B - Gravel Aggregate
- 3. Type C - Iron Ore Topsoil
- 4. Type D - Shell Aggregate with Sand Admixture
- 5. Type E - Shell Aggregate with Sand and Caliche Ad mixture
- 6. Type F - Caliche
- 7. Type G - Crushed Slag
- 8. Unless otherwise noted on the plans, the CONTRACTOR may use any one type of these types provided the material used meet the requirements set forth in the specification test limits herein.

2.04 GRADES:

1. Unless otherwise shown on the plans or directed by the ENGINEER, the final course of base material shall consist of Grades 1, 2, 3, or 4 as specified in Table 02601-1.
2. Base courses or subbase materials, unless otherwise noted on the plans or directed by the ENGINEER, may consist of Grades 1, 2, 3, or 4 as specified in Table 02601-1.
3. All grades shall, when tested in accordance with standard laboratory test procedures, meet the physical requirements set forth in Table 0260 1 - 1.
4. Testing of flexible base materials shall be in accordance with the following test procedures:

TEST

TESTING PROCEDURE

Preparation for soil constants and sieve analysis	TEX-101-E
Liquid Limit	TEX-104-E
Plastic Limit	TEX-105-E
Plasticity Limit	TEX-106-E
Sieve Analysis	TEX-110-E
Wet Ball Mill	TEX-116-E
Triaxial Test	TEX-117-E (Part I or II)

5. Unless otherwise specified on the plans, samples for testing the material for Soil constants, Graduation and Wet Ball Mill shall be taken prior to the compaction operations.
6. Unless otherwise specified on the plans, samples for triaxial tests shall be taken from the stockpile or from production, as directed by the ENGINEER, where stockpiling is required and from production where stockpiling is not required.

PHYSICAL REQUIREMENTS FOR FLEXIBLE BASE MATERIALS				
GRADES				
TYPES	Grade 1:	Grade 2:	Grade 3:	Grade 4:
	(Triaxial class 1 Min. compressive Strength, psi: 45 at 0 psi lateral pressure and 175 at 15 psi lateral pressure	(Triaxial class 1 to 2.3)Min. compressive strength, psi: 35 at 0 psi lateral pressure and 175 at 15 lateral pressure	(Unspecified Triaxial Class)	
TYPE A Crushed or Broken Aggregate (excluding gravel aggregate)	Retained on % Sq. Sieve 1-3/4".....0 7/8".....10-35 3/8".....30-50 No. 4.....45-65 No. 40.....70-85 Max LL.....35 Max PI.....10 Wet Ball Mill Max Amt.....40 in Passing	Retained on % Sq. Sieve 1-3/4".....0-10 No. 4.....45-75 No. 40.....60-85 Max LL.....40 Max PI.....12 Wet Ball Mill Max. Amt.....50 Max increase in passing No. 40.....20	Retained on % Sq. Sieve 1-3/4".....0-10 No. 40.....60-85 Max LL.....45 Max PI.....15 Wet Ball Mill Max. Amt.....55 Max increase in passing No. 40.....20	As Shown On Plans

	No. 40.....20			
TYPE B Gravel Aggregate		Retained on % Sq. Sieve 12-2/4".....0-10 No. 4.....30-75 No. 40.....70-85 Max LL.....35 Max PI.....12	Retained on % Sq. Sieve 1-3/4".....0-5 No. 4.....30-75 No. 40.....65-85 Max LL.....35 Max PI.....12	As Shown On Plans
TYPE C Iron Ore Topsoil		Retained on % Sq. Sieve 2-1/2".....0 No. 40.....50-85 Max LL.....35 Max PI.....12	Retained on % Sq. Sieve 2-3/4".....0 No. 40.....45-85 Max LL.....35 Max PI.....12	As Shown On Plans
TYPE D Sand-Shell		Retained on % Sq. Sieve 1-3/4".....0-10 No. 4.....45-65 No. 40.....50-70 Max LL.....35 Max PI.....12	Retained on % Sq. Sieve 1-3/4".....0 No. 40.....45-65 Max LL.....35 Max PI.....12	As Shown On Plans
TYPE E Shell with Sand and Caliche		Retained on % Sq. Sieve 1-3/4".....0 No. 40.....45-65 Max LL.....35 Max PI.....10	Retained on % Sq. Sieve 1-3/4".....0 No. 40.....45-65 Max LL.....35 Max PI.....12	As Shown On Plans
TYPE F Caliche		Retained on % Sq. Sieve 1-3/4".....0 No. 4.....45-75 No. 40.....50-85 Max LL.....40 Max PI.....12	Retained on % Sq. Sieve 1-3/4".....0 No. 40.....50-85 Max LL.....40 Max PI.....12	As Shown On Plans
TYPE G Crushed Blast Furn- ance Slag				As Shown On Plans

7. The limits establishing reasonable close conformity with the specified gradation and plasticity index are defined by the following:

- 1) The ENGINEER may accept the material, providing not more than 2 of 10 consecutive gradation tests performed are outside the specified limits on any

individual or combination of sieves by no more than 5% and where no two consecutive tests are outside the specified limits.

- 2) The ENGINEER may accept the material providing not more than 2 of 10 consecutive plasticity index samples tested are outside the specified limit by no more than two points and where no two consecutive tests are outside the specified limit.

2.05 STOCKPILING:

1. When specified on the plans, the material shall be stockpiled prior to delivery on the road. The stockpile shall be not less than the height indicated and shall be made up of layers of material not to exceed the depth shown on the plans.
2. After a sufficient stockpile has been constructed as specified on the plans, the CONTRACTOR may proceed with loading from the stock - pile for delivery to the road.
3. In loading from the stockpile for delivery to the road, the material shall be loaded by making successive vertical cuts through the entire depth of the stockpile.
4. If the CONTRACTOR elects to produce the Type A material from more than one material or more than one source, each material shall be crushed separately and placed in separate stockpiles so that at least 75 percent of the material in the coarse aggregate stockpiles will be retained on the No. 4 sieve and at least 70 percent of the material in the fine aggregate stockpile will pass the No. 4 sieve.
5. The materials shall be combined in a central mixing plant in the proportions determined by the ENGINEER to produce a uniform mixture which meets all of the requirements of the specification. In the event that combinations of the materials produced fail to meet all of the specification requirements, the CONTRACTOR will be required to secure other materials which will meet specifications requirements.
6. The central mixing plant shall be either the batch or continuous flow type, and shall be equipped with feeding and metering devices which will add the materials into the mixer in the specified quantities.
7. Mixing shall continue until a uniform mixture is obtained.

PART 3 - EXECUTION

3.01 PREPARATION OF SUBGRADE

1. Type roadbed shall be excavated and shaped in conformity with the typical sections shown on the plans and to the lines and grades as established by the ENGINEER.
2. All unstable or otherwise objectionable material shall be removed from the subgrade and replaced with approved material.
3. All holes, ruts and depressions shall be filled with approved material and, if required, the subgrade shall be thoroughly wetted with water and reshaped and rolled to the extent directed in order to place the subgrade in an acceptable condition to receive the base material.
4. The surface of the subgrade shall be finished to line and grade as established and in conformity with the typical section shown on the plans, and any deviation in excess of 2 inch in cross section and in a length of 16-feet measured longitudinally shall be corrected by loosening, adding or removing material, reshaping and recompacting by sprinkling and rolling.
5. Sufficient subgrade shall be prepared in advance to insure satisfactory prosecution of the work.
6. Material excavated in the preparation of the subgrade shall be utilized in the construction of adjacent shoulders and slopes or otherwise disposed on as directed, and any additional material required for the completion of the shoulders and slopes shall be secured from sources indicated on plans or as directed by the ENGINEER.

3.02 PLACEMENT OF FIRST COURSE-TYPE A, TYPE B, TYPE C, TYPE F, AND TYPE G MATERIAL:

1. Immediately before placing the base material, the subgrade shall be checked as to conformity with grade and section.
2. The material shall be delivered in approved vehicles of a uniform capacity, and it shall be the charge of the CONTRACTOR that the required amount of specified material shall be delivered in each 100-foot station.
3. Material deposited upon the subgrade shall be spread and shaped the same day.
4. In the event inclement weather or other unforeseen circumstances render impractical the spreading of the material during the first 24-hour period, the material shall be scarified and spread as directed ENGINEER.
5. The material shall be sprinkled, if directed, and shall then be bladed, dragged and shaped to conform to typical sections as shown on plans.
6. All areas and Nests of segregated coarse or fine material shall be corrected to removed and replaced with well graded material, as directed by the ENGINEER.
7. If additional binder is considered desirable or necessary after the material is spread and shaped, it shall be furnished and supplies in the amount directed by the ENGINEER. Such binder material shall be carefully and evenly incorporated with the material in place by scarifying, harrowing, brooming or by other approved methods.
8. The course shall be compacted by method of compaction hereinafter specified as the Ordinary Compaction method or the Density Control method of compaction as indicated on the plans, or as directed by the ENGINEER.
 1. When the Ordinary Compaction method is to be used, the following provisions shall apply:
 - 1) The course shall be sprinkled as required and rolled as directed until a uniform compaction is secured. Throughout this entire operation, the shape of the course shall be maintained by blading and the surface upon completion shall be smooth and in conformity with the typical sections shown on the plans and to established lines and grades.
 - 2) In that area on which pavement is to be placed, any deviation in excess of 1/4 inch in cross section in a length of 16-feet measured longitudinally shall be corrected by loosening, adding or removing material, reshaping, and recompacting by sprinkling and rolling.
 - 3) All irregularities, depressions or weal spots which develop shall be corrected immediately by scarifying the areas affected, adding suitable material as required, reshaping and recompacting by sprinkling and rolling.
 2. When the Density Control method of compaction is to be used, the following provisions shall apply:
 - 1) The course shall be sprinkled as required and compacted to the extent necessary to provide not less than the percent density as hereinafter specified under Density.
 - 2) In addition to the requirement specified for density, the full depth of the flexible base shown on the plans shall be compacted to the extent necessary to remain firm and stable under construction equipment.
 - 3) After each section of flexible base is completed, tests as necessary will be made by the ENGINEER. If the material fails to meet the density requirements, it shall be reworked as necessary to meet this requirements.
 - 4) Throughout this entire operation, the shape of the course shall be maintained blading, and the surface upon completion shall be smooth and in conformity with the typical sections shown on the plans and to established lined and grades.
 - 5) In that area on which pavement is to be placed, any deviation in excess of 1/4 inch in cross section in a length of 16 feet measured longitudinally shall be corrected by

- loosening, adding or removing material, reshaping and recompacting by sprinkling and rolling.
- 6) All irregularities, depressions or weak spots which develop shall be corrected immediately by scarifying the areas affected, adding suitable material as required, reshaping and recompacting by sprinkling and rolling.
 9. Should the base course, due to any reason or cause, lose the required stability, density or finish before the surfacing is complete, it shall be recompact and refinished at the sole expense of the CONTRACTOR.
 10. Where Type C material is used, the material shall be scarified, thoroughly wetted, mixed, manipulated, and bladed so as to secure a uniformly wetted material, and pulled in over the subgrade in courses and set under the action of blading and rolling. The work of mixing, blading, rolling, shaping and subsequent maintenance shall be performed by the continuous use of sufficient number of satisfactory rollers and power maintainers with adequate scarifier attachments.

3.03 PLACEMENT OF FIRST COURSE – TYPE D MATERIAL:

1. Immediately before placing the base material, the subgrade shall be checked as to conformity with grade and section, and corrections made if necessary.
2. All materials shall be delivered in approved vehicles of a uniform capacity.
3. The required amount of shell shall be uniformly spread across the section and allowed to dry sufficiently to insure proper slaking and mixing of the binder material. Immediately upon completion of the drying period, as determined by the ENGINEER, the specified amount of sand admixture as produce a combined material meeting the requirements hereinbefore specified, shall be spread uniformly across the shell.
4. The material shall then be sprinkled as required and thoroughly mixed by blading and harrowing, or other approved methods.
5. Failure to proceed with the placing of sand admixtures or mixing and placing operations will be grounds for the suspension of placing of shell.
6. Under no condition will the CONTRACTOR be allowed to place an excessive amount of shell without proceeding with the mixing and placing operations.
7. The course shall be compacted by the method of compaction hereinafter specified as the Ordinary Compaction method of the Density Control method of compaction as indicated on the plans, or as directed by the ENGINEER.
 1. When the plans indicate that the Ordinary Compaction method is to be used, the following provisions shall apply:
 - 1) After mixing, all material shall be windrowed, and then spread over the section in layers.
 - 2) The layer shall not exceed 2 inches in loose depth.
 - 3) If necessary to prevent segregation, the material shall be wetted in the window prior to spreading.
 - 4) After each lift is spread, it shall be sprinkled and rolled to secure maximum compaction as directed by the ENGINEER. Succeeding layers shall then be placed similarly until the course is completed.
 - 5) All areas and nest of segregated coarse or fine material shall be corrected or removed and replaced with well graded material, as directed by the ENGINEER.
 - 6) The course shall then be sprinkled as required and rolled as directed until a uniform compaction is secured.
 - 7) Throughout this entire operation, the shape of the course shall be maintained by blading,; and the surface, upon completion, shall be smooth and in conformity with the typical sections shown on the plans, and to the established lines and grades.
 - 8) In that area on which pavement is to be place, any deviation in excess of 1/4 inch in cross section in a length of 16-feet measured longitudinally shall be corrected by loosening, adding or removing material, reshaping and recompacting by sprinkling and rolling.

- 9) All irregularities, depressions or weak spots which develop shall be corrected immediately by scarifying the areas affected, adding suitable material as required, reshaping and recompacting by sprinkling and rolling.
 2. When the plans indicate that the Density Control method of compaction is to be used, the compaction method shall be the same as prescribed for Type A, Type B, Type C, Type F and Type G materials.
 8. When indicated on the plans or permitted by the ENGINEER, Type D material may be mixed in a central mixing plant and delivered to the road as a combined mixture. When this method is used, the combined mixture shall meet the requirements for Type D material as hereinbefore specified and the placing and compaction requirement shall be the same as prescribed for Type A, Type B, Type C, Type F and Type G material.
- 3.04 PLACEMENT OF FIRST COURSE-TYPE E MATERIAL
1. The construction methods for placing the first course of Type E material shall be the same as prescribed for Type D material except that after the shell and sand have been placed, the prescribed amount of caliche shall then be spread across the sand and shell.
 2. The composite mixture shall then be sprinkled as required and thoroughly mixed by blading and harrowing or other approved methods.
 3. Compaction of the first course of Type E material shall be the same as prescribed above for Type D material.
 4. Failure to proceed with placing the sand and caliche admixture or mixing and placing operations will be grounds for the suspension of placing the shell.
 5. Under no conditions will the CONTRACTOR be allowed to place an excessive amount of shell without proceeding with the mixing and placing operations.
- 3.05 PLACEMENT OF SUCCEEDING COURSES – ALL MATERIAL TYPES:
1. Construction methods shall be the same as prescribed for the first course.
 2. Prior to placing the surfacing on the completed base, the base shall be dry cured to the extent directed by the ENGINEER.
- 3.06 DENSITY CONTROL:
1. When the Density Control method of compaction is indicated on the plans, each course of flexible base shall be compacted to the percent density shown on the plans.
 2. The testing will be as outlined in Test Method Tex- I 14-E.
 3. It is the intent of this specification to provide in that part of the base included in the top 8 inches immediately below the finished surface of the roadway not less than 100 percent of the density as determined by the compaction ratio method.
 4. Field density determination shall be made in accordance with Test Method Tex115-E.
- 3.07 TOLERANCES:
1. Flexible base will be measured by the square yard of surface area of completed and accepted work based on the width of flexible base as shown on the plans.
 1. The ENGINEER may accept the work providing not more than 25 percent of the density tests performed each day are outside the specified density by no more than three pounds per cubic foot and where no two consecutive tests on continuous work are outside the specified limits.

PART 4 - MEASUREMENT AND PAYMENT

4.01 MEASUREMENT:

1. Flexible base will be measure by the square yard of surface area of completed and accepted work based on the width of flexible base as shown on the plans.
 1. The flexible base shall be measured for depth by the units of 2000 square yards, with one measurement taken at location selected by the ENGINEER.
 2. In that unit where flexible base is deficient by more than 2 inch in thickness, the deficiency shall be corrected by scarifying, adding material as required, reshaping and recompacting by sprinkling and rolling.
 3. No additional payment over the contract unit price will be made for any flexible base of a thickness exceeding that required by plans.
2. The CONTRACTOR shall schedule his operations in such a manner as to facilitate the measurement of the pay item.
3. The ENGINEER may accept the work provided no more than 2 out of 10 depth tests performed are deficient by not more 2 inch and where no two consecutive tests on continuous work are outside the specified depth.

4.02 PAYMENT:

1. The accepted quantities of flexible base of the type, grade, and compaction method specified will be paid at the contract unit bid price per square yard, complete in place.
2. Where ordinary Compaction is used, all sprinkling, rolling, and manipulation required will not be paid for directly, but will be incidental to other bid items.
3. The unit prices bid shall each be full compensation for shaping and fine grading the roadbed; for securing and furnishing all materials, including all royalty and freight involved, for furnishing scales and labor involved in weighing the material when required; for loosening, blasting, excavating, screening, crushing and temporary stockpiling when required; for loading all materials for all hauling and delivering on the road; for spreading, mixing, blading, dragging, shaping and finishing and for all manipulation, labor, tools, and incidentals necessary to complete the work.

END OF SECTION

SECTION 32 13 13 — CONCRETE PAVING, CURBS AND SIDEWALK

PART 1 - GENERAL

1.1 COORDINATION

- A. The General Conditions of the Contract for Construction and the Supplementary Conditions to the General Conditions of the Contract for Construction shall be considered as part of this section of the specifications.
- B. Each Bidder shall be responsible for determining during the bidding period the extent that any addenda issued during the bidding period may affect this section of the specifications.
- C. Reference Instructions to Bidders for requirements regarding substitutions of materials and products.
- D. Where conflicts occur between the drawings and specifications, between different drawings, between different portions of this section of the specifications, or between different sections of the specifications, the more stringent requirements and the greater quantity shall apply.

1.2 WORK INCLUDED

- A. All site concrete work, including sidewalks, paving, equipment slabs, ramps, and other miscellaneous concrete.
- B. All form work.
- C. Reinforcing steel.
- D. Installation of sleeves provided by plumbing, heating, and electrical contractors for work under site concrete. Sleeves for irrigation system.

1.3 RELATED WORK SPECIFIED IN OTHER SECTIONS

- A. Testing Laboratory services.
- B. Excavation and fill.
- C. Soil stabilization.

1.4 DRAWING REFERENCES: See drawings for reinforcing sizes and placement.

1.5 SUBMITTALS

- A. DESIGN MIX: Submit six (6) copies directly to the Owners Testing Laboratory the proposed concrete mix for concrete paving and sidewalks. Include cement brand and type, aggregate identification, admixtures, proportions and anticipated strengths.

- B. PLASTIC CHAIR SUPPORT: Submit manufacturer's literature indicating dimensions, configuration, and performance data. Submit sample for approval by the Architect.
- C. JOINT FORMS: Submit manufacturer's literature indicating dimensions, configuration, reinforcing and accessories related to load transfer units.
- D. ADMIXTURES: Submit manufacturer's literature indicating composition and mix proportions.
- E. CURING COMPOUND: Submit manufacturer's literature indicating composition and recommended application procedures.
- F. JOINT SEALANT: Submit manufacturer's literature indicating sealant type(s), performance, recommended application procedures, and recommending open or closed cell backer material for the application.
- G. DELIVERY TICKETS: Furnish copies of delivery tickets for each load of concrete delivered to the site. Provide items of information as follows:
 - 1. Ambient temperature.
 - 2. Any modifications and dispositions of the load.
 - 3. Driver's identification.
 - 4. Identification of placement location at jobsite.
 - 5. Ingredients by weight.
 - 6. Number of cubic yards.
 - 7. Time emptied.
 - 8. Time loaded.
- H. TEST REPORTS: Arrange for the Owner's Testing Laboratory to submit reports to the Owner, Architect and Contractor indicating compressive strength, aggregate type and slump for samples taken at the site.

1.6 SAMPLES

- A. Plastic chair support.
- B. Minimum 36" x 36" finish samples at the job site for Architects approval. Provide sample for each type of finish (smooth, light broom, medium broom, etc.) and each type of joint.

1.7 WARRANTY

- A. Provide written warranty against defects in materials and workmanship for the work under this section for a period of one year after the date of Substantial Completion of the project.

1.8 QUALITY ASSURANCE

- A. Cast-in-place concrete shall be installed by technicians specially trained in the proper handling, placing and protection of concrete and reinforcing steel. If required by the Architect, installer shall submit for approval a list of similar installations successfully completed.
- B. Cast-in-place concrete shall be mixed and installed in strict accordance with applicable written recommendations and requirements of the Texas State Department of Highways and Public Transportation (TSDHPT) and the American Concrete Association (ACI) including but not necessarily

limited to the following where documents conflict, the most stringent of the requirements as determined by the Architect shall apply:

1. TSDHPT, item 360.
2. ACI 302.
3. Building Code Requirements for Reinforced Concrete, ACI 318.
4. Recommended Practice for Hot Weather Concreting, ACI 305.
5. Recommended Practice for Cold Weather Concreting, ACI 306

PART 2 - PRODUCTS

2.1 MATERIALS

- A. GENERAL: All materials used in the Work shall be stored or handled in a manner which will prevent deteriorations; any materials that have been damaged shall be immediately and completely removed from the Work. All manufactured materials, such as cement, shall be delivered and stored in their original packages, plainly marked with the brand and manufacturer's name. Broken packages or packages that show marks or other evidence of damage shall be wholly rejected.
- B. CEMENT: Portland cement shall conform to standard specifications of ASTM,C-150, Type 1, latest edition. The brand shall be one approved by the Architect, and this one brand shall be used throughout the project.
- C. AGGREGATES: Aggregates for concrete of normal weight shall be clean, hard, strong, uncoated, free of loam, fine sand, clay dust, organic or other deleterious matter and shall conform to ASTM C-33.

FINE AGGREGATE			COARSE AGGREGATE		
Sieve Size	Percent Passing	Sieve Size	1-1/2	Percent	3/4
4	95-100	1-1/2	95-100	-	-
16	50- 88	1"	-	90-100	-
50	10-30	3/4"	40-70	-	90-100
100	0- 5	1/2"	-	25- 60	
		3/8"	10-30	-	20-55
		#4	0- 5	0- 10	0- 10

- D. Clay - 3% Maximum Clay - 1 % Maximum
- E. WATER: Water shall be clean and potable, free from injurious amounts of oil, acid, Alkali, organic matter or other deleterious substances.

- F. REINFORCING STEEL: All reinforcing steel shall be high bond, new billet stock, and shall conform with ASTM A-615, except that mesh shall conform with ASTM A-1 85. All materials must be free from seams, flaws, scale or an excessive amount of rust. The supplier shall furnish Architect with a certificate certifying the reinforcing steel is domestic, or supply laboratory tests acceptable to the Architect, that foreign steel meets these tests. Laboratory tests shall be made on each size of steel. Samples for testing shall be taken from jobsite. The samples shall be replaced with bar of like size and length, plus 40 diameter.
- G. ANCHORS: Install all necessary anchors, wire loops or other miscellaneous fasteners to be installed in concrete for anchoring masonry or other work.
- H. WOOD JOINT FORMS:
1. Sidewalk Joints: Expansion joints at concrete walks shall be 1X Redwood.
 2. Paving Joints: 3/4" thick redwood form with minimum 1" deep removable top strip, 3/4" x 1 0" steel reinforcing bars at 24" o.c. with bond-breaker sleeve on one side, and 3/16" thick steel rebar support plates each side. Provide custom size as required for full depth of paving as manufactured by Shepler Equipment Co., or equivalent by Commercial Lumber Supply, Marine Lumber Co., or Southern States Lumber.
- I. TRANSIT MIX CONCRETE: Contractor shall provide concrete meeting the specifications with regard to compressive strength, method of handling, and controlled by testing lab at batch plant. Concrete shall meet ASTM C-94; Certificate from supplier shall be furnished to Architect.
- J. CURING COMPOUND: Shall be Southform 4-way (cures, seals, dustproofs, and hardens), or equivalent product by Gifford-Hill, Nox-Chem, Sonneborn, or W.R. Grace.
- K. ADMIXTURES:
1. General: All admixtures shall be added at the plant during mixing and must be prior approved by the Testing Laboratory. Admixtures shall comply with requirements of ASTM C-260 and C-494. Admixtures containing calcium chloride are not acceptable. **Do not use admixtures in footings or seal slabs.**
 2. Water Reducing Agents: All design mixes must test with the required slumps prior to the addition of a water reducing agent. Each specified maximum slump may be increased by a maximum of 2" at the plant by the addition of a maximum of 3 ounces of water reducing agent per 94 pound bag of cement. Meet requirements of ASTM C494, Type F.
 - a. "PSI Super" as manufactured by Cormix Construction Chemicals.
 - b. "WRDA-1 9" as manufactured by W.R. Grace.
 - c. "Sikament" as manufactured by Sika Chemical Corp.
 3. Set-Controlling Agents: Under 40 degrees F., add accelerating agent Over 80 degrees F., add retarding agent.
 - a. Cormix Construction Chemicals.
 - b. Master Builders
 - c. Protex Industries
 - d. Sika Chemical Corp.
 4. Air Entrainment: All structural concrete shall contain an air entraining agent compatible with other approved admixtures. Agent added at the plant shall produce 4-5% air entrainment - not required at drilled footings.

- L. REINFORCING BAR SUPPORTS: Heavy-duty type four-legged plastic chair supports with sand plate. Series "G" or "B" (as determined by job conditions) as manufactured by W.H.C. Products, Inc. or approved equivalent by Aztec Concrete Accessories. Provide sand plate for slab on grade. Space at a maximum of 45" centers each way. Provide closer spacing where required to prevent excessive sag, or to support the weight of concrete pump hose.
- M. METAL REINFORCEMENT:
1. Bars
 - a. General: Detailing conform to ACI detailing manual.
 - b. Grade 60: Comply with ASTM A 615.
 - c. Grade 40 (#3 bars): Comply with ASTM A 615.
 2. Mesh
 - a. Comply with ASTM A 185.
 - b. Mesh shall be type which is fabricated and delivered in flat sheets.
 - c. Use mesh only where specifically indicated in the drawings for sidewalks or equipment pads.
- N. PAVING JOINT SEALANT: Polyurethane base, multi-component, chemical curing, self-leveling Type 1, conforming to requirements of FS TT-S-00227E, Class A (provide equivalent non-sagging Type 2 at vertical joints in curbs), as manufactured by Tremco or equivalent by Sonneborn, Sheplers, or Pecora. Use with flat strip, non-absorbent polyethylene joint backer-open or closed cell type as recommended by the sealant manufacturer.

2.2 MIX DESIGNS

- A. The concrete mix shall be designed by the concrete supplier and approved by the Owner's Testing Laboratory. Contractor shall furnish to the laboratory samples of the aggregate he proposes to use in the concrete work. Concrete mixes shall achieve twenty eight (28) day compressive strengths indicated below, and shall be so proportioned as to obtain a workable mix in accordance with the following limits:

Compressive Strength	Minimum Cement	Maximum Total
at 28 days	Content 94#	SacksWater Per Sack of Cement
<u>Minimum P.S.I.</u>	<u>Cubic Yard</u>	<u>Gallons</u>
Paving 3,500	5.5	7.0

- B. SLUMPS: Slumps greater than specified can adversely affect concrete performance due to excessive shrinkage. Slumps specified below are based upon concrete design mix prior to addition of any approved water reducing agent.
1. 5"+/-1": Sidewalks
 2. 3"+/-1": Paving,curbs
- C. The use of fly ash in the concrete mix is not acceptable.
- D. MIXING
1. Comply with ASTM C 94.

2. Mix concrete to a uniform distribution of materials. Mix at least two minutes after materials are in mixer. Discharge concrete completely before mixer is recharged.
 3. Mix each batch not less than 70 or more than 100 revolutions of the drum at mixing speed. Additional mixing is to be done at agitating speed.
- E. ADJUSTMENTS TO MIX DESIGN: Submit for approval by the Owner's Testing Laboratory any proposed adjustments to the approved mix design due to job conditions, weather or testing results. Necessary adjustments to the mix design shall be at the Contractor's expense.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Any portions of the subgrade or fill that are below optimum moisture content shall be wetted at least one (1) week prior to placing concrete in order to achieve a proper uniform distribution of moisture.
- B. All preliminary work shall be carefully checked, all trash and debris removed, and the approval of the Architect obtained before any concrete is placed. The Architect shall be notified twenty-four (24) hours before any concrete is scheduled to be placed.
- C. SUBGRADE APPROVAL- The bearing grade of slab-on-grade concrete shall require approval of the Owner's testing laboratory immediately prior to the placement of concrete regardless of any previous test results. Bearing grade which is overly dry, saturated, exhibits standing water, contaminants, irregularities or other properties which may tend to be deleterious to the performance of the cast-in-place concrete will not be approved by the Owner's testing laboratory as suitable for concrete placement.
- D. Coordinate and provide for plumbing, electrical, carpentry, masonry, miscellaneous metals and other installation requirements, which must be completed prior to concrete work or which may require special forming or block-outs.
- E. CLEANING: Clean all forms of debris and thoroughly wet wood forms before placing concrete.
- F. Inspect subgrade to determine that uniform thickness of concrete paving and walks will result in proper drainage and no standing water. Notify Architect prior to beginning work of any no slope areas or potential standing water conditions.
- G. HOT WEATHER CONDITIONS: Where ambient temperature exceeds 95 degrees F. with a wind velocity exceeding 5 MPH or temperature exceeds 90 degrees F. with a wind velocity exceeding 15 MPH, follow recommendations in ACI publication "SLABS ON GRADE" to protect against rapid drying.
- H. Do not place concrete when air temperature is 40 degrees F. or below or when the air temperature is expected to go below 30 degrees F. in the following 48 hours after placing of concrete unless the concrete is protected from such temperature.
- I. Install all anchors, fasteners, junction boxes, curb dowels collection boxes or other construction to be installed within concrete paving.

3.2 INSTALLATION

- A. TRANSIT: Concrete shall be agitated continuously with slow revolutions of the drum while in transit. No concrete shall be deposited after being in the mixer more than 90 minutes. Testing laboratory shall

check each delivery ticket and notify Contractor immediately of any concrete arriving more than 90 minutes after plant loading.

- B. HANDLING: Concrete shall be deposited in the forms as rapidly as practicable by methods which will prevent loss or separation. It shall be deposited as nearly as practicable in its final position to avoid rehandling. Provide runways, or other means for wheeled equipment to carry concrete to points of deposit.

C. PLACING REINFORCEMENT:

1. A thin film of rust will not be considered objectional, but no loose or scaly rust, dirt, mud or cement will be allowed. Steel must be cleaned with wire brushes or replaced if pitted from rust.
2. Accurately position, secure against displacement with #18 gauge wire ties or suitable clips, support by heavy duty plastic chairs with sand plates. Do not use "brick bats" or rubble for support.
3. Follow recommendations of Concrete Reinforcing Steel Institute as to type of steel, splicing, location and placement.

D. PLACING CONCRETE:

1. Deposit and consolidate concrete in a continuous operation, within the limits of joint forms, until the placing of a panel or section is completed.
2. Consolidate concrete during placing operations so that concrete is thoroughly worked around reinforcement, other embedded items, and into corners.
3. Maintain reinforcing steel in the proper position continuously during concrete placement operations.
4. Bring slab surfaces to the correct plane with a straight edge or vibrating screed and strike off. Use bull floats or derbies to smooth the surface, leaving it free of humps or hollows. Do not sprinkle water on the plastic surface. Do not disturb the slab surfaces prior to beginning finishing operations.
5. Concrete surface shall be true to plane within 1/4" against a 10' straight edge.

3.3 JOINTS

A. LOAD TRANSFER UNITS:

1. Install wood joint form in accordance with manufacturer's printed directions prior to concrete pour. All plastic sleeves at reinforcing bars shall be placed running in same direction.
2. Install manufacturers stakes at 48" o.c. maximum where concrete is to be placed on both sides of form simultaneously. Install at 36" o.c. maximum at cold joints.
3. Longitudinal joint forms shall be continuous through transverse joint forms.
4. Pre-wet form boards prior to placement to ensure against dry wood forms removing water at edges of concrete.
5. Leave removable top strip in place and protect until sealant operations begin.

B. WOOD FORMS:

1. Install similar to load transfer units. Use at radiused areas and sidewalks.
2. Kerf where required for radius.
3. Leave removable top strip in place at paving and protect until sealant operations begin. Top strip and sealant not required at sidewalks.

C. KEYED JOINTS:

1. Align metal joint forms and install manufacturer's splice clip at ends to keep joints in alignment during concrete placement.
2. Set all stakes securely to keep joint form from moving during concrete placement.
3. Do not remove forms until concrete has obtained sufficient strength. When removing forms, apply no vertical uplift which may damage or weaken concrete key.

3.4 CURBS

- A. Provide machine laid (extruded) reinforced concrete curbs unless monolithic or formed curbs are indicated in the drawings.
- B. Apply epoxy to cured concrete paving and continuously lay curb over installed dowels.

3.5 FINISHING

- A. GENERAL: Concrete finishes shall match approved jobsite samples approved by the Architect. Spreading of dry cement for finishing is not acceptable. Begin finishing operations as soon as water sheen has disappeared from surface.
- B. PAVING FINISHES: Slabs shall be true to plane within 1/4" in a length of 10' machine finish and provide light to medium broom finish (across the direction of traffic) at all paving as approved by the Architect.
- C. SIDEWALKS: Provide light broom finish perpendicular to walk. Provide Architect with sample panel of proposed finish for approval prior to beginning work.
- D. STEPS AND RAMPS: Shall be constructed as detailed. Exterior steps, landings, and ramps shall be medium broom finished.
- E. PAVING JOINTS: Provide tooled eased edges along both sides of redwood joint form to ensure neat appearance, sealant adhesion, and to facilitate removal of top strip. Use 1/8" radius jointing tool.
- F. OPEN TOOLED JOINT: Provide scored lines on concrete sidewalks 5'-0" o.c. unless spaced otherwise on the drawings. Joint size shall be 1/4" wide x 1/4 depth of concrete.
- G. All concrete paving and walks shall be uniform in color and consistent in finish. Remove and replace any areas dimpled by rain or discolored (concrete mix).

3.6 CURING

- A. Apply complete covering of curing compound as soon as concrete is finished and in accordance with manufacturer's instructions. Curing compound shall be applied as it comes from the can, at the rate of 200 to 300 square feet per gallon.
- B. To avoid sealant adhesion problems ensure that curing compound does not seep into paving joints that receive sealant.

3.7 CAP SEALANT

- A. Remove redwood top strip from joint forms. Take care to avoid damaging concrete edges. Clean sealant cavity and inspect for proper depth as recommended by sealant manufacturer.

- B. Ensure that sealant cavity is clean, dry, and free of dust, dirt, and small stones. Ensure that edges are not contaminated with curing compound, oil or other agents, which might cause adhesion failure. Prime side walls in accordance with sealant manufacturer's recommendations.
- C. Install flat ethafoam strip in bottom of sealant cavity to provide bond-breaker at bottom of sealant and to ensure against sealant loss past the joint form. Install strip in thickness required to provide sealant cavity size as recommended by sealant manufacturer. Use no sand or other loose material in joint cavity.
- D. Mix sealant thoroughly in accordance with manufacturer's recommendations and pour to within 1/8" of top of paving. Where sealant must be repoured due to run off or improper level, remove completely all traces of sealant on side walls before next application.
- E. At concrete curbs rake joint filler to minimum 1" depth and install sealant manufacturer's vertical joint grade sealant.

3.8 CLEANING AND PROTECTION

- A. Paving is to be kept free of any foreign substances (wax, oil, paint, etc.) or surface irregularities, which may affect the final appearance of the completed installation.
- B. Unless otherwise approved by the Architect, no vehicular traffic will be allowed on any concrete slab, paving or drive until after the 7 day concrete tests have been made by the laboratory indicating that the concrete has attained 3,000 psi compressive strength.
- C. Contractor shall coordinate with Architect and Owner to determine a suitable on-site "wash-out" area for concrete trucks. Contractor shall be responsible for clean up of the designated area.
- D. Contractor shall keep clean all adjacent public streets and rights of way. Wash down daily or more often as needed to maintain a safe condition at entrances/exits to site.

3.9 TESTING LABORATORY CONTROL

- A. Contractor shall contact Owner's Testing Laboratory at least 24 hours prior to time of anticipated concrete placement.
- B. Contractor shall require the manufacturers of the cement and metal reinforcement to be used in the work to furnish mill certificates showing that such materials meet ASTM standards as specified.
- C. Contractor shall follow all requirements of ASTM C 31 concerning the proper handling and protection of concrete test cylinders. Contractor shall provide locked storage facilities for test cylinders with all heat, insulation and protection as required by ASTM C 31.

END OF SECTION

SECTION 33 05 00 — SITE DRAINAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The General Conditions of the Contractor for Construction and the Supplementary Conditions to the General Conditions of the Contract for the Construction shall be considered as part of this section of the specifications.
- B. Each Bidder shall be responsible for determining during the bidding period the extent that any addendum issued during the bidding period may affect this section of the specifications.
- C. Reference Instructions to Bidders for requirements regarding substitutions of materials and products.
- D. Where conflicts occur between the drawings and specifications, between different drawings, between different portions of this section of the specifications, or between different sections of the specifications, the stringent requirements and the greater quantity shall apply.

1.2 WORK INCLUDED

- A. Provide and install storm sewer piping, collection boxes, grates, manholes, culverts, inlets and headwalls as indicated in the Architectural drawings and specified herein.
- B. Related trenching, pipe bedding, backfill, and compaction as indicated in the Civil and MEP documents drawings and specified herein.
- C. Trench safety in accordance with OSHA requirements and as specified under Trench Safety Section.

1.3 RELATED WORK SPECIFIED IN OTHER SECTIONS

- A. Piping indicated on plumbing drawings.
- B. Site clearing, grading and filling.

1.4 SUBMITTALS

- A. **PRODUCT DATA:** Submit manufacturer's literature for piping precast drainage structures and grates illustrating performance, fabrication procedures, materials and sizes.
- B. Reference Section 01 33 00 SUBMITTALS for additional submittal requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. **CONCRETE SEWER PIPING:** Extra strength tongue and groove pipe conforming to ASTM C-76, Class III for reinforced pipe.

B. JOINT SEALS:

1. Under 42" diameter: Provide Talcote Asphalt Primer No. 041 and Talcote Cold Plastic No. 052 joint compound.
2. 42" diameter and larger: Bell and rubber gasketed joints.

C. CONCRETE: Minimum compressive strength of 3,000 psi. Conform to requirements of Cast in Place Concrete Section 3.

D. POLYVINYL CHLORIDE (PVC) SDR 26 PIPING: Provide PVC piping where indicated on the drawings. Jointing shall be solvent weld or bell and gasket meeting requirements of A.S.T.M. 3212. Piping shall meet requirements of A.S.T.M. D-3034.

E. INLETS:

1. Precast concrete, cast in place concrete or brick collection boxes as indicated in the drawings. Brooks Products, or equivalent. Form both inner and outer walls for cast-in-place items.
2. Brick: ASTM C-32 sewer brick, Grade SS, 2-1/4" x 3-3/4" x 8".
3. Gratings, Covers and Frames: Cast iron, McKinley, Neenah or approved equal. Heavy duty in paving. Medium duty in walks. Light duty in grass or planting areas.

PART 3 - EXECUTION

3.1 INSTALLATION

A. INLETS:

1. All storm sewer inlets shall be constructed to the line and grade and at location shown on the drawings. Inlets shall be constructed in strict accordance with details as indicated in the drawings.
2. When the box section of the inlet has been completed, the floor of the inlet shall be shaped by filling with one-two mortar to conform to the section shown on the detail drawings.
3. Cast iron inlet frames and grates shall be accurately adjusted to line, grade and slope and grouted in place with mortar consisting of one part Portland Cement to two parts sand.

B. PIPING:

1. Inspection: Review drawings and job conditions and verify all inverts before trenching to avoid conflict with other below grade utilities either planned or existing. Immediately notify Architect of any apparent conflicts before beginning work.
2. Trenching: Provide trenching in strict compliance with current OSHA regulations and in accordance with Trench Safety Section. Do not trench ahead of pipe laying unless trench is protected.
3. Begin excavation work at the lower end of flow line and proceed to higher flow line. Avoid over-excavating; return over-excavated bed to grade and thoroughly compact. Remove large rocks, foreign or organic material; return bed to grade and thoroughly compact.
4. Lay all pipe on required bedding to a true line slope as indicated in the drawings. Hand excavate at joints to ensure that full length of pipe lays on a solid bed. Install tongue end of pipes facing direction of drainage flow.
5. Bedding and backfilling of pipe:
 - a. Bed and backfill all piping in accordance with the details indicated on the drawings. Where local or other applicable codes require more stringent specifications, those codes shall govern.

- b. All piping located in County Flood Control District right of way shall be bedded and backfilled with cement stabilized sand in accordance with Flood control District requirements.
- c. Cement stabilized sand shall be a homogeneous mixture of 1-1/2 sacks Portland Cement per cu. yd. of mixed material. Provide greater cement content where required by City or County Requirements.

END OF SECTION

SECTION 012210 – MEASUREMENT AND BASIS

1.00 GENERAL

IT IS THE INTENT OF THIS CONTRACT TO COVER ALL THE WORK TO BE PERFORMED SUBSIDIARY TO ALL THE ITEMS INCLUDED IN THE BID AND SHALL BE BALANCED INDIVIDUALLY AND SHALL INCLUDE FURNISHING ALL MATERIALS, SUPERINTENDENCY, SUPERVISION, CONSTRUCTION SURVEYING AND LAYOUT, LABOR, INSURANCE, BONDS, BENEFITS, MACHINERY, FUEL, VEHICLES, SAFETY EQUIPMENT, ADMINISTRATIVE COSTS, QUALITY CONTROL, GUARANTEES AND WARRANTIES, OVERHEAD, AND ALL INCIDENTALS FOR COMPLETING THE ASSIGNED WORK IN ACCORDANCE WITH THE PLANS AND SPECIFICATIONS COMPLETE IN PLACE. **IN CASE THE FOLLOWING MEASUREMENT AND DESCRIPTIONS CONFLICT WITH THE CORRESPONDING DESCRIPTIONS CONTAINED WITHIN THE TECHNICAL SPECIFICATIONS FOR THIS PROJECT, THE FOLLOWING DESCRIPTIONS SHALL GOVERN.**

THE FOLLOWING APPLICABLE ITEMS SHALL BE CONSIDERED AS PAY ITEMS. ALL OTHER WORK NOT SPECIFICALLY LISTED OR INDICATED BELOW SHALL BE SUBSIDIARY TO THE OVERALL COST OF THE PROJECT. ALL EXCAVATION IS UNCLASSIFIED. COST FOR DEWATERING AND TRENCH STABILIZATION, IF REQUIRED FOR INSTALLATION OF DRAINAGE/STORM SEWER LINES, SHALL BE SUBSIDIARY TO THE VARIOUS ITEMS OF THIS SECTION. ALTHOUGH NOT EVERY NUT OR BOLT IS SHOWN ON THE PLANS AND SPECIFICATIONS, THE OWNER EXPECTS THAT ALL COMPONENTS OF THIS BID AS LISTED BELOW WILL BE COMPLETE AND IN PLACE UPON COMPLETION OF THE PROJECT.

A. CONSTRUCTION PREPARATION

1. **SITE PREPARATION/DEMOLITION PLAN:** When called for in the proposal, shall include all clearing and grubbing, demolition, removal of fence, conduit, and any other appurtenances, removal and disposal of unsuitable material such as asphalt, organic materials, and shall include stripping of underlying soil, excavation, and fine grading, filling and compaction, cutting down to subgrade depth, disposal of debris and other material deemed not suitable for filling, hauling in fill material as required, all complete in place. Any material deemed salvageable by the Owner or Engineer shall be carefully removed and hauled to a designated location as directed by the Owner or Engineer, with such cost being subsidiary to this item.
2. **STORMWATER POLLUTION PREVENTION PLAN (SWPPP) AND STORMWATER PERMIT:** When called for in the proposal, shall include all necessary plan preparation as required by the City, County, State and Federal guidelines. Plan shall include, but not be limited to, Site Evaluation, Assessment, Planning, Erosion and Sediment Control Best Management Practices (BMPs), Post Construction BMPs, Inspections, Recordkeeping and Training and Final Stabilization. Plan must be submitted and approved by appropriate regulatory agency and shall include preparation and filings of Notice of Intent (NOI), Notice of Change (NOC) and Notice of Termination (NOT), as well as any other required forms.
3. **EROSION CONTROL DEVICES:** When called for in the proposal, shall include all necessary installation of devices such as construction Entrances/Exits, silt fences, inlet sediment control screens as required and in accordance with requirements under the Stormwater Pollution Prevention Plan (SWPPP).
4. **TRAFFIC CONTROL PLAN:** When called for in the proposal shall include submittal of traffic control plan signed and sealed by a Licensed Professional Engineer and in conformance with the most

recent TMUTCD, including all traffic control devices, equipment and personnel as necessary to protect Work and Public.

B. PARKING LOTS, DRIVEWAYS, SIDEWALKS AND RELATED IMPROVEMENTS

1. **LIME OR PORTLAND CEMENT STABILIZED SUBGRADE:** When called for in the proposal, shall include all necessary excavation, compaction as shown, working of lime or Portland cement material to the strength specified (Calculated from unit weight of subgrade material), clearing and grubbing, demolition, removal and disposal of unsuitable material such organic materials, removal of material deemed unsuitable for filling, hauling in fill material as required, all complete in place in accordance with plans and specifications.
2. **COMPACTED FLEXIBLE BASE:** When called for in the proposal, shall include furnishing all new material, working of Lime (if required), spreading, watering, fine grading and compacting, all complete in place in accordance with plans and specifications. Proof Rolling may be required in certain locations as determined by the Owner's Representative, and the cost for such work shall be considered subsidiary to the Paving Improvement Items of the Proposal.
3. **COMPACTED HOT-MIX ASPHALTIC CONCRETE:** When called for in the proposal, shall include PRIME COAT as shown in the plans and specifications, all complete in place. Tamping and Proof Rolling may be required in certain locations of the roadway as determined by the Owner's Representative, and the cost for such work shall be considered subsidiary to the Paving Improvement Items of the Proposal.
4. **CONCRETE CURB AND GUTTER/LAY DOWN CURB:** When called for in the proposal, shall include all necessary labor, excavation, membrane curing compound, joints, backfilling, reinforcement, concrete of thickness and strength specified, as shown in the plans and specifications, all complete in place. **(Concrete Curb and Gutter shall be laid over prepared base and subgrade as indicated in the typical sections. The prepared base and subgrade shall be considered subsidiary to this item).**
5. **REINFORCED CONCRETE DRIVES AND APRONS:** When called for in the proposal, shall include handicap ramps, and all necessary labor, excavation, backfilling, reinforcement, concrete of the strength specified, Compacted Subgrade as shown, Sand Cushion, seal-tight jointing material, concrete finish specified, as shown in the plans and specifications, complying with Texas Accessibility Standards (TAS) requirements.
6. **REINFORCED CONCRETE SIDEWALKS/CONCRETE WALKWAY:** When called for in the proposal, include handicap ramps, and all necessary labor, excavation, backfilling, reinforcement, concrete of the strength specified, Compacted Subgrade as shown, Sand Cushion, seal-tight jointing material, concrete finish specified, as shown in the plans and specifications, including pre-fabricated truncated domes, ADA required color, all complete in place. **(Wings and connections to sidewalk ramps must comply with Texas Accessibility Standards (TAS) Requirements).**
7. **SAFETY BOLLARDS:** When called for in the proposal shall include the type, size, and color specified in the plans and specifications, concrete filled, installed as per the plans or as directed by Engineer/Architect.
8. **THERMOPLASTIC PAVEMENT STRIPING/MARKINGS AND SIGNAGE:** When called for in the proposal, shall include all necessary materials, labor, equipment, paint color as specified, pre-fabricated pavement markers, handicap markings, installation of new concrete wheel stops,

including raised pavement markers of type and class specified meeting TxDOT standards, truncated domes, regulatory signs, in accordance with plans and specifications, all complete in place. **PARKING LOT STRIPING LAYOUT MUST BE APPROVED BY OWNER'S REPRESENTATIVE PRIOR TO INSTALLATION.**

9. **LIGHTING INSTALLATION:** When called for in the proposal, shall include all necessary materials, labor, equipment for installation, including foundation installation, conduit installation including trenching and pavement repair, wiring, light fixtures, connection to existing lighting control panel, service meter, panel board, verification and coordination with existing infrastructure and power company, equipment, transformer and associated fees, relocation and reinstallation of existing equipment, in accordance with plans and specifications.
10. **PAVERS AT FLAG POLE PAD:** When called for in the proposal, shall be for the size and type specified, including regrading, addition and compaction of base, materials, and labor.
11. **FLAG POLE:** When called for in the proposal, shall include concrete foundation, flag pole, all materials, labor and equipment and installation, all complete in place as per plans and specifications.
12. **PARKING/PATIO CANOPY:** When called for in the proposal shall include concrete foundation, poles and roof canopy for the size and height specified on the plans and specifications, lighting, extension of lighting from source, conduit, installation, trenching and backfilling, and any other appurtenances.
13. **BASKETBALL COURT:** When called for in the proposal, shall include reinforced concrete foundation, hand painting of regulation white textured basketball lines with three point arcs, basketball in-ground poles, backboards and netting.
14. **MONUMENT SIGN:** When called for in the proposal, shall include concrete base, extension of conduit from electrical source, lighting and controls, masonry, anodized aluminum and painted lettering, and any other appurtenances.

C. WATER AND SEWER UTILITIES AND CONNECTIONS

15. **DOMESTIC SERVICE CONNECTION:** When called for in the proposal, from SWSC water line to buildings, shall include tapping of SWSC line, boring from Shary Road with casing (as shown on plans), for the diameter, pressure class and material specified, for all depths, and shall include all necessary tapping saddles, curb stops, "U" branches, valves, backflow, and box as per plans and specifications, including any Sharyland Water Supply Corporation standard installation details, as per plans and specifications.
16. **WATER SERVICES WITH METER:** When called for in the proposal, shall include the diameter, pressure class and material specified, parts, and installation. Sharyland Water Supply fees to be waived. Meter to be provided by Sharyland Water Supply and installed by contractor.
17. **SANITARY SEWER STEEL CASING AND BORE:** When called for in the proposal, shall include boring from Shary Road with casing, as per plans and specifications, including any City of Alton standard installation details, as per plans and specifications.
18. **SANITARY SEWER SERVICE CONNECTION:** When called for in the proposal, shall include extension of sewer service from source, all piping, excavation, trenching or other ancillary work.

19. **SANITARY SEWER MANHOLES:** When called for in the proposal, shall include the depth and diameter specified for all depths, measured from natural ground, and shall include all necessary preformed fiberglass bases, sections and cones, cast iron ring and cover, excavation, bedding, select backfill, compaction, dewatering (if required), connect service lines.
20. **CONNECTION TO EXISTING MANHOLE:** When called for in the proposal, shall include all appurtenances, all piping, excavation, trenching and backfilling.
21. **TRENCH SAFETY SYSTEM FOR WATER, SANITARY SEWER, AND FIRE LINES:** When called for in the proposal shall include all shoring, bracing, materials, equipment, daily maintenance and inspection of equipment, safety instructions to installers and laborers, slope backs, safety equipment, ladders, barricades, etc., and the requirements in the Trench Safety System Specifications, all to accomplish a safe and secure trench opening during installation.
22. **DUMPSTER ENCLOSURE:** When called for in the proposal, shall include any minor excavation, chain link gate with locking mechanism, impact bollards, split face CMU perimeter, concrete foundation and any ancillary work to comply with local regulatory specifications. Where a conflict with the plans/specifications and local code exists, the more stringent of the two will prevail unless directed by the Owner's representative.

D. FIRE PROTECTION AND IRRIGATION UTILITIES

23. **FIRE HYDRANT:** When called for in the proposal, shall include, trenching, thrust blocking, 4 mil plastic wrap, backfilling, all necessary materials, set at the location and elevation specified, all complete in place and as per plans and specifications. Gate valves, all necessary Fittings, incidental PVC C-900 pipe shall be subsidiary to this bid item.
24. **FDC (FIRE DEPARTMENT CONNECTIONS):** When called for in the proposal, shall be for the size and type specified, including material, labor and equipment, installed as per plans and specifications, coordination with local Fire Department and owner and any other permits or local code requirements.
25. **C-900 PRIVATE FIRE LINE:** When called for in the proposal, shall include the fire line from water source to buildings or any other locations, including tapping of line, boring as required, line installation for the diameter, pressure class and material specified, for all depths, and shall include all necessary tapping saddles, curb stops, "U" branches, valves, backflow, and box as per plans and specifications, including any SWSC standard installation details.
26. **TEE:** When called for in the proposal, shall include material, backfill, compaction, thrust blocking, and all other appurtenances, installed as per plans and specifications.
27. **VALVE AND BOX WITH MARKER:** When called for in the proposal, shall include all necessary material, valve, cast iron valve box and cover, 4 mil poly wrap, fittings, concrete thrust blocking, all complete in place and in accordance with the plans and specifications.
28. **IRRIGATION SYSTEM BACKFLOW PREVENTER:** When called for in the proposal, shall be for the size and type specified, including material, backfill, compaction, installed as per plans and specifications.
29. **IRRIGATION SYSTEM:** When called for in the proposal shall be designed by a licensed and registered irrigation professional (plans are for schematic purposes only), for all the work according to the submitted and approved plans and specs, and shall include all necessary

pipe and hoses of the diameter and type specified for the specified location, and shall include all necessary fittings, air relief ball valves, Controller, pressure vacuum Breaker, Electric Remote Control Valves, adaptors, demolition of existing lines.

30. **LANDSCAPING:** When called for in the proposal shall be for all work according to the plans and specifications and final landscaping design, and shall include all plants, shrubs, trees, mulch, additional topsoil, compost, edging, and any other material to achieve the design as shown on the plans, and any other appurtenances, all complete in place. Any hauling of additional material required shall be subsidiary to this bid item.

E. DRAINAGE IMPROVEMENTS AND DRAINAGE MASTER PLAN

31. **DETENTION AREA EXCAVATION:** When called for in the proposal shall include all necessary materials, labor and equipment to excavate, grade, and compact areas as indicated in the Plans.
32. **SWALE:** When called for in the proposal shall include all necessary materials, labor and equipment to excavate, **grade to drain**, and compact areas as indicated in the Plans.
33. **REINFORCED CONCRETE PIPE (RCP):** When called for in the proposal, shall include all necessary labor, excavation, backfilling, reinforced concrete pipe of the class specified, RUBBER GASKET JOINTS, connections.
34. **REINFORCED CONCRETE STORM SEWER INLETS:** When called for in the proposal, shall include all necessary connections, grouting, concrete aprons (when called for in the Plans), excavation, backfilling.
35. **STORM SEWER INLETS:** When called for in the proposal include all necessary materials to make the adjustment and if damaged, shall include new lids with cast iron rings and covers, all necessary connections, and when called for, replacement with new pre-cast concrete storm sewer manholes with rings and covers, or replacement with new tops or grates, as specified in the Proposal and Plans.
36. **BLEEDER LINE PIPE:** When called for in the proposal, shall include all necessary material, labor, excavation, backfilling, connections, as specified on the plans and specifications.
37. **CAST IN PLACE REINFORCED CONCRETE SAFETY END TREATMENTS:** When called for in the proposal, shall include all necessary reinforced concrete RIP-RAP, connecting pipe CONCRETE BULKHEADS as shown on the Plan and Profile Sheets, **all depths**, and shall include all necessary labor, excavation, backfilling, reinforced pipe of the diameter, class and type specified, connections.
38. **REINFORCED CONCRETE VALLEY GUTTERS:** When called for in the proposal shall include fillets, joints, tie-ins to the limits shown on the plans, all necessary labor, excavating, backfilling, steel reinforcement, concrete of thickness and strength specified, concrete curb and gutter as shown in the plans and specifications, all complete in place. ***(Reinforced Concrete Valley Gutters shall be laid over prepared base and subgrade as indicated in the typical sections. The prepared base and subgrade shall be paid for within the subgrade and flexible base items).***
39. **TRENCH SAFETY SYSTEM FOR STORM SEWER LINES:** When called for in the proposal shall include all shoring, bracing, materials, equipment, daily maintenance and inspection of equipment, safety instructions to installers and laborers, slope backs, safety equipment, ladders, barricades,

etc., and the requirements in the Trench Safety System Specifications, all to accomplish a safe and secure trench opening during installation.

40. **SIDEWALK DRAIN CHUTES:** When called for in the proposal shall include all labor, materials and installation as per plans and specifications.

F. FENCING AND SITE SECURITY IMPROVEMENTS

41. **WROUGHT IRON FENCING WITH IRON COLUMNS:** When called for in the proposal, shall include of end, corner, and pull post panels. Installation shall include all materials, labor, tools and equipment necessary, including excavation, backfilling, concrete footings, miscellaneous hardware and fittings, smoothing the irregularities of the ground at the fence site, clearing the line for the fence and disposing of debris as shown in the plans and specifications.
42. **MASONRY COLUMNS:** When called for in the proposal, shall include installation and all materials, labor, tools and equipment necessary, including excavation, backfilling, concrete footings, miscellaneous hardware and fittings, smoothing the irregularities of the ground at the fence site, clearing the line for the fence and disposing of debris as shown in the plans and specifications.
43. **RAIL INSTALLATION (HOT DIP GALVANIZED):** When called for in the proposal, shall be for the length and height specified in the plans and shall include all necessary materials, labor, equipment, fabrication, installation of footings, galvanized applicable paint as specified (submittal required), hot-dipped galvanized steel, in accordance with plans and specifications.
44. **GATES:** When called for in the proposal, shall include all materials and labor as shown in the plans and specifications.

G. DEVELOPMENT FEES, PERMITS, AND RELATED

45. **SITE ELECTRICAL AND TRANSFORMER:** When called for in the proposal, shall include trenching, conduit and transformer pad, transformer, coordination with MVEC and SWSC personnel.
46. **TxDOT PERMITS AND DRIVEWAY UTILITIES:** When called for in the proposal, TxDOT permits will be obtained by Engineer in coordination with Contractor. Contractor shall provide installation of all utilities required for the completion of the project as shown on the plans and specifications.

H. CONTINGENCIES

47. **CONTINGENCY:** When called for in the proposal, shall be subject to the Owner's authorization and written approval of mutually agreed upon amounts prior to use.

END OF SECTION

SECTION 013300 – SUBMITTAL PROCEDURES

1.0 GENERAL

1.01 RELATED DOCUMENTS

1. 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:

1. Submittal schedule requirements.
2. Administrative and procedural requirement for submittal.

1.03 SUBMITTAL FORMATS

A. Submittal Information: Include the following information in each submittal:

1. Project name.
2. Date.
3. Name of Architect/Engineer.
4. Name of Contractor.
5. Name of firm or entity that prepared submittal.
6. Names of subcontractor, manufacturer, and supplier.
7. Unique submittal number, including revision identifier.
8. Category and type of submittal.
9. Submittal purpose and description.
10. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
11. Applicable standards, such as ASTM or Federal Specification numbers.
12. Drawing number and detail references, as appropriate.
13. Indication of full or partial submittal.
14. Location(s) where product is to be installed, as appropriate.
15. Other necessary identification.
16. Remarks
17. Signature of transmitter.
18. Two 8 inch x 3 inch blank spaces for Contractor and Engineer stamps.

B. Options: Identify options requiring selection by Architect/Engineer.

C. Deviations and Additional Information. On each submittal, clearly indicate deviation from requirements in the Contract Documents. Including minor variations and limitations; include relevant additional information and revisions, other than those requested by Architect/Engineer on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.

D. Paper Submittals:

1. Place a permanent label or title block on each submittal item for identification: include name of firm or entity that prepared submittal.
2. Provide a space approximately 6 by 8 inches on label or beside title block to record Contractor's review and approval markings and action taken by Architect/Engineer.
3. Action Submittals: Submit three (3) paper copies of each submittal unless otherwise indicated. Architect/Engineer will not return copies.
4. Informational Submittals: Submit three (3) paper copies of each submittal unless otherwise indicated. Architect/Engineer will not return copies.
5. Additional Copies: Unless additional copies are required for final submittal, and unless Architect/Engineer observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.
6. Transmittal for Submittals: Assemble each submittal using General Contractor's company letterhead transmittal form.

E. PDF Submittals: Prepare submittals as PDF package, incorporating complete information into each PDF file. Name PDF file with submittal number.

F. No submittals will be transmitted to Architect/Engineer though text messages or via facsimile.

1.04 SUBMITTAL PROCEDURES

A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.

1. Email: Prepare submittals as PDF package, and transmit to Engineer by sending via e-mail. Include PDF transmittal form. Include information in e-mail subject line as requested by Engineer.
2. Engineer will return annotated file. Annotate and retain one copy of file as a digital Project Record Document file.
3. Paper: Prepare submittals in paper form, and deliver to Engineer.

- 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. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are approved by Architect/Engineer.
 3. Submit action submittals with informational submittals required by the same Specification Section as separate packages under separate submittals.
 4. Coordinate transmittal of submittals for related parts of the Work specified in different Sections so processing will not be delayed because of need to review submittals concurrently for coordination.
 - a. Architect/Engineer reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
 - b. Architect/Engineer reserves the right to withhold action on a submittal requiring review by other Engineer or Owner until response from additional entity is received.
- C. Processing Time: Allow time for submittal review, including time for resubmittal, 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 resubmittal.
1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals or entities 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 15 days for review of each submittal.
 4. Sequential Review: When sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow 21 days for initial review of each submittal.
 - a. Civil Engineer's specification sections.
 - b. Landscape Architect's specification section.
 - c. Structural Engineer's specification sections.
 - d. Mechanical Engineer's specification sections.
 - e. Plumbing Engineer's specification sections.
 - f. Electrical Engineer's specification sections.
 - g. Specifications where Owner must select color or product.

- D. 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 with approval notation from Architect's/Engineer's action stamp.
- E. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and other necessary for performance of construction activities on a timely basis. Show distribution on transmittal forms.
- F. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect/Engineer's action stamp.

1.05 SUBMITTAL REQUIREMENTS

- A. 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 published data are unsuitable 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 catalog cuts, product specifications, photographs, and installation instructions.
 - b. Roughing-in diagrams and templates.
 - c. Standard color and pattern charts.
 - d. Statement of compliance with specified reference standards.
 - e. Testing by recognized testing agency.
 - f. Application of testing agency labels and seals.
 - g. Notation of coordination requirements.
 - h. Availability and delivery time information.
 - 4. For equipment, include the following in addition to the above, as applicable:
 - a. Wiring diagrams that show factory-installed wiring.
 - b. Printed performance curves and operational range diagrams.
 - c. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
 - d. Operating and maintenance instructions, recommended spare-parts listing, and printed product warranties.

5. Submit Product Date before Shop Drawings, and before or concurrent with Samples.
- B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Shop drawings for components of a system shall be submitted with all other system components as a complete shop drawing package, not individually. 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. Schedules.
 - c. Compliance with specified standards.
 - d. Notation of coordination requirements.
 - e. Notation of dimensions and custom templates established by field measurements.
 - f. Shopwork manufacturing instructions, fabrication and installation drawings.
 - g. Relationship and attachment to adjoining construction clearly indicated, including setting diagrams.
 - h. Seal and signature of professional engineer if specified.
 2. Paper Sheet Size: Except for templates, patterns, and similar full-size Drawings, submit Shop Drawings on sheets at least 8 ½ by 11 inches, but no larger than 30 by 42 inches.
 - a. Three opaque copies of each submittal. Architect will retain two copies; remainder will be returned.
- C. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other materials.
 1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
 2. Identification: Permanently attach label on unexposed side of Samples that includes the following:
 - a. Project Name and submittal number.
 - b. Generic description of Sample
 - c. Product name and name of manufacturer.
 - d. Sample source.
 - e. Number and title of applicable Specification Section.
 - f. Specification paragraph number and generic name of each item.
 3. Email Transmittal: Provide PDF transmittal. Include digital image file illustrating Sample characteristics, and identification information for record.

4. Paper Transmittal: Include paper transmittal including complete submittal information indicated.
5. Disposition: Maintain sets of approved Samples at Project site, available for quality control comparison throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
 - a. Samples may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
 - b. Samples not incorporated into work, or otherwise designated at Owner's property are the property of the Contractor.
6. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of color, textures, and patterns available.
 - a. Number of Samples: Submit one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect/Engineer will return submittal with options selected.
7. 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 manufacturer 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 three sets of Samples. Architect/Engineer will retain two Sample sets; remainder will be returned. Mark up and retain one returned Sample set as a project record Sample.
 - 1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated. (To be retained by Architect/Engineer).
 - 2) If variation in color, pattern, texture, or other characteristics is inherent in material or product represented by a Sample, submit at least three sets of paired unites that show approximate limits of variations.

D. Certificates:

1. Certificates and Certification Submittals: Submit a statement that includes signature of entity responsible for preparing certification.

Certificates and certification shall be signed by an officer or other individual authorized to sign documents on behalf of that entity. Provide a notarized signature where indicated.

2. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
3. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
4. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
5. Product Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
6. Welding Certificates: Prepare written certification that welding procedures and personnel comply with the requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Records on AWS Forms. Include names of firms and personnel identified.

- E. Test and Research Reports: Submit reports as required by the Contract Documents and written by qualified testing agencies or individuals as specified in the Contract Documents.

1.06 DELEGATED DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
 1. If criteria indicated are insufficient to perform services or certification required, submit a written request for additional information to the Architect/ Engineer.
- B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF File and three paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.

1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

1.07 CONTRACTOR'S REVIEW

- A. No portion of the Work requiring a shop drawing, working drawing, sample, catalog data, or other submittal requiring review and approval shall be started, nor shall any materials be fabricated or installed prior to the approval or qualified approval of such item. Fabrication performed, materials purchased or on-site construction accomplished which does not conform to approved shop drawings and data shall be at the Contractor's risk. The Owner will not be liable for any expense or delay due to corrections or remedies required to accomplish conformity.
- B. Action Submittals and Information Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections in field dimensions. Mark with approval stamp before submitting to Architect/Engineer.
- C. Contractor's Approval: Indicate Contractor's approval for each submittal with a uniform approval stamp. Include 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.
 1. **Architect/Engineer will not review submittals received from Contractor that do not have Contractor's review approval.**

1.08 ARCHITECT'S/ENGINEER'S REVIEW

- A. The review and approval of shop drawings, samples or catalog data by the Engineer shall not relieve the Contractor from his responsibility with regard to the fulfillment of the terms of the Contract. All risks of error and omission are assumed by the Contractor and the Engineer will have no responsibility therefor.
- B. Action Submittals: Architect/Engineer will review each submittal, indicate corrections or revisions required, and return it.
 1. PDF Submittals: Architect/Engineer will indicate, via markup on each submittal, the appropriate action.
 2. Paper Submittals: Architect/Engineer will indicate, via markup on each submittal, the appropriate action.

- C. Informational Submittals: Architect/Engineer will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect/Engineer will forward each submittal to appropriate party.
- D. Partial Submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect/Engineer.
- E. Incomplete Submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- F. Architect/Engineer will return without review submittals received from sources other than Contractor.
- G. Submittals not required by the Contract Documents will be returned by Architect/Engineer without action.
- H. Submittals received without a cover sheet, as text messages, or fax will not be reviewed and will be returned to Contractor for resubmittal.

2.00 PRODUCTS

(Not Used)

3.00 EXECUTION

(Not Used)

END SECTION

SECTION 015626 – TEMPORARY FENCING

1.00 GENERAL

1.01 PROTECTIVE BARRIERS AND SIGNAGE

- A. No public access shall be allowed on the site of work until the construction is completed and accepted by the Owner. Enclose the site and maintain protective fencing and barriers during demolition and construction operations to prevent public access. Provide all specified and necessary signage to inform and restrict public access.
- B. Protective barriers to restrict access to the construction site shall be temporary, portable chain-link fencing: minimum 2-inch, 0.148 inch-thick, galvanized steel, chain-link fabric fencing: minimum 6 feet tall with galvanized steel pipe posts; minimum 2-3/8 inch OD line posts and 2-7/8 inch OD corner and pull posts, with 1-5/8 inch OD top and bottom rails, with galvanized steel bases for supporting posts. Provide access as required for the construction operations. Secure all fencing at the end of each work day and monitor at busy times of day, i.e. the start, end, and lunch times. Install fence before construction operations begin.

1.02 DAMAGE TO PROPERTY

- A. Without expense to the Owner, restore to its original condition any adjacent property that has been damaged due to the negligence and/or work of the Contractor's agents, employees or subcontractors. Complete all such repairs to the satisfaction of the Engineer.

2.00 PRODUCTS (NOT USED)

3.00 EXECUTION (NOT USED)

END OF SECTION

SECTION 03 10 00 – CONCRETE FORMING AND ACCESSORIES

1.00 GENERAL

1.01 SECTION INCLUDES

- A. Formwork for cast in place concrete, with shoring, bracing and anchorage.
- B. Form accessories.
- C. Form stripping.

1.02 RELATED REQUIREMENTS

- A. Section 03 20 00 – Concrete Reinforcing
- B. Section 03 30 00 – Cast in Place Concrete
- C. Section 03 39 00 – Concrete Curing
- D. Section 04 20 00 – Unit Masonry: Spacing for veneer anchor reglets recessed in concrete

1.03 REFERENCE STANDARDS

- A. ACI 117 – Standards Specifications for Tolerances for Concrete Construction and Materials; Latest Edition.
- B. ACI 301 – Specifications for Structural Concrete for Buildings; American Concrete Institute; Latest Edition.
- C. ACI 318 – Building Code Requirements for Structural Concrete and Commentary; American Concrete Institute; Latest Edition.

1.04 DESIGN REQUIREMENTS

- A. Design, engineer and construct formwork, shoring and bracing to conform to design and code requirements; resultant concrete to conform to required shape, line and dimension.

1.05 SUBMITTALS

- A. See Section – Administrative Requirements, for submittal procedures.
- B. Manufacturer's Literature: Submit copies of manufacturer's product specifications and installation instructions for manufactured products, including form sealer and release agent.
- C. Shop Drawings: Indicate pertinent dimensions, materials, bracing, and arrangement of joints and ties.
- D. Shop Drawings for formwork where concrete is exposed to view that show form construction including jointing, special form joint or reveals,

location and pattern of form tie placement and other items that become a feature of the wall.

1.06 QUALITY ASSURANCE

- A. Perform work of this section in accordance with ACI 301 and ACI 318.
- B. Maintain one copy of each installation standard on site throughout the duration of concrete work.
- C. Industry Standards
 - 1. American Concrete Institute, ACI-301, Specifications for structural concrete for buildings.
 - 2. American Concrete Institute, ACI-318, Building code requirements for reinforced concrete.
 - 3. American Concrete Institute, ACI-347, Recommended practice for concrete formwork.
 - 4. American Concrete Institute, ACI-SP-15, Field reference manual.
 - 5. Southern Pine Inspection Bureau (SPIB) Grading Rules.
 - 6. Western Wood Products Association (WWPA) Grading Rules.
 - 7. American Plywood Association (APA) Grading Rules.
- D. Allowable Tolerances: Construct formwork within tolerance requirement of ACI 347 – or as approved by Engineer. Maximum deflection of form facing material between supports shall be limited to $0.0025 \times \text{span}$.

1.07 REGULATORY REQUIREMENTS

- A. Conform to applicable code for design, fabrication, erection and removal of formwork.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver void forms and installation instructions in manufacturer's packaging.
- B. Store void forms off ground in ventilated and protected manner to prevent deterioration from moisture.

2.00 PRODUCTS

2.01 FORMWORK – GENERAL

- A. Provide concrete forms, accessories, shoring, and bracing as required to accomplish cast-in-place concrete work.

- B. Design and construct to provide resultant concrete that conforms to design with respect to shape, lines, and dimensions.
- C. Comply with applicable State and local codes with respect to design, fabrication, erection, and removal of formwork.

2.02 WOOD FORM MATERIALS

- A. Forms for Exposed Finish Concrete: Plywood with Formica faced; or other acceptable panel-type materials to provide continuous straight, smooth, exposed surfaces. Furnish in largest practicable size to minimize number of joints and to conform to joint system shown on drawings.
- B. Forms of Unexposed Finish Concrete; Plywood timber, metal or other acceptable material. Provide lumber dressed on at least 2 edges and side for tight fit.
- C. Forms for Textured Finish Concrete: Units of face design, size arrangement, and configuration to match Architect/Engineer's control sample. Provide solid backing and firm supports to ensure stability of textured form liners.
- D. Forms for Cylindrical Columns: Metal, fiberglass-reinforced plastic, paper or fiber tubes with Formica interior face. Provide paper or fiber tubes of laminated plies with water-resistant adhesive and wax-impregnated exterior for weather and moisture protection. Provide units with sufficient wall thickness to resist wet concrete loads without deformation.
- E. Form Coatings; Sealers and Release Agents: Provide commercial formulated form-coating compounds that will not bond with, stain or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces. Use single source for all forms.
- F. Form Ties: Factory fabricated, adjustable length, removable or snap-off metal form ties, designed to prevent form deflection and to prevent spalling concrete upon removal. Provide units that will leave no metal closer than 1 ½ inches to exposed surface. Spreader cones on ties shall not exceed 1 inch in diameter.
- G. Earth Forms: Forms for footings may be cut into earth provided that earth is dry, stable, level and sound. Provide full depth forming at all perimeter grade beams and footings exterior faces.

2.03 PREFABRICATED FORMS

- A. Manufacturers:
 - 1. Alabama Metal Industries Corporation: www.amico-online.com
 - 2. Molded Fiber Glass Construction Products Co: www.mfgcp.com
 - 3. Reward Wall Systems: www.rewardwalls.com

- 4. Substitutions: See Section – Product requirements.
- B. Void Forms: Moisture resistant treated paper faces, biodegradable, structurally sufficient to support weight of wet concrete mix until initial set; 2 inches thick.

2.04 FORMWORK ACCESSORIES

- A. Form Ties: Removable type, galvanized metal, fixed length, with waterproofing washer, free of defects that could leave holes larger than 1 inch in concrete surface.
- B. Form Release Agent: Colorless mineral oil that will not stain concrete.
- C. Flashing Reglets: Galvanized steel, 22 gauge thick, longest possible lengths, with alignment splines for joints, foam filled, release tape sealed slots, anchors for securing to concrete formwork.
- D. Waterstops: Preformed mineral colloid strips, 3/8 inch thick, moisture expanding.

3.00 EXECUTION

3.01 EXAMINATION

- A. Verify lines, levels and centers before proceeding with formwork. Ensure that dimensions agree with drawings.

3.02 ERECTION – FORMWORK

- A. Erect formwork, shoring and bracing to achieve design requirements, in accordance with requirements of ACI 301.
- B. Provide bracing to ensure stability of formwork. Shore or strengthen formwork subject to overstressing by construction loads.
- C. Arrange and assemble formwork to permit dismantling and strip. Do not damage concrete during stripping. Permit removal of remaining principle shores.
- D. Coordinate this section with other sections of work that require attachment of components to formwork.
- E. If formwork is placed after reinforcement, resulting in insufficient concrete cover over reinforcement, request instruction from Engineer before proceeding.
- F. General: Design, erect, support, brace and maintain formwork to support vertical and lateral loads that might be applied until concrete structure can support such loads. Construct formwork so concrete members and structures are of correct size, shape, alignment,

elevation and position. Maintain formwork construction tolerances complying with ACI 347.

- G. Construct forms to sizes, shapes, lines, and dimensions shown and obtain accurate alignment, locations, grades, level, and plumb work in finished structures. Provide for openings, offsets, keyways, rustications, chamfers, and other features required in work. Use selected materials to obtain required finishes. Solidly butt joints and provide backup at joints to prevent leakage of cement paste.
- H. Fabricate forms for easy surface removal without hammering or prying against concrete surfaces. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only. Kerf wood inserts for easy removal.
- I. Provide temporary openings where interior area of formwork is inaccessible for cleanout, for inspection and for placement of concrete. Locate temporary openings in forms at inconspicuous locations.
- J. Chamfer exposed corners and edges as indicated, using wood, metal, PVC or rubber chamfer strips fabricated to produce uniform smooth lines and tight edge joints.

3.03 APPLICATION – FORM RELEASE AGENT

- A. Apply form release agent on formwork in accordance with manufacturer's recommendations.
- B. Apply prior to replacement of reinforcing steel, anchoring devices, and embedded items.
- C. Do not apply form release agent where concrete surfaces will receive special finishes or applied coverings that are affected by agent. Soak inside surfaces of untreated forms with clean water. Keep surfaces coated prior to placement of concrete.
- D. Forms coated to prevent bond with concrete shall be done in accordance with manufacturer's instructions. Materials which will stain or discolor the concrete shall not be applied to the form surfaces.

3.04 FORM CLEANING

- A. Clean forms as erection proceeds to remove foreign matter within forms.
- B. Clean formed cavities of debris prior to placing concrete.
- C. Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt or other debris just before concrete is placed. Retighten forms and bracing before concrete placement as required to prevent mortar leaks and maintain proper alignment.

3.05 FORM TOLERANCES

- A. Construct formwork to maintain tolerances required by AC 117.
- B. Construct and align formwork for elevator hoist way in accordance with ASME A17.1

3.06 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field quality control tests.

3.07 FORM REMOVAL

- A. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads.
- B. General: Formwork not supporting weight of concrete such as sides of walls and slabs may be removed after cumulatively curing at not less than 50 degrees for 48 hours after placing concrete, provided concrete is sufficiently hard to not be damaged by form removal operations, and provided curing protection operations are maintained.
- C. Contractor shall assume full responsibility for removal of formwork and forms shall be removed in such a manner as to insure complete safety of structure.

END OF SECTION

SECTION 03 20 00 – CONCRETE REINFORCING

1.00 GENERAL

1.01 SECTION INCLUDES

- A. Reinforcing steel for cast-in-place concrete.
- B. Supports and accessories for steel reinforcement.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast in Place Concrete

1.03 REFERENCE STANDARDS

- A. ACI 301 – Specifications for Structural Concrete for Buildings; American Concrete Institute International; 2005
- B. ACI SP-66 – ACI detailing Manual; American Concrete Institute International; 2004.
- C. ASTM A 185/A 185M – Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete; 2007.
- D. ASTM A 615/A 615M – Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement; 2007.
- E. CRSI (DA4) – Manual of Standard Practice; Concrete Reinforcing Steel Institute; 2001.

1.04 SUBMITTALS

- A. See Section – Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Comply with requirements of ACI SP-66. Include bar schedules, shapes of bent bars, spacing of bars, and location of splices.

1.05 QUALITY ASSURANCE

- A. Perform work of this section in accordance with ACI 301

2.00 PRODUCTS

2.01 REINFORCEMENT

- A. Reinforcing Steel: ASTM A 615/A 615M Grade 60 (420)
 - 1) Deformed billet-steel bars.

- 2) Unfinished.
- B. Steel Welded Wire Reinforcements: ASTM A 185/A 185M, plain type.
 - 1) Flat Sheets.
 - 2) Mesh Size: 4 x 4.
 - 3) Wire Gage: W2.9 x W2.9 or as indicated on the plans.
- C. Reinforced Accessories:
 - 1) Tie Wire: Annealed, minimum 16 gage.
 - 2) Chairs, Bolsters, Bar Supports, and Spacers: Sized and shaped for adequate support of reinforcement during concrete placement.
 - 3) Provide stainless steel or plastic components for placement within 1 ½ inches of weathering surfaces.

2.02 FABRICATION

- A. Fabricate concrete reinforcing in accordance with CRSI (DA4) – Manual of Standards Practice.
- B. Welding of reinforcement is not permitted.

3.00 EXECUTION

3.01 PLACEMENT

- A. Place, support and secure reinforcement against displacement. Do not deviate from required position.
- B. Do not displace or damage vapor barrier.
- C. Accommodate placement of formed openings.
- D. Maintain concrete cover around reinforcing as follows:
 - 1) Footings and Concrete Formed Against Earth: 3 inch.
 - 2) Slabs on Fill: 2 inch
- E. Conform to applicable code for concrete cover over reinforcement.

END OF SECTION

SECTION 033000- CAST IN PLACE CONCRETE

1.00 GENERAL

1.01 SECTION INCLUDES

- A. Labor, materials, services and equipment required in conjunction with or properly incidental to placing of cast-in-place concrete slabs, building members, and MEP equipment pads as described herein or as shown on the Drawings, including but not limited to:
 - 1. Concrete mix designs.
 - 2. Assistance with Owner provided laboratory testing of concrete.
 - 3. Installation of items to be built-in formwork or embedded in concrete but furnished by other trades, including metal anchors, anchor slots, reglets, hangers, supports, ties, inserts, bolts, corner guards, and sleeves.
 - 4. Cast-in-place concrete, with formwork, under slab vapor barrier, reinforcing, accessories, appurtenances, finishing and curing required completing concrete work.
 - 5. Grouting under structural steel base plates.
 - 6. Foundation for columns, walls, and slabs on grade.
 - 7. Super-structure for walls, columns, slabs, curbs, stairs, steps, equipment pads, walks, and pre-molded expansions joints.
- B. Examine the drawings for Plumbing, Mechanical, and Electrical work. These subcontractors will furnish and set sleeves or box forms required for openings. Contractor shall use care in placing reinforcement and pouring concrete so as not to displace such sleeves or boxes.
 - 1. All slots, chases, recesses, or openings indicated on the drawings, which are not formed by sleeves or boxes shall be provided in locations shown. When the work of other contractors is completed, the excess part of the openings shall be completely closed with concrete.

1.02 RELATED REQUIREMENTS

- A. Division 1 Sections applicable to the Work of this Section.

1.03 RELATED SECTIONS

- A. Section - Testing and Inspecting Services
- B. Section 04 20 00 - Unit Masonry

- C. Section 05 12 00 - Structural Steel
- D. Section 05 50 00 - Miscellaneous Metals
- E. Section 31 00 00 – Earthwork
- F. Electrical and Mechanical Drawings and Specifications for sleeves, conduit, and other items embedded in concrete.

1.04 QUALITY ASSURANCE

- A. Where standards or requirements of this Section are in conflict with those noted on the Contract Drawings, or the Building Code, the more stringent requirements shall govern. Bring all conflicts and discrepancies to the attention of the Architect/Engineer and do not start work until such conflicts and discrepancies are clarified and corrected. Failure to do so will not relieve the Contractor from performing the Work correctly at no additional expense to the Owner.
- B. Testing Laboratory Services:
 - 1. Test results shall meet or exceed established standards. A technician from the Owner's Testing Laboratory must be present during all operations.
- C. Evaluation and Acceptance:
 - 1. Codes and Standards: The Work described in this Section, unless otherwise noted on the Drawings, or herein specified, shall be governed by the editions of the following codes or specifications approved by authorities having jurisdiction.
 - a. American Association of State Highway and Transportation Officials (AASHTO)
 - 1) TP 23, "Proposed Standard Method of Test for Water Content of Freshly Mixed Concrete Using Microwave Oven Drying"
 - b. American Concrete Institute (ACI)
 - 1) 211.1, "Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete"
 - 2) 214, "Recommended Practice for Evaluation of Strength Test Results of Concrete"
 - 3) 301, "Specifications for Structural Concrete for Buildings"
 - 4) 302, "Guide for Concrete Floor and Slab Construction"
 - 5) 304, "Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete"
 - 6) 305, "Hot Weather Concreting"
 - 7) 306, "Cold Weather Concreting"

- 8) 309, "Standard Practice for Consolidation of Concrete"
 - 9) 311, "ACI Manual of Concrete Inspection"
 - 10) 315, "Manual of Standard Practice for Detailing Reinforced Concrete Structures"
 - 11) 318, "Building Code Requirements for Reinforced Concrete"
 - 12) 347, "Recommended Practice for Concrete Formwork"
 - 13) Keep one copy of "Manual of Concrete Practice" at job site at all times.
- c. American Society for Testing and Materials (ASTM)
- 1) A36, Standard Specification for Carbon Structural Steel
 - 2) A108, Standard Specification for Steel Bars, Carbon, Cold-Finished, Standard Quality
 - 3) A123, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
 - 4) A185, Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
 - 5) A615, Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
 - 6) A704, Standard Specification for Welded Steel Plain Bar or Rod Mats for Concrete Reinforcement
 - 7) C33, Standard Specification for Concrete Aggregate
 - 8) C42, Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
 - 9) C94, Standard Specification for Ready-Mix Concrete
 - 10) C136, Standard Method for Sieve Analysis of Fine and Coarse Aggregates
 - 11) C150, Standard Specification for Portland Cement
 - 12) C172, Standard Practice for Sampling Freshly Mixed Concrete
 - 13) C260, Standard Specification for Air-Entraining Admixtures
 - 14) C330, Standard Specification for Lightweight Aggregates for Structural Concrete
 - 15) C494, Standard Specification for Chemical Admixtures for Concrete
 - 16) C595, Standard Specification for Blended Hydraulic Cements
 - 17) C881, Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete
 - 18) C979, Standard Specification for Pigments for Integrally Colored Concrete
 - 19) C1107, Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-Shrink)
 - 20) C1315, Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete

- 21) E96, Standard Test Methods for Water Vapor Transmission of Materials
- 22) E1643, Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill under Concrete Slabs
- 23) E1745, Standard Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs
- 24) F710, Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring
- d. Federal Specification (FS)
 - 1) D1.4 Structural Welding Code- Reinforcing Steel
- e. Federal Specification (FS)
 - 1) FF-S-325
 - 2) QQ-Z-325C
- f. Concrete Reinforcing Steel Institute (CRSI)
 - 1) "Reinforced Concrete – A Manual of Standard Practice"
 - 2) "Recommended Practice for Placing Reinforcing Bars"
 - 3) "Recommended Practice for Placing Bar Supports"

D. Source Quality Control:

1. Concrete production facilities shall meet the requirement for certification by the National Ready Mixed Concrete Association. All ready mix concrete trucks proposed for use on the project shall meet the requirements of NRMCA, Certification of Ready Mix Concrete Production Facilities.
2. Concrete batchers shall be completely interlocked semi-automatic or automatic batchers, as defined by the Concrete Plant Manufacturers Bureau.
3. Concrete batchers shall have graphic, digital, or photographic recorders, which shall register both empty balance and total weight (or volume of water or admixture) of each batched material, time to the nearest minute, date, identification of batch, and numerical count of each batch. Copies of the record shall be furnished to the Inspection and Testing Laboratory.
4. The Inspection and Testing Laboratory shall provide concrete batch plant inspection as follows:
 - a. Provide a qualified inspector with necessary equipment and apparatus to inspect weighing and batching of controlled concrete at batch plant on a random basis, approximately once daily as the concrete is being placed on this project.
 - b. Make certain that materials and batch equipment used are in accordance with requirements of Specifications.
 - c. Check for adjustment in batch weights to compensate for variations in moisture content.

- d. Submit promptly to Architect/Engineer, certification of weights used in loads of acceptable concrete which has been batched during plant inspection time.

E. Concrete Mix Design Criteria:

1. Design concrete mixes in accordance with ACI 318, Section 5.3, and proportioning on the basis of field experience and/or trial mixtures.
2. Submit the proposed mix designs for each concrete mix type proposed.
3. Determination of required average strength above specified strength shall be in accordance with ACI 318.
4. If trial mixes are used as the basis for the proposed mix design, mold and cure test cylinders in accordance with ASTM C39. Do not place concrete on project until laboratory reports and results of confirmation cylinder tests have been evaluated by the Inspection and Testing Laboratory and results indicate that proposed mixes will develop required strengths.
5. Inspection and Testing Laboratory shall furnish the Architect/Engineer with a written evaluation of each proposed concrete mix design submitted by the Contractor.
6. Check mix designs and revise if necessary wherever changes are made in aggregates or in surface water content of aggregate or workability of concrete. Water content shall be the minimum to produce workable mix. The water content shall be verified in the field by use of the Microwave Test.

1.05 SUBMITTALS

- A. Mix Designs: Submit proposed mix designs, including confirmation cylinder test results, in accordance with ACI 318, Section 5.3, Proportioning on the basis of field experience and/or trial mixtures. Submit mix designs to Architect/Engineer and Inspection and Testing Laboratory for evaluation a minimum of 14 days prior to placing concrete. Key requirements:
1. Combined aggregate gradation.
 2. Proportions of cement, fine and coarse aggregates, and water.
 3. Type, color and dosage of integral coloring compounds, where applicable.
 4. Range of ambient temperature and humidity for which design is valid.
 5. Any special characteristics of mix which require precautions in mixing, placing, or finishing techniques to achieve finished product.

- B. Complete test data for trial mixes or a complete summary of previous project test results for mix design based on standard deviation analysis must be included.
- C. Provide duplicate delivery tickets for each load of ready-mix concrete delivered to site, in accordance with ASTM C94. Show batch weights on each ticket.
- D. Provide mill test reports on an as-used basis for each type and brand of cementitious material used. Provide certification from independent test laboratory indicating underslab vapor retarder compliance with specification and ASTM 1745 Class A requirements.
- E. Provide product data for each accessories item specified but not necessarily listed above, which are required for a complete installation, including, but not limited to reinforcing, chairs, admixtures, stains and color pigments, grouts, sealers, vapor retarders and barriers, water stops, epoxy adhesives, curing compounds and anchors.
- F. Provide Shop Drawings for all reinforcing steel. Show bending diagrams, splicing and laps of rods, shapes, dimensions and details of bar reinforcement and accessories.

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Mix and deliver concrete to project ready-mixed in accordance with ASTM C94. Mix concrete a minimum of 70 revolutions of transit mix drum at mixing speed. A minimum of 40 revolutions shall be at the production plant.
- B. Schedule delivery so that continuity of any pour will not be interrupted for over 15 minutes.
- C. Place concrete on site within 90 minutes after proportioning materials at batch plant.
- D. Store bagged cement on platforms off ground. Protect stored cement against the elements. Handle and store fine and coarse aggregate separately in manner to prevent intrusion of foreign material or segregation of the material. Protect all reinforcement until used. Do not use any hardened cement.
- E. Mild steel reinforcement at the time of placement of concrete shall be clean and free of all loose dirt, form oil, and other coatings affecting bond.

1.07 JOB CONDITIONS

- A. Hot Weather Concreting:
 - 1. Follow ACI 301 and ACI 305.
 - 2. Provide water-reducing retarding admixture conforming to ASTM C494, Type D when necessary to retard initial set. The admixture shall be dispensed in accordance with manufacturer's recommendations.
 - 3. Maximum concrete temperature shall not exceed 95 degrees F at time of placement.
 - a. Concrete with temperatures above 90 degrees F shall be placed only if a high range water reducer (superplasticizer) is added to the mix as directed by the Testing Laboratory to maintain the specified slump during placement.
- B. Cold Weather Concreting: Protect concrete work from physical damage or reduced strength which could be caused by frost, freezing actions, or low temperatures.
 - 1. Follow ACI 301 and ACI 306.
 - 2. When ambient temperature at site is below 40 degrees F or is expected to fall to that temperature within ensuing 24 hours, heat water and/or aggregate prior to adding to mix so that temperature of concrete will be between 55 degrees F and 85 degrees F at time of placement.
 - 3. Maintain temperature of deposited concrete between 50 degrees F and 70 degrees F for minimum of seven (7) days after placing.
 - 4. Add the specified non-corrosive accelerator for all floor concrete placed at air temperatures below 50 degrees F.
- C. Temperature Changes: Maintain changes in concrete temperature as uniformly as possible, but in no case exceed change of 5 degrees F per hour or 25 degrees F in any 24 hour period.
- D. Combustion heaters shall not be used during the first 48 hours without precautions to prevent exposure of concrete and workmen to exhaust gasses containing carbon dioxide and/or carbon monoxide.
- E. Admixtures intended to accelerate hardening of concrete or produce higher than normal strength at early periods will not be permitted unless approved by the Architect/Engineer. The use of calcium chloride is specifically prohibited.

1.08 PRE-INSTALLATION CONFERENCE

- A. Refer to Section – Project Coordination

1.09 SEQUENCING/SCHEDULING

- A. Coordinate Work of this Section with work of other Sections as required

to properly execute the Work and as necessary to maintain satisfactory progress of the work of other Sections.

2.00 PRODUCTS

2.01 APPROVED MANUFACTURERS

- A. Manufacturers named within this Section are approved for use on the Project for the product for which they are specified. Other manufacturers must have a minimum of five (5) years' experience manufacturing the product specified and meet or exceed the specifications for that product. Substitution of products must be in accordance with the General Conditions, Supplementary Conditions, and Section 01 30 00, Submittals to be considered prior to proposal.

2.02 MATERIALS

A. Formwork:

1. General: Contractor may use any of the following formwork materials as long as material meets the following and will not stain, or impart any undesirable texture, i.e. wood grain, where such texture would be objectionable in an exposed location.
 - a. Wood Forms:
 - 1) Plywood: PS 1, Douglas Fir or Spruce species.
 - 2) Medium Density Overlay (MDO): One (1) side grade; sound undamaged sheets with clean, true edges.
 - 3) Lumber: Southern Yellow Pine species; No. 2 grade, with grade stamp clearly visible.
 - b. Pre-Fabricated Forms:
 - 1) Preformed Steel Forms: Minimum 16 gauge matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.
 - 2) Glass Fiber Fabric Reinforced Plastic Forms: Matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.
 - c. Form Liner: Any material recommended by manufacturer to impart finish which will exhibit the finish or design characteristics, i.e. smooth, textured, ribbed, etc. detailed by the Architect/Engineer for exposed locations as shown or required and capable of being stripped from complex designs without damaging the finish or design. Form liner shall be as

- manufactured by Symons Corporation, Greenstreak, Inc. or Architect/Engineer approved equal.
- d. Self-expanding corkboard expansion joint fillers should conform to ASTM D1752 for exterior work. Joint fillers shall extend full depth of slab or joint and be of thickness and lengths indicated on drawings.
- B. Metal Reinforcement:
- 1. Bars:
 - a. General: Conform to ACI 315, latest edition.
 - b. Comply with ASTM A615, Grade 60.
 - c. Number 3 bars comply with ASTM A615, Grade 40
 - 2. Welded Steel Wire Fabric (Mesh): Not permitted in structural concrete, unless approved by Structural Engineer
- C. Concrete, General:
- 1. Ready-mixed concrete, ASTM C94
 - 2. Comply with ACI 318.
 - 3. Concrete must be approved by Architect/Engineer through design mix and cylinder test of testing laboratory.
 - 4. Unless approved otherwise by the Architect/Engineer, use one (1) brand of cement throughout the work where finished surface will be exposed to view.
 - 5. Strength: Refer to Paragraph 2.3, A.
 - 6. Unless approved otherwise by the Structural Engineer, use one (1) ready-mix concrete company throughout the project.
- D. Concrete Materials:
- 1. Cement:
 - a. Portland Cement, Type I or III, conforming to the requirements of ASTM C150.
 - b. Combined aggregate gradation for slabs and other designated concrete shall be 8 percent - 18 percent for large top size aggregates (1-1/2 in.) or 8 percent - 22 percent for smaller top size aggregates (1 in. or 3/4 in.) retained on each sieve below the top size and above the No. 100.
 - 2. Fly ash: Maximum of 25% fly ash by weight is acceptable.
- E. Aggregate:
- 1. Fine Aggregate: ASTM C33; clean, hard, durable, uncoated, natural and manufactured sand, free of silt, loam or clay.
 - 2. Coarse Aggregate: ASTM C33; hard, durable, uncoated, crushed stone; gradation in accordance with Size No. 467 for piers and concrete footings and Size No. 67 for all other concrete. Maximum aggregate size in accordance with ACI 318.
 - 3. Grading shall be in accordance with "Standard Method for Fine Analysis of Sieve and Coarse Aggregates" (ASTM C136).

F. Water: ASTM C94, Paragraph 4.1.3; potable, clean and free from oil, acid and injurious amount of vegetable matter, alkalies, and other impurities.

G. Admixtures:

1. Cement-dispersing, water-reducing types. Admixtures shall conform to ASTM C494, Type A or D, and shall be used strictly in accordance with manufacturer's recommendations and as determined by the Inspection and Testing Laboratory. Admixture shall not discolor concrete or in any way affect the appearance of the concrete.
 - a. High-range water reducing admixture conforming to ASTM C494, Type F or G shall be used as required and shall be one (1) of the following or Architect/Engineer approved equal:
 - 1) Eucon 37 (Type F), Eucon 537 (Type G) by The Euclid Chemical Company
 - 2) Rheobuild 1000 (Type F), Rheobuild 716 (Type G) by Master Builders
 - 3) Sikament 300 (Type F), Sikament 86 (Type G) by Sika Chemical Corp.
 - 4) WRDA-19 (Type F), Daracem 100 (Type G) by W.R. Grace
2. An air-entraining admixture conforming to ASTM C260 shall be used as required on the Drawings and shall be one (1) of the following or Architect/Engineer approved equal:
 - a. Air-Mix or AEA-92 by The Euclid Chemical Company
 - b. Sika Aer by Sika Corporation
 - c. MB-VR or MB-AE by Master Builders
3. Prohibited Admixtures: Calcium chloride, thiocyanates or admixtures containing more than 0.05 percent chloride ions are not permitted.
4. Certification: Written conformance to the above-mentioned requirements and the chloride ion content of admixtures will be required from the admixture manufacturer prior to mix design review by the Architect/Engineer.

H. Non-Shrink Cement Grout:

1. The non-shrink grout shall be a factory pre-mixed grout and shall conform to ASTM C1107, "Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-Shrink)." In addition, the grout manufacturer shall furnish test data from an independent laboratory indicating that the grout when placed at a fluid consistency shall achieve 95 percent bearing under a 4 foot x 4 foot base plate. Provide one (1) of the following or Architect/Engineer approved equal:
 - a. NS Grout by The Euclid Chemical Company
 - b. Five Star Grout by U.S. Grout Corp.
 - c. Horn Non-Corrosive Non-Shrink Grout by Tamms Industries

- d. Duragrout by L & M Construction Chemicals, Inc.
 - e. Masterflow 713 by Master Builders
 - f. SikaGrout 212 by Sika Corp.
 - g. SonogROUT 10K by Sonneborn
 - h. 588 Grout by W. R. Meadows, Inc.
 - i. US SPEC GP Grout by US Mix Products Company
2. High Flow Grout: Where high fluidity and/or increased placing time is required, use high flow grout. The factory pre-mixed grout shall conform to ASTM C1107, "Standard Specification for Packages Dry, Hydraulic-Cement Grout (Non-Shrink)." In addition, the grout manufacturer shall furnish test data from an independent laboratory indicating that the grout when placed at a fluid consistency shall achieve 95 percent bearing under an 18 inch x 36 inch base plate. Provide one (1) of the following or Architect/Engineer approved equal:
- a. Hi-Flow Grout by The Euclid Chemical Company
 - b. Crystex by L & M Construction Chemicals, Inc.
 - c. Masterflow 928 by Master Builders
 - d. CG-86 Grout by W. R. Meadows, Inc.
 - e. US SPEC MP Grout by US Mix Products Company
- I. Evaporation Retardant:
1. Evaporation Retardant shall be a thin, continuous film which prevents rapid moisture loss from the concrete surface. For use when concrete operations must be performed in direct sun, wind, high temperatures, or for relative humidity. Products: Subject to compliance with requirements, provide one (1) of the following or Architect/Engineer approved equal:
- a. Eucobar by The Euclid Chemical Company
 - b. Confilm by Master Builders
 - c. Evapre by W. R. Meadows, Inc.
 - d. US SPEC Monofilm ER by US Mix Products Company.
 - e. E-Con by L& M Construction Chemicals
- J. Sealer/Densifier: Provide "Euco Diamond Hard" by The Euclid Chemical Company, "Sealhard" by L&M Construction Chemicals, or equal by Master Builders, Sika Corp., Sonneborn, US SPEC, or Architect/Engineer approved equal.
- K. Chemical Hardener/Dustproofer: Provide "Surfhard" by The Euclid Chemical Company, "Chemhard" by L&M Construction Chemicals, or equal by Master Builders, Sika Corp., Sonneborn, US SPEC, or Architect/Engineer approved equal.
- L. Curing Compound: dissipating resin type, which chemically breaks down after approximately eight (8) weeks. Membrane forming compound shall meet ASTM C309, Types 1 and 1D Class B, water based, VOC/AIM Compliant. Provide "Kurez DR VOX" by The Euclid

- Chemical Company, "Cure R" by L&M Construction Chemicals, "1100 Clear" by W. R. Meadows, Inc., US SPEC "Maxcure Resin Clear" by US Mix Products Company, or equal by Master Builders, Sika Corp., BASF, or Architect/Engineer approved equal.
- M. Curing and Sealing Compound: high solids acrylic copolymer emulsion blend. Membrane forming compound shall meet ASTM C1315, Type 1 Class B. Provide "Super Rez-Seal" by The Euclid Chemical Company, "Dress & Seal" by L&M Construction Chemicals, "VOCOMP 25 1315" by W. R. Meadows, Inc., US SPEC "CS-25-1315" by US Mix Products Company, or equal by Master Builders, Sika Corp., BASF, or Architect/Engineer approved equal.
- N. Epoxy Adhesive: ASTM C881, two (2) components, 100 percent solids, 100 percent reactive compound suitable for use on dry or damp surfaces. Provide one (1) of the following or Architect/Engineer approved equal:
1. Euco #452 Epoxy System or Euco #620 Epoxy System by the Euclid Chemical Company
 2. Sikadur Hi-Mod by Sika Corp.
 3. Rezi-Weld 1000 by W. R. Meadows, Inc.
 4. US SPEC Maxibond 2500 by US Mix Products Company.
 5. Epobond by L& M Construction Chemicals.
- O. Underslab Vapor Retarders and Barriers:
1. Vapor Retarder Membrane:
 - a. Requirements:
 - 1) Class: ASTM E1745, Class A.
 - 2) Water Vapor Permeance: ASTM E96, 0.01 perms maximum.
 - 3) Tensile Strength: ASTM E154 (Section 9, Average), 45.0 pounds per inch, minimum.
 - 4) Puncture Resistance: ASTM D1709 (Method B), 2300 grams, minimum.
 - b. Provide compatible seam taping and pipe boots or sealing mastic in accordance with manufacturer's requirements.
 - c. Provide proof of compliance to Architect/Engineer at time of delivery of materials.
 - d. Provide one (1) of the following under entire slab, unless noted otherwise:
 - 1) Stego Wrap 15-mil Vapor Barrier by STEGO INDUSTRIES LLC, San Juan Capistrano, CA (877) 464-7834 www.stegoindustries.com
 - 2) Premoulded Membrane with Plasmatic Core by W.R. Meadows.
 - 3) Zero-Perm by Alumiseal.
 2. Vapor Barrier: Under Wood Floors at Gymnasiums, Stages, and Dance Floors, and at Auditorium Areas Below Finish Floor Level:

Premoulded Membrane Vapor Seal with Plasmatic Core manufactured by W.R. Meadows, Inc., Hampshire, IL; or Architect/Engineer approved equal.

3. Below Grade Waterproofing: Provide below grade waterproofing at vertical walls below grade.

P. Miscellaneous Structural Metals Associated with Structural Concrete:

1. Structural steel pieces, including miscellaneous structural metals placed in concrete, exposed to weather, in permanent contact with soil, or accessible to salt intrusion shall be hot dipped galvanized in accordance with ASTM A123.
2. Structural steel pieces embedded in concrete shall conform to ASTM A36, unless noted otherwise on the Drawings.
3. Welding of inserts, anchors and other steel pieces used in conjunction with structural concrete shall conform to AWS D1.4.
4. Welding of reinforcing steel used in conjunction with structural concrete shall conform to AWS D1.4.
5. Headed stud anchors shall conform to ASTM A108, minimum tensile strength 60,000 PSI.
6. Concrete expansion anchors shall be wedge-type anchors, meeting the requirements of FS FF-S-325, Group 11, Type 4, Class 1, plated in accordance with FS QQ-Z-325C, Type 11, Class 3. Size and location shall be as indicated on the Drawings. Products shall be by Hilti Corp., Powers Fasteners, Inc. or Architect/Engineer approved equal.

Q. Miscellaneous Materials and Accessories:

1. Form ties: Adjustable length and type which will not leave holes larger than 1 inch in diameter in face of concrete. Ties shall be such that when forms are removed, no metal will be within 1 inch of the finished concrete surface. The holes must be patched.
2. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages, Fasteners: Sized as required, of sufficient strength and character to maintain formwork in place while placing concrete.
3. Form Release Agent: Colorless mineral oil which will not stain concrete, or absorb moisture.
4. Chairs and Spacers: Heavy-duty plastic-type sized to support all reinforcing steel to proper height. Use type with sand cushion pads where concrete is on grade. Provide chairs and spacers Series "B" by W.H.C. Products, Inc., E-Z Chair by Aztec Concrete Accessories, Inc., GTI Bar Chair by General Technologies, Inc., or Architect/Engineer approved equal.
5. Waterstops:
 - a. Ribbed flat 3/16 inch by six (6) inch with 1/8 inch ribs, rated for 75 foot of head pressure. Provide factory made corner fittings weld

- splices with thermostatically controlled heating iron. Style No. 782 by Greenstreak, Inc., or Architect/Engineer approved equal.
- b. Contractor's Material Option: Specially formulated preformed joint sealant that provides a lasting, watertight bond to both fresh and cured concrete surfaces. Synko-Flex Preformed Plastic Adhesive Waterstop and Synko-Flex Primer manufactured by Synko-Flex Products, Division of Henry Company, Houston, Texas; (713) 671-9502 or Architect/Engineer approved equal.
6. Carton Void Forms: If shown or required, shall be wax impregnated cardboard trapezoidal shape, with 1/8 inch thick tempered hardboard for top plane when requested by Architect/Engineer.
7. Corners: Chamfer, wood strip type; one (1) inch x one (1) inch size; maximum possible lengths.
8. Dovetail Anchor Slot: Galvanized steel, 22 gauge thick, foam filled, release tape sealed slots, anchors for securing to concrete formwork.
9. Flashing Reglets: Galvanized steel, 22 gauge thick, longest possible lengths, with alignment splines for joints, foam filled, release tape sealed slots, anchors for securing to concrete formwork.
10. Bonding Agent: Acrylic latex emulsion type as recommended for bonding new concrete to old concrete.
11. Integral Color Pigment (If shown or required): Mineral oxide, lightfast, lime-proof, water-resistant type conforming to ASTM C979. Color(s) shall be as selected by Architect/Engineer from manufacturer's standard color line. Provide one (1) of the following or Architect/Engineer approved equal:
- a. ChemSystems, Inc.
 - b. Davis Colors
 - c. New Riverside Ochre Co., Inc.
 - d. L.M. Scofield Company
12. Color Stain (If shown or required): A chemically reactive stain, designed for adding variegated color to new or old concrete. Color(s) shall be as selected by Architect/Engineer from manufacturer's standard color line. Provide Lithochrome Chemstain by L.M. Scofield Company or Architect/Engineer approved equal.
13. Joint Sealants: Refer to Section 07 90 00, Building Sealants

2.03 CONCRETE MIXES

- A. Strength: Concrete is classified and specified by ultimate compressive strength (f_c) at the age of 28 days. Unless indicated otherwise on the Drawings, strengths shall be as follows:
- 1. All concrete including grade beams, footings, slabs, and pads: 5 sack/3,000 psi/28 days.

2. Strength recommendations on Structural Drawings supersede when they are greater than specified here.
- B. Interior slabs subjected to vehicular traffic: This concrete shall have a maximum W/cm of 0.48 and maximum air content of 3 percent. No air-entraining admixture shall be added to this mix.
- C. Concrete permanently exposed to freezing and thawing shall contain an air-entraining admixture to produce 4.5 percent - 7.5 percent of air by volume of concrete.
- D. Proportions: Proportions of cement, aggregate, admixture and water to attain required plasticity and compressive strength shall be in accordance with ACI 318, Section 5.3, Proportioning on the basis of field experience and/or trial mixtures. Do not make changes in proportions without submitting proposed changes to Inspection and Testing Laboratory for evaluation.
 1. Trial mixtures having proportions and consistencies suitable for the work shall be made based on ACI 211. 1, using at least three (3) different water-cement ratios which will produce a range of strengths encompassing those required for this project.
 2. Trial mixes shall be designed to produce a slump within 3/4 inch of the maximum permitted, and for air-entrained concrete, within 0.5 percent of maximum allowable air content. The temperature of concrete used in trial batches shall not exceed the maximum temperature specified.
 3. For each water-cement ratio, at least three confirmation compression test cylinders for each test age shall be made and cured in accordance with ASTM C192. Confirmation cylinders shall be tested at seven (7) and twenty-eight (28) days in accordance with ASTM C39.
 4. From the results of the twenty-eight (28) day confirmation tests, a curve shall be plotted showing the relationship between the water-cement ratio and compressive strengths. From this curve, the water-cement ratio to be used in the concrete shall be selected to produce the average strength required.
 5. The cement content and mixture proportions to be used shall be such that this water-cement ratio is not exceeded when slump is the maximum permitted. Control in the field shall be based upon maintenance of proper cement, water content, slump and air content.
 6. Mix designs furnished by the concrete supplier, shall be based on the standard deviation analysis of previous test records meeting the requirements of Section 5.3.1 - Standard deviation of ACI 318. These mixes will be accepted in lieu of trial mixtures described in paragraphs above.
 - a. Temperature of concrete in test data shall be within 5 degrees F of maximum temperature specified for this project.

- b. Strengths indicated in test data shall be in accordance with ACI 318, Section 5.3.
- c. The specified strength of concrete used in supporting test data shall vary no more than 500 PSI plus or minus from that specified for this project.
- d. The Testing Laboratory shall keep strength and standard deviation record of all concrete for the duration of the project as specified in this section.

3.00 EXECUTION

3.01 GENERAL

- A. Inserts: Give the various trades and subcontractors ample notification and opportunity to furnish all anchors, nailers, pipes, conduits, boxes, inserts, thimbles, sleeves, frame vents, wires, supports, or other items required to be built into the concrete by the provisions of the Drawings or of the Specification governing the work of such trades and subcontractors, or as it may be necessary for the proper execution of their work. Obtain suitable templates or instructions for the installation of such items which are required to be placed in the forms.
- B. Install under-slab vapor retarder as instructed by manufacturer in accordance with ASTM E1643. Penetrations shall be sealed to maintain integrity of barrier. Tape around all openings and seal all penetrations as instructed by the barrier manufacturer. Grade stakes shall not be driven through the vapor barrier. Avoid punctures during reinforcement and concrete placement.
- C. Slump:
 - 1. Concrete not containing a high range water reducing admixture shall not be placed when its plasticity, as measured by slump test, is outside the following limits:
 - a. Footings: 5 inches maximum, 4 inches minimum.
 - b. All other Structural Concrete: 5 inches maximum, 4 inches minimum.
 - c. Slump drop not to exceed 2 inches when pumped.
 - 2. Concrete containing a high range water reducing admixture shall not be placed when its plasticity, as measured by slump test, is outside the following limits:
 - a. Prior to addition high range water reducer: 3 inches maximum, 2 inches minimum.
 - b. After addition of high range water reducer: 9 inches maximum.

- D. Classes of Concrete and Usage: Concrete of the several classes of concrete required shall have the characteristics shown on the Drawings.
- E. Mixing:
1. Transit-mixed concrete conforming to the requirements of ASTM C94 and ACI 304 shall be used in lieu of concrete mixed at the job site. Concrete shall not be transported or used in any case after a period in excess of 90 minutes has elapsed after the introduction of water into the mixer.
 2. Indiscriminate addition of water to increase slump of concrete is prohibited. Add water only at the direction of the Testing Laboratory. No water shall be added which increases the water cement ratio of the concrete in excess of the water cement ratio indicated on the approved mix design. At the direction of the Inspection and Testing Laboratory the addition of a high range water reducing admixture may be used to retemper concrete.
 3. The agency supplying transit-mixed concrete shall have a plant of sufficient capacity and adequate transportation facilities, to assure continuous delivery at the rate required. The frequency of deliveries to the site of the work must be such as to provide for placing the concrete continuously throughout any one (1) pour.
- F. Conveying Concrete: Convey concrete from the mixer to the place of final deposit by methods which will prevent the separation or loss of the ingredients. Concrete to be conveyed by pumping shall be submitted to the Inspection and Testing Laboratory for evaluation for each class of concrete specified before being used. Test cylinders for pumped concrete shall be taken at the discharge end of the pumping equipment.
- G. Equipment for chuting, pumping, and pneumatically conveying concrete shall be of such size and design as to assure a practically continuous flow of concrete at the delivery end without separation of the materials. The use of gravity-flow or aluminum chutes or conveyors for transporting concrete horizontally will not be permitted.
- H. Miscellaneous Materials and Accessories: if not specifically noted, install all materials and accessories per manufacturer's instructions as if noted here in full.
- I. Extend underslab vapor barrier continuously under entire slab, slab turn downs, vertical face of grade beams and footings to completely protect concrete adjacent to earth. Overlap joints and install seam tape and pipe boots, and seal penetrations as instructed by manufacturer.
- J. Bars shall be supported on chairs or spacers on metal hangers, accurately placed and securely fastened to steel reinforcement in place. No wood or clay brick will be permitted inside forms.

- K. All reinforcing shall be set in place, spaced, and rigidly and securely tied or wired at all splices and at all crossing points and intersections.
- L. Minimum center to center distance between parallel bars shall be in accordance with the details on the drawings. Where not shown, the clear spacing shall be 1-1/2 times the bar diameter but never less than 1-1/2 inches.
- M. Lap of splices where shown and noted on the drawings shall be a minimum of 32 bar diameters but never less than 12 inches.
- N. Except where shown on the drawings, minimum concrete coverage for reinforcing steel shall be:
 - 1) 3 inches...where concrete is placed against earth
 - 2) 1-1/2 inches...over column ties
 - 3) 1-1/2 inches...for #5 and smaller bars in formed walls
 - 4) 2 inches...for all bars larger than #5 in formed walls
 - 5) 1 inch...for #11 and smaller bars in suspended slabs
 - 6) 1-1/2 inches...for all bars larger than #11 in suspended slabs

3.02 CONCRETE CONTROL AND TESTING

- A. Inspection and Testing Laboratory Services.
- B. Except as noted below, all inspection and testing related to concrete placement, including reinforcing and embedded items, shall be the responsibility of the Owner. The Owner will directly engage the services of a qualified Testing and Inspection Laboratory, however, the Contractor shall provide access to the Owner's consultant, and, if required, the Contractor shall provide patching and repairing of surfaces removed to facilitate testing and inspection.
- C. Should the strength of concrete fall below the minimum, then additional tests, including load tests, may be required. These tests, if required, shall be made at the Contractor's expense and shall be in accordance with ASTM C42 and ACI 318. If tests do not meet the applicable requirements, then the structure, or any part of the structure, shall be removed and replaced at the Contractor's expense.
- D. Any concrete testing requested by the Contractor for early formwork or shoring removal, etc., shall be at the Contractor's expense.
- E. Do not permit placement of concrete having a measured slump outside limits given on Drawings or Specifications, except when approved by Architect/Engineer.

3.03 PLACING CONCRETE

- A. Place concrete in reasonably uniform layers, approximately horizontal, and not more than 18 inches deep, exercising care to avoid vertical joints or inclined planes. The piling up of concrete in the forms in such

- a manner as to cause the separation or loss of any of its ingredients will not be permitted. Concrete which has partially set or hardened shall not, under any circumstances, be deposited in the work. All slabs shall be placed for full thickness in one operation without change in proportions, screeded to proper elevation, and floated. Dusting of surfaces with cement is prohibited.
- B. Place concrete in the forms as nearly in its final position as is practical to avoid re-handling. Exercise special care to prevent splashing the forms or reinforcement with concrete. Remove any hardened or partially hardened concrete which has accumulated on the forms or reinforcement before the work proceeds. Do not place concrete on previously deposited concrete which has hardened sufficiently to cause the formation of seams or planes of weakness within the respective member of section, except as hereinafter specified.
 - C. Do not permit concrete to drop freely any distance greater than five (5) feet. Where longer drops are necessary, use a chute, tremie, or other acceptable conveyance to assist the concrete into place without separation. Do not pour directly into any excavations where water is standing.
 - D. Vibration: As soon as concrete is deposited, thoroughly agitate same by means of mechanical vibrators and suitable hand tools, so manipulated as to work the mixture well into all parts and corners of the forms, and entirely around the reinforcement and inserts. Mechanical vibrators shall maintain frequencies in accordance with the recommendations of ACI 309, Table 5.1.4, and shall be operated by competent workmen. Over vibrating and use of vibrators to transport concrete within forms shall not be allowed. A spare vibrator shall be kept on the job site during all concrete placing operations.
 - E. Bonding: Before depositing any new concrete on or against previously deposited concrete which has partially or entirely set, the surface of the latter shall be thoroughly roughened and cleaned of all foreign matter, scum and laitance. The specified or an Architect/Engineer approved bonding agent or epoxy adhesive shall be used.
 - F. Construction Joints: Except as otherwise specifically indicated on the Drawings, each concrete member shall be considered as a single unit of operation, and all concrete for the same shall be placed continuously in order that such unit will be monolithic in construction. Should construction joints prove to be absolutely unavoidable, same shall be located at or near the midpoints of spans. Additional construction joints shall not be made under any circumstances without prior review by the Architect/Engineer.
 - G. Protect all freshly placed concrete from washing by rain, flowing water, etc. Do not allow the concrete to dry out from the time it is deposited in the forms until the expiration of the curing period.

- H. Imperfect or damaged work or any material damaged or determined to be defective before final completion and acceptance of the entire job, shall be satisfactorily replaced at the Contractor's expense and shall be in conformity with all of the requirements of the Contract Documents. Removal and replacement of concrete work shall be done in such a manner as not to impair the appearance or strength of the structure in any way.
- I. Cleaning: Upon completion of the work, all forms, equipment, protective coverings and any rubbish resulting therefrom shall be removed from the premises. Finished concrete surfaces shall be left in clean and perfect condition, satisfactory to the Owner. Sweep with an ordinary broom and remove all mortar, concrete droppings, loose dirt, mud, etc.

3.04 FLOOR AND SLAB FINISHES

- A. Scratch Finish: Apply scratch finish to monolithic slab surfaces that are to receive concrete floor topping or mortar setting beds for tile, Portland cement terrazzo, and other bonded applied cementitious finish flooring material, and as otherwise indicated.
 - 1. After placing slabs, surface shall be leveled to an F_F 15 - F_L 13 tolerance. Slope surfaces uniformly to drains where required. After leveling, roughen surface before final set, with stiff brushes, brooms or rakes.
- B. Float Finish: Apply float finish to monolithic slab surfaces to receive trowel finish and other finishes as hereinafter specified, and slab surfaces which are to be covered with membrane or elastic waterproofing, or sand-bed terrazzo, and as otherwise indicated.
 - 1. After screening, consolidating, and leveling concrete slabs, do not work surface until ready for floating. Begin floating when surface water has disappeared or when concrete has stiffened sufficiently to permit operation of power-driven floats, or both. Consolidate surface with power-driven floats, or by hand-floating if area is small or inaccessible to power units. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat surface to a uniform, smooth, granular texture. Surface shall achieve an F_F 20 - F_L 17 tolerance.
- C. Trowel Finish: Apply 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 other thin film finish coating system.
 - 1. After floating, begin first trowel finish operation using a power-driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over surface. Consolidate concrete surface by

final troweling operation, free of trowel marks, uniform in texture and appearance and to a F_{35}/F_{L30} tolerance (F_{L17} for elevated slabs). Grind smooth surface defects, which would telegraph through applied floor covering system.

- D. Non-Slip Broom Finish: Apply non-slip broom finish to exterior concrete platforms, steps and ramps, and elsewhere as indicated.
 - 1. Immediately after float finishing, slightly roughen concrete surface by brooming with fiber bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect/Engineer before application. A sample panel is required.
- E. Liquid Densifier/Sealer: Apply liquid densifier/sealer on exposed interior floors subject to vehicular abrasion and as indicated on the Drawings. Compound shall be mechanically scrubbed into the surface in strict accordance with the directions of the manufacturer and just prior to completion of construction.

3.05 NON-SHRINK GROUT

- A. Refer to Structural Drawings for column base plates and other structural grouting requirements.
- B. Non-shrink grout shall be mixed only in such quantities as are needed for immediate use. No retempering shall be permitted and materials which have been mixed for a period exceeding 30 minutes shall in no case be used upon any portion of the work.
- C. Where high fluidity and/or increased placing time is required use the specified high flow grout. This grout shall be used for all base plates larger than ten (10) square feet.
- D. For every $1/3$ cubic yards of grout placed, grout strength shall be tested with a set of cubes as follows:
 - 1. A set of cubes shall consist of three cubes to be tested seven (7) days, and three (3) cubes to be tested at twenty-eight (28) days.
 - 2. Test cubes shall be made and tested in accordance with ASTM C1107, Section 12.5, with the exception that the grout should be restrained from expansion by a top plate.

3.06 CURING AND PROTECTION

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. All concrete shall be kept continuously moist and above 50 degrees F for seven days. When high early strength concrete is used this temperature requirement may be lowered to three (3) days.

- B. Curing Methods: Perform curing of concrete by curing and sealing compound, by moist curing, by moisture-retaining cover curing, and by combinations thereof, as herein specified.
 - 1. Provide specified curing compound to exposed interior slabs. This curing compound must be dissipating or easily removed in the cleaning process prior to the application of any liquid densifier/sealer.

3.07 DEFECTIVE WORK

- A. Imperfect or damaged work, or any material damaged or determined to be defective before final completion and acceptance of the entire job, shall be satisfactorily replaced at the Contractor's expense and shall be in conformity with all of the requirements of the Contract Documents. Removal and replacement of concrete work shall be done in such a manner as not to impair the appearance or strength of the structure in any way.

3.08 CLEANING

- A. Upon completion of the work, all forms, equipment, protective coverings and any rubbish resulting there from, shall be removed from the premises. Finished concrete surfaces shall be left in clean and perfect condition, satisfactory to the Owner. Sweep with an ordinary broom and remove all mortar, concrete droppings, loose dirt, mud, etc.

3.09 REPAIR OF DEFECTIVE AREAS

- A. With prior approval of the Architect/Engineer, as to method and procedure, all repairs of defective areas shall conform to ACI 301, Section 5.3.7, using the polymer repair mortars and/or epoxy adhesives furnished by The Euclid Chemical Company, Sika Chemical Corp., or Architect/Engineer approved equal.

3.10 FIELD QUALITY CONTROL AND TESTING

- A. An Independent Testing Agency will perform Inspection and Testing.

END OF SECTION

SECTION 033900 – CONCRETE CURING

1.00 GENERAL

1.01 SECTION INCLUDES

- A. Initial and final curing of horizontal and vertical concrete surfaces.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast in Place Concrete

1.03 REFERENCE STANDARDS

- A. ACI 301 – Specifications for Structural Concrete for Buildings; American Concrete Institute International; 2005
- B. ACI 302.1R – Guide for Concrete Floor and Slab Construction; American Concrete Institute International; 2004 (Errata 2007)
- C. C. ACI 308R - Guide to Curing Concrete; American Concrete Institute International; 2001 (Reapproved 2008)
- D. D. ASTM C 171 – Standard Specification for Sheet Materials for Curing Concrete; 2007.
- E. E. ASTM C 309 – Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete; 2007.

1.04 SUBMITTALS

- A. See Section – Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on curing compounds and moisture-retaining sheet, including compatibility of different products and limitations.

1.05 QUALITY ASSURANCE

- A. Perform work of this section in accordance with ACI 301 and ACI 302 1 R.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver curing materials in manufacturer's sealed packaging, including application instructions.

2.00 PRODUCTS

2.01 MATERIALS

- A. Membrane Curing Compound: ASTM C 309 Type 1 – Clear or translucent, Class A
- B. Moisture-Retaining Sheet: ASTM C 171

3.00 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate surfaces are ready to be cured.

3.02 EXECUTION - HORIZONTAL SURFACES

- A. Cure floor surfaces in accordance with ACI 308 R.

3.03 EXECUTION – VERTICAL SURFACES

- A. Cure surfaces in accordance with ACI 308R.

3.04 PROTECTION

- A. Do not permit traffic over unprotected floor surface.

END OF SECTION

SECTION 05 21 00 – REINFORCING STEEL

(Referenced from 2004 TxDOT, ITEM 440 Reinforcing Steel – references made to any other Sections of the 2004 TxDOT Manual shall become part of the Contract to be followed)

440.1. Description. Furnish and place reinforcing steel of the sizes and details shown on the plans.

440.2. Materials.

A. APPROVED MILLS:

Before furnishing steel, producing mills of reinforcing steel for the Department must be pre-approved in accordance with DMS-7320, "Qualification Procedure for Reinforcing Steel Mills," by the Construction Division, which maintains a list of approved producing mills. Reinforcing steel obtained from unapproved sources will not be accepted.

B. DEFORMED BAR AND WIRE REINFORCEMENT:

Unless otherwise shown on the plans, reinforcing steel must be Grade 60, and bar reinforcement must be deformed. Reinforcing steel must conform to one of the following:

- ASTM A 615, Grades 40 or 60;
- ASTM A 996, Type A, Grades 40 or 60;
- ASTM A 996, Type R, Grade 60, permitted in concrete pavement only (Furnish ASTM A 996, Type R bars as straight bars only and do not bend them. Bend tests are not required.); or
- ASTM A 706.

The provisions of this Item take precedence over ASTM provisions.

The nominal size, area, and weight of reinforcing steel bars covered by this Item are shown in Table 1. Designate smooth bars up to No. 4 by size number and above No. 4 by diameter in inches.

Table 1
Size, Area, and Weight of Reinforcing Steel Bars

Bar Size Number (in.)	Bar Size Number (mm)	Diameter (in.)	Area (Sq. in.)	Weight per Ft.
3	10	0.375	0.11	0.376
4	13	0.500	0.20	0.668
5	16	0.625	0.31	1.043
6	19	0.750	0.44	1.502
7	22	0.875	0.60	2.044
8	25	1.000	0.79	2.670
9	29	1.128	1.00	3.400
10	32	1.270	1.27	4.303
11	36	1.410	1.56	5.313
14	43	1.693	2.25	7.650
18	57	2.257	4.00	13.60

Note: Bar size numbers (in.) are based on the number of eighths of an inch included in the nominal diameter of the bar. Bar size numbers (mm) approximate the number of millimeters included in the nominal diameter of the bar.

C. SMOOTH BAR AND SPIRAL REINFORCEMENT:

Smooth bars and dowels for concrete pavement must have minimum yield strength of 60 ksi and 644 meet ASTM A 615. For smooth bars that are larger than No. 3, provide steel conforming to ASTM A 615 or meet the physical requirements of ASTM A 36.

Spiral reinforcement may be smooth or deformed bars or wire of the minimum size or gauge shown on the plans. Bars for spiral reinforcement must comply with ASTM A 615, Grade 40; ASTM A 996, Type A, Grade 40; or ASTM A 675, Grade 80, meeting dimensional requirements of ASTM A 615. Smooth wire must comply with ASTM A 82, and deformed wire must comply with ASTM A 496.

D. WELDABLE REINFORCING STEEL:

Reinforcing steel to be welded must comply with ASTM A 706 or have a carbon equivalent (C.E.) of at most 0.55%. A report of chemical analysis showing the percentages of elements necessary to establish C.E. is required for reinforcing steel that does not meet ASTM A 706 to be structurally welded. These requirements do not pertain to miscellaneous welds on reinforcing steel as

defined in Section 448.4.B.1.a, "Miscellaneous Welding Applications."

Calculate C.E. using the following formula:

$$C.E. = \%C + \frac{\%Mn}{6} + \frac{\%Cu}{40} + \frac{\%Ni}{20} + \frac{\%Cr}{10} - \frac{\%Mo}{50} - \frac{\%V}{10}$$

E. WELDED WIRE FABRIC:

For fabric reinforcement, use wire that conforms to ASTM A 82 or A 496. Use wire fabric that conforms to ASTM A 185 or A 497. Observe the relations shown in Table 2 among size number, diameter in inches, and area when ordering wire by size numbers, unless otherwise specified. Precede the size number for deformed wire with "D" and for smooth wire with "W."

Designate welded wire fabric as shown in the following example: 6 × 12 – W16 × W8 (indicating 6-in. longitudinal wire spacing and 12-in. transverse wire spacing with smooth No. 16 wire longitudinally and smooth No. 8 wire transversely).

Table 2
Wire Size Number, Diameter, and Area

Size Number (in.)	Size Number (mm)	Diameter (in.)	Area (sq. in.)
31	200	0.628	0.310
30	194	0.618	0.300
28	181	0.597	0.280
26	168	0.575	0.260
24	155	0.553	0.240
22	142	0.529	0.220
20	129	0.505	0.200
18	116	0.479	0.180
16	103	0.451	0.160
14	90	0.422	0.140
12	77	0.391	0.120
10	65	0.357	0.100
8	52	0.319	0.080
7	45	0.299	0.070
6	39	0.276	0.060
5.5	35	0.265	0.055
5	32	0.252	0.050
4.5	29	0.239	0.045
4	26	0.226	0.040
3.5	23	0.211	0.035
2.9	19	0.192	0.035
2.5	16	0.178	0.025
2	13	0.160	0.020
1.4	9	0.134	0.014
1.2	8	0.124	0.012
0.5	3	0.080	0.005

Note: Size numbers (in.) are the nominal cross-sectional area of the wire in hundredths of a square inch. Size numbers (mm) are the nominal cross-sectional area of the wire in square millimeters. Fractional sizes between the sizes listed above are also available and acceptable for use.

F. EPOXY COATING:

Epoxy coating will be required as shown on the plans. Before furnishing epoxy-coated reinforcing steel, an epoxy applicator must be pre-approved in accordance with DMS-7330, "Qualification Procedure for Reinforcing Steel Epoxy Coating Applicators." The Construction Division maintains a list of approved applicators.

Coat reinforcing steel in accordance with Table 3.

Table 3
Epoxy Coating Requirements for Reinforcing Steel

Material	Specification
Bar	ASTM A 775 or A 934
Wire or fabric	ASTM A 884 Class A or B
Mechanical couplers	As shown on the plans
Hardware	As shown on the plans

Use epoxy coating material and coating repair material that complies with DMS-8130, "Epoxy Powder Coating for Reinforcing Steel." Do not patch more than 1/4 in. total length in any foot at the applicator's plant.

Epoxy-coated reinforcement will be sampled and tested in accordance with Tex-739-I.

Maintain identification of all reinforcing throughout the coating and fabrication and until delivery to the project site.

Furnish 1 copy of a written certification that the coated reinforcing steel meets the requirements of this Item and 1 copy of the manufacturer's control tests.

G. MECHANICAL COUPLERS:

When mechanical splices in reinforcing steel bars are shown on the plans, use the following types of coupler:

- sleeve-filler,
- sleeve-threaded,
- sleeve-swaged, or
- sleeve-wedge.

Furnish only couplers that have been produced by a manufacturer that has been prequalified in accordance with DMS-4510, "Mechanical Couplers." Sleeve-wedge type couplers will not be permitted on coated reinforcing. Couplers for use on individual projects must be sampled and tested in accordance with DMS-4510. Furnish couplers only at locations shown on the plans.

440.3. Construction.

A. BENDING:

Cold-bend the reinforcement accurately to the shapes and dimensions shown on the plans. Fabricate in the shop if possible. Field-fabricate, if permitted, using

a method approved by the Engineer. Replace improperly fabricated, damaged, or broken bars at no additional expense to the Department. Repair damaged or broken bars embedded in a previous concrete placement using a method approved by the Engineer.

Unless otherwise shown on the plans, the inside diameter of bar bends, in terms of the nominal bar diameter (d), must be as shown in Table 4.

Table 4
Minimum Inside Diameter of Bar Bends

Bend	Bar Size Number (in.)	Bar Size Number (mm)	Diameter
Bends of 90° and greater in stirrups, ties, and other secondary bars that enclose another bar in the bend	3, 4, 5	10, 13, 16	4d
	6, 7, 8	19, 22, 25	6d
Bends in main bars and in secondary bars not covered above	3 through 8	10 through 25	6d
	9, 10, 11	29, 32, 36	8d
	14, 18	43, 57	10d

Note: Bar size numbers (in.) are based on the number of eighths of an inch included in the nominal diameter of the bar. Bar size numbers (mm) approximate the number of millimeters included in the nominal diameter of the bar.

Where bending No. 14 or No. 18 Grade 60 bars is required, bend-test representative specimens as described for smaller bars in the applicable ASTM specification. Make the required 90° bend around a pin with a diameter of 10 times the nominal diameter of the bar.

B. TOLERANCES:

Fabrication tolerances for bars are shown in Figure 1.

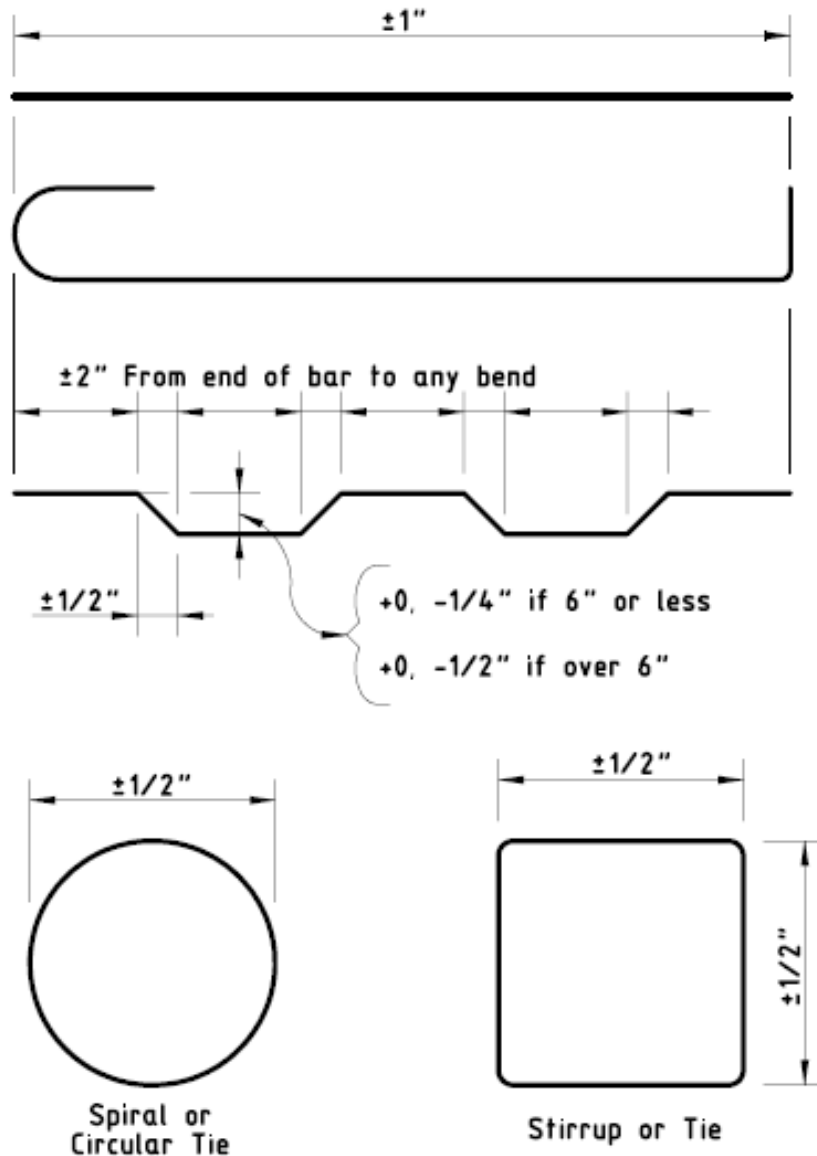


Figure 1
Fabrication tolerances for bars.

C. STORAGE:

Store steel reinforcement above the ground on platforms, skids, or other supports, and protect it from damage and deterioration. Ensure that reinforcement is free from dirt, paint, grease, oil, and other foreign materials when it is placed in the work. Use reinforcement free from defects such as cracks and delamination's. Rust, surface seams, surface irregularities, or mill scale will not be cause for rejection if the minimum cross-sectional area of a hand wire-brushed specimen meets the requirements for the size of steel

specified.

D. SPLICES:

Lap-splice, weld-splice, or mechanically splice bars as shown on the plans. Additional splices not shown on the plans will require approval. Splices not shown on the plans will be permitted in slabs 15 in. or less in thickness, columns, walls, and parapets. x Unless otherwise approved, splices will not be permitted in bars 30 ft. or less in plan length. For bars exceeding 30 ft. in plan length, the distance center-to-center of splices must be at least 30 ft. minus 1 splice length, with no more than 1 individual bar length less than 10 ft. Make lap splices not shown on the plans, but otherwise permitted, in accordance with Table 5. Maintain the specified concrete cover and spacing at splices, and place the lap-spliced bars in contact, securely tied together.

Table 5
Minimum Lap Requirements for Bar Sizes through No. 11

Bar Size Number (in.)	Bar Size Number (mm)	Uncoated Lap Length	Coated Lap Length
3	10	1 ft. 4 in.	2 ft. 0 in.
4	13	1 ft. 9 in.	2 ft. 8 in.
5	16	2 ft. 2 in.	3 ft. 3 in.
6	19	2 ft. 7 in.	3 ft. 11 in.
7	22	3 ft. 5 in.	5 ft. 2 in.
8	25	4 ft. 6 in.	6 ft. 9 in.
9	29	5 ft. 8 in.	8 ft. 6 in.
10	32	7 ft. 3 in.	10 ft. 11 in.
11	36	8 ft. 11 in.	13 ft. 5 in.

Note: Bar size numbers (in.) are based on the number of eighths of an inch included in the nominal diameter of the bar. Bar size numbers (mm) approximate the number of millimeters included in the nominal diameter of the bar.

- Do not lap No. 14 or No. 18 bars.
- Lap spiral steel at least 1 turn.
- Splice welded wire fabric using a lap length that includes the overlap of at least 2 cross wires plus 2 in. on each sheet or roll. Splices using bars that develop equivalent strength and are lapped in accordance with Table 5 are permitted.
- For box culvert extensions with less than 1 ft. of fill, lap the existing longitudinal bars with the new bars as shown in Table 3. For extensions with more than 1 ft. of fill, lap at least 1 ft. 0 in.
- Ensure that welded splices conform to the requirements of the plans and

of Item 448, "Structural Field Welding." Field-prepare ends of reinforcing bars if they will be butt-welded. Delivered bars must be long enough to permit weld preparation.

- Install mechanical coupling devices in accordance with the manufacturer's recommendations at locations shown on the plans. Protect threaded male or female connections, and make sure the threaded connections are clean when making the connection. Do not repair damaged threads.
- Mechanical coupler alternate equivalent strength arrangements, to be accomplished by substituting larger bar sizes or more bars, will be considered if approved in writing before fabrication of the systems.

E. PLACING:

Unless otherwise shown on the plans, dimensions shown for reinforcement are to the centers of the bars. Place reinforcement as near as possible to the position shown on the plans. In the plane of the steel parallel to the nearest surface of concrete, bars must not vary from plan placement by more than 1/12 of the spacing between bars. In the plane of the steel perpendicular to the nearest surface of concrete, bars must not vary from plan placement by more than 1/4 in. Cover of concrete to the nearest surface of steel must be at least 1 in. unless otherwise shown on the plans.

For bridge slabs, the clear cover tolerance for the top mat of reinforcement is .0, +1/2 in.

Locate the reinforcement accurately in the forms, and hold it firmly in place before and during concrete placement by means of bar supports that are adequate in strength and number to prevent displacement and to keep the steel at the proper distance from the forms. Support bars by standard bar supports with plastic tips, approved plastic bar supports, or precast mortar or concrete blocks when supports are in contact with removable or stay-in-place forms. Use bright basic bar supports to support reinforcing steel placed in slab overlays on concrete panels or on existing concrete slabs. Bar supports in contact with soil or subgrade must be approved.

For bar supports with plastic tips, the plastic protection must be at least 3/32 in. thick and extend upward on the wire to a point at least 1/2 in. above the formwork. All accessories such as tie wires, bar chairs, supports, or clips used with epoxy-coated reinforcement must be of steel, fully coated with epoxy or plastic. Plastic supports approved by the Engineer may also be used with epoxy-coated reinforcement.

Cast mortar or concrete blocks to uniform dimensions with adequate bearing

area. Provide a suitable tie wire in each block for anchoring to the steel. Cast the blocks to the thickness required in approved molds. The surface placed adjacent to the form must be a true plane, free of surface imperfections. Cure the blocks by covering them with wet burlap or mats for a period of 72 hr. Mortar for blocks should contain approximately 1 part hydraulic cement to 3 parts sand. Concrete for blocks should contain 850 lb. of hydraulic cement per cubic yard of concrete.

Place individual bar supports in rows at 4-ft. maximum spacing in each direction. Place continuous type bar supports at 4-ft. maximum spacing. Use continuous bar supports with permanent metal deck forms.

The exposure of the ends of longitudinal, stirrups, and spacers used to position the reinforcement in concrete pipe and in precast box culverts or storm drains is not cause for rejection.

Tie reinforcing steel for bridge slabs, top slabs of direct traffic culverts, and top slabs of pre-stressed box beams at all intersections, except tie only alternate intersections where spacing is less than 1 ft. in each direction. For reinforcing steel cages for other structural members, tie the steel at enough intersections to provide a rigid cage of steel. Fasten mats of wire fabric securely at the ends and edges.

Before concrete placement, clean mortar, mud, dirt, debris, oil, and other foreign material from the reinforcement. Do not place concrete until authorized.

If reinforcement is not adequately supported or tied to resist settlement, reinforcement is floating upward, truss bars are overturning, or movement is detected in any direction during concrete placement, stop placement until corrective measures are taken.

F. HANDLING, PLACEMENT, AND REPAIR OF EPOXY-COATED REINFORCING STEEL:

1. Handling: Provide systems for handling coated reinforcement with padded contact areas. Pad bundling bands or use suitable banding to prevent damage to the coating. Lift bundles of coated reinforcement with a strong back, spreader bar, multiple supports, or a platform bridge. Transport the bundled reinforcement carefully, and store it on protective cribbing. Do not drop or drag the coated reinforcement.
2. Construction Methods: Do not flame-cut coated reinforcement. Saw or shear-cut only when approved. Coat cut ends as specified in Section 440.3.F.3, "Repair of Coating." Do not weld or mechanically couple coated reinforcing steel except where specifically shown on the plans.

Remove the epoxy coating at least 6 in. beyond the weld limits before welding and 2 in. beyond the limits of the coupler before assembly. After welding or coupling, clean the steel of oil, grease, moisture, dirt, welding contamination (slag or acid residue), and rust to a near-white finish. Check the existing epoxy for damage. Remove any damaged or loose epoxy back to sound epoxy coating.

After cleaning, coat the splice area with epoxy repair material to a thickness of 7 to 17 mils after curing. Apply a second application of repair material to the bar and coupler interface to ensure complete sealing of the joint.

3. Repair of Coating: For repair of the coating, use material that complies with the requirements of this Item and ASTM D 3963. Make repairs in accordance with procedures recommended by the manufacturer of the epoxy coating powder. For areas to be patched, apply at least the same coating thickness as required for the original coating. Repair all visible damage to the coating. Repair sawed and sheared ends, cuts, breaks, and other damage promptly before additional oxidation occurs. Clean areas to be repaired to ensure that they are free from surface contaminants. Make repairs in the shop or in the field as required.

00440.4. MEASUREMENT AND PAYMENT

- A. When listed as a separate contract pay item, shall be measured in accordance with "Measurement and Basis of Payment" section or as shown on the Bid Proposal Form.
- B. When not listed as a separate contract pay item, shall be considered as incidental work, and the cost thereof shall be included in such contract pay item(s) as are provided in the proposal contract.
- C. Compensation, whether by contract pay item or incidental work will be for furnishing all materials, labor, equipment, tools and incidentals required for the work, all in accordance with the plans and these specifications.

END OF SECTION

SECTION 311010 – SITE CLEARING, GRADING, AND FILLING

PART 1 – GENERAL

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. This Section includes the following:
 - 1. Protecting existing trees and grass to remain.
 - 2. Removing existing trees, shrubs, groundcovers, plants, and grass.
 - 3. Clearing and grubbing.
 - 4. Stripping and stockpiling topsoil.
 - 5. Removing above- and below-grade site improvements.
 - 6. Disconnecting, capping or sealing, and abandoning site utilities in place.
 - 7. Temporary erosion and sedimentation control measures.
- B. Related Sections include the following:
 - 1. Division 01 Section "Sustainable Design Requirements" for additional LEED requirements.
 - 2. Division 01 Section "Temporary Tree and Plant Protection" for protecting trees remaining on-site that are affected by site operations.
 - 3. Division 02 Section "Structure Demolition" for demolition of buildings, structures, and site improvements.
 - 4. Division 31 Section "Earth Moving" for soil materials, excavating, backfilling, and site grading.
 - 5. Division 23 Section "Turf, Grasses and Plants" for finish grading including preparing and placing planting soil mixes and testing of topsoil material.

1.3 DEFINITIONS

- A. Topsoil: Natural or cultivated surface-soil layer containing organic matter and sand, silt, and clay particles; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 2 inches (50 mm) in diameter; and free of subsoil and weeds, roots, toxic materials, or other non-soil materials.

- B. Tree Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and defined by the drip line of individual trees or the perimeter drip line of groups of trees, unless otherwise indicated.

1.4 MATERIAL OWNERSHIP

- A. Except for stripped topsoil or other materials indicated to remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.5 SUBMITTALS

- A. Photographs or videotape, sufficiently detailed, of existing conditions of trees and plantings, adjoining construction, and site improvements that might be misconstrued as damage caused by site clearing.
- B. Record drawings, according to Division 01 Section "Project Record Documents," identifying and accurately locating capped utilities and other subsurface structural, electrical, and mechanical conditions.

1.6 QUALITY ASSURANCE

- A. Pre-Installation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.7 PROJECT CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
 - 2. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
- B. Improvements on Adjoining Property: Authority for performing site clearing indicated on property adjoining Owner's property will be obtained by Owner before award of Contract.
 - 1. Do not proceed with work on adjoining property until directed by Engineer.

- C. Utility Locator Service: Notify utility locator service for area where Project is located before site clearing.
- D. Do not commence site clearing operations until temporary erosion and sedimentation control measures are in place.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. Satisfactory Soil Materials: Requirements for satisfactory soil materials are specified in Division 31 Section "Earth Moving."
 - 1. Obtain approved borrow soil materials off-site when satisfactory soil materials are not available on-site.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect and maintain benchmarks and survey control points from disturbance during construction.
- B. Locate and clearly flag trees and vegetation to remain or to be relocated.
- C. Protect existing site improvements to remain from damage during construction.
 - 1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- A. Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to sediment and erosion control Drawings.
- B. Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
- C. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.3 TREE PROTECTION

- A. Erect and maintain temporary fencing around tree protection zones before starting site clearing. Remove fence when construction is complete.
 - 1. Do not store construction materials, debris, or excavated material within fenced area.
 - 2. Do not permit vehicles, equipment, or foot traffic within fenced area.
 - 3. Maintain fenced area free of weeds and trash.
- B. Do not excavate within tree protection zones, unless otherwise indicated.
- C. Where excavation for new construction is required within tree protection zones, hand clear and excavate to minimize damage to root systems. Use narrow-tine spading forks, comb soil to expose roots, and cleanly cut roots as close to excavation as possible.
 - 1. Cover exposed roots with burlap and water regularly.
 - 2. Temporarily support and protect roots from damage until they are permanently redirected and covered with soil.
 - 3. Coat cut faces of roots more than 1-1/2 inches (38 mm) in diameter with emulsified asphalt or other approved coating formulated for use on damaged plant tissues.
 - 4. Backfill with soil as soon as possible.
- D. Repair or replace trees and vegetation indicated to remain that are damaged by construction operations, in a manner approved by Landscape Architect.
 - 1. Employ an arborist, licensed in jurisdiction where Project is located, to submit details of proposed repairs and to repair damage to trees and shrubs.

3.4 UTILITIES

- A. Locate, identify, disconnect, and seal or cap off utilities indicated to be removed.
 - 1. Owner will arrange to shut off indicated utilities when requested by Contractor.
- B. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Engineer not less than two days in advance of proposed utility interruptions.
 2. Do not proceed with utility interruptions without Engineer's written permission.
- C. Excavate for and remove underground utilities indicated to be removed.

3.5 CLEARING AND GRUBBING

- A. Remove obstructions, trees, shrubs, grass, and other vegetation to permit installation of new construction.
1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
 2. Cut minor roots and branches of trees indicated to remain in a clean and careful manner where such roots and branches obstruct installation of new construction.
 3. Grind stumps and remove roots, obstructions, and debris extending to a depth of 18 inches (450 mm) below exposed subgrade.
 4. Use only hand methods for grubbing within tree protection zone.
 5. Chip removed tree branches and stockpile in areas approved by Landscape Architect.
- B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.
1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches (200 mm), and compact each layer to a density equal to adjacent original ground.

3.6 TOPSOIL STRIPPING

- A. Remove sod and grass before stripping topsoil.
- B. Strip topsoil to whatever depths are encountered in a manner to prevent intermingling with underlying subsoil or other waste materials.
1. Remove subsoil and non-soil materials from topsoil, including trash, debris, weeds, roots, and other waste materials.
- C. Stockpile topsoil materials away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust.
1. Limit height of topsoil stockpiles to 72 inches (1800 mm).
 2. Do not stockpile topsoil within tree protection zones.
 3. Stockpile surplus topsoil to allow for re-spreading deeper topsoil.

3.7 SITE IMPROVEMENTS

- A. Remove existing above- and below-grade improvements as indicated and as necessary to facilitate new construction.
- B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.
 - 1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut length of existing pavement to remain before removing existing pavement. Saw-cut faces vertically.
 - 2. Paint cut ends of steel reinforcement in concrete to remain to prevent corrosion.

3.8 DISPOSAL

- A. Disposal: Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.
 - 1. Separate recyclable materials produced during site clearing from other non-recyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities.

END OF SECTION

SECTION 311100 – SITE CLEARING AND GRUBBING

1.00 GENERAL

1.01 SECTION INCLUDES

- A. Cleaning of site, consisting of removal and satisfactory disposal of trees, stumps, brush, roots, logs, vegetation, debris, rubbish and other objectionable weather from the entire project area.
- B. Grubbing of site, consisting of complete uprooting, removal and satisfactory disposal of all stumps, brush, roots, logs, etc., to full depth, from the project areas. All roots, branches, etc., greater than or equal to 1-1/2" in diameter shall be removed from the site. Stump hole pits shall be cleared of refuse and loose earth.

2.00 PRODUCTS

Not Used

3.00 EXECUTION

3.01 CONDITIONS AT SITE:

- A. Execute all work in an orderly and careful manner with due consideration for any and all surrounding areas, planting or structures which are to remain. Periodically, water as required to allay dust and dirt. Protect any adjacent property and improvements from damage and replace any portions damaged through this operation.
- B. Coordinate and comply with the following:
 - 1. [Geotechnical Report.]
 - 2. Local ordinances and requirements of authorities having jurisdiction.
- C. The Contractor shall take proper precautions to protect adjacent or adjoining property from damage caused by clearing and grubbing activities. All damage shall be repaired or replaced at Contractor's expense.

3.02 DISPOSAL OF MATERIAL:

- A. Unless otherwise specified, cleared and grubbed material becomes the

property of the Contractor to be removed off-site. On site burning of combustible is not acceptable unless permission from Owner, City, and County is granted. The Contractor shall be responsible for obtaining all permits required by State and local governing agencies. The Contractor shall provide adequate fire protection to adjacent property. The Contractor will be held responsible for fire damage to adjacent trees and property. Upon completion of the burning process, the ashes are to be removed and disposed of off-site. The burn pit or pits shall be cleared of all debris and backfilled. The laboratory shall verify the removal of debris, preparation of the pit for backfill and backfill operation. The laboratory shall provide the Engineer with a report verifying the preparation and backfill of the pit. The Contractor shall furnish to the Engineer a location survey of the burn pit or pits. This location survey shall be performed and certified by a Registered Professional Land Surveyor.

3.03 FINAL SITE PREPARATION

- A. Remove from the site all rubbish, debris, etc., resulting from Work of this Section, except as otherwise specified above.
- B. After clearing, grubbing and disking the project site, rake and pick the entire site to remove all material as outlined in Section 1.1, B above.

END OF SECTION

SECTION 312216 – FINE GRADING

1.00 GENERAL

1.01 SECTION INCLUDES

- A. Excavate to line, grade and configuration as shown in the plans and specifications for proposed and future pavement areas.
- B. Fill to line, grade and configuration as shown in the plans and specifications for proposed and future pavement areas.
- C. Compacting fill materials in an acceptable manner as stated herein.

1.02 RELATED SECTIONS

- A. Section 31 23 10 – Site Clearing, Grading and Filling
- B. Section 32 16 00 – Curbs and Gutters
- C. Geotechnical Report (if available) for Boring Locations and Findings of Subsurface Materials and Conditions.
- D. Construction Drawings

1.03 REFERENCE STANDARDS

- A. AMERICAN Society for Testing and Materials (ASTM) latest edition.
 - D 422 Method for Particle Size Analysis of Soils
 - D 698 Test for Moisture-Density Relations of Soils Using 5.5 lb (2.5 kg) Rammer and 12-inch (304.8 mm) Drop (Standard Proctor)
 - D 1556 Test for Density of soil in place by the Sand Cone Method.
 - D 1557 Test for Moisture-Density Relations of Soils using 10-lb (4.5 kg) Rammer and 18-inch (457 mm) Drop (Modified Proctor).
 - D 1559 Test Method for Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus.
 - D 2167 Test for Density of Soil in place by the Rubber Balloon Method.
 - D 2216 Laboratory Determination of Moisture content of Soil.
 - D 2487 Classification of Soils for Engineering Purposes.
 - D 2922 Tests for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
 - D 3017 Test for Moisture Content of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

- D 4318 Test for Plastic Limit, Liquid, Limit, and Plasticity Index of Soils.
- C 25 Chemical Analysis of Limestone, Quicklime and Hydrated Lime.
- C 110 Physical Testing for Quicklime and Hydrated Lime, Wet Sieve Method.
- C 618 Specification for Fly Ash and Raw or Calcined Natural Pozzolan for use as a Mineral Admixture in Portland Cement Concrete.
- C 997 Quicklime and Hydrated Lime for Soil Stabilization

B. American Association of State Highway and Transportation Officials (AASHTO) latest edition T 88 Mechanical Analysis of Soils.

1.04 QUALITY ASSURANCE

A. Independent Testing Laboratory paid by Contractor, shall be retained to perform construction on filling operation and subgrade analysis as specified in Section 31 23 10 and as stated herein.

1.5 SUBMITTALS

- A. Shop Drawings or details pertaining to excavating and filling for Pavement are not required unless otherwise shown on the drawing or Specifications or if contrary procedures to the project document are proposed.
- B. Submit a sample of each type of off-site fill materials that is to be used in backfilling in tan air-tight, 10 lb container for testing laboratory or submit a gradation and certification of the aggregate material that is to be used to the testing laboratory for review.

2.00 PRODUCTS

2.01 PRODUCTS

- A. Fill material from on-site as specified in Section 31 23 10 and approved by the Owner or Owner's Representative.
- B. Acceptable stabilization fabrics and geogrids:
 1. Mirafi 500X or 600X
 2. Phillips 66 Supac 6WS
 3. Dupont Typar 3401 and 3601
 4. Trevira S1114 and S1120

5. Tensar SS-1 and SS-2
6. Exxon GTF-200 or 350

3.00 EXECUTION

3.01 PREPARATION

- A. Identify all lines, elevations and grades necessary to construct pavements, curb and gutter, bases, walkways and roadways as shown in the plans and specifications.
- B. Carefully protect benchmarks, property corners, monuments or other reference points.
- C. Locate and identify all site utilities that have previously been installed and may be in danger of damage by grading operations.
- D. Locate and identify all existing utilities that are to remain and protect them from damage.

3.02 EXCAVATION

- A. Excavate roadway and pavement areas to line and grade as shown in the plans and specifications.
- B. Engage all suitable material into the project fill areas as specified in Section 31.23.10.
- C. Unsuitable excavated material is to be disposed of in manner and location that is acceptable to the owner and local governing agencies.
- D. Perform excavation using capable, well maintained equipment and methods acceptable to the owner and the project document requirements.

3.03 FILLING AND SUBGRADE PREPARATION

- A. Areas exposed by excavation or stripping and on which subgrade preparations for paving are to be performed, including future pavement areas, shall be scarified to minimum depth of 8" and compacted to minimum of 95% of optimum density, in accordance with ASTM D698 (or 92% of optimum density, in accordance with ASTM

D1557), at a moisture content of not less than 1% below and not more than 3% above the optimum moisture content. These areas shall then be proof rolled to detect any areas of insufficient compaction. Proof rolling shall be accomplished by making a minimum of two (2) complete passes with a fully-loaded tandem-axle dump truck, or approved equivalent, in each of the two perpendicular directions under the supervision and direction of a field Geotechnical Engineer. Areas of failure shall be excavated and re-compacted as stated above.

- B. Fill materials used in preparation of subgrade shall be placed in lifts or layers not to exceed 8" loose measure and compacted to a minimum density of 95% of optimum density, in accordance with ASTM D698, (or 92% of the optimum density, in accordance with ASTM D1557) at a moisture content of not less than 1% below and not more than 3% above the optimum moisture content.
- C. The following table stipulates maximum allowable values for plasticity index (PI) and liquid limit (LL) of suitable fill materials to be used in the specified areas, unless specifically stated otherwise on the drawings.

	<u>PI</u>	<u>LL</u>
*Paving Area, below upper two feet	20	50
*Paving Area, upper two feet	15	40
(*References to depth are to proposed subgrade elevations.)		

- D. Material imported from off-site shall have a CBR (California Bearing Ratio) or LBR (Limerock Bearing Ratio) value equal to or above the pavement design subgrade CBR or LBR value indicated on the drawings.

3.04 COMPACTION

- A. Maintain optimum moisture content of fill materials to attain required compaction density.
- B. All materials shall be tested as specified.
- C. An independent testing laboratory selected and paid by the Owner, shall be retained to perform testing on-site.
- D. Compaction test will be as specified together with the following for paving areas:

1. In cut areas not less than one compaction tests for every 10,000 square feet.
 2. In fill areas, same rate of testing for each 8" lift (measured loose).
- E. If compaction requirements are not complied with at any time during construction process, remove and re-compact deficient areas until proper compaction is obtained at no additional expense to Owner.

3.05 MAINTENANCE OF SUBGRADE

- A. Finished subgrades shall be verified to ensure proper elevation and conditions for construction above subgrade.
- B. Protect subgrade from excessive wheel loading during construction including concrete trucks and dump trucks.
- C. Remove areas of finished subgrade found to have insufficient compaction density to depth necessary and replace in a manner that will comply with compaction requirements by use of material equal to or better than best subgrade material on-site. Surface of subgrade after compaction shall be hard, uniform, smooth, stable, and true to grade and cross-section.

3.06 FINISH GRADING

- A. Finish grading shall be as specified and as more specifically stated herein.
- B. Grading of paving areas shall be checked by string line from grade stakes (blue tops) set at not more than 50' centers. Tolerances of 0.10 feet, more or less, will be permitted. Contractor to provide engineering and field staking necessary for verification of lines, grades, and elevations. Contractor to acquire, and not cost to the Owner, the services of a Professional Engineer or Registered Land Surveyor to provide field staking and verify finished grade elevations.

END OF SECTION

SECTION 312300 – EXCAVATION AND FILL

1.00 GENERAL

1.01 SECTION INCLUDES

- A. Protection, modification and/or installation of utilities as site work progresses, paying particular attention to grade changes and any necessary staging of work.
- B. Cutting, filling and grading to required lines, dimensions, contours and proposed elevations for proposed improvements.
- C. Scarifying, compaction, drying and removal of unsuitable material to ensure proper preparation of areas for fills or proposed improvements.

1.02 RELATED SECTIONS

- A. Section 31 10 10 – Site Clearing, Grading and Filling
- B. Geotechnical Report (if applicable) for boring locations and finding of surface materials and conditions.
- C. Construction Drawings
- D. Architectural Plans and Specifications as they relate specifically to the earthwork beneath the buildings, where the architectural requirements are more stringent than the civil requirements.

1.03 REFERENCE STANDARDS

- A. AMERICAN Society for Testing and Materials (ASTM) latest edition.
 - D 422 Method for Particle Size Analysis of Soils
 - D 698 Test for Moisture-Density Relations of Soils Using 5.5 lb (2.5 kg) Rammer and 12-inch (304.8 mm) Drop (Standard Proctor)
 - D 1556 Test for Density of soil in place by the Sand Cone Method.
 - D 1557 Test for Moisture-Density Relations of Soils using 10-lb (4.5 kg) Rammer and 18-inch (457 mm) Drop (Modified Proctor).
 - D 1559 Test Method for Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus.
 - D 2167 Test for Density of Soil in place by the Rubber Balloon Method.
 - D 2216 Laboratory Determination of Moisture content of Soil.
 - D 2487 Classification of Soils for Engineering Purposes.

- D 2922 Tests for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
- D 3017 Test for Moisture Content of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
- D 4318 Test for Plastic Limit, Liquid Limit, and Plasticity Index of Soils.
- C 25 Chemical Analysis of Limestone, Quicklime and Hydrated Lime.
- C 110 Physical Testing for Quicklime and Hydrated Lime, Wet Sieve Method.
- C 618 Specification for Fly Ash and Raw or Calcined Natural Pozzolan for use as a Mineral Admixture in Portland Cement Concrete.
- C 997 Quicklime and Hydrated Lime for Soil Stabilization

B. American Association of State Highway and Transportation Officials (AASHTO) latest edition T 88 Mechanical Analysis of Soils.

1.04 QUALITY ASSURANCE

- A. Independent Testing Laboratory paid by Contractor, shall be retained to perform construction testing on site based on the following:
 - 1. Building Subgrade Areas, including 10'-0" Outside Exterior Building Lines: In cut areas, not less than one compaction test for every 2,500 square feet. Infill areas, same rate of testing for each 8" lift (measured loose).
 - 2. Areas of Construction exclusive of building subgrade: In cut areas, not less than one compaction test for every 10,000 square feet. If fill areas, same rate of testing for each 8" lift (measured loose).
- B. If Compaction requirements are not complied with at any time during the construction process, remove and re-compact any deficient areas until proper compaction is obtained at no additional expense to Owner.
- C. In all areas to receive pavement, a CBR (or LBR) test shall be performed for each type of material imported from off-site.
- D. The following tests shall be performed on each type of on-site or imported soil material used as compacted fill as part of construction testing requirements.
 - 1. Moisture and Density Relationship: ASTM D 698 or ASTM D1557
 - 2. Mechanical Analysis: AASHTO T-88
 - 3. Plasticity Index: ASTM D 4318

- E. Field density tests for in-place materials shall be performed according to one of the following standards as part of construction testing requirements.
 - 1. Sand-Cone Method: ASTM D 1556
 - 2. Balloon Method: ASTM D 2167
 - 3. Nuclear Method: ASTM D 2922(Method B-Direct Transmission)
- F. Independent Testing Laboratory shall prepare test reports that indicate test location, elevation data, and test results. Owner, Engineer, and Contractor shall be provided with copies of reports within 96 hours of time test was performed. In event that any test performed fails to meet these specifications, Owner and Contractor shall be notified immediately by Independent Testing Laboratory.
- G. All costs related to retesting due to failures shall be paid for by the Contractor at no additional expense to Owner. Owner reserves the right to employ an independent Testing Laboratory and to direct any retesting that is deemed necessary. Contractor shall provide free access to site for testing activities.

1.05 SUBMITTALS

- A. Submit a sample of each type of off-site fill materials that is to be used at the site in an air tight, 10 lb container for the testing laboratory.
- B. Submit the name of each material supplier and specific type and source of each material. Any change in source throughout the job requires approval of the owner or Engineer.
- C. For use of fabrics or geogrids, a design shall be submitted for approval by the Engineer.

2.00 PRODUCTS

2.01 MATERIALS

- A. Excavated and re-used material for subsoil fill as specified herein.
- B. Not Applicable.
- C. Imported subsoil material approved by the Owner and specified herein.

D. Not Applicable.

E. Filter/Drainage Fabrics:

1. Mirafi 140NS
2. Phillips 66 Supac 4NP
3. Dupont Typar 3341

3.00 EXECUTION

3.01 PREPARATION

- A. Identify required lines, levels, contours and datum. Locate and identify existing utilities that are to remain, and protect them from damage.
- B. Notify utility companies to remove and/or relocate any utilities that are in conflict with the proposed improvements.
- C. Protect plant life, lawns, fences, existing structures, sidewalks, paving and curbs from excavating equipment and vehicular traffic.
- D. Protect benchmarks, property corners and all other survey monuments from damage or displacement. If a marker needs to be removed it shall be referenced by a licensed land surveyor and replace, as necessary, by the same.
- E. Remove from site material encountered in grading operations that, in opinion of Owner or Owners Representative, is unsuitable of undesirable for backfilling, subgrade or foundation purposes. Dispose of in a manner satisfactory to Owner. Backfill areas with layers of suitable material and compact as specified.
- F. Prior to placing fill in low areas, such as previously existing creeks, ponds, or lakes, perform following procedures:
 1. Drain water out by gravity with ditch having flow line lower than lowest elevation in low area. If drainage cannot be performed by gravity ditch, use adequate pump to obtain same results.
 2. After drainage of low areas is complete, remove mulch, mud, debris, and other unsuitable material by using acceptable equipment and methods that will keep natural soils underlying low areas dry and undisturbed.
 3. If proposed for fill, all muck, mud, and other materials removed from above low areas shall be dried on-site by spreading in thin layers for observation by Owner or Owners Representative. Material shall be

inspected and, if found to be suitable for use as fill material, shall be incorporated into lowest elevation of site filling operation, but not under the building area or within 10'-0" of perimeter of building pad or paving subgrade. If after observation by Owner or Owners Representative, material is found to be unsuitable, all unsuitable material shall be removed from site.

3.02 EXCAVATING FOR FILLING AND GRADING

- A. Classification of Excavation: Contractor by submitting bid acknowledges that he/she has investigated the site to determine type, quantity, quality, and character of excavation work to be performed. Excavation shall be considered unclassified excavation, except as may be indicated by the Contract in the "Supplementary Conditions" portion of the specification.
- B. Perform excavation using capable, well maintained equipment and methods acceptable to Owner and governing agencies.
- C. When performing grading operations during periods of wet weather, provide adequate drainage and ground water management to control moisture of soils.
- D. Shore, brace, and drain excavations as necessary to maintain the site safe, secure, and free of water at all times.
- E. Excavated material containing rock or stone greater than 6" in largest dimension is unacceptable as fill to within the proposed building and paving area.
- F. Rock or stone less than 6" in largest dimensions is acceptable as fill to within 24" of surface of proposed subgrade when mixed with suitable material.
- G. Rock or stone less than 2" in largest dimension and mixed with suitable material is acceptable as fill within the upper 24" of proposed subgrade.

3.03 FILLING AND SUBGRADE PREPARATION

- A. Fill areas to contours and elevations shown with unfrozen materials.
- B. Place fill in continuous lifts specified herein.

- C. Areas exposed by excavation or stripping and on which subgrade preparations are to be performed shall be scarified to minimum depth of 8" and compacted to minimum of 95% of optimum density, in accordance with ASTM D698 (or 92% of optimum density, in accordance with ASTM D1557), at a moisture content of not less than 1% below and not more than 3% above the optimum moisture content. These areas shall then be proof rolled to detect any areas of insufficient compaction. Proof rolling shall be accomplished by making a minimum of two (2) complete passes with a fully-loaded tandem-axle dump truck, or approved equivalent, in each of the two perpendicular directions under the supervision and direction of a Field Geotechnical Engineer. Areas of failure shall be excavated and re-compacted as stated above.
- D. Fill materials used in preparation of subgrade shall be placed in lifts or layers not to exceed 8" loose measure and compacted to a minimum density of 95% of optimum density, in accordance with ASTM D698, (or 92% of the optimum density, in accordance with ASTM D1557) at a moisture content of not less than 1% below and not more than 3% above the optimum moisture content.
- E. Material imported from off-site shall have a CBR (California Bearing Ratio) or LBR (Limerock Bearing Ratio) value equal to or above the pavement design subgrade CBR or LBR value indicated.

3.04 MAINTENANCE OF SUBGRADE

- A. Finished subgrades shall be verified to ensure proper elevation and conditions for construction above subgrade.
- B. Protect subgrade from excessive wheel loading during construction, including concrete trucks and dump trucks.
- C. Remove areas of finished subgrade found to have insufficient compaction density to depth necessary and replace in manner that will comply with compaction requirements by use of material equal to or better than best subgrade material on site. Surface of subgrade after compaction shall be hard, uniform, smooth, stable, and true to specified cross-section.

3.05 RIP RAP

- A. Place rip-rap in all areas where indicated on the drawings. The stone for rip-rap shall consist of field stone or rough unhewn quarry stone as

nearly uniform in section as is practical. The stones shall be dense, resistant to the action of air and water, and suitable in all aspects for the purpose intended. Unless otherwise specified, all stones used as rip-rap shall weigh between 50 and 150 pounds each, and at least 60 percent of the stones shall weight more than 100 pounds each.

- B. Slopes and other areas to be protected shall be dressed to the line and grade shown on the plans prior to the placing of rip-rap. Contractor shall undercut the areas to receive rip-rap to an elevation equal to the final elevation less the average diameter of the stones before placing the rip-rap.
- C. Filter fabric and bedding stone shall be installed prior to the placement of the stone if so indicated on the drawings. The bedding stone shall be quarried and crushed angular limestone in accordance with Section 32 11 23 and shall be 6" in depth. Filter fabric shall be as specified herein and as detailed on the plans.
- D. Stones shall be placed so that the greater portion of their weight is carried by the earth and not by the adjacent stones. The stones shall be placed in a single layer with close joints. The upright areas of the stone shall make an angle of approximately 90 degree with the embankment upward, the larger stones being placed in the lower courses. Open joints shall be filled with spalls. Stones shall be embedded in the embankment as necessary to present a uniform top surface such that the variation between tops of adjacent stones shall not exceed three inches.

3.06 FINISH GRADING

- A. Grade all areas where finish grade elevations or contours are indicated on drawings, other than paved areas and buildings, including excavated areas, filled and transition areas, and landscape areas. Graded areas shall be uniform and smooth, free from rock, debris, or irregular surface changes. Finished subgrade surface shall not be more than 0.10 feet above or below established finished subgrade elevation, and all ground surfaces shall vary uniformly between indicated elevations. Finish ditches shall be graded to allow for proper drainage without ponding and in a manner that will minimize erosion potential. For topsoil application, refer to Landscaping Specifications.
- B. Correct all settlement and eroded areas within one (1) year after date of completion at no additional expense to Owner. Bring grades to proper elevation. Replant or replace any grass, shrubs, bushes, or

other vegetation that appears dead, dying or disturbed by construction activities. Refer to Section 31 25 00 for slope protection and erosion control.

END OF SECTION

SECTION 312316 – EXCAVATION

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section

1.00 GENERAL

1.01 SECTION INCLUDES

- A. Excavation for footings, slabs-on-grade, and utilities within the building.

1.02 RELATED REQUIREMENTS

- A. Section 31 00 00 – Earthwork: Fill materials, filling, and compacting.

2.00 PRODUCTS

NOT USED

PART 3 EXECUTION

3.01 PREPARATION

- A. Identify required lines, levels, contours, and datum locations.
- B. Locate, identify, and protect utilities that remain and protect from damage.

3.02 EXCAVATING

- A. Remove and discard existing top soil, subgrade, paving, and etc. to a depth indicated in the contract documents to a distance of 5 feet outside the building line.
- B. Excavate to accommodate new structures and construction operations.
- C. Notify the Engineer of unexpected subsurface conditions and discontinue affected Work in are until notified to resume work.
- D. Slope banks of excavations deeper than 4 feet to angle of repose or less until shored.
- E. Do not interfere with 45 degree bearing splay of foundations.

- F. Correct areas that are over-excavated and load-bearing surfaces that are disturbed.
- G. Grade top perimeter of excavation to prevent surface water from draining into excavation.
- H. Remove excavated material that is unsuitable for re-use from site.
- I. Remove excess excavated material from site.

3.03 EXCAVATION FOR FOUNDATION AFTER FILL AND BACKFILL

- A. Excavate foundation beam trenches and widened beam footings to indicated elevations and dimensions.
 - 1. Trim bottoms to required lines and grades to leave solid base to receive other work.
 - 2. Remove loose material from excavations and from within the foundation lines.
- B. Remove excavated materials from within the foundation lines.
- C. Cut utility trenches wide enough to allow inspection of installed utilities.
 - 1. Hand trim excavations. Remove loose matter.

3.04 EXCAVATION SLOPING AND BENCHING

- A. If excavation extends to or below a depth of 5 feet below construction grade, the General Contractor shall be required to develop a trench safety plan to protect personnel entering the excavation vicinity.

3.05 FIELD QUALITY CONTROL

- A. Quality Requirements, for general requirements for field inspection and testing.
- B. Provide for visual inspection of load-bearing excavated surfaces before placement of foundations.

END OF SECTION

SECTION 312333 - TRENCH EXCAVATION AND BACKFILL

1.00 GENERAL

1.01 GENERAL DESCRIPTION OF WORK

- A. Excavation, shoring, dewatering, pipe bleeding, trench backfill, compaction, grading and cleanup of all pipeline trenching for the project.
- B. All work must be done in accordance with these specifications and the safety requirements of the State and OSHA Standards.

1.02 JOB CONDITIONS

- A. Site Acceptance
 - 1. Accept site in condition existing during Contract time frame.
 - 2. Ground water/surface water found during construction is conditions of the contract and responsibility of Contractor.
- B. Adverse Weather
 - 1. Place no backfill that is excessively wet or frozen.
 - 2. Place no backfill in excessively wet or frozen trenches.

2.00 PRODUCT

2.01 MATERIAL CLASSIFICATIONS

- A. Materials for backfill shall be classified for the purpose of quality control in accordance with the Unified Soil Classification Symbols as defined in ASTM D2487. Material use and application is defined in utility installation specifications and Drawings either by class, as described in Paragraph 2.10B, or by product descriptions, as given in Paragraph 2.02.
- B. Class Designations Based on Laboratory Testing:
 - 1. Class I: Well-graded sands and gravels, gravel-sand mixtures, crushed well- graded rock, little or no fines (GW,SW)
 - a. Plasticity Index: Non-plastic
 - b. Gradation: D60/D10 – greater than 4 percent. Amount passing No. 200 ≤5%.

- C. Class II: Poorly-graded gravels and sands, silty sands and gravels, little to moderate fines (GM, GP, SP, and SM)
 - a. Plasticity Index: Non-plastic to 4
 - b. Gradation (GP, SP): Amount passing No. 200 Sieve – less than 5%.
 - c. Gradation (GM, SM): Amount passing No. 200 Sieve – 12% to 50%
- D. Class III: Clayey gravels and sands, poorly graded mixtures of sand, gravel, and clay (GC, SC)
 - a. Plasticity Index

2.02 PIPE BEDDING AND BACKFILL

- A. The type of bedding shall be stated on the Plans or in the Specification. Determination of source of materials for bedding and backfill to meet the stated conditions shall be responsibility of Contractor, but use of such materials shall be subject to approval of Engineer.
- B. Excavated Material Backfill
 - 1. Excavated material may be used in the trench backfill, provided that all hard rock and stones having any dimensions greater than 6" and frozen earth debris and roots larger than 2" are removed for the initial backfill. Plasticity Index shall be less than 30. Excavated backfill material must be approved by Engineer for bedding material.
- C. Select Backfill
 - 1. Select Backfill shall be gravel, fine rock cuttings, sand, sandy loam or loam free from excessive clay. Rock cuttings shall have no dimensions greater than 2 inches. Plasticity Index shall be between 7 and 22. Select backfill must be approved by Engineer.
- D. Sand Backfill
 - 1. Sand backfill shall be clean, hard, durable, uncoated grains, free from lumps and organic material. All materials must pass a No. 8 Sieve.
- E. Granular Backfill
 - 1. Granular backfill shall be free flowing, such as sand or hydraulically grade stone fines, or mixed sand and gravel, or sandy loam. The material shall be free from lumps, stones over 2 inches in diameter, clay and organic matter.

F. Controlled Density Fill

1. Use high slump mixture of Portland cement, fly ash and fine aggregate formulated, licensed and marketed as K-Krete or equal. Provide mixture with minimum 28-day compressive strength of 70 psi with no measurable shrinkage or surface settlement.

2.02 CRADLING ROCK

- A. Use crushed rock or stone with 70-100% passing 1 > inch sieve and no more than 50% passing 1 inch sieve.

2.03 SHEETING, SHORING AND BRACING

- A. Use sound timber or structural steel.
- B. Use shapes and sizes as required.

3.00 **EXECUTION**

3.01 GENERAL

A. Dewatering

1. Execute work "dry". No pipe or conduits shall be laid or concrete poured on excessively wet soil.
2. Prevent surface water from flowing into excavation.
3. Provide equipment for handling water encountered as required. Obtain approval of proposed method of dewatering.
4. No Sanitary sewer shall be used for disposal of trench water.

B. Protection of Existing Utilities:

1. Notify all utilities of location and schedule of work.
2. Locations and elevations of utilities shown on plans are to be considered approximate only. Notify utility and Engineer of conflicts between existing and proposed facilities.
3. Repair, relay or replace existing utilities damaged, destroyed or disrupted during work. Unless specified otherwise, replacement will be at the Contractors expense.

C. Sheet piling, Shoring and Bracing

1. Provide as necessary, to hold walls of excavation, prevent damage to adjacent structures, and to protect workmen and property.
2. Leave Sheet piling and shoring in place where removal might cause damage to work or otherwise indicated on drawings.

3. When movable trench shield is used below spring line of pipe, it shall be lifted prior to any forward movement to avoid pipe displacement.
- D. Changes in Grade
 1. Grades may be adjusted 1.5 feet (plus or minus) from plan grades to suit unforeseen construction conflicts or conditions with approval of Engineer.
 2. No additional compensation will be made for such changes.

3.02 EXCAVATION AND TRENCHING

- A. General
 1. Method of excavation at Contractor's option.
 2. Excavate by hand under tree roots 3 inches and larger, and under and around structures and utilities.
 3. Stockpile and replace topsoil to a minimum of 4-inches for surface restoration in grassed or agricultural areas.

B. Trench Characteristics

1. Depth
 - a. As indicated for pipe installation to lines and grades required with proper allowance for thickness of pipe and type of bedding specified or indicated.
2. Width
 - a. Keep width of trench as narrow as possible and yet provide adequate room for backfilling and jointing.
 - b. Maximum width as follows:

Pipe Size	Maximum Trench Width
Inches	
4	2-feet 0-inches
6	2-feet 0-inches
8	2-feet 4-inches
10	2-feet 4-inches
12	2-feet 6-inches
15	2-feet 9-inches
18	3-feet 0-inches
Over 18	Pipe O.D. + 12-inches

3. Trench walls must be vertical below top of pipe and may be vertical or sloped above pipe to conform to excavating codes.
4. Provide bell holes for each pipe joint where pipe bears on undisturbed earth.

5. Trench bottom shall be free of large stones and other foreign material.

3.03 SOFT, SPONGY OR UNSTABLE MATERIALS

- A. Stop work and notify Engineer.
- B. Perform remedial work as directed.
- C. If material is judged unsuitable and removal is authorized, remove and replace with trench stabilizing material as directed by Engineer.

3.04 ROCK EXCAVATION

- A. Excavate any rock to maintain minimum 6-inch clearance around pipe.
- B. Dispose of rock material not suitable for backfill as directed by Engineer.
- C. Use of explosives not permitted without prior written authorization from owner and Engineer.
- D. Provide Special Hazard Insurance covering liability for blasting operations.

3.05 BEDDING

- A. Place after bottom of trench has been excavated to proper depth and grade.
- B. Place, compact and shape bedding material to conform to barrel of pipe to insure continuous firm bedding for full length of pipe.
- C. Provide bedding as described in following table unless indicated otherwise on Plans or in Special Conditions.

<u>Pipe Material</u>	<u>Minimum Bedding</u>
	<u>Class</u>
1. Vitrified Clay Pipe	Class C*
2. Non-reinforced Concrete Pipe	Class C*
3. Reinforced Concrete Pipe	Class D*
4. Ductile Iron Pipe	Class D*
5. Steel Cylinder	Class C*
6. Flexible or Composite Pipe (PVC)	Class 1**

*Refers to standard detail, "Pipe Envelope Requirements"

**Refers to standard detail, "Bedding Detail"

3.06 TRENCH BACKFILL

- A. Use excavated material for backfill unless otherwise specified.
- B. Use Sand Backfill for all trenches within 5 feet of buildings and beneath walks, parking areas, paved streets or existing exposed utilities, unless otherwise specified in the plans.
- C. Initial Backfill
 1. Place after pipe has been bedded and checked for alignment, grade and internal obstructions.
 2. Carry out in an orderly fashion after authorization to cover pipe has been given.
 3. Allow no more than 300 feet of trench to be open at one time.
 4. Do not backfill until concrete or mortar has sufficiently cured.
 5. Record location of connections and appurtenances before backfilling.
 6. Place by hand and hand tamp to not less than 12-inches above top of pipe, in approximately 4-inch layers.
 7. Backfill simultaneously on both sides of pipe to prevent displacement.
 8. Place cushion of 4-foot backfill above pipe envelope before using heavy compacting equipment.
- D. Subsequent Backfill
 1. Place backfill into trench at an angle so that impact on installed pipe is minimized.
 2. Compaction of all backfill material shall be performed in a manner that shall not crack, crush, and/or cause the installed pipe to be moved from the established grade and/or alignment.
 3. Area under or within 5-feet of pavement; and under or within 2-feet of utilities, buildings, or walks shall be mechanically compacted to the top of the subgrade in 6- inch lifts to a minimum of 95% Standard Proctor Density.
 4. Areas not subject to vehicular traffic shall be backfilled in layers not more than 12- inches in depth.
 5. Compaction method is at discretion of Contractor with following exceptions:
 - a. If in Owner's opinion compaction method presents potential damage to pipe, it will not be allowed.
 - b. Compaction of any backfill material by flooding or jetting is not allowed.
 6. Mound excavated materials no greater than 6-inches in open areas only.
 7. Fill upper portion of trench with topsoil as specified hereinbefore.

- E. Controlled Density Fill
 - 1. Use where shown on plans.
 - 2. Provide suitable forms to limit volume of control density fill material.
 - 3. Prevent flow of material into existing drain lines.
 - 4. Protect exposed utility lines during placement.
 - 5. Place material in accordance with suppliers' written recommendations unless directed otherwise by Engineer.

3.07 EXCESS MATERIAL

- A. Waste of excess excavated material shall be the responsibility of the Contractor.

3.08 TESTING

- A. Unless specified elsewhere, testing will be responsibility of Owner.
- B. Standard Proctor Density
 - 1. ASTM D698.
 - 2. One (1) required for each type of material encountered.
- C. In Place Density
 - 1. ASTM D1556 (Sand Cone)
 - 2. ASTM D2167 (Balloon)
 - 3. ASTM D3017 (Nuclear)
- D. One (1) test per each 400 cubic yards of backfill placed or as directed by the Engineer.

4.00 MEASUREMENT AND PAYMENT

4.01 TRENCH EXCAVATION, BACKFILL AND COMPACTION

- A. When listed as a separate contract pay item, shall be measured in accordance with "Measurement and Basis of Payment" section or as shown on the Bid Proposal Form.
- B. When not listed as a separate contract pay item, shall be considered as incidental work, and the cost thereof shall be included in such contract pay item(s) as are provided in the proposal contract.

- C. Compensation, whether by contract pay item or incidental work will be for furnishing all materials, labor, equipment, tools and incidentals required for the work, all in accordance with the plans and these specifications.

END OF SECTION

SECTION 312500 - EROSION AND SEDIMENTATION CONTROL

1.00 GENERAL

1.01 WORK INCLUDED

Furnish labor, materials, equipment and incidentals necessary to provide erosion and sediment control for the duration of the construction period including furnishing, installing and maintaining erosion and sediment control structures and procedures and the proper removal when no longer required.

The intent of this specification is to provide guidelines for the Contractor to adhere to all State, Federal, and Local environmental regulations. It is also the intent to provide preventive measures to keep sediment from entering any storm water system, including open channels. It is the Contractor's responsibility to adhere to all State, Federal and Local requirements. While the Owner may require the Contractor to install erosion control devices during construction, this will in no way relieve the Contractor of his responsibility.

1.02 QUALITY ASSURANCE

- A. Comply with applicable requirements of all governing authorities having jurisdiction. The Specifications and the Plans are not represented as being comprehensive, but rather to convey the intent to provide complete slope protection and erosion control for both the Owner's and adjacent property.
- B. Erosion control measures shall be established at the beginning of construction and maintained during the entire length of construction. On-site areas which are subject to severe erosion and off-site areas which are especially vulnerable to damage from erosion and/or sedimentation are to be identified and receive additional erosion control measures as directed by the Owner or the Engineer.
- C. All land-disturbing activities shall be planned and conducted to minimize the size of the area to be exposed at any one time and to minimize the time of exposure.
- D. Surface water runoff originating upgrade of exposed area shall be controlled to reduce erosion and sediment loss during the period of exposure.

- E. When the increase in the peak rates and velocity of storm water runoff resulting from a land-disturbing activity is sufficient to cause accelerated erosion of the receiving ditch or stream, the Contractor shall install measures to control both the velocity and rate of release so as to minimize accelerated erosion and increased sedimentation of the stream as directed by the Owner or the Engineer.
- F. All land-disturbing activities shall be planned and conducted so as to minimize off-site sedimentation damage.
- G. The Contractor shall be responsible for periodically cleaning out and disposing of all sediment once the storage capacity of the drainage feature or structure receiving the sediment is reduced by one-half. The Contractor shall also be responsible for cleaning out and disposing of all sediment at the time of completion of the Work.

1.03 SUBMITTALS

1.04 STANDARDS

1.05 DELIVERY AND STORAGE *[Not Used]*

1.06 JOB CONDITIONS; CODES AND ORDINANCES

Comply with the local codes and ordinances. If local codes and ordinances require more stringent or additional erosion and sediment control measures during construction, Contractor shall provide such measures.

1.07 OPTIONS

1.08 GUARANTEES

2.00 PRODUCTS

2.01 MATERIALS

- A. STRAW BALES: Straw bales shall weigh a minimum of fifty (50) pounds and shall be at least 30" in length. Bales shall be composed entirely of vegetable matter and be free of seeds. Binding shall be wire or nylon string; jute or cotton binding is unacceptable. Bales shall be used for not more than three months before being replaced. However, if weather conditions cause biological degradation of the straw bales, they shall be

replaced sooner than the three month time period to prevent a loss of structural integrity of the dike.

- B. SILT FENCE: Silt fence fabric shall be nylon reinforced polypropylene fabric which has a built-in cord running the entire length of the top edge of the fabric. The fabric must meet the following minimum criteria:

Tensile Strength, ASTM D4632	90 lbs.,
Puncture Rating, ASTM D4833	60 lbs.,
Mullen Burst Rating, ASTM D3786	200 psi,
Apparent Opening Size, U.S. Sieve No.	40

Silt fence shall be "Enviro Fence" preassembled silt fence, AMXCO Silt Stop prefabricated silt fence, AMOCO Style 2155 preassembled silt fence or approved equal.

- C. SILT FENCE POSTS: A minimum 2" x 2" (nominal) x 54" pressure treated wood posts of Number 2 Grade southern yellow pine or approved equal.
- D. SAND BAG: Sand bag material shall be polypropylene, polyethylene, polyamide or cotton burlap woven fabric, minimum unit weight four (4) ounces per square yard, mullen burst strength exceeding 300 psi and ultraviolet stability exceeding 70%. Length shall be 24 to 30 inches, width shall be 16 to 18 inches and thickness shall be six (6) to eight (8) inches and having an approximate weight of 40 pounds. Sand bags shall be filled with coarse grade sand, free from deleterious material. All sand shall pass through a No. 10 sieve.
- E. P.V.C. PIPE: Pipe shall be SDR-35 polyvinyl chloride having a minimum nominal internal diameter of 4". Pipes shall be sized for anticipated flows.
- F. SOIL RETENTION BLANKET: Soil retention blankets shall consist of a geocomposite of excelsior or fiber blanket with an extruded plastic net attached to the tope side. The plastic net shall be photodegradable and the excelsior or fiber blanket shall be made smolder resistant without the use of chemicals. Soil retention blankets shall be high velocity type to resist severe runoff. The soil retention blanket shall be one (1) of the following classes and types:
1. Class 1. "Slope Protection"
 - (a) Type A. Slopes of 3:1 or flatter - Clay soils
 - (b) Type B. Slopes of 3:1 or flatter - Sandy soils
 - (c) Type C. Slopes steeper than 3:1 - Clay soils

(d) Type D. Slopes steeper than 3:1 - Sandy soils

2. Class 2. "Flexible Channel Liner"

(a) Type E. Short-term duration (Up to 2 Years)

Shear Stress (t_d) < 1.0 lb./sq. ft.

(b) Type F. Short-term duration (Up to 2 Years)

Shear Stress (t_d) 1.0 to 2.0 lb./sq. ft.

(c) Type G. Long-term duration (Longer than 2 Years)

Shear Stress (t_d) > 2.0 to < 5.0 lb./sq. ft.

(d) Type H. Long-term duration (Longer than 2 Years)

Shear Stress (t_d) greater than 0 Equal to 5.0 lb./sq. ft.

The Contractor has the option of selecting an approved soil retention blanket provided that selection conforms to the following list of approved soil retention blankets for slope protection applications:

CLASS I. SLOPE PROTECTION

TYPE A: Slopes of 3:1 or Flatter-Clay Soils

Airtrol® ANTI-WASH®/GEOJUTE® (Regular)

Contech Standards®

Contech Standards Plus®

Green Triangle Regular®

Green Triangle Superior®

GREENSTREAK® PEC MAT

Curlex®

North American Green® S150

North American Green® S75

North American Green® SC150

POLYJUTE® 407/GT

SOIL SAVER®

TerraJute®

Verdyol® ERO-MAT®

Xcel Regular®

Xcel Superior®

TYPE B: Slopes of 3:1 or Flatter-Sandy Soils

Contech Standards®

Contech Standards Plus®

GEOCOIR®/DEKOWE® 700

Green Triangle Superior®

Green Triangle Regular®

North American Green® S75

North American Green® SC150
North American Green® S150
POLYJUTE® 407/GT
TerraJute®
Verdyol® ERO-MAT®
Xcel Superior®
Xcel Regular®

TYPE C: Slopes Steeper than 3:1-Clay Soils

Airtrol®
ANTI-WASH®/GEOJUTE® (Regular)
Contech Standards Plus®
Curlex®
Green Triangle Superior®
GREENSTREAK® PEC-MAT
North American Green® SC150
North American Green® S150
POLYJUTE® 407/GT
SOIL SAVER®
TerraJute®
Xcel Superior®

TYPE D: Slopes Steeper than 3:1-Sandy Soils

Contech Standards Plus®
GEOCOIR®/DEKOWE® 700
Green Triangle Superior®
North American Green® S150
North American Green® SC150
POLYJUTE® 407GT
TerraJute®
Xcel Superior®

CLASS II: FLEXIBLE CHANNEL LINER PROTECTION

2.02 MIXES *[Not Used]*

2.03 FABRICATIONS *[Not Used]*

2.04 MANUFACTURED PRODUCTS *[Not Used]*

3.00 EXECUTION

3.01 PREPARATION

3.02 INSTALLATION

A. TEMPORARY STRAW BALE DIKE

1. Straw bales shall be embedded a minimum of 4" and securely anchored using 2" x 2" wood stakes driven through the bales into the ground a minimum of 6". Straw bales are to be placed directly adjacent to one another leaving no gap between them.
2. Bales shall be placed in a single row, lengthwise on proposed line, with ends of adjacent bales tightly abutting one another. In swales and ditches, the barrier shall extend to such a length that the bottoms of the end bales are higher in elevation than the top of the lowest middle bale. Additional bales shall be placed behind the first row where the bales abut each other. The additional bale is used to prevent unfiltered runoff from escaping between the bales.
3. The excavated soil shall be backfilled against the barrier. Backfill shall conform to ground level on the downhill side and shall be built up to 4" above ground level on the uphill side. Loose straw shall be scattered over the area immediately uphill from a straw barrier.

B. SILT FENCE

The purpose of a silt fence is to intercept and detain water-borne sediment from unprotected areas to a limited extent. The Contractor shall excavate a 6" by 6" trench for site fence bedding along the lower perimeters of the site where necessary to prevent sediment from entering any drainage system. The Contractor shall install the silt fence in accordance with the manufacturer's recommendations and instructions. Silt fence is used during the period of construction near the perimeter of a disturbed area to intercept sediment while allowing water to percolate through. This fence shall remain in place until the disturbed area is permanently stabilized. Silt fence should not be used where there is a concentration of water in a channel or drainage way or where soil conditions prevent a minimum toe-in depth of 6" or installation of support post to depth of 12". Fabric shall overlap at abutting ends a minimum of 3' and shall be jointed such that no leakage or bypass occurs. If concentrated flow occurs after installation, corrective action must be taken such as placing rock berm in the areas of concentrated flow.

C. SAND BAG BERM

1. The purpose of a sandbag berm is to intercept sediment-laden water from disturbed areas such as construction in stream beds, create a retention pond, detain sediment and release water in sheet flow.
2. A temporary sand bag berm shall be installed across a channel or right of way in a developing or disturbed area and should be used when the contributing drainage area is greater than 5 acres. The berm shall be a minimum height of 18", measured from the top of the existing ground at the upslope toe to the top of the berm. The berm shall be sized to have a minimum width of 48" measured at the bottom of the berm and 18" measured at the top of the berm.
3. The sand bag berm shall be inspected after each rain. The sand bags shall be reshaped or replaced as needed during inspection. Additional inspections shall be made daily by the responsible party and when the silt reaches 6", the accumulated silt shall be removed and disposed of at an approved site in a manner that will not contribute to additional siltation. The sand bag berm shall be left in place until all upstream areas are stabilized and accumulated silt removed; removal must be done by hand.

D. SOIL RETENTION BLANKETS

1. A soil retention blanket (SRB) is a geotextile or biodegradable fabric placed over disturbed areas to limit the effects of erosion due to rainfall impact and runoff across barren soil. Soil retention blankets are manufactured by a wide variety of vendors addressing a wide variety of conditions such as vegetation establishment and high velocity flow. Blankets are used in areas which are difficult to stabilize such as steep slopes, drainage swales or high pedestrian traffic areas.
2. The soil retention blanket, whether installed as slope protection or as flexible channel liner, shall be placed within 24 hours after seeding or sodding operations have been completed, or as approved by the Engineer. Prior to placing the blanket, the area to be covered shall be relatively free of all rocks or clods over 1-1/2" in maximum dimension and all sticks or other foreign material which will prevent the close contact of the blanket with the soil. The area shall be smooth and free of ruts and other depressions. If as a result of rain, the prepared bed becomes crusted or eroded or if any eroded places, ruts or depressions exist for any reason, the Contractor shall be required to rework the soil until it is smooth and to reseed or resod the area at the Contractor's expense. Installation and anchorage of the soil retention blanket shall be in accordance with the manufacturer's recommendations.

E. PROTECTION OF BARE AREAS

1. Apply seeding and soil retention blanket to bare areas including new embankment areas, fills, stripped areas, graded areas or otherwise disturbed areas, which have a grade greater than 5% or which will be exposed for more than 30 days.
2. Bare working areas on which it is not practical or desirable to install seeding and soil retention blankets, as determined by the Engineer, such as areas under proposed building slabs, shall be temporarily sloped to drain at a minimum of 0.2% and a maximum of 5% grade. These areas shall then be "trackwalked" with a crawler dozer traveling up and down the slope to form the effect of small "terraces" with the tracks of the dozer. Apply a minimum of three (3) coverages to each area with the dozer tracks.
3. Route runoff from the areas through the appropriate silt fence system.
4. Protect earth spoil areas by "trackwalking" and silt fences.

F. INTERCEPTOR SWALE

1. Interceptor swales may have a v-shape or be trapezoidal with a flat bottom and side slopes of 3:1 or flatter. These are used to shorten the length of exposed slope by intercepting runoff and can also serve as perimeter swales preventing off-site runoff from entering the disturbed area or prevent sediment-laden runoff from leaving the construction site or disturbed area. The outflow from a swale must be directed to a stabilized outlet or sediment trapping device. The swales should remain in place until the disturbed area is permanently stabilized.
2. Stone Stabilization shall be used when grades exceed 2% or velocities exceed 6' per second and shall consist of a layer of crushed stone 3" thick, or flexible channel liner soil retention blankets. Stabilization shall extend across the bottom of the swale and up both sides of the channel to minimum height of 3" above the design water surface elevation based on a two year storm.
3. Interceptor swale shall be installed across exposed slopes during construction and should intercept no more than five (5) acres of runoff. Swales shall have a minimum bottom width of 2'-0" and a maximum depth of 1'-6" with side slopes of 3:1 or flatter. Swale must have positive drainage for its entire length to an outlet. When the slope exceeds 3%, or velocities exceed 4' per second (regardless of slope), stone stabilization is required. Check dams are also recommended to reduce velocities in the swales possibly reducing the amount of stabilization necessary. Swales should be inspected on a weekly basis during wet weather and repairs should be made promptly to maintain a consistent cross section.

4. All trees, brush, stumps, obstructions and other material shall be removed and disposed of so as not to interfere with the proper functioning of the swale.
5. The swale shall be excavated or shaped to line, grade, and cross-section as required to meet criteria specified herein and be free of bank projections or other irregularities which will impede normal flow.
6. All earth removed and not needed in construction shall be disposed of in an approved spoils site so that it will be conveyed to a sediment trapping device.
7. Diverted runoff from a disturbed or exposed upland area shall be conveyed to a sediment trapping device.
8. The on-site location may need to be adjusted to meet field conditions in order to utilize the most suitable outlet.
9. Minimum compaction for the swale shall be 90% standard proctor.

G. LOCATION OF EROSION AND SEDIMENT CONTROL STRUCTURES

1. Locate erosion and sediment control structures as required to prevent erosion and removal of sediment from the project site. Silt fences shall be required for disturbed areas and soil stockpiles/spoil areas. Each silt fence installation shall have a minimum net length (exclusive of embedments into diversion dikes or other ineffective areas) of 25'. The runoff from a maximum of one (1) acre of disturbed area or soil stockpile/ spoil area shall be routed through any individual silt fence installation.
2. Install diversion dikes to divert runoff to the silt fence installation.
3. Install silt traps at the inlet (upstream) end of the drainage structures, including open channels, through which runoff from disturbed areas or soil stockpiles/spoil areas may drain.
4. Provide an overall erosion and sediment control system which protects disturbed areas and soil stockpiles/spoil areas. The system shall be modified by the Contractor from time to time to effectively control erosion and sediment during construction.

3.03 MAINTENANCE

- A. Maintain erosion and sediment control structures and procedures in full working order at all times during construction. This shall include any necessary repair or replacement of items which have become damaged or ineffective. Remove sediment on a regular basis which accumulates in sediment control devices and place the material in approved earth spoil areas or return the material to the area from which it eroded.
- B. Upon completion of construction, properly remove the temporary erosion and sediment control structures and complete the area as indicated.

- C. Soil retention blankets will not require removal if installed on a finished graded area specified to receive seeding.

3.04 FIELD QUALITY CONTROL

In the event of conflict between the requirements and storm water pollution control laws, rules or regulations or other Federal, State or Local agencies, the more restrictive laws, rules or regulations shall apply.

3.05 CLEAN AND ADJUST *[Not Used]*

4.00 MEASUREMENT AND PAYMENT

4.01 EROSION AND SEDIMENT CONTROL DURING CONSTRUCTION

- A. When listed as a separate contract pay item, shall be measured in accordance with "Measurement and Basis of Payment" section or as shown on the Bid Proposal Form.
- B. When not listed as a separate contract pay item, shall be considered as incidental work, and the cost thereof shall be included in such contract pay item(s) as are provided in the proposal contract.
- C. Compensation, whether by contract pay item or incidental work will be for furnishing all materials, labor, equipment, tools and incidentals required for the work, all in accordance with the plans and these specifications.

END OF SECTION

SECTION 314110 – REINFORCED CONCRETE PIPE

1.00 GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals necessary to install and test reinforced concrete pipe and fittings for raw water lines and irrigation pipelines as shown on the Drawings and as specified herein.
- B. All pipe shall be manufactured for this project and no pipe shall be furnished from stock.

1.02 RELATED WORK NOT INCLUDED

- A. ASTM C 1103-89 Standard Practice for Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines.
- B. ASTM 361, Reinforced Concrete Low-Head Pressure Pipe

1.03 SUBMITTALS

- A. Submit to the Engineer, within thirty days of the Effective Date of the Agreement, the name of the pipe and fitting suppliers and a list of materials to be furnished.
- B. Submit to the Engineer, shop drawings showing layout and details of reinforcement, joint, method of manufacture and installation of pipe, specials and fittings, and a schedule of pipe lengths (including the length of individual pipes by diameter) for the entire job.
- C. Prior to each shipment of pipe, submit certified test reports that the pipe for this Contract was manufactured and tested in accordance with the ASTM and ANSI/AWWA Standards specified herein.

1.04 QUALITY ASSURANCE

- A. The manufacturer shall be responsible for the performance of all acceptance tests as specified in Paragraph 5.1.2 of ASTM C76. In addition, all reinforced concrete pipe to be installed under this Contract may be inspected at the plant for compliance with these Specifications by an independent testing laboratory provided by the

Owner. The Contractor shall require the manufacturer's cooperation in these inspections. The cost of inspection of all pipe approved for this Contract, plus the cost of inspection of a reasonable amount of disapproved pipe will be borne by the Owner.

- B. Prior to each shipment of units for the raw water, or irrigation, pipeline, hydrostatic pressure tests on the pipe and the pipe joint shall be conducted according to the procedures of ASTM 361, section 10.4. Tests will be conducted on each run at the manufacturer's facility. Tests will be conducted on each 100 units (or less) from a run. The pipe shall be tested to a pressure of 13 psi for 30 minutes, with no visible leaks in the pipe or joints. Each test will be witnessed by the Engineer's representative.
- C. Inspection of the pipe will also be made by the Engineer or other representatives of the Owner after delivery. The pipe shall be subject to rejection at any time on account of failure to meet any of the Specification requirements, even though pipes may have been accepted as satisfactory at the place of manufacture. Pipe rejected after delivery shall be marked for identification and shall immediately be removed from the job.

2.00 PRODUCTS

2.01 REINFORCED CONCRETE PIPE

- A. Except as otherwise specified herein, pipe shall conform to ASTM Standards Specifications for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe, Designation C76, Class III, Wall C. The pipe interior shall be smooth and even, free from roughness, projections, indentations, offsets, or irregularities of any kind. The concrete mass shall be dense and uniform.
- B. Non-air-entraining portland cement conforming to ASTM C150, Type II shall be used. The use of a non-bleeding, water-reducing, dispersing agent may be permitted subject to the specific approval of the Engineer. The use of any other admixture will not be permitted.
- C. Fine aggregate shall consist of washed inert natural sand conforming to the requirements of ASTM C33, except for gradation, with a maximum loss of 8 percent when subjected to 5 cycles of the soundness test using magnesium sulfate. Coarse aggregate shall consist of well-graded crushed stone conforming to the requirements

of ASTM C33, except for gradation, with a maximum loss of 8 percent when subjected to 5 cycles of the soundness test using magnesium sulfate. Documentation that the aggregates to be used in the manufacture of reinforced concrete pipe meet these requirements shall be submitted to the Engineer as stated in Paragraph 1.03.

- D. The 28-day compressive strength of the concrete, as indicated by cores cut from the pipe shall be not less than 6,000 psi. The concrete mass shall be dense and uniform. The average absorption shall not exceed 5.5 percent of the dry weight and no specimen shall exceed 6.0 percent. Reinforcement shall be circular for all concrete pipe. Quadrant steel shall not be used. Reinforcement shall be installed in both the bell and the spigot. At least one circumferential reinforcement wire shall be in both the bell and spigot area, and reinforcement in the bell and spigot shall be adequate to prevent damage to concrete during shipping, handling and after installation. Cores indicating reinforcing steel having less than 85 percent bond shall be cause for rejection of the lot of pipes.
- E. Pipe may be rejected for any of the following reasons:
1. Exposure of any wires, positioning spacers or chairs used to hold the reinforcement cage in position, or steel reinforcement in any surface of the pipe, except for ends of longitudinal reinforcing.
 2. Transverse reinforcing steel found to be in excess of ¼ inch out of specified position after the pipe is molded.
 3. Any shattering or flaking of concrete at a crack.
 4. Voids, with the exception of a few minor bugholes, on the interior and exterior surfaces of the pipe exceeding 1/4 inch in depth unless properly and soundly pointed with mortar or other approved material.
 5. Unauthorized application of any wash coat of cement or grout.
 6. A deficiency greater than ¼ inch from the specified wall thickness of pipe 30 inches or smaller in internal diameter.
 7. A deficiency greater than 6% from the specified wall thickness of pipe larger than 30 inches in internal diameter, except that the deficiency may be 8% adjacent to the longitudinal form joint, provided that the additional deficiency does not lie closer than 20%

of the internal diameter of the pipe. The deficiencies in wall thickness permitted herein do not apply to gasket contact surfaces in gasket joint pipe.

8. A variation from the specified internal diameter in excess of 1%, or interior surfaces which have been reworked after placing of concrete. The variation in internal diameter permitted herein does not apply to gasket contact surface in gasket joint pipe.
9. A hollow spot (identified by tapping the internal surface of the pipe) which is greater than 30 inches in length or wider than 3 times the specified wall thickness. Repair of such defective areas not exceeding these limitations may be made as specified in Paragraph 2.01R.
10. Defects that indicate imperfect molding of concrete, or any surface defect indicating honeycomb or open texture (rock pockets) greater in size than area equal to a square with a side dimension of 2-1/2 times the wall thickness or deeper than two times the maximum graded aggregate size, or local deficiency of cement resulting in loosely bonded concrete, the area of which exceeds in size the limits of area described in Paragraph 9 above when the defective concrete is removed. Repair of such defects not exceeding these limits may be made as specified in Paragraph 2.01R.
11. Any of the following cracks:
 - a. A crack having a width of 0.005 inch to 0.01 inch throughout a continuous length of 36 inches or more.
 - b. A crack having a width of 0.01 inch to 0.03 inch or more throughout a continuous length of one foot or more.
 - c. Any crack greater than 0.005 inch extending through the wall of pipe and having a length in excess of the wall thickness.
 - d. Any crack showing two visible lines of separation for a continuous length of two feet or more, or an interrupted length of three feet or more anywhere in evidence, both inside and outside.
 - e. Cracks anywhere greater than 0.03 inch in width.
- F. The pipe shall be clearly marked as required by ASTM C76 in a manner acceptable to the Engineer. The markings may be at either end of the pipe for the convenience of the manufacturer, but for any one size shall always be at the same end of each pipe length. Pipe shall not be shipped until the compressive strength of the concrete has attained

4,000 psi and not before 5 days after manufacture, and/or repair, whichever is the longer.

- G. Pipe shall have a minimum laying length of approximately 8 feet, except for closure and other special pieces as approved by the Engineer. The Contractor shall have available at the site of the work sufficient pipe of various lengths to affect closure at structures that cannot be located to accommodate standard lengths. Short lengths of pipe made for closure etc. may be used in the pipeline at the end of construction if properly spaced. The length of the incoming and outgoing concrete pipe at each structure shall not exceed 4 feet, except where the joint is cast flush with the exterior wall of the structure, where steel wall fittings are provided or where otherwise noted on the Drawings. Maximum laying length shall not exceed 16 feet, but the installation of 16 foot lengths will depend upon the ability of the Contractor to handle such lengths of pipe in sheeted trenches, comply with trench width requirements, maintain the integrity of the sheeting and avoid disturbance to adjacent ground. If, in the opinion of the Engineer, the use of 16 foot lengths is impracticable, shorter lengths shall be used.
- H. After manufacture, each length of pipe shall be checked against the length noted on the shop drawings. Pipe more than 1-1/2 inch longer than that shown on the shop drawings shall not be used on this project. Variations in length of the same pipe shall not exceed ASTM C76 requirements.
- I. During manufacturing, measuring devices shall be used to assure joint assembly is within the tolerance of ASTM C76 and these Specifications.
- J. The Engineer shall have the right to cut cores from such pieces of the finished pipe as he desires for such inspection and tests as he may wish to apply. Holes left by the removal of cores shall be filled in an approved manner by and at the expense of the manufacturer. Core drilling shall be carried out by the pipe manufacturer at his expense.
- K. The Engineer shall also have the right to take samples of the concrete after it has been mixed, or as it is being placed in the forms or molds, and to make such inspection and tests thereof as he may wish.
- L. At the start of the work, a set of test cylinders shall be taken each day on which pipe is manufactured for the project or more often if required. This may ultimately be reduced to one set of three specimens for every 50 cubic yards of concrete placed, if the

uniformity of results warrants, and if approved by the Engineer. At the start of the work, a relationship shall be established between ultimate strength of test cylinders stored in a standard manner as compared to cylinders steam-cured with the pipe and as compared to cores taken from the corresponding finished pipe. At least five sets of tests shall be made.

- M. Test cores may be taken for every 500 linear feet of pipe manufactured, but not less than once each day on which pipe is manufactured for the project. Cores may be reduced to one set of two per week (or possibly fewer, but not less than one set for every 1,500 linear feet), if a satisfactory relationship is established between cores and cylinders made and cured in the standard manner. This relationship shall not vary by more than 10 percent more or less from the average ratio. Cores may be drilled in any manner which will provide a smooth core face. All pipe cylinders and cores shall be 4 inches in diameter. Cores shall be carefully saw-trimmed and capped in a vertical position with a sulfur cap of minimum thickness, at least one day before being tested.
- N. Core testing shall conform to Standard ASTM Methods.
- O. At the time of inspection, the pipe will be carefully examined for compliance with the appropriate ASTM and project specifications, and shop drawings. All pipes shall be inspected for general appearance, dimension, "scratch-strength", blisters, cracks, roughness, soundness, etc. All pipes will be checked for soundness by being tapped and scratched over a reasonable portion of the area, at least once on every 50 square inches of pipe surface. The surface shall be dense and close-textured. Cores also shall serve as a basis for rejection of pipe, particularly if lamination or poor bond of reinforcement is apparent.
- P. The manufacturer shall use measuring devices to assure joint assembly is within tolerances of ASTM C76 and these Specifications. If, during construction, the pipes cannot be satisfactorily joined, the manufacturer shall pre-join the pipe at his shop.
- Q. Unsatisfactory or damaged pipe will be either permanently rejected or returned for minor repairs. Only that pipe actually conforming to the Specifications and accepted will be listed for approval, shipment and payment. Approved pipe will be so stamped or stenciled on the inside before it is shipped. All pipe which has been damaged after delivery will be rejected, and if such pipe already has been laid in the trench, it

shall be acceptably repaired, if permitted, or removed and replaced, entirely at the Contractor's expense.

- R. Pitts, blisters, rough spots, breakage, and other imperfections may be repaired, subject to the approval of the Engineer, after demonstration by the manufacturer that strong and permanent repairs result. Repairs shall be carefully inspected before final approval. Non-shrink cement mortar used for repairs shall have a minimum compressive strength of 6,000 psi at the end of 7 days and 7,000 psi at the end of 28 days, when tested in 3-inch cylinders stored in the standard manner. Epoxy mortar may be utilized for repairs subject to the approval of the Engineer.
- S. Steel wall fittings to be used in the walls of the cast-in-place structures shall be equal to those manufactured by Interpace Corp., and shall be compatible with rubber and steel joints of reinforced concrete pipe and prestressed concrete cylinder pipe where applicable.

2.02 JOINTS FOR CONCRETE PIPE

A. Raw Water and Irrigation Pipelines

- 1. A rubber gasket shall be the sole element of the joint depended upon to provide water-tightness. Rubber gaskets shall be solid gaskets of circular cross section. The gasket shall be confined in an annular space formed by the bell or bell ring and a groove in the spigot end of the pipe or spigot right or by shoulders on the bell and spigot ends of the pipe in such a manner that slight movement of the pipe or hydrostatic pressure can not displace the gasket and so that when the joint is assembled, the gasket is compressed to form a watertight seal. Joints shall be designed so that the gasket will not be required to support the weight of the pipe. The joint will be a Type R-4 with a formed gasket groove in spigot end, details conforming to Figures 5 and 6 of the Bureau of Reclamation Standard Specifications for Reinforced Concrete Pressure Pipe, November 1, 1991. Leading edge of bell shall be chamfered or rounded to facilitate entrance of gasket. The minimal cross-sectional area of annular space for gasket, with joint in normal concentric closure position, shall not be less than the cross-sectional area of gasket calculated using the maximum stretched cross-sectional diameter. Minimal cross-sectional area of annular space for gasket shall be calculated for minimum bell diameter, maximum spigot diameter, minimum groove width at spigot surface, and minimum groove depth. The average stretch cross-sectional area of the gasket shall meet the requirements of the Bureau of

Reclamation specifications for Concrete pipe, dated November 1, 1991 for the Type R-4 joint.

2. Other Rubber Gasket Joints (These joints are not acceptable for irrigation pipelines)
 - B. Joints shall be the bell and spigot type of joint with provisions for using a round rubber "O-Ring" gasket in a recess in the spigot end of the pipe. The bevel on the bell of the pipe shall be between 1-1/2 degrees and 2-1/2 degrees. The diameters of the joint surfaces which compress the gasket shall not vary from the true diameters by more than 1/16 inch.
 - C. The round rubber "O-Ring" gaskets shall conform to ASTM C443. Two gaskets shall be submitted to the Engineer for tests at least 30 days before joining any of the pipes. Specimens of the gaskets shall be subjected to tensile tests of approximately 100 psi before and after immersion and heating tests, and shall show an elongation of at least 25 percent. Upon release from the tensile tests, each specimen shall return to its original length.
 - D. Specimens shall be heated in a dry oven to 150°F for 6-hour duration and five specimens shall be tested by immersion, one each as follows: 2-hour immersion in petroleum ether, 72-hour immersion in saturation Hydrogen Sulfide solution, 72-hour immersion in 1 percent NaOH solution, 72-hour immersion in standard soap solution (80 per-cent alcohol), and 72-hour immersion in 10 percent NaCl solution. The specimens shall show no detrimental change in color, texture, or feeling upon completion of the above tests. The manufacturer shall supply test data and affidavits showing compliance with these requirements. Tests shall have been conducted within six months of the start of manufacture of the pipe.
 - E. The gaskets shall be designed and manufactured so that the completed joint will withstand an internal water pressure in excess of 15 psi for a period of ten minutes without showing any leakage by the gasket or displacement of it, see ASTM C443. The pipe manufacturer shall provide facilities for testing the effectiveness of the joints against leakage and one such test may be required for each 500 feet of pipe. Such tests shall be made by an internal or external pressure against the joint of at least 15 psi for a period of ten minutes. The completed joint, when installed in place in the work, shall be capable of withstanding a ground water pressure of 15 psi without exceeding the allowable leakage specified herein.

- F. The pipe manufacturer shall furnish information and supervise the installation of at least the first five joints installed by the Contractor. The ends of the pipe shall be made true to form and dimension, and the bell shall be made by casting against steel forms.
- G. The manufacturer shall inspect all pipe joint surfaces for out-of-roundness and pipe ends for squareness. The manufacturer shall furnish to the Engineer a notarized affidavit stating all pipe meets the requirements of ASTM C76, these Specifications and the joint design.

3.00 EXECUTION

3.01 LAYING CONCRETE PIPE

- A. Care shall be taken in loading, transporting, and unloading to prevent injury to the pipe or fittings and the joint surfaces. Pipe or fittings shall not be dropped. All pipe or fittings shall be examined before laying, and no piece shall be installed which is found to be defective.
- B. The pipe shall be laid to the grade shown on the plans. The Contractor, or the Engineer shall stake the trench line with optical equipment. As soon as the excavation is completed to the normal grade of the bottom of the trench, the Contractor shall place screened gravel in the trench, and the pipe shall be firmly bedded in this gravel to conform accurately to the lines and grades indicated on the Drawings. Screened gravel shall conform to the requirements of Section 02200. Blocking under the pipe will not be permitted.

As an alternate to the above paragraph, if approved by the Engineer, the pipe may be laid on an approved subgrade of insitu soils. The trench must be excavated to grade and the trench bottom shall be finish to smooth, firm, and uniform finish. The trench shall be over excavated at the pipe bell location, so that the pipe loading shall be full resisted on the barrel of the pipe. Unstable soil shall be removed and replaced with gravel which shall be thoroughly tamped. The Engineer will determine the depth of removal, and the replacement of unstable soil shall be included in the gravel unit price item.

- C. Screened gravel shall be placed and compacted to give complete vertical and lateral support for the lower section of the pipe as indicated on the Drawings. A depression shall be left in the supporting gravel, or trench bottom, at the joint to prevent contamination of the rubber gasket immediately before being forced home. Before the

pipe is lowered into the trench, the spigot and bell shall be cleaned and free from dirt. Gasket, bell, and spigot shall be lubricated by a vegetable lubricant which is not soluble in water, furnished by the pipe manufacturer, and harmless to the rubber gasket. The rubber gasket shall be equalized in the spigot groove by running a smooth, round object, inserted between gasket and spigot, around the entire circumference several times. The pipe shall be properly aligned in the trench to avoid any possibility of contact with the side of the trench and fouling the gasket. As soon as the spigot is centered in the bell of the previously laid pipe, it shall be forced home with jacks or come-alongs. After the gasket is compressed and before the pipe is brought fully home, each gasket shall be carefully checked for proper position around the full circumference of the joint. Steel inserts shall be used to prevent the pipe from going home until the feeler gage is used to check the final position of the gasket. The jacks or come-alongs shall be anchored sufficiently back along the pipeline (a minimum of 5 lengths) so that the pulling force will not dislodge the pieces of pipe already in place. Only a jack or come-along shall be employed to force the pipe home smoothly and evenly and hold the pipe while backfilling is in progress. Under no circumstances shall crowbars be used nor shall any of the motor driven equipment be used.

- D. As soon as the pipe is in place and before the come-along is released, screened gravel, or select, backfill shall be placed as indicated on the Drawings and compacted for at least one-half the length of pipe. The Contractor shall take extra care to compact backfill under the pipe haunches. Not until this backfill is placed shall the come-along be released. If any motion at joints can be detected, a greater amount of back-fill shall be placed before pressure is released. When pipe laying is not in progress, including lunchtime, the open ends of the pipe shall be closed by a watertight plug or other approved means.
- E. The Contractor shall carefully regulate his equipment and construction operations such that the loading of the pipe does not exceed the loads for which the pipe is designed and manufactured. Any pipe damaged during construction operations shall promptly and satisfactorily be repaired or replaced at the Contractor's expense.
- F. The interior joints of all pipes, 30 inches and larger shall be filled with non-shrinking grout after the backfilling and testing is completed. Grout shall consist of one part by volume of cement, 1-1/2 parts by volume of sand, conforming to ASTM C33 and 1/4 part by volume of EMBECO or equal. The mixture shall have a dry, crumbly consistency

and shall be pounded into place and troweled to make a smooth joint.

3.02 TESTING AND CLEANING

A. Irrigation, or Raw Water, Pipeline Leak Test

The installed raw water line will be blocked and filled with water to operating pressure. All visible leaks will be repaired by the Contractor. Leak repair will be made as follows: The joint will be filled with non-shrink epoxy grout with a water activated polyurethane chemical grout pneumatically injected behind the non-shrink epoxy grout.

If leaks are excessive in the installed line, the Engineer reserves the right to require the Contractor to successfully complete joint-by-joint hydrostatic tests to 13 psi for 10 minutes on each repaired joint before final acceptance.

B. Low Pressure Air Test (These tests are not required for irrigation pipelines)

1. For making low-pressure air tests, the Contractor shall use equipment specifically designed and manufactured for the purpose of testing sewer pipelines using low-pressure air. The equipment shall be provided with an air regulator valve or air safety valve so set that the internal air pressure in the pipeline cannot exceed 8 psig. The leakage test using low-pressure air shall be made on each manhole-to-manhole section of pipeline. Pneumatic plugs shall have a sealing length equal to or greater than the diameter of the pipe to be tested. Pneumatic plugs shall resist internal test pressure without requiring external bracing or blocking. All air used shall pass through a single control panel.
2. Low-pressure air shall be introduced into the sealed line until the internal air pressure reaches 4 psig greater than the maximum pressure exerted by ground water that may be above the invert of the pipe at the time of the test. However, the internal air pressure in the sealed line shall not be allowed to exceed 8 psig. When the maximum pressure exerted by the ground water exceeds 4 psi, the Contractor shall only conduct an infiltration test as specified in Section 01666.

At least two minutes shall be allowed for the air pressure to stabilize in the section under test. After the stabilization period, the low-pressure air supply hose shall be quickly disconnected from the control panel. The time required in minutes for the pressure in the section under test to

decrease from 3.5 to 2.5 psig (greater than the maximum pressure exerted by ground water that may be above the invert of the pipe) shall not be less than that shown in the tables prepared by the National Clay Pipe Institute.

3. If the pipe section does not pass the air test, either sectionalize the section tested to determine the location of the leak or perform a hydrostatic leak test. Once the leak has been located, repair and retest.

END OF SECTION

**TABLE 31 41 30-1
TRENCH SHORING, MINIMUM REQUIREMENTS**

Depth Of Trench Feet	Kind or Condition of Earth	Size and Spacing of Members										
		Uprights		Stringers		Cross Braces		Width of Trench		Maximum Spacing		
		Minimum Dimension Inches	Maximum Spacing Feet	Minimum Dimension Inches	Maximum Spacing Feet	Up to 3 Feet Inches	3-6 Feet Inches	6-9 Feet Inches	9-12 Feet Inches	12-15 Feet Inches	Vertical Feet	Horizontal Feet
5 to 10	Hard, Compact	3 x 4 or 2 x 6	6	---	---	2 x 6	4 x 4	4 x 6	6 x 6	6 x 8	4	6
	Likely to Crack	3 x 4 or 2 x 6	3	4 x 6	4	2 x 6	4 x 4	4 x 6	6 x 6	6 x 8	4	6
	Soft, Sandy or Filled	3 x 4 or 2 x 6	Close Sheeting	4 x 6	4	4 x 4	4 x 6	6 x 6	6 x 8	8 x 8	4	6
	Hydrostatic Pressure	3 x 4 or 2 x 6	Close Sheeting	6 x 8	4	4 x 4	4 x 6	6 x 6	6 x 8	8 x 8	4	6
10-15	Hard, Compact	3 x 4 or 2 x 6	4	4 x 6	4	4 x 4	4 x 6	6 x 6	6 x 8	8 x 8	4	6
	Likely to Crack	3 x 4 or 2 x 6	2	4 x 6	4	4 x 4	4 x 6	6 x 6	6 x 8	8 x 8	---	6
	Soft, Sandy or Filled	3 x 4 or 2 x 6	Close Sheeting	4 x 6	4	4 x 6	6 x 6	6 x 8	8 x 8	8 x 10	4	6
	Hydrostatic Pressure	3 x 6	Close Sheeting	8 x 10	4	4 x 6	6 x 6	6 x 8	8 x 8	8 x 10	4	6
15-20	All Kinds of Conditions	3 x 6	Close Sheeting	4 x 12	4	4 x 12	6 x 8	8 x 8	8 x 10	10 x 10	4	6
Over 20	All Kinds of Conditions	3 x 6	Close Sheeting	6 x 8	4	4 x 12	8 x 8	8 x 10	10 x 12	10 x 12	4	6

Trench jacks may be used in lieu of, or in combination with cross braces

Shoring is not required in solid rock, hard shale or hard slag.

Where desirable, steel sheet piling and bracing of equal strength may be substituted for wood.

SECTION 314133 - TRENCH PROTECTION SYSTEM

1.00 GENERAL

1.01 GENERAL DESCRIPTION OF WORK

- A. This work shall consist of shoring, bracing, bank stabilization, bank sloping, providing trench boxes or trench shields or other equivalent means to protect employees from the effects of moving ground or cave-ins for all trenches 5-feet or more in depth.
- B. All work shall be done in conformance with OSHA Safety and Health Standards (29 CFR 1926/1010 Chapter XVII Subpart P-Excavations, Trenching and Shoring.).
- C. Trench safety plan shall be submitted by a Texas Registered Professional Engineer 30 days prior to commencement of any trenching operation in accordance with the Special Provisions of the specifications.

1.02 DEFINITIONS APPLICABLE TO THIS SPECIFICATION

- A. "Accepted engineering requirements (or practices)" - Those requirements or practices which are compatible with standards required a Registered Professional Engineer, or other duly licensed or recognized authority.
- B. "Angle of repose" - The greatest angle above the horizontal plane at which a material will lie without sliding.
- C. "Bank" - A mass of soil rising above a digging level.
- D. "Belled excavation" - A part of shaft or footing excavation, usually near the bottom and bell-shaped; i.e., an enlargement of the cross section above.
- E. "Braces (trench)" - The horizontal members of the shoring system whose ends bear against the uprights or stringers.
- F. "Excavation" - Any manmade cavity or depression in the earth's surface, including its sides, walls, or faces, formed by earth removal and producing unsupported earth conditions by reasons of the excavation. If installed forms or similar structures reduce the depth-to-width relationship, an excavation may become a trench.
- G. "Faces" - See paragraph (k) of this section.

- H. "Hard compact soil" - All earth materials not classified as running or unstable.
- I. "Kickouts" - Accidental release or failure of a shore or brace.
- J. "Sheet pile" - A pile, or sheeting, that may form one of the continuous interlocking line, or a row of timber, concrete, or steel piles, driven in close contact to provide a tight wall to resist the lateral pressure of water, adjacent earth, or other materials.
- K. "Sides", "Walls", or "Faces" - The vertical or inclined earth surfaces formed as a result of excavation work.
- L. "Slope" - The angle with the horizontal at which a particular earth material will stand indefinitely without movement.
- M. "Stringers" (wales) - The horizontal members of a shoring system whose sides bear against the uprights or earth.
- N. "Trench" - A narrow excavation made below the surface of the ground. In general, the depth is greater than the width, but the width of a trench is not greater than 15-feet.
- O. "Trench shield" - A shoring system composed of steel plates and bracing, welded or bolted together, which support the walls of a trench from the ground level to the trench bottom and which can be moved along as work progresses.
- P. "Unstable soil" - Earth material, other than running, that because of its nature of the influence of related conditions cannot be depended upon to remain in place without extra support, such as would be furnished by a system of shoring.
- Q. "Uprights" - the vertical members of a shoring system.
- R. "Wales" - See paragraph M of this section.
- S. "Walls" - See paragraph K of this section.

2.00 PRODUCTS

No information for this section

3.00 EXECUTION

3.01 GENERAL PROTECTION REQUIREMENTS

- A. Walkways, runways, and sidewalks shall be kept clear of excavated material or other obstructions and no sidewalks shall be undermined unless shored to carry a minimum live load of one hundred and twenty-five (125) pounds per square foot.
- B. If planks are used for raised walkways, runways, or sidewalks they shall be laid parallel to the length of the walk and fastened together against displacement.
- C. Planks shall be uniform in thickness and all exposed ends shall be provided with beveled cleats to prevent tripping.
- D. Raised walkways, runways, and sidewalks shall be provided with plank steps on string stringers. Ramps, used in lieu of steps, shall be provided with cleats to insure a safe walking surface.
- E. All employees shall be protected with personal protective equipment for the protection of the head, eyes, respiratory organs, hands, feet and other parts of the body as set forth in OSHA Standards.
- F. Employees exposed to vehicular traffic shall be provided with and shall be instructed to wear warning vests marked with or made or reflectorized with high visibility material.
- G. Employees subjected to hazardous dusts, gases, fumes, mists, or atmospheres deficient in oxygen, shall be protected with approved respiratory protection as set forth in OSHA Standards.
- H. No person shall be permitted under loads handled by power shovels, derricks, or hoists. To avoid any spillage, employees shall be required to stand away from any vehicle being loaded.
- I. Daily inspections of excavations shall be made by a competent person. If evidence of possible cave-ins or slides is apparent, all work in the excavation shall cease until the necessary precautions have been taken to safeguard employees.

3.02 SPECIFIC EXCAVATION REQUIREMENTS

- A. Prior to opening an excavation, effort shall be made to determine

- whether underground installations, i.e., sewer, telephone, water, fuel, electric lines, etc., will be encountered, and if so, where such underground installations are located. When the excavation approaches the estimated location of such an installation, the exact location shall be determined and when it is uncovered, proper supports shall be provided for the existing installation. Utility companies shall be contacted and advised of proposed work prior to the start of actual excavation.
- B. Trees, boulders, and other surface encumbrances, located so as to create a hazard employees involved in excavation work or in the vicinity thereof at any time during operations, shall be removed or made safe before excavating is begun.
 - C. The walls and faces of all excavations in which employees are exposed to danger from moving ground shall be guarded by a shoring system, sloping of the ground or some other equivalent means.
 - D. Excavations shall be inspected by a competent person after every rainstorm or other hazard-increasing occurrence, and the protection against slides and cave-ins shall be increased if necessary.
 - E. The determination of the angle of repose and design of the supporting system shall be based on careful evaluation of pertinent factors such as: Depth of cut; possible variation in water content of the material while the excavation is open; anticipated changes in materials from exposure to air, sun, water, or freezing; loading imposed by structures, equipment, overlying materials, or stored material; and vibration from equipment, blasting, traffic, or other sources.
 - F. Supporting systems, i.e., piling, cribbing, shoring, etc., shall be designed by a qualified person and meet accepted engineering requirements. When tie rods are used to restrain the top of sheeting or other retaining systems, the rods shall be securely anchored well back of the angle of repose. When tight sheeting or sheet piling is used, full loading due to ground water table shall be assumed, unless prevented by weep holes or drains or other means. Additional stringers, ties, and bracing shall be provided to allow for any necessary temporary removal of individual supports.
 - G. All slopes shall be excavated to at least the angle of repose except for areas where solid rock allows for line drilling or presplitting.
 - H. The angle of repose shall be flattened when an excavation has water conditions, silty materials, loose boulders, and areas where erosion deep frost action and slide planes appear.

- I. Clearances:
 - 1. In excavations which employees may be required to enter, excavated or other material shall be effectively stored and retained at least 2-feet or more from the edge of the excavation.
 - 2. an alternative to the clearance prescribed in subparagraph 1, the Contractor may use effective barriers or other effective retaining devices in lieu thereof in order to prevent excavated or other materials from falling into the excavation.
- J. Sides, slopes, and faces of all excavations shall meet accepted engineering requirements by scaling, benching, barricading, rock bolting, wire meshing or other equally effective means. Special attention shall be given to slopes which may be adversely affected by weather or moisture content.
- K. Support systems shall be planned and designed by a qualified person when excavation is in excess of 20-feet in depth, adjacent to structures or improvements, or subject to vibration or ground water.
- L. Materials used for sheeting, sheet piling, cribbing, bracing, shoring and underpinning shall be in good serviceable condition, and timbers shall be sound, free from large or loose knots, and of proper dimensions.
- M. Special precautions shall be taken in sloping or shoring the sides of excavations adjacent to previously backfilled excavation for a fill, particularly when the separation is less than the depth of the excavation. Particular attention also shall be paid to joints and seams of material comprising a face and the slope of such seams and joints.
- N. Except in hard rock, excavations below the level of the base of footing of any foundation or retaining wall shall not be permitted, unless the wall is underpinned and all other precautions taken to insure the stability of the adjacent walls for the protection of employees involved in excavation work or in the vicinity thereof.
- O. If the stability of adjoining building or walls is endangered by excavations, shoring, bracing or underpinning shall be provided as necessary to insure their safety. Such shoring, bracing or underpinning shall be inspected daily or more often, as conditions warrant, by a competent person the protection effectively maintained.
- P. Diversion ditches, dikes, or other suitable means shall be used to prevent surface water from entering an excavation and to provide adequate drainage of the area adjacent to the excavation. Water shall not be

allowed to accumulate in an excavation.

- Q. If it is necessary to place or operate power shovels, derricks, trucks, materials, or other heavy objects on a level above and near an excavation, the side of the excavation shall be sheet-piled, shored, and braced as necessary to resist the extra pressure due to such superimposed loads.
- R. Blasting and the use of explosives are not allowed unless authorized in other portions of the specifications.
- S. When mobile equipment is utilized or allowed adjacent to excavations, substantial stop logs or barricades shall be installed. If possible, the grade should be away from the excavation.
- T. Adequate barrier physical protection shall be provided at all remotely located excavations. All wells, pits shafts, etc., shall be barricaded or covered. Upon completion of exploration and similar operations, temporary wells, pits, shafts, etc. shall be backfilled.
- U. If possible, dust conditions shall be kept to a minimum by the use of water, salt, calcium chloride, oil, or other means.
- V. In locations where oxygen deficiency or gaseous conditions are possible, air in the excavation shall be tested. Controls, as set forth in OSHA Standards shall be established to assure acceptable atmospheric conditions. When flammable gases are present, adequate ventilation shall be provided or sources of ignition shall be eliminated. Attended emergency rescue equipment, such as breathing apparatus, a safety harness and line, basket stretcher, etc. shall be readily available where adverse atmospheric conditions may exist or develop in an excavation.
- W. Where employees or equipment are required or permitted to cross over excavations, walkways or bridges with standard guardrails shall be provided.
- X. Where ramps are used for employees or equipment, they shall be designed and constructed by qualified persons in accordance with accepted engineering requirements.
- Y. All ladders used on excavation operations shall be in accordance with requirements of OSHA Standards.

3.03 SPECIFIC TRENCHING REQUIREMENTS

- A. Banks more than 5-feet shall be shored, laid back to a stable slope or some other equivalent means of protection shall be provided where employees may be exposed to moving ground or cave-ins. Trenches less than 5-feet in depth shall also be effectively protected when examination of the ground indicates hazardous ground movement may be expected.
- B. Sides of trenches in unstable or soft material, 5-feet or more in depth, shall be shored, sheeted, braced, sloped, or otherwise supported by means of sufficient strength to protect the employees working within them.
- C. Sides of trenches in hard or compact soil, including embankments, shall be shored or otherwise supported when the trench is more than 5-feet in depth and 8-feet or more in length. In lieu of shoring, the sides of the trench above the 5-foot level may be sloped to preclude collapse, but shall not be steeper than a 1-foot rise to each 1/2-foot horizontal. When the outside diameter of a pipe is greater than 6-feet, a bench of 4-foot minimum shall be provided at the toe of the sloped portion.
- D. Materials used for sheeting and sheet piling, bracing, shoring, and underpinning, shall be in good serviceable condition, and timbers used shall be sound and free from large or loose knots, and shall be designed and installed so as to be effective to the bottom of the excavation.
- E. Additional precautions by way of shoring and bracing shall be taken to prevent slides or cave-ins when excavations or trenches are made in locations adjacent to backfilled excavations, or where excavations are subjected to vibrations from railroad or highway traffic, the operation of machinery, or any other source.
- F. Employees entering bell-bottom pier holes shall be protected by the installation of a removable-type casing of sufficient strength to resist shifting of the surrounding earth. Such temporary protection shall be provided for the full depth of that part of each pier and securely fastened to shoulder harness, shall be worn by each employee entering the shafts. This lifeline shall be individually manned and separate from any line used to remove materials excavated from the bell footing.
- G. Minimum requirements for trench timbering shall be in accordance with Table 19000-1. Braces and diagonal shores in a wood shoring system shall not be subjected to compressive stresses in excess of values given by the following formula:

$$S + 1300 - \frac{20L}{D}$$

$$\frac{\text{Maximum Ratio } L}{D} = 50$$

Where:

L = Length, unsupported, inches

D = Least side of the timber in inches

S = Allowable stress in pounds per square inch of cross-section.

- H. When employees are required to be in trenches 4-feet deep or more, an adequate means of exit, such as a ladder or steps shall be provided and located so as to require no more than 25-feet of lateral travel.
- I. Bracing or shoring of trenches shall be carried along with the excavation.
- J. Cross braces or trench jacks shall be placed in true horizontal position, be spaced vertically, and be secured to prevent sliding, falling, or kickouts.
- K. Portable trench boxes or sliding trench shields may be used for the protection of personnel in lieu of a shoring system or sloping. Where such trench boxes or shields are used, they shall be designed, constructed, and maintained in a manner which will provide protection equal to or greater than the sheeting or shoring required for the trench. The Contractor shall provide a statement certified by a Registered Professional Engineer of the adequacy of trench boxes or shields.
- L. Backfilling and removal of trench supports shall progress together from the bottom of the trench. Jacks or braces shall be released slowly and, in unstable soil, ropes shall be used to pull out the jacks or braces from above after employees have cleared the trench.

3.04 CONSTRUCTION REQUIREMENTS

- A. The Contractor unless provided for in the plans otherwise shall provide the minimum shoring shown in Table 19000-1 for the soil class noted in the plans.
- B. Should the soil conditions differ from those specified or should ground water be encountered in the excavation the contractor shall notify the Engineer immediately. The Contractor shall refrain from operating in that portion of the trench where changed conditions are noted until such time as an inspection of conditions takes place and the contractor is notified of measures necessary for continued operation.
- C. The Contractor shall prepare and submit a plan of operation. This plan of

operation shall identify material, equipment, methods and installation and shall be inspected by a Registered Professional Engineer. The Contractor's Engineer shall certify the adequacy of the trench protection system and its adherence of OSHA Standards.

4.00 MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

- A. Providing shoring in trenches or other alternate means in accordance with this specification shall be measured by the linear foot of trench of specified sizes or sizes of pipe in ranges of depth to the invert elevation of the pipe or structure. Additional depth for foundations, etc. shall be considered incidental to the price bid for the protection.
- B. The Contractor shall provide shoring systems for construction of structures 5-feet or greater in depth. There will be no direct payment for these systems but it shall be considered incidental to the price bid for the structure.

4.02 PAYMENT

- A. The unit price bid for trench protection shall be full compensation for providing acceptable shoring or other alternate means, installing, inspecting, certifying and maintaining the shoring and for all manipulations, labor, tools, equipment and incidentals necessary to complete the work.
- B. When not listed as a separate contract pay item, trench protection system shall be considered as incidental work, and the cost thereof shall be included in such contract pay item(s) as are provided in the proposal contract.

END OF SECTION

SECTION 321100 – BASE COURSES

1.00 GENERAL

1.01 SECTION INCLUDES

- A. Granular Base
- B. Caliche Base
- C. Full Depth Asphalt Base
- D. Hot Mix Sand Asphalt Base
- E. Soil Cement Stabilized Base

1.02 RELATED SECTIONS

- A. Section 31 10 10 – Site Clearing, Grading and Filling
- B. Section 31 23 00 – Excavation and Fill
- C. Section 32 11 23 – Aggregate Base Courses
- D. Section 32 12 16 – Asphalt Paving
- E. Section 32 13 13 – Concrete Paving
- F. Section 32 16 13 – Concrete Curbs and Gutters
- G. Section 32 92 00 – Lawns and Hydromulch
- H. Construction Drawings

1.03 REFERENCES

- A. ANSI/ASTM D698 – Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 5.5 lb (2.49 kg) Rammer and 12 inch (304.8 mm) Drop.
- B. ANSI/ASTM D1557 – Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures using 10 lb (4.4 kg) Rammer and 18 inch (457 mm) Drop.

- C. ASTM D2167 – Test Method for Density and Unit Weight of Soil in-place by the Rubber Balloon Method.
- D. ASTM D1556 – Test Method for Density of Soil in-place by the Sand-Cone Method.
- E. ASTM D2922 – Test Methods for Density of Soil and Soil-Aggregate in-place by Nuclear Methods (Shallow Depth), Method B (Direct Transmission).
- F. ASTM D3017 – Test Methods for Moisture Content of Soil and Soil-Aggregate Mixtures.

2.00 PRODUCTS

2.01 FILL MATERIALS

- A. Submit materials certificate to on-site independent testing laboratory which is signed by material producer and Contractor, certifying that material comply with, or exceed, the requirements herein.

3.00 EXECUTION

3.01 EXAMINATION

Contractor shall verify that the subgrade has been inspected, tested and the gradients and elevations are correct, dry and properly prepared.

3.02 CONSTRUCTION

- A. Perform base course construction in a manner that will drain surface properly at all times and at the same time prevent runoff from adjacent areas from draining onto base course construction.
- B. Compact base material to not less than 98% of optimum density as determined by ASTM D698 or 95% of optimum density, as determined by ASTM D1557, unless otherwise indicated on the drawings.
- C. Granular Base: Construct to thickness indicated on drawings. Apply in lifts or layers not exceeding 8", measured loose.

- D. Caliche Base: Construct to thickness indicated on drawings. Use Type A or B, Grades 1, 2, or 3 Caliche per TXDOT Spec Item 247.
- E. Asphalt Institute Type IV Mix for Full Depth Asphalt Base: Construct to thickness indicated on drawings in lifts or layers not exceeding 3", measured loose.
- F. Asphalt Institute Type VI, VII, or VIII Mixes for Hot Mix Sand Asphalt Bases: Construct to thickness indicated on drawings. Apply in lifts or layers not exceeding 3", measured loose.
- G. Soil Cement Stabilized Base: Construct to thickness and strength as indicated on drawings and in accordance with applicable state highway specifications. If not indicated on the drawings, the minimum compressive strength shall be 500 psi, tested at 28 days.

3.03 FIELD QUALITY CONTROL

- A. An Independent Testing Laboratory, selected and paid by Owner, shall be retained to perform construction testing of in-place base courses for compliance with requirements for thickness, compaction, density and tolerance. Paving base course tolerances shall be verified (by rod and level readings on not more than fifty (50) foot centers) to be not more than 0.10 feet above design elevation which will allow for paving thicknesses as shown in the drawings. Contractor shall provide instruments and suitable benchmark.
 - 1. The following tests shall be performed on each type of material used as base course material:
 - a. Moisture and Density Relationship: ASTM D698 or ASTM D1557
 - b. Mechanical Analysis: AASHTO T-88
 - c. Plasticity Index: ASTM D4318
 - d. Base material thickness: Perform one test for each 20,000 square foot of in-place base material area.
 - e. Base material compaction: Perform one test in each lift for each 20,000 square feet of in-place base material area.
 - f. Test each course of base material for compliance with applicable state highway specifications.
- B. Field density tests for in-place materials shall be performed according to one of the following standards as part of construction testing requirements:
 - 1. San-Cone Method: ASTM D1556
 - 2. Balloon Method: ASTM D2167
 - 3. Nuclear Method: ASSTM D2922, Method B (Direct Transmission).

C. Independent Testing Laboratory shall prepare test reports that indicate test location, elevation data, and test results. The Owner, Engineer, and Contractor shall be provided with copies of reports within 96 hours of time test was performed. In event that any test performed fails to meet these specifications, the Owner, Engineer and Contractor shall be notified immediately by Independent Testing Laboratory. The Owner reserves right to employ Independent Testing Laboratory and to direct any testing that is deemed by them to be necessary. Contractor shall provide free access to site for testing activities.

END OF SECTION

SECTION 321120 – SUBGRADE PREPARATION

(Referenced from 2004 TxDOT, ITEM 260 Lime Treatment (Road-Mixed) – references made to any other Sections of the 2004 TxDOT Manual shall become part of the Contract to be followed)

260. Description. Mix and compact lime, water, and subgrade or base (with or without asphaltic concrete pavement) in the roadway.

260.2. Materials. Furnish uncontaminated materials of uniform quality that meet the requirements of the plans and specifications. Notify the Engineer of the proposed material sources and of changes to material sources. Obtain verification from the Engineer that the specification requirements are met before using the sources. The Engineer may sample and test project materials at any time before compaction. Use Tex-100-E for material definitions.

- A. Lime. Furnish lime that meets the requirements of DMS-6350 "Lime and Lime Slurry," and DMS-6330, "Lime Sources Prequalification of Hydrated Lime and Quicklime." Use hydrated lime, commercial lime slurry, or quicklime, as shown on the plans. When furnishing quicklime, provide it in bulk.
- B. Flexible Base. Furnish base material that meets the requirements of Section 32 11 40, "Flexible Base," for the type and grade shown on the plans, before the addition of lime.
- C. Water. Furnish water free of industrial wastes and other objectionable material.
- D. Asphalt. When asphalt or emulsion is permitted for curing purposes, furnish materials that meet the requirements of Section 32 12 20, "Asphalts, Oils, and Emulsions," as shown on the plans or as directed.
- E. Mix Design. The Engineer will determine the target lime content and optimum moisture content in accordance with Tex-121-E or prior experience with the project materials. The Contractor may propose a mix design developed in accordance with Tex-121-E. The Engineer will use Tex-121-E to verify the Contractor's proposed mix design before acceptance. Reimburse the Department for subsequent mix designs or partial designs necessitated by changes in the material or requests by the Contractor. When treating existing materials, limit the amount of asphalt concrete pavement to no more than 50% of the mix unless otherwise shown on the plans or directed.

260.3. Equipment. Provide machinery, tools, and equipment necessary for proper

execution of the work. Provide rollers in accordance with Section 32 11 24, "Rolling." Provide proof rollers in accordance with Section 32 11 25, "Proof Rolling," when required.

- A. Storage Facility. Store quicklime and dry hydrated lime in closed, weatherproof containers.
- B. Slurry Equipment. Use slurry tanks equipped with agitation devices to slurry hydrated lime or quicklime on the project or other approved location. The Engineer may approve other slurring methods.

Provide a pump for agitating the slurry when the distributor truck is not equipped with an agitator. Equip the distributor truck with a sampling device in accordance with Tex-600-J, Part I, when using commercial lime slurry.

- C. Pulverization Equipment. Provide pulverization equipment that:

- cuts and pulverizes material uniformly to the proper depth with cutters that plane to a uniform surface over the entire width of the cut,
- provides a visible indication of the depth of cut at all times, and
- uniformly mixes the materials.

260.4. Construction. Construct each layer uniformly, free of loose or segregated areas, and with the required density and moisture content. Provide a smooth surface that conforms to the typical sections, lines, and grades shown on the plans or as directed.

- A. Preparation of Subgrade or Existing Base for Treatment. Before treating, remove existing asphalt concrete pavement when shown on the plans or as directed. Shape existing material in accordance with applicable bid items to conform to typical sections shown on the plans and as directed.

When shown on the plans or directed, proof roll the roadbed in accordance with Section 32 11 25, "Proof Rolling," before pulverizing or scarifying existing material. Correct soft spots as directed.

When new base material is required to be mixed with existing base, deliver, place, and spread the new material in the required amount per station. Manipulate and thoroughly mix new base with existing material to provide a uniform mixture to the specified depth before shaping.

- B. Pulverization. Pulverize or scarify existing material after shaping so that 100% passes a 2-1/2-in. sieve. If the material cannot be uniformly processed to the required depth in a single pass, excavate and windrow the material to

expose a secondary grade to achieve processing to plan depth.

- C. Application of Lime. Uniformly apply lime using dry or slurry placement as shown on the plans or as directed. Add lime at the percentage determined in Section 260.2.E, "Mix Design." Apply lime only on an area where mixing can be completed during the same working day.

Start lime application only when the air temperature is at least 35°F and rising or is at least 40°F. The temperature will be taken in the shade and away from artificial heat. Suspend application when the Engineer determines that weather conditions are unsuitable.

Minimize dust and scattering of lime by wind. Do not apply lime when wind conditions, in the opinion of the Engineer, cause blowing lime to become dangerous to traffic or objectionable to adjacent property owners. When pebble grade quicklime is placed dry, mix the material and lime thoroughly at the time of lime application. *Use of quicklime can be dangerous. Inform users of the recommended precautions for handling and storage.*

1. Dry Placement. Before applying lime, bring the prepared roadway to approximately optimum moisture content. When necessary, sprinkle in accordance with Section 32 84 23, "Sprinkling." Distribute the required quantity of hydrated lime or pebble grade quicklime with approved equipment. Only hydrated lime may be distributed by bag. Do not use a motor grader to spread hydrated lime.
2. Slurry Placement. Provide slurry free of objectionable materials, at or above the approved minimum dry solids content, and with a uniform consistency that will allow ease of handling and uniform application. Deliver commercial lime slurry to the jobsite or prepare lime slurry at the jobsite or other approved location by using hydrated lime or quicklime, as specified.

Distribute slurry uniformly by making successive passes over a measured section of roadway until the specified lime content is reached. Uniformly spread the residue from quicklime slurry over the length of the roadway being processed, unless otherwise directed.

- D. Mixing. Begin mixing within 6 hours of application of lime. Hydrated lime exposed to the open air for 6 hours or more between application and mixing, or that experiences excessive loss due to washing or blowing, will not be accepted for payment.

Thoroughly mix the material and lime using approved equipment. Allow

the mixture to mellow for 1 to 4 days, as directed. When pebble grade quicklime is used, allow the mixture to mellow for 2 to 4 days, as directed. Sprinkle the treated materials during the mixing and mellowing operation, as directed, to achieve adequate hydration and proper moisture content. After mellowing, resume mixing until a homogeneous, friable mixture is obtained.

After mixing, the Engineer will sample the mixture at roadway moisture and test in accordance with Tex-101-E, Part III, to determine compliance with the gradation requirements in Table 1.

Table 1 Gradation Requirements (Minimum % Passing)

Sieve Size	Base	Subgrade
1-3/4 in.	100	100
3/4 in.	85	85
No. 4	–	60

- E. Compaction. Compact the mixture using density control, unless otherwise shown on the plans. Multiple lifts are permitted when shown on the plans or approved. Bring each layer to the moisture content directed. When necessary, sprinkle the treated material in accordance with Section 32 84 23, "Sprinkling." Determine the moisture content of the mixture at the beginning and during compaction in accordance with Tex-103-E.

Begin rolling longitudinally at the sides and proceed toward the center, overlapping on successive trips by at least one-half the width of the roller unit. On super elevated curves, begin rolling at the low side and progress toward the high side. Offset alternate trips of the roller. Operate rollers at a speed between 2 and 6 MPH, as directed. Rework, re-compact, and refinish material that fails to meet or that loses required moisture, density, stability, or finish before the next course is placed or the project is accepted. Continue work until specification requirements are met. Rework in accordance with Section 260.4.F, "Reworking a Section." Perform the work at no additional expense to the Department.

1. Ordinary Compaction. Roll with approved compaction equipment, as directed. Correct irregularities, depressions, and weak spots immediately by scarifying the areas affected, adding or removing treated material as required, reshaping, and re-compacting.
2. Density Control. The Engineer will determine roadway density of completed sections in accordance with Tex-115-E. The Engineer may

accept the section if no more than 1 of the 5 most recent density tests is below the specified density and the failing test is no more than 3 pcf below the specified density.

a. Subgrade. Compact to at least 95% of the maximum density determined in accordance with Tex-121-E, unless otherwise shown on the plans.

b. Base. Compact the bottom course to at least 95% of the maximum density determined in accordance with Tex-121-E, unless otherwise shown on the plans. Compact subsequent courses treated under this Item to at least 98% of the maximum density determined in accordance with Tex-121-E, unless otherwise shown on the plans.

F. Reworking a Section. When a section is reworked within 72 hours after completion of compaction, rework the section to provide the required density. When a section is reworked more than 72 hr. after completion of compaction, add additional lime at 25% of the percentage determined in Section 260.2.E, "Mix Design." Reworking includes loosening, adding material or removing unacceptable material if necessary, mixing as directed, compacting, and finishing. When density control is specified, determine a new maximum density of the reworked material in accordance with Tex-121-E, and compact to at least 95% of this density or as shown on the plans.

G. Finishing. Immediately after completing compaction of the final course, clip, skin, or tight-blade the surface of the lime-treated material with a maintainer or subgrade trimmer to a depth of approximately 1/4 in. Remove loosened material and dispose of at an approved location. Roll the clipped surface immediately with a pneumatic tire roller until a smooth surface is attained. Add small amounts of water as needed during rolling. Shape and maintain the course and surface in conformity with the typical sections, lines, and grades shown on the plans or as directed.

Finish grade of constructed subgrade in accordance with Section 132.3.F.1, "Grade Tolerances." Finish grade of constructed base in accordance with Section 02601.4.D, "Finishing."

H. Curing. Cure for the minimum number of days shown in Table 2 by sprinkling in accordance with Section 32 84 23, "Sprinkling," or by applying an asphalt material at a rate of 0.05 to 0.20 gal. per square yard as directed. Maintain moisture during curing. Upon completion of curing, maintain the moisture content in accordance with Article 132.3E, "Maintenance of Moisture and Reworking" for subgrade and Article 247.4E, "Curing" for bases prior to placing subsequent courses. Do not allow equipment on the finished course

during curing except as required for sprinkling, unless otherwise approved. Apply seals or additional courses within 14 calendar days of final compaction.

Table 2 Minimum Curing Requirements before Placing Subsequent Courses¹

Untreated Material	Curing (Days)
$PI \leq 35$	2
$PI > 35$	5

260.5 MEASUREMENT AND PAYMENT

- A. When listed as a separate contract pay item, shall be measured in accordance with "Measurement and Basis of Payment" section or as shown on the Bid Proposal Form.
- B. When not listed as a separate contract pay item, shall be considered as incidental work, and the cost thereof shall be included in such contract pay item(s) as are provided in the proposal contract.
- C. Compensation, whether by contract pay item or incidental work will be for furnishing all materials, labor, equipment, tools and incidentals required for the work, all in accordance with the plans and these specifications.

END OF SECTION

SECTION 32 11 23 – AGGREGATE BASE COURSES

1.00 GENERAL

1.01 SECTION INCLUDES

A. Aggregate Materials

1.02 RELATED SECTION

- A. Section 31 10 10 – Site Clearing, Grading and Filling
- B. Section 31 23 00 – Excavation and Fill
- C. Section 31 23 33 – Trench Excavation and Backfill
- D. Section 31 22 16 – Fine Grading
- E. Section 31 25 00 – Erosion and Sedimentation Controls
- F. Construction Drawings

1.03 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM) latest edition.
 - ANSI/ASTM C136 - Method for Sieve Analysis of Fine and Course Aggregates.
 - ANSI/ASTM D698 - Test Methods for Moisture-Density Relations of Soils and Soil Aggregate Mixtures using 5.5 lb (2.49 kg) Rammer and 12-inch (304.8 mm) Drop.
 - ANSI/ASTM D1557 - Test Method of Moisture-Density Relations of soils and Soil Aggregate Mixtures using 10 lb (4.54 kg) Rammer and 18-inch (457) Drop.
 - ASTM D2167 - Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
 - ASTM D2487 - Classification of Soils for Engineering Purposes.
 - ASTM D2922 - Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
 - ASTM D3017 - Test Methods for Moisture Content of Soil and Soil-Aggregate Mixtures.
 - ASTM D4318 - Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
- B. American Association of State Highway and Transportation Officials (AASHTO) latest edition.
 - AASHTO T180 – Moisture-Density Relations of Soils Using a 10 lb (4.54 kg) Rammer and an 18-inch (457 mm) Drop.

ASSHTO M147 – Materials for Aggregate and Soil-Aggregate.

1.04 QUALITY ASSURANCE

Tests and analysis of aggregate material will be performed in accordance with standard ASTM and AASHTO procedures listed herein.

1.05 SUBMITTALS

- A. Submit in air tight containers a 10-pound sample of each aggregate or mixture that is to be incorporated into the project to the testing laboratory designated by the owner.
- B. Submit the name of each material supplier and specific type and source of each material. Any change in source throughout the job requires approval of the Owner and Engineer.
- C. Submit material certificate to on-site independent testing laboratory which is signed by material producer and Contractor, certifying that materials comply with, or exceed the requirements herein.

2.00 PRODUCTS

2.01 MATERIALS

- A. All construction and materials shall meet or exceed the requirements of this section and any state highway department specification section referred to or noted on the drawings which pertain to paving base course design, materials, preparation, and/or execution. All materials shall be as indicated on drawings and shall comply with applicable state highway specification regarding source, quality, gradation, liquid limit, plasticity index, and mix proportioning.

3.00 EXECUTION

3.01 STOCKPILING

- A. Stockpile on-site at locations indicated by the Owner in such a manner that there will be no standing water or mixing with other materials.

3.02 BORROW SITES

- A. Upon completion of borrow operations, clean up borrow areas as indicated on the plans in a neat and reasonable manner to the satisfaction of the property owner, the Owner and the Engineer.

3.03 TRANSPORTATION

- A. Off-site materials shall be transported to the project using well maintained and operating vehicles. Once on the job site, all transporting vehicles shall stay on designated haul roads and shall at no time endanger any of the improvements by rutting, overloading or pumping the haul road.

END OF SECTION

SECTION 321124 – ROLLING

(Referenced from 2004 TxDOT, ITEM 210 Rolling – references made to any other Sections of the 2004 TxDOT Manual shall become part of the Contract to be followed)

00210.1. Description. Compact embankment, subgrade, base, surface treatments, broken concrete pavement, or asphalt pavement using rollers. Break up asphalt mats, pit run material, or base materials.

00210.2. Equipment. The Contractor may use any type of roller to meet the production rates and quality requirements of the Contract unless otherwise shown on the plans or directed. When specific types of equipment are required, use equipment that meets the requirements of this Article. The Engineer may allow the use of rollers that operate in one direction only when turning does not affect the quality of work or encroach on traffic.

Table 1
Roller Requirements¹

Roller Type	Materials to be Compacted	Load (tons)	Contact Pressure	Roller Speed (mph)
Steel wheel	Embankment, subgrade, base, asphalt concrete	≥ 10	≥ 325 lb. per linear inch of wheel width	2–3
Tamping	Embankment, subgrade, base	–	125–550 psi per tamping foot	2–3
Heavy tamping	Embankment, subgrade, base	–	≤ 550 psi per tamping foot	2–3
Vibratory	Embankment, subgrade, base, asphalt concrete	Type A < 6 Type B > 6 Type C as shown on plans	Per equipment specification and as approved	As approved
Light pneumatic	Embankment, subgrade, base, surface treatment	4.5–9.0	≥ 45 psi	2–6
	Asphalt Concrete			4–12
Medium pneumatic	Same as light pneumatic	12–25	≥ 80 psi, as directed	Same as light pneumatic
Heavy pneumatic	Embankment, subgrade, base, previously broken concrete pavement, other pavements	≥ 25	≤ 150 psi	2–6
Grid	Embankment, base, breaking up existing asphalt mats or base	5–13	–	2–3

1. Unless otherwise specified in the Contract.

- A. Static Steel Wheel Rollers. Furnish single, double, or triple steel wheel, self-propelled power rollers weighing at least 10 tons capable of operating in a forward and backward motion. Ensure all wheels are flat. When static steel wheel rollers are required, vibratory rollers in the static mode may be used.

For single steel wheel rollers, pneumatic rear wheels are allowed for embankment, subgrade, and base. For triple steel wheel rollers, provide

rear wheels with a minimum diameter of 48 in., a minimum width of 20 in., and a minimum compression of 325 lb. per inch of wheel width.

- B. Tamping Rollers. Furnish self-propelled rollers with at least 1 self-cleaning metal tamping drum capable of operating in a forward or backward motion with a minimum effective rolling width of 5 ft. For rollers with more than 1 drum, mount drums in a frame so that each drum moves independently of the other. Operate rollers in static or vibratory mode.
1. Tamping Roller (Minimum Requirement). For all tamping rollers except for heavy tamping rollers, provide tamping feet that exert a static load of 125 to 550 psi and project at least 3 in. from the surface of the drum.
 2. Heavy Tamping Roller. Provide tamping rollers that have:
 - 2 metal tamping drums, rolls, or shells, each with a 60-in. minimum diameter and a 5-ft. minimum width, or
 - 1 rear and 2 forward drums, each with a 60-in. minimum diameter. Arrange drums so that the rear drum compacts the space between the 2 forward drums and the minimum overall rolling width is 10 ft.

Equip drums with tamping feet that:

- project at least 7 in. from the drum surface,
- have an area of 7 to 21 sq. in.,
- are self-cleaning,
- exert a static load of at least 550 psi, and
- are spaced at 1 tamping foot per 0.65 to 0.70 sq. ft. of drum area.

- C. Vibratory Rollers. Furnish self-propelled rollers with at least 1 drum equipped to vibrate. Select and maintain amplitude and frequency settings per manufacturer's specifications to deliver maximum compaction without material displacement or shoving, as approved. Furnish the equipment manufacturer's specifications concerning settings and controls for amplitude and frequency. Operate rollers at speeds that will produce at least 10 blows per foot unless otherwise shown on the plans or approved. Pneumatic rear wheels are allowed for embankment, subgrade, and base. Equip each vibrating drum with:

- separate frequency and amplitude controls,
- controls to manually start and stop vibration, and
- a mechanism to continuously clean the face of the drum.

For asphalt-stabilized base and asphalt concrete pavement, furnish a roller that also has the ability to:

- automatically reverse the direction of the rotating eccentric weight,
- stop vibration before the motion of the roller stops, and
- thoroughly moisten the drum with water or approved asphalt release agent.

1. **Drum (Type A).** Furnish a roller with a static weight less than 6 tons and a vibratory drum.
2. **Drum (Type B).** Furnish a roller with a minimum static weight of 6 tons and a vibratory drum.
3. **Drum (Type C).** Furnish a roller as shown on plans.

D. **Pneumatic Tire Rollers.** Pneumatic tire rollers consist of rubber tire wheels on axles mounted in a frame with either a loading platform or body suitable for ballast loading. Arrange the rear tires to cover the gaps between adjacent tires of the forward group. Furnish rollers capable of forward and backward motion. Compact asphalt pavements and surface treatments with a roller equipped with smooth-tread tires. Compact without damaging the surface. When necessary, moisten the wheels with water or an approved asphalt release agent.

Select and maintain the operating load and tire air pressure within the range of the manufacturer's charts or tabulations to attain maximum compaction throughout the lift, as approved. Furnish the manufacturer's chart or tabulations showing the contact areas and contact pressures for the full range of tire inflation pressures and for the full range of loadings for the particular tires furnished. Maintain individual tire inflation pressures within 5 psi of each other. Provide uniform compression under all tires.

1. **Light Pneumatic Tire.** Furnish a unit:
 - with at least 9 pneumatic tires,
 - with an effective rolling width of approximately 5 ft.,
 - capable of providing a total uniform load of 4.5 to 9 tons, and
 - with tires capable of maintaining a minimum ground contact pressure of 45 psi.
2. **Medium Pneumatic Tire.** Furnish a unit:
 - with at least 7 pneumatic tires,
 - with an effective rolling width of approximately 7 ft.,
 - capable of providing a total uniform load of 12 to 25 tons, and
 - with tires capable of maintaining a minimum ground contact pressure of 80 psi or 90 psi as directed.

3. Heavy Pneumatic Tire. Furnish a unit:

- with at least 4 pneumatic-tired wheels mounted on axles carrying at most 2 wheels,
- with wheels arranged to carry approximately equal loads on uneven surfaces,
- with a width between 8 and 10 ft. that can turn 180° in the crown width,
- capable of providing a total uniform load of at least 25 tons,
- with tires capable of maintaining a maximum ground contact pressure of 150 psi, and
- with liquid-filled tires inflated to such a level that liquid will flow from the valve stem when the stem is in the uppermost position.

E. Grid Rollers. Furnish rollers that have 2 cylindrical cages with a minimum diameter of 66 in. and a minimum width of 32 in. Mount cages in a rigid frame with weight boxes. Use a cage surface of cast or welded steel fabric grid with bars 1-1/2 in. wide, spaced on 5-in. centers in each direction, that undulate approximately 1 in. between the high and low points.

Furnish rollers capable of providing a total load of 5 to 13 tons and capable of being operated in a forward or backward motion.

F. Alternate Equipment. Instead of the specified equipment, the Contractor may, as approved, operate other compaction equipment that produces equivalent results. Discontinue the use of the alternate equipment and furnish the specified equipment if the desired results are not achieved.

00210.3. Construction. Perform this work in accordance with the applicable Items using equipment and roller speeds specified in Table 1. Use only rubber-tired equipment to push or pull compaction equipment on base courses. Use equipment that does not damage material being rolled.

00210.4. MEASUREMENT AND PAYMENT

- A. When listed as a separate contract pay item, shall be measured in accordance with "Measurement and Basis of Payment" section or as shown on the Bid Proposal Form.
- B. When not listed as a separate contract pay item, shall be considered as incidental work, and the cost thereof shall be included in such contract pay item(s) as are provided in the proposal contract.

- C. Compensation, whether by contract pay item or incidental work will be for furnishing all materials, labor, equipment, tools and incidentals required for the work, all in accordance with the plans and these specifications.

END OF SECTION

SECTION 321125 – PROOF ROLLING

(Referenced from 2004 TxDOT, ITEM 216 Proof Rolling – references made to any other Sections of the 2004 TxDOT Manual shall become part of the Contract to be followed)

00216.1. Description. Proof-roll earthwork, base, or both to locate unstable areas.

00216.2. Equipment.

- A. Specified Equipment.** Furnish rollers that when loaded weigh at least 25 tons. The maximum acceptable load is 50 tons. Provide rollers that meet the requirements of Section 210.2.D, "Pneumatic Tire Rollers."
- B. Alternative Equipment.** Instead of the specified equipment, the Contractor may, as approved, operate other compaction equipment that produces equivalent results in the same period of time. Discontinue the use of the alternative equipment and furnish the specified equipment if the desired results are not achieved.

00216.3. Construction. Perform proof rolling as directed. Adjust the load and tire inflation pressures within the range of the manufacturer's charts or tabulations, as directed. Make at least 2 coverages with the proof roller. Offset each trip of the roller by at most 1 tire width. Operate rollers at a speed between 2 and 6 miles per hour, as directed. If an unstable or nonuniform area is found, correct the area in accordance with the applicable Item.

00216.4. MEASUREMENT AND PAYMENT

- A.** When listed as a separate contract pay item, shall be measured in accordance with "Measurement and Basis of Payment" section or as shown on the Bid Proposal Form.
- B.** When not listed as a separate contract pay item, shall be considered as incidental work, and the cost thereof shall be included in such contract pay item(s) as are provided in the proposal contract.
- C.** Compensation, whether by contract pay item or incidental work will be for furnishing all materials, labor, equipment, tools and incidentals required for the work, all in accordance with the plans and these specifications.

END OF SECTION

SECTION 321140 - FLEXIBLE BASE

(Referenced from 2004 TxDOT, ITEM 247 Flexible Base – references made to any other Sections of the 2004 TxDOT Manual shall become part of the Contract to be followed)

02601.1. Description. Construct a foundation course composed of flexible base.

02601.2. Materials. Furnish uncontaminated materials of uniform quality that meet the requirements of the plans and specifications. Notify the Engineer of the proposed material sources and of changes to material sources. The Engineer may sample and test project materials at any time before compaction throughout the duration of the project to assure specification compliance. Use Tex-100-E material definitions.

A. Aggregate. Furnish aggregate of the type and grade shown on the plans and conforming to the requirements of Table 1. Each source must meet Table 1 requirements for liquid limit, plasticity index, and wet ball mill for the grade specified. Do not use additives such as but not limited to lime, cement, or fly ash to modify aggregates to meet the requirements of Table 1, unless shown on the plans.

Table 1
Material Requirements

Property	Test Method	Grade 1	Grade 2	Grade 3	Grade 4
Master gradation sieve size (% retained)	Tex-110-E				As shown on the plans
2-1/2 in.		–	0	0	
1-3/4 in.		0	0–10	0–10	
7/8 in.		10–35	–	–	
3/8 in.		30–50	–	–	
No. 4		45–65	45–75	45–75	
No. 40		70–85	60–85	50–85	
Liquid limit, % max. ¹	Tex-104-E	35	40	40	As shown on the plans
Plasticity index, max. ¹	Tex-106-E	10	12	12	As shown on the plans
Plasticity index, min. ¹		As shown on the plans			
Wet ball mill, % max. ²	Tex-116-E	40	45	–	As shown on the plans
Wet ball mill, % max. increase passing the No. 40 sieve		20	20	–	
Classification ³	Tex-117-E	1.0	1.1–2.3	–	As shown on the plans
Min. compressive strength ³ , psi					As shown on the plans
lateral pressure 0 psi		45	35	–	
lateral pressure 15 psi		175	175	–	

1. Determine plastic index in accordance with Tex-107-E (linear shrinkage) when liquid limit is unattainable as defined in Tex-104-E.
 2. When a soundness value is required by the plans, test material in accordance with Tex- 411- A.
 3. Meet both the classification and the minimum compressive strength, unless otherwise shown on the plans.
-
1. **Material Tolerances.** The Engineer may accept material if no more than 1 of the 5 most recent gradation tests has an individual sieve outside the specified limits of the gradation. When target grading is required by the plans, no single failing test may exceed the master grading by more than 5 percentage points on sieves No. 4 and larger or 3 percentage points on sieves smaller than No. 4.
The Engineer may accept material if no more than 1 of the 5 most recent plasticity index tests is outside the specified limit. No single failing test may exceed the allowable limit by more than 2 points.
 2. **Material Types.** Do not use fillers or binders unless approved. Furnish the type specified on the plans in accordance with the following.
 - a. Type A. Crushed stone produced and graded from oversize quarried aggregate that originates from a single, naturally occurring source. Do not use gravel or multiple sources.
 - b. Type B. Crushed or uncrushed gravel. Blending of 2 or more sources is allowed.
 - c. Type C. Crushed gravel with a minimum of 60% of the particles retained on a No. 4 sieve with 2 or more crushed faces as determined by Tex-460-A, Part I. Blending of 2 or more sources is allowed.
 - d. Type D. Type A material or crushed concrete. Crushed concrete containing gravel will be considered Type D material. Crushed concrete must meet the requirements in Section 02601.2.A.3.b, "Recycled Material (Including Crushed Concrete) Requirements," and be managed in a way to provide for uniform quality. The Engineer may require separate dedicated stockpiles in order to verify compliance.
 - e. Type E. As shown on the plans.
 3. **Recycled Material.** Recycled asphalt pavement (RAP) and other recycled materials may be used when shown on the plans. Request approval to

blend 2 or more sources of recycled materials.

a. Limits on Percentage. When RAP is allowed, do not exceed 20% RAP by weight unless otherwise shown on the plans. The percentage limitations for other recycled materials will be as shown on the plans.

b. Recycled Material (Including Crushed Concrete) Requirements.

(1) Contractor Furnished Recycled Materials. When the Contractor furnishes the recycled materials, including crushed concrete, the final product will be subject to the requirements of Table 1 for the grade specified. Certify compliance with DMS- 11000, "Evaluating and Using Non-hazardous Recyclable Materials Guidelines," for Contractor furnished recycled materials. In addition, recycled materials must be free from reinforcing steel and other objectionable material and have at most 1.5% deleterious material when tested in accordance with Tex-413-A. For RAP, do not exceed a maximum percent loss from decantation of 5.0% when tested in accordance with Tex-406-A. Test RAP without removing the asphalt.

(2) Department Furnished Required Recycled Materials.

When the Department furnishes and requires the use of recycled materials, unless otherwise shown on the plans:

- Department required recycled material will not be subject to the requirements in Table 1,
- Contractor furnished materials are subject to the requirements in Table 1 and this Item,
- The final product, blended, will be subject to the requirements in Table 1, and
- For final product, unblended (100% Department furnished required recycled material), the liquid limit, plasticity index, wet ball mill, classification, and compressive strength is waived.

Crush Department-furnished RAP so that 100% passes the 2 in. sieve. The Contractor is responsible for uniformly blending to meet the percentage required.

(3) Department Furnished and Allowed Recycled Materials. When the Department furnishes and allows the use of recycled materials or allows the Contractor to furnish recycled materials, the final blended product is subject to the requirements of Table 1 and the plans.

- a. Recycled Material Sources.** Department-owned recycled material is available to the Contractor only when shown

on the plans. Return unused Department-owned recycled materials to the Department stockpile location designated by the Engineer unless otherwise shown on the plans. The use of Contractor-owned recycled materials is allowed when shown on the plans. Contractor-owned surplus recycled materials remain the property of the Contractor. Remove Contractor-owned recycled materials from the project and dispose of them in accordance with federal, state, and local regulations before project acceptance. Do not intermingle Contractor-owned recycled material with Department-owned recycled material unless approved by the Engineer.

- b. **Water.** Furnish water free of industrial wastes and other objectionable matter.
- c. **Material Sources.** When non-commercial sources are used, expose the vertical faces of all strata of material proposed for use. Secure and process the material by successive vertical cuts extending through all exposed strata, when directed.

02601.3. Equipment. Provide machinery, tools, and equipment necessary for proper execution of the work. Provide rollers in accordance with Item 210, "Rolling." Provide proof rollers in accordance with Item 216, "Proof Rolling," when required.

02601.4. Construction. Construct each layer uniformly, free of loose or segregated areas, and with the required density and moisture content. Provide a smooth surface that conforms to the typical sections, lines, and grades shown on the plans or as directed. Stockpile base material temporarily at an approved location before delivery to the roadway. Build stockpiles in layers no greater than 2 ft. thick. Stockpiles must have a total height between 10 and 16 ft. unless otherwise shown on the plans. After construction and acceptance of the stockpile, loading from the stockpile for delivery is allowed. Load by making successive vertical cuts through the entire depth of the stockpile. Do not add or remove material from temporary stockpiles that require sampling and testing before delivery unless otherwise approved. Charges for additional sampling and testing required as a result of adding or removing material will be deducted from the Contractor's estimates. Haul approved flexible base in clean trucks. Deliver the required quantity to each 100-ft. station or designated stockpile site as shown on the plans. Prepare stockpile sites as directed. When delivery is to the 100-ft. station, manipulate in accordance with the applicable Items.

- A. Preparation of Subgrade or Existing Base.** Remove or scarify existing asphalt concrete pavement in accordance with Item 105, "Removing Stabilized Base and Asphalt Pavement," when shown on the plans or as directed. Shape the subgrade or existing base to conform to the typical sections shown on the plans or as directed. When new base is required to be mixed with existing base, deliver, place, and spread the new flexible base in the required amount per station. Manipulate and thoroughly mix the new base with existing material to provide a uniform mixture to the specified depth before shaping. When shown on the plans or directed, proof roll the roadbed in accordance with Item 216, "Proof Rolling," before pulverizing or scarifying. Correct soft spots as directed.
- B. Placing.** Spread and shape flexible base into a uniform layer with an approved spreader the same day as delivered unless otherwise approved. Construct layers to the thickness shown on the plans. Maintain the shape of the course. Control dust by sprinkling, as directed. Correct or replace segregated areas as directed, at no additional expense to the Department. Place successive base courses and finish courses using the same construction methods required for the first course.
- C. Compaction.** Compact using density control unless otherwise shown on the plans. Multiple lifts are permitted when shown on the plans or approved. Bring each layer to the moisture content directed. When necessary, sprinkle the material in accordance with Item 204, "Sprinkling." Begin rolling longitudinally at the sides and proceed towards the center, overlapping on successive trips by at least 1/2 the width of the roller unit. On super elevated curves, begin rolling at the low side and progress toward the high side. Offset alternate trips of the roller. Operate rollers at a speed between 2 and 6 mph as directed. Rework, re-compact, and refinish material that fails to meet or that loses required moisture, density, stability, or finish before the next course is placed or the project is accepted. Continue work until specification requirements are met. Perform the work at no additional expense to the Department.
- 1. Ordinary Compaction.** Roll with approved compaction equipment as directed. Correct irregularities, depressions, and weak spots immediately by scarifying the areas affected, adding or removing approved material as required, reshaping, and re-compacting.
 - 2. Density Control.** Compact to at least 100% of the maximum density determined by Tex-113-E unless otherwise shown on the plans. Determine the moisture content of the material at the beginning

and during compaction in accordance with Tex-103-E. The Engineer will determine roadway density of completed sections in accordance with Tex-115-E. The Engineer may accept the section if no more than 1 of the 5 most recent density tests is below the specified density and the failing test is no more than 3 pcf below the specified density.

- D. **Finishing.** After completing compaction, clip, skin, or tight-blade the surface with a maintainer or subgrade trimmer to a depth of approximately 1/4 in. Remove loosened material and dispose of it at an approved location. Seal the clipped surface immediately by rolling with a pneumatic tire roller until a smooth surface is attained. Add small increments of water as needed during rolling. Shape and maintain the course and surface in conformity with the typical sections, lines, and grades as shown on the plans or as directed. In areas where surfacing is to be placed, correct grade deviations greater than 1/4 in. in 16 ft. measured longitudinally or greater than 1/4 in. over the entire width of the cross-section. Correct by loosening, adding, or removing material. Reshape and re-compact in accordance with Section 02601.4.C, "Compaction."
- E. **Curing.** Cure the finished section until the moisture content is at least 2 percentage points below optimum or as directed before applying the next successive course or prime coat.

02601.5. MEASUREMENT AND PAYMENT

- A. When listed as a separate contract pay item, shall be measured in accordance with "Measurement and Basis of Payment" section or as shown on the Bid Proposal Form.
- B. When not listed as a separate contract pay item, shall be considered as incidental work, and the cost thereof shall be included in such contract pay item(s) as are provided in the proposal contract.
- C. Compensation, whether by contract pay item or incidental work will be for furnishing all materials, labor, equipment, tools and incidentals required for the work, all in accordance with the plans and these specifications.

END OF SECTION

ITEM 247. Flexible Base Parameters

Flexible Base Type E will composed of caliche (argillaceous Limestone, calcareous or calcareous clay particles) and may contain stone, conglomerate, gravel, sand or granular materials when these materials are in situ with the caliche.

Blended material for Flexible Base TY E GR 4

The Contractor may blend base material with another caliche source or with crushed concrete, meeting the requirements for TY "D" materials, provided a minimum of 50% caliche is used. The crushed concrete may contain sand or granular materials. Stabilizing additives will not be allowed in the raw crushed concrete base. Acceptance will be under the following conditions:

- Condition One (1): When both components of the blend in their individual stockpiles meet all the physical requirements of this Item, the field blending will be allowed.
- Condition Two (2): When only one component of the blend passes the physical requirements of this Item, the materials shall be blended through a plant for stockpile testing and approval.

Flexible Base (TY E GR 4) shall conform to the following requirements:

BEFORE LIME IS ADDED

Retained on Sq. Sieve	Percent Required
2"	0
1/2"	20-60
No. 4	40-75
No. 40	70-90
Max. PI:	15
Max. Wet Ball PI:	15
Wet Ball Mill Max Amount	50

The Wet Ball Test (Tex-116-E) shall be run and the Plasticity Index of the material passing the No. 40 sieve shall be determined (Wet Ball PI).

After 1% lime (laboratory) is added to unlimed material

Min. Strength Triaxial Class 1. Triaxial Test (Lime Treated)	Tex-121-E
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The percent of density as determined by Compaction Ratio (Tex-113-E) for the new Flexible Base shall be a minimum of 98%.

The Contractor's attention is called to the fact that certain existing and/or proposed structures may be within the limits of the Flexible Base. It shall be the Contractor's responsibility to perform construction operations without damage to these structures.

For water added under Item 247, the sulfate content should not exceed 3000-ppm and the chloride content should not exceed 3000-ppm.

Perform base ride quality testing for all base with only one lift of ACP or a seal coat as the final surface in accordance with Engineer's recommendation. Perform base ride quality testing before placing the ACP or seal coat.

SECTION 321216 – ASPHALT PAVING

1.00 GENERAL

1.01 SECTION INCLUDES

- A. Asphalt Pavements
- B. Asphalt Surface Rehabilitation

1.02 RELATED SECTIONS

- A. Section 31 23 00 – Excavation and Fill
- B. Section 31 22 16 – Fine Grading
- C. Section 32 11 00 – Base Courses
- D. Section 32 13 13 – Concrete Paving
- E. Section 32 16 13 – Curbs and Gutters
- F. Section 32 17 23.13 – Pavement Markings
- G. Section 32 17 23.23 – Raised Pavement Markings
- H. Section 32 17 23.33 – Thermoplastic Pavement Markings
- I. Construction Drawings
- J. State Highway Department Standard Specifications

1.03 SUBMITTALS

- A. Design Mix: Before any asphaltic concrete paving is constructed, submit actual design mix to the Owner's Construction Department for review and/or approval. Design mix submittal shall follow the format as indicated in the Asphalt Institute Manual MS-2, Mashall Stability Method; and shall include the type/name of the mix gradation analysis, grade of asphalt cement used, Marshall Stability (lbs), flow, effective asphalt content (percent), and direct references to the applicable highway department specifications sections for each material. The design shall be for a mixture listed in the current edition of the applicable state roadway specifications. Mix designs over three (3) years old will not be accepted by the owner.
- B. Material Certificates: Submit materials certificate to on-site independent testing laboratory which is signed by material producer and Contactor, certifying that materials comply with, or exceed, the requirements herein.

1.04 JOB CONDITIONS

- A. Weather Limitations.
 - 1. Apply prime and tack coats when ambient temperature is above 40°F, and when temperature has been above 35°F for 12 hours immediately prior to application. Do not apply when base is wet, contains excess moisture, or during rain.
 - 2. Construct asphaltic concrete paving when atmospheric temperature is above 40°F.

1.05 REFERENCES

- A. MS-2 Mix design methods for asphaltic concrete and other hot Mix types per The Asphalt Institute (AI).
- B. MS-3 Asphalt Plant Manual per The Asphalt Institute (AI).
- C. Hot Mix Asphalt Paving Handbook per US Army Corp of Engineers, UN-13 (CE MP-ET)
- D. MS-10 Basic Asphalt Emulsion Manual per The Asphalt Institute (AI).
- E. ASTM D946 – Penetration – Graded Asphalt Cement for use in Pavement Construction.
- F. AASHTO M-226/ASTM D3381 Asphalt Cement.
- G. AASHTO M-140/ASTM D997 or AASHTO M-208/ASTM D2397 Tack Coat.
- H. AASHTO M-117/ASTM D242 Mineral Filler.
- I. AASHTO T-245/ASTM D1559 Marshall Mix Design.

2.00 PRODUCTS

2.01 MATERIALS

- A. Provide asphalt-aggregate mixture as recommended by local or state paving authorities to suit project conditions. Use locally available materials and gradations which meet state highway Specifications and exhibit satisfactory records of previous installations.
- B. Asphalt Cement: Comply with AASHTO M-226/ASTM D3381; Table 2 AC-10, AC-20, or AC-30 viscosity grade, depending on local mean annual air temperature. (See chart below):

- | <u>Temperature Condition</u> | <u>Asphalt Grades</u> |
|---|-----------------------|
| Cold, mean annual air temperature
At 7 degrees C (45 D F) or lower 85/100 pen. | AC-10 |
| Warm, mean annual air temperature between
7 degrees C (45 degrees F) and 60/70 pen.
24 degrees C (75 degrees F) | AC-20 |
| Hot, mean annual air temperature
At 24 degrees C (75 degrees F) or higher | AC-30 |
- C. Prime Coat: A medium curing cut-back asphalt or an asphalt penetrating prime coat consisting of either MC-30 or SS-1h.
- D. Tack Coat: Emulsified asphalt; AASHTO M-140/ASTM D997 or AASHTO M208/ASTM D2397, SS-1 or CSS-1h, diluted with one part water to one part emulsified asphalt.
- E. Mineral Filler: Rock or slag dust, hydraulic cement, or other inert material complying with AASHTO M-17/ASTM D242, if recommended by applicable state highway standards.
- F. Asphalt-Aggregate Mixture: Unless otherwise noted on the drawings the design mix shall have a minimum stability based on a 50-blow Mashall complying with ASTM D1559 of 1000 lb with a flow between 8 and 16. The Design Mix shall be within the following sieve analysis and bitumen ranges:

SIEVE ANALYSIS OF MIX

<u>Square Sieve</u>	<u>Total % Passing</u>	<u>% Tolerance</u>
1/4"	100	7%
1/2"	80-100%	5%
3/8"	65-93%	4%
#8	40-55%	4%
#50	12-27%	2%
#200	0-10%	0%

Percent bitumen by weight of total mix: 5.0-8.35

Air voids: 3-6% Percent aggregate voids filled with asphalt cement: 70-82%

Allowable variance of percent bitumen by weight of total mix = 0.04

2.02 EQUIPMENT

- A. Maintain equipment in satisfactory operating condition and correct breakdown in manner that will not delay or be detrimental to progress of paving operations.

3.00 EXECUTION

3.01 PREPARATION

- A. Remove loose material from compacted base material surface immediately before applying prime coat.
- B. Proof roll prepared base material surface to check for areas requiring additional compaction and areas requiring removal and re-compaction.
- C. Do not begin paving work until deficient base material areas have been corrected and are ready to receive paving.
- D. Remove all dirt and other debris from existing pavement surfaces to be resurfaced, by brooming, blading, or other approved methods. Heat, scarify and rework pavement surface to the widths and elevations shown on the plans. Patch and level pavement surface as is necessary to ensure a final smooth driving surface (refer to 3.05 Paragraph D). Mill edges adjacent to concrete pavement and curbs to the specified depths for a level transition to the new pavement.

3.02 APPLICATIONS

- A. Prime Coat:
 - 1. Apply bituminous prime coat to all base material surfaces where asphaltic concrete paving will be constructed.
 - 2. Apply bituminous prime coat in accordance with APWA Section 2204 and applicable state highway specifications.
 - 3. Apply at minimum rate of 0.25 gallon per square yard over compacted base material. Apply to penetrate and seal, but not flood surface.
 - 4. Make necessary precautions to protect adjacent areas from overspray.
 - 5. Cure and dry as long as necessary to attain penetration of compacted base and evaporation of volatile substances.
- B. Tack Coat:

1. Apply to contact surfaces of previously constructed asphaltic concrete base courses, pavement, and surfaces s butting or projecting into asphaltic concrete or into asphaltic concrete pavement.
2. Apply tack coat to asphaltic concrete base course or sand asphalt base course. Apply emulsified asphalt tack coat between each lift or layer of full depth asphaltic concrete and sand asphalt base and on surface of all such bases where asphaltic concrete paving will be constructed.
3. Apply emulsified asphalt tack coat in accordance with APWA Section 2204 and applicable state highway specifications.
4. Apply at minimum rate of 0.05 gallon per square yard of surface.
5. Allow to dry until at proper condition to receive paving.

3.03 ASPHALTIC CONCRETE PLACEMENT

- A. Place asphaltic concrete mixture on completed surface, spread, and strike off. Spread mixture at following minimum temperatures:
 1. When ambient temperature is between 40°F and 50°F, mixture temp. = 285°F
 2. When ambient temperature is between 50°F and 60°F, mixture temp.= 280°F
 3. When ambient temperature is higher than 60°F, mixture temp. = 275°F
- B. Whenever possible, all pavements shall be spread by a finishing machine; however, inaccessible irregular areas may be placed by hand methods. The hot mixture shall spread uniformly to the required depth with hot shovels and rakes. After spreading, the hot mixtures shall be carefully smothered to remove all segregated course aggregate and rake marks. Rakes and lutes used for hand spreading shall be of the type designed for use on asphalt mixtures. Loads shall not be dumped faster that they can be properly spread. Workers shall not stand on the loose mixture while spreading.
- C. Paving Machine Placement: Apply successive lifts of asphaltic concrete in transverse directions with the surface course placed in the direction of surface-water flow. Place in typical strips not less than 10'-0" wide.
- D. Joints: Make joints between old and new pavements, or between successive days and work in a manner that will provide a continuous bond between adjoining works. Construction joints shall have same texture, density, and smoothness as other sections of asphaltic

concrete course. Clean contact surfaces of all joints and apply tack coat.

3.04 ROLLING AND COMPACTION

- A. The mixture, after being spread, shall be thoroughly compacted by rolling as soon as it will bear the weight of the rollers without undue displacement. The number, weight and types of rollers and sequences of rolling operations shall be such that the required density and surface are consistently attained while the mixture is in a workable condition.
- B. Compact mixture with hot hand tampers or vibrating plate compactors in areas inaccessible to rollers.
- C. Breakdown Rolling: Accomplished breakdown or initial rolling immediately following rolling of joints and outside edge. Check surface after breakdown rolling, and repair displaced areas by loosening and filling with hot material.
- D. Second Rolling: Follow breakdown rolling as soon as possible, while mixture is hot. Continue second rolling until mixture has been thoroughly compacted.
- E. Finish Rolling: Perform finish rolling while mixture is still warm enough for removal of roller marks. Continue rolling until roller marks are eliminated and course has attained maximum density.
- F. Patching: Remove and replace paving areas mixed with foreign materials and defective areas. Cut out such areas and fill with fresh, hot asphaltic concrete. Compact by rolling to maximum surface density and smoothness.
- G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened. Erect barricades to protect paving from traffic until mixture has cooled not to become marked.

3.05 FIELD QUALITY CONTROL

- A. Independent Testing Laboratory, selected and paid by Owner, shall be retained to perform construction testing on in-placed asphaltic concrete courses for compliance with requirements for thickness, compaction and surface smoothness. Asphaltic surface and base courses shall be randomly cored at a minimum rate of one core for

every 20,000 square feet of paving. However, no less than three (3) cores in light duty areas and three (3) cores in heavy duty areas shall be obtained. Coring holes shall be immediately filled with full-depth asphalt or with concrete. Asphaltic Concrete pavement samples shall be tested for conformance with the mix design.

- B. Grade Control: Establish and maintain required lines and elevations.
- C. Thickness: In-place compacted thickness shall be not less than thickness specified on the drawings. Areas of deficient paving thickness shall receive a tack coat and a minimum 1" overlay; or shall be removed and replaced to the proper thickness, at the discretion of the Owner; until specified thickness of the course is met or exceeded at no additional expense to the Owner.
- D. Surface Smoothness: Testing shall be performed on the finished surface of each asphalt concrete course for smoothness, using 10'-0" straightedge applied parallel with, and at right angles to centerline of paved area. The results of these tests shall be made available to the owner upon request. Surfaces will not be acceptable if the following 10' straightedge tolerances for Smoothness are exceeded:

Base Course Surface:	1/4"
Wearing Course Surface:	3/16"
- E. Check surface areas at intervals necessary to eliminate ponding areas. Remove and replace unacceptable paving as directed by Owner.
- F. Compaction: Field density test for in place material shall be performed by examination of field cores in accordance with one of the following standards:
 - 1. Bulk specific gravity of paraffin-coated specimens: ASTM D1188
 - 2. Bulk specific gravity using saturated surface-dry specimens: ASTM D2726

Rate of testing shall be one core per 20,000 square feet of pavement, with a minimum of three (3) cores from heavy duty areas and three (3) cores from standard-duty areas. Cores shall be cut from areas representative of the project.

Areas of insufficient compaction shall be delineated, removed, and replaced in compliance with the specifications at no expense to the Owner.

END OF SECTION

SECTION 321220 – ASPHALTS, OILS AND EMULSIONS

(Referenced from 2004 TxDOT, ITEM 300 Asphalts, Oils, and Emulsions – references made to any other Sections of the 2004 TxDOT Manual shall become part of the Contract to be followed)

02577.1. Description. Provide asphalt cements, cutback and emulsified asphalts, performance-graded asphalt binders, and other miscellaneous asphalt materials as specified on the plans.

02577.2. Materials. Provide asphalt materials that meet the stated requirements when tested in accordance with the referenced Department, AASHTO, and ASTM test methods. Refer to the Material Inspection Guide (maintained by the Construction Division), Section 11. "Asphalt Inspection, Quality Control and Quality Assurance," for sampling and testing requirements.

Acronyms used in this Item are defined in Table 1.

Table 1
Acronyms

Acronym	Definition
Test Procedure Designations	
Tex	Department
T or R	AASHTO
D	ASTM
Polymer Modifier Designations	
P	polymer-modified
SBR or L	styrene-butadiene rubber (latex)
SBS	styrene-butadiene-styrene block co-polymer
TR	tire rubber (from ambient temperature grinding of truck and passenger tires)
AC	asphalt cement
AE	asphalt emulsion
AE-P	asphalt emulsion prime
A-R	asphalt-rubber
C	cationic
EAP&T	emulsified asphalt prime and tack
H-suffix	harder residue (lower penetration)
HF	high float
MC	medium-curing

Table 1 (continued)**Acronyms**

Acronym	Definition
MS	medium-setting
PCE	prime, cure, and erosion control
PG	performance grade
RC	rapid-curing
RS	rapid-setting
S-suffix	stockpile usage
SCM	special cutback material
SS	slow-setting

- A. Asphalt Cement.** Asphalt cement must be homogeneous, water-free, and non-foaming when heated to 347°F, and must meet Table 2 requirements.

Table 2
Asphalt Cement

Property	Test Procedure	Viscosity Grade									
		AC-0.6		AC-1.5		AC-3		AC-5		AC-10	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Viscosity 140°F, poise	T 202	40	80	100	200	250	350	400	600	800	1,200
275°F, poise		0.4	—	0.7	—	1.1	—	1.4	—	1.9	—
Penetration, 77°F, 100g, 5 sec.	T 49	350	—	250	—	210	—	135	—	85	—
Flash point, C.O.C., °F	T 48	425	—	425	—	425	—	425	—	450	—
Solubility in trichloroethylene, %	T 44	99.0	—	99.0	—	99.0	—	99.0	—	99.0	—
Spot test	Tex-509-C	Neg.		Neg.		Neg.		Neg.		Neg.	
Tests on residue from Thin-Film Oven Test:											
Viscosity, 140°F, poise	T 179										
Ductility ¹ , 77°F	T 202	—	180	—	450	—	900	—	1,500	—	3,000
5 cm/min., cm	T 51	100	—	100	—	100	—	100	—	100	—

1. If AC-0.6 or AC-1.5 ductility at 77°F is less than 100 cm, material is acceptable if ductility at 60°F is more than 100 cm.

- B. Polymer-Modified Asphalt Cement.** Polymer-modified asphalt cement must be smooth and homogeneous, and comply with the requirements of Table 3. If requested, supply samples of the base asphalt cement and polymer additives.

Table 3
Polymer-Modified Asphalt Cement

Property	Test Procedure	Polymer-Modified Viscosity Grade							
		AC-5 w/2% SBR		AC-10 w/2% SBR		AC-15P		AC-20-5TR	
		Min	Max	Min	Max	Min	Max	Min	Max
Polymer		SBR		SBR		SBS		TR	
Polymer content, % (solids basis)	Tex-533-C	2.0	—	2.0	—	3.0	—	5.0	—
Dynamic shear, G*/sin δ , 64°C, 10 rad/s, kPa	T 315	—	—	—	—	—	—	1.0	—
Viscosity									
140°F, poise	T 202	700	—	1,300	—	1,500	—	2,000	—
275°F, poise	T 202	—	7.0	—	8.0	—	8.0	—	10.0
Penetration, 77°F, 100 g, 5 sec.	T 49	120	—	80	—	100	150	75	115
Ductility, 5 cm/min., 39.2°F, cm	T 51	70	—	60	—	—	—	—	—
Elastic recovery, 50°F, %	Tex-539-C	—	—	—	—	55	—	55	—
Softening point, °F	T 53	—	—	—	—	—	—	120	—
Polymer separation, 48 hr.	Tex-540-C	None		None		None		None	
Flash point, C.O.C., °F	T 48	425	—	425	—	425	—	425	—
Tests on residue from Thin-Film Oven Test:	T 179								
Retained penetration ratio, 77°F	T 49	—	—	—	—	0.60	1.00	0.60	1.00
Tests on residue from RTFOT aging and pressure aging:	Tex-541-C and R 28								
Creep stiffness	T 313								
S, -18°C, MPa		—	—	—	—	—	—	—	300
m-value, -18°C		—	—	—	—	—	—	0.300	—

- C. Cutback Asphalt.** Cutback asphalt must meet the requirements of Tables 4, 5, and 6 for the specified type and grade. If requested, supply samples of the base asphalt cement and polymer additives.

Table 4
Rapid-Curing Cutback Asphalt

Property	Test Procedure	Type-Grade					
		RC-250		RC-800		RC-3000	
		Min	Max	Min	Max	Min	Max
Kinematic viscosity, 140°F, cSt	T 201	250	400	800	1,600	3,000	6,000
Water, %	T 55	—	0.2	—	0.2	—	0.2
Flash point, T.O.C., °F	T 79	80	—	80	—	80	—
Distillation test:	T 78						
Distillate, percentage by volume of total distillate to 680°F							
to 437°F		40	75	35	70	20	55
to 500°F		65	90	55	85	45	75
to 600°F		85	—	80	—	70	—
Residue from distillation, volume %		70	—	75	—	82	—
Tests on distillation residue:							
Penetration, 100 g, 5 sec., 77°F	T 49	80	120	80	120	80	120
Ductility, 5 cm/min., 77°F, cm	T 51	100	—	100	—	100	—
Solubility in trichloroethylene, %	T 44	99.0	—	99.0	—	99.0	—
Spot test	Tex-509-C	Neg.		Neg.		Neg.	

Table 5
Medium-Curing Cutback Asphalt

Property	Test Procedure	Type-Grade							
		MC-30		MC-250		MC-800		MC-3000	
		Min	Max	Min	Max	Min	Max	Min	Max
Kinematic viscosity, 140°F, cSt	T 201	30	60	250	500	800	1,600	3,000	6,000
Water, %	T 55	—	0.2	—	0.2	—	0.2	—	0.2
Flash point, T.O.C., °F	T 79	100	—	150	—	150	—	150	—
Distillation test:	T 78								
Distillate, percentage by volume of total distillate to 680°F									
to 437°F		—	25	—	10	—	—	—	—
to 500°F		40	70	15	55	—	35	—	15
to 600°F		75	93	60	87	45	80	15	75
Residue from distillation, volume %		50	—	67	—	75	—	80	—
Tests on distillation residue:									
Penetration, 100 g, 5 sec., 77°F	T 49	120	250	120	250	120	250	120	250
Ductility, 5 cm/min., 77°F, cm ¹	T 51	100	—	100	—	100	—	100	—
Solubility in trichloroethylene, %	T 44	99.0	—	99.0	—	99.0	—	99.0	—
Spot test	Tex-509-C	Neg.		Neg.		Neg.		Neg.	

1. If the penetration of residue is more than 200 and the ductility at 77°F is less than 100 cm, the material is acceptable if its ductility at 60°F is more than 100 cm.

Table 6
Special-Use Cutback Asphalt

Property	Test Procedure	Type-Grade					
		MC-2400L		SCM I		SCM II	
		Min	Max	Min	Max	Min	Max
Kinematic viscosity, 140°F, cSt	T 201	2,400	4,800	500	1,000	1,000	2,000
Water, %	T 55	—	0.2	—	0.2	—	0.2
Flash point, T.O.C., °F	T 79	150	—	175	—	175	—
Distillation test:	T 78						
Distillate, percentage by volume of total distillate to 680°F							
to 437°F		—	—	—	—	—	—
to 500°F		—	35	—	0.5	—	0.5
to 600°F		35	80	20	60	15	50
Residue from distillation, volume %		78	—	76	—	82	—
Tests on distillation residue:							
Polymer		SBR		—		—	
Polymer content, % (solids basis)	Tex-533-C	2.0	—	—	—	—	—
Penetration, 100 g, 5 sec., 77°F	T 49	150	300	180	—	180	—
Ductility, 5 cm/min., 39.2°F, cm	T 51	50	—	—	—	—	—
Solubility in trichloroethylene, %	T 44	99.0	—	99.0	—	99.0	—

- D. Emulsified Asphalt.** Emulsified asphalt must be homogeneous, not separate after thorough mixing, and meet the requirements for the specified type and grade in Tables 7, 8, 9, and 10.

Table 7
Emulsified Asphalt

Property	Test Procedure	Type-Grade									
		Rapid-Setting		Medium-Setting		Slow-Setting					
		HFRS-2		MS-2		AES-300		SS-1		SS-1H	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Viscosity, Saybolt Furol 77°F, sec. 122°F, sec.	T 72	—	—	—	—	75	400	20	100	20	100
		150	400	100	300	—	—	—	—	—	—
Sieve test, %	T 59	—	0.1	—	0.1	—	0.1	—	0.1	—	0.1
Miscibility	T 59	—	—	—	—	—	—	Pass	Pass	—	—
Cement mixing, %	T 59	—	—	—	—	—	—	—	2.0	—	2.0
Coating ability and water resistance: dry aggregate/after spray wet aggregate/after spray	T 59	—	—	—	—	Good/Fair Fair/Fair	—	—	—	—	—
Demulsibility, 35 ml of 0.02 N CaCl ₂ , %	T 59	50	—	—	30	—	—	—	—	—	—
Storage stability, 1 day, %	T 59	—	1	—	1	—	1	—	1	—	1
Freezing test, 3 cycles ¹	T 59	—	—	Pass	—	—	—	Pass	Pass	—	—
Distillation test: Residue by distillation, % by wt. Oil distillate, % by volume of emulsion	T 59	65	—	65	—	65	—	60	—	60	—
		—	0.5	—	0.5	—	5	—	0.5	—	0.5
Tests on residue from distillation: Penetration, 77°F, 100 g, 5 sec.	T 49	100	140	120	160	300	—	120	160	70	100
Solubility in trichloroethylene, %	T 44	97.5	—	97.5	—	97.5	—	97.5	—	97.5	—
Ductility, 77°F, 5 cm/min., cm	T 51	100	—	100	—	—	—	100	—	80	—
Float test, 140°F, sec.	T 50	1,200	—	—	—	1,200	—	—	—	—	—

1. Applies only when the Engineer designates material for winter use.

Table 8
Cationic Emulsified Asphalt

Property	Test Procedure	Type-Grade							
		Rapid-Setting		Medium-Setting		Slow-Setting			
		CRS-2	CRS-2H	CMS-2	CMS-2S	CSS-1	CSS-1H		
		Min: Max	Min: Max	Min: Max	Min: Max	Min: Max	Min: Max	Min: Max	Min: Max
Viscosity, Saybolt Furol 77°F, sec. 122°F, sec.	T 72	— — 150	— — 400	— — 150	— — 400	— — 100	— — 300	— — 20	— — 100
Sieve test, %	T 59	—	0.1	—	0.1	—	0.1	—	0.1
Cement mixing, %	T 59	—	—	—	—	—	—	2.0	—
Coating ability and water resistance: dry aggregate/after spray wet aggregate/after spray	T 59	— —	— —	— —	— —	Good/Fair Fair/Fair	Good/Fair Fair/Fair	— —	— —
Demulsibility, 35 ml of 0.8% sodium dioctyl sulfosuccinate, %	T 59	70	—	70	—	—	—	—	—
Storage stability, 1 day, %	T 59	—	1	—	1	—	1	—	1
Particle charge	T 59	Positive	Positive	Positive	Positive	Positive	Positive	Positive	Positive
Distillation test: Residue by distillation, % by wt. Oil distillate, % by volume of emulsion	T 59	65 —	— 0.5	65 —	— 0.5	65 —	— 7	65 —	— 5
Tests on residue from distillation: Penetration, 77°F, 100 g, 5 sec. Solubility in trichloroethylene, % Ductility, 77°F, 5 cm/min., cm	T 49 T 44 T 51	120 97.5 100	160 — —	70 97.5 80	110 — —	120 97.5 100	200 — —	300 97.5 —	— — —
		120	160	70	110	120	200	300	—
		97.5	—	97.5	—	97.5	—	97.5	—
		100	—	80	—	100	—	100	—

Table 9
Polymer-Modified Emulsified Asphalt

Property	Test Procedure	Type-Grade											
		Rapid-Setting				Medium-Setting				Slow-Setting			
		RS-1P		HFRS-2P		AES-150P		AES-300P		AES-300S		SS-1P	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Viscosity, Saybolt Furol 77°F, sec. 122°F, sec.	T 72	—	—	—	—	75	400	75	400	75	400	30	100
Sieve test, %	T 59	50	200	150	400	—	—	—	—	—	—	—	—
Miscibility	T 59	—	0.1	—	0.1	—	0.1	—	0.1	—	0.1	—	0.1
Coating ability and water resistance: dry aggregate/after spray wet aggregate/after spray	T 59	—	—	—	—	—	—	—	—	—	—	—	Pass
Demulsibility, 35 ml of 0.02 N CaCl ₂ , %	T 59	60	—	50	—	—	—	—	—	—	—	—	—
Storage stability, 1 day, %	T 59	—	1	—	1	—	1	—	1	—	1	—	1
Breaking index, g	Tex-542-C	—	80	—	—	—	—	—	—	—	—	—	—
Distillation test: ¹ Residue by distillation, % by wt. Oil distillate, % by volume of emulsion	T 59	65	—	65	—	65	—	65	—	65	—	60	—
		—	3	—	0.5	—	3	—	5	—	7	—	0.5
Tests on residue from distillation: Polymer content, wt. % (solids basis)	Tex-533-C	—	—	3.0	—	—	—	—	—	—	—	3.0	—
Penetration, 77°F, 100 g, 5 sec.	T 49	225	300	90	140	150	300	300	—	300	—	100	140
Solubility in trichloroethylene, %	T 44	97.0	—	97.0	—	97.0	—	97.0	—	97.0	—	97.0	—
Viscosity, 140°F, poise	T 202	—	—	1,500	—	—	—	—	—	—	—	1,300	—
Float test, 140°F, sec.	T 50	—	—	1,200	—	1,200	—	1,200	—	1,200	—	—	—
Ductility ² , 39.2°F, 5 cm/min., cm	T 51	—	—	50	—	—	—	—	—	—	—	50	—
Elastic recovery ² , 50°F, %	Tex-539-C	55	—	55	—	—	—	—	—	—	—	—	—
Tests on RIFO curing of distillation residue Elastic recovery, 50°F, %	Tex-541-C	—	—	—	—	50	—	50	—	30	—	—	—
	Tex-539-C	—	—	—	—	—	—	—	—	—	—	—	—

- Exception to T 59: Bring the temperature on the lower thermometer slowly to 350°F ±10°F. Maintain at this temperature for 20 min. Complete total distillation in 60 ±5 min. from the first application of heat.
- HFRS-2P must meet one of either the ductility or elastic recovery requirements.

Table 10
Polymer-Modified Cationic Emulsified Asphalt

Property	Test Procedure	Type-Grade					
		Rapid-Setting				Slow-Setting	
		CRS-1P		CRS-2P		CSS-1P	
		Min	Max	Min	Max	Min	Max
Viscosity, Saybolt Furol 77°F, sec. 122°F, sec.	T 72	— 50	— 150	— 150	— 400	20 —	100 —
Sieve test, %	T 59	—	0.1	—	0.1	—	0.1
Demulsibility, 35 ml of 0.8% sodium dioctyl sulfosuccinate, %	T 59	60	—	70	—	—	—
Storage stability, 1 day, %	T 59	—	1	—	1	—	1
Breaking index, g	Tex-542-C	—	80	—	—	—	—
Particle charge	T 59	Positive		Positive		Positive	
Distillation test: ¹ Residue by distillation, % by weight Oil distillate, % by volume of emulsion	T 59	65 —	— 3	65 —	— 0.5	62 —	— 0.5
Tests on residue from distillation: Polymer content, wt. % (solids basis)	Tex-533-C	—	—	3.0	—	3.0	—
Penetration, 77°F, 100 g, 5 sec.	T 49	225	300	90	150	55	90
Viscosity, 140°F, poise	T 202	—	—	1,300	—	—	—
Solubility in trichloroethylene, %	T 44	97.0	—	97.0	—	97.0	—
Softening point, °F	T 53	—	—	—	—	135	—
Ductility, 77°F, 5 cm/min., cm	T 51	—	—	—	—	70	—
Ductility ² , 39.2°F, 5 cm/min., cm	T 51	—	—	50	—	—	—
Elastic recovery ² , 50°F, %	Tex-539-C	45	—	55	—	—	—

- Exception to T 59: Bring the temperature on the lower thermometer slowly to 350°F ±0°F. Maintain at this temperature for 20 min. complete total distillation in 60 ±5 min. from the first application of heat.
 - CRS-2P must meet one of either the ductility or elastic recovery requirements.
- E. Specialty Emulsions.** Specialty emulsions may be either asphalt-based or resin-based and must meet the requirements of Table 11.

Table 11
Specialty Emulsions

Property	Test Procedure	Type-Grade					
		Medium-Setting				Slow-Setting	
		AE-P		EAP&T		PCE ¹	
		Min	Max	Min	Max	Min	Max
Viscosity, Saybolt Furol 77°F, sec. 122°F, sec.	T 72	—	—	—	—	10	100
Sieve test, %	T 59	—	0.1	—	0.1	—	0.1
Miscibility ²	T 59	—	—	Pass	—	Pass	—
Demulsibility, 35 ml of 0.10 N CaCl ₂ , %	T 59	—	70	—	—	—	—
Storage stability, 1 day, %	T 59	—	1	—	1	—	—
Particle size ³ , % by volume < 2.5 µm	Tex-238-F ³	—	—	90	—	90	—
Asphalt emulsion distillation to 500°F followed by Cutback asphalt distillation of residue to 680°F: Residue after both distillations, % by wt. Total oil distillate from both distillations, % by volume of emulsion	T 59 & T 78	40	—	—	—	—	—
		25	40	—	—	—	—
Residue by distillation, % by wt.	T 59	—	—	60	—	—	—
Residue by evaporation ⁴ , % by wt.	T 59	—	—	—	—	60	—
Tests on residue after all distillation(s): Viscosity, 140°F, poise Kinematic viscosity ⁵ , 140°F, cSt Flash point C.O.C., °F Solubility in trichloroethylene, % Float test, 122°F, sec.	T 202 T 201 T 48 T 44 T 50	— — — 97.5 50	— — — — 200	800 — — — —	— — — — —	— 100 400 — —	— 350 — — —

- Supply with each shipment of PCE: a) a copy of a lab report from an approved analytical lab, signed by a lab official, indicating the PCE formulation does not meet any characteristics of a Resource Conservation Recovery Act (RCRA) hazardous waste; b) a certification from the producer that the formulation supplied does not differ from the one tested and that no listed RCRA hazardous wastes or PCBs have been mixed with the product; and c) a Material Safety Data Sheet.
 - Exception to T 59: In dilution, use 350 ml of distilled or deionized water and a 1,000-ml beaker.
 - Use Tex-238-F, beginning at "Particle Size Analysis by Laser Diffraction," with distilled or deionized water as a medium and no dispersant, or use another approved method.
 - Exception to T 59: Leave sample in the oven until foaming ceases, then cool and weigh.
 - PCE must meet either the kinematic viscosity requirement or the particle size requirement.
- F. Recycling Agent.** Recycling agent and emulsified recycling agent must meet the requirements in Table 12. Additionally, recycling agent and residue from emulsified recycling agent, when added in the specified proportions to the recycled asphalt, must meet the properties specified on the plans.

Table 12
Recycling Agent and Emulsified Recycling Agent

Property	Test Procedure	Recycling Agent		Emulsified Recycling Agent	
		Min	Max	Min	Max
Viscosity, Saybolt Furol, 77°F, sec.	T 72	—	—	15	100
Sieve test, %	T 59	—	—	—	0.1
Miscibility ¹	T 59	—		No coagulation	
Residue by evaporation ² , % by wt.	T 59	—	—	60	—
Tests on recycling agent or residue from evaporation:					
Flash point, C.O.C., °F	T 48	400	—	400	—
Kinematic viscosity, 140°F, cSt	T 201	75	200	75	200
275°F, cSt		—	10.0	—	10.0

1. Exception to T 59: Use 0.02 N CaCl₂ solutions in place of water.
2. Exception to T 59: Maintain sample at 300°F until foaming ceases, then cool and weigh.

G. Crumb Rubber Modifier. Crumb rubber modifier (CRM) consists of automobile and truck tires processed by ambient temperature grinding. CRM must be: free from contaminants including fabric, metal, and mineral and other non-rubber substances; free-flowing; and non-foaming

When added to hot asphalt binder. When tested in accordance with Tex-200-F, Part I, using a 50-g sample, the rubber gradation must meet the requirements of the grades in Table 13.

Table 13
CRM Gradations

Sieve Size (% Passing)	Grade A		Grade B		Grade C		Grade D	Grade E
	Min	Max	Min	Max	Min	Max		
#8	100	—	—	—	—	—	As shown on the plans	As approved
#10	95	100	100	—	—	—		
#16	—	—	70	100	100	—		
#30	—	—	25	60	90	100		
#40	—	—	—	—	45	100		
#50	0	10	—	—	—	—		
#200	—	—	0	5	—	—		

H. Crack Sealer. Polymer modified asphalt-emulsion crack sealer must meet the requirements of Table 14. Rubber-asphalt crack sealer must meet the requirements of Table 15.

Table 14
Polymer-Modified Asphalt Emulsion Crack Sealer

Property	Test Procedure	Min	Max
Rotational viscosity, 77°F, cP	D 2196, Method A	10,000	25,000
Sieve test, %	T 59	–	0.1
Storage stability, 1 day, %	T 59	–	1
Evaporation	Tex-543-C		
Residue by evaporation, % by wt.		65	–
Tests on residue from evaporation:			
Penetration, 77°F, 100 g, 5 sec.	T 49	35	75
Softening point, °F	T 53	140	–
Ductility, 39.2°F, 5 cm/min., cm	T 51	100	–

Table 15
Rubber-Asphalt Crack Sealer

Property	Test Procedure	Class A		Class B	
		Min	Max	Min	Max
CRM content, Grade A or B, % by wt.	Tex-544-C	22	26	–	–
CRM content, Grade B, % by wt.	Tex-544-C	–	–	13	17
Virgin rubber content ¹ , % by wt.		–	–	2	–
Flash point ² , COC, °F	T 48	400	–	400	–
Penetration ³ , 77°F, 150 g, 5 sec.	T 49	30	50	30	50
Penetration ³ , 32°F, 200 g, 60 sec.	T 49	12	–	12	–
Softening point, °F	T 53	–	–	170	–
Bond ⁴	D5329	–		Pass	

1. Provide certification that the min. % virgin rubber was added.
 2. Before passing the test flame over the cup, agitate the sealing compound with a 3/8- to 1/2-in. (9.5- to 12.7-mm) wide, square-end metal spatula in a manner so as to bring the material on the bottom of the cup to the surface, i.e., turn the material over. Start at one side of the thermometer, move around to the other, and then return to the starting point using 8 to 10 rapid circular strokes. Accomplish agitation in 3 to 4 sec. Pass the test flame over the cup immediately after stirring is completed.
 3. Exception to T 49: Substitute the cone specified in ASTM D 217 for the penetration needle.
 4. No crack in the crack sealing materials or break in the bond between the sealer and the mortar blocks over 1/4 in. deep for any specimen after completion of the test.
- I. **Asphalt-Rubber Binders.** Asphalt-rubber (A-R) binders are mixtures of asphalt binder and CRM, which have been reacted at elevated temperatures. The A-R binders meet D 6114 and contain a minimum of 15% CRM by weight. Types I or II, containing CRM Grade C, are used for hot mixed aggregate mixtures. Types II or III, containing CRM Grade B, are used for surface treatment binder. Table 16 describes required binder properties.

Table 16
A-R Binders

Property	Test Procedure	Binder Type					
		Type I		Type II		Type III	
		Min	Max	Min	Max	Min	Max
Apparent viscosity, 347°F, cP	D 2196, Method A	1,500	5,000	1,500	5,000	1,500	5,000
Penetration, 77°F, 100 g, 5 sec.	T 49	25	75	25	75	50	100
Penetration, 39.2°F, 200 g, 60 sec.	T 49	10	—	15	—	25	—
Softening point, °F	T 53	135	—	130	—	125	—
Resilience, 77°F, %	D 5329	25	—	20	—	10	—
Flash point, C.O.C., °F	T 48	450	—	450	—	450	—
Tests on residue from Thin-Film Oven Test:	T 179						
Retained penetration ratio, 39.2°F, 200 g, 60 sec., % of original	T 49	75	—	75	—	75	—

- J. Performance-Graded Binders.** PG binders must be smooth and homogeneous, show no separation when tested in accordance with Tex-540-C, and meet Table 17 requirements.

Separation testing is not required if:

- a modifier is introduced separately at the mix plant either by injection in the asphalt line or mixer,
- the binder is blended on site in continuously agitated tanks, or binder acceptance is based on field samples taken from an in-line sampling port at the hot mix plant after the addition of modifiers.

Table 17
Performance-Graded Binders

Property and Test Method	Performance Grade																	
	PG 58			PG 64			PG 70			PG 76			PG 82					
	-22	-28	-34	-16	-22	-28	-34	-16	-22	-28	-34	-16	-22	-28	-34	-16	-22	-28
Average 7-day max pavement design temperature, °C ¹	< 58			< 64			< 70			< 76			< 82					
Min pavement design temperature, °C ¹	>-22	>-28	>-34	>-16	>-22	>-28	>-34	>-16	>-22	>-28	>-34	>-16	>-22	>-28	>-34	>-16	>-22	>-28
ORIGINAL BINDER																		
Flash point, T 48, Min, °C	230																	
Viscosity, T 316: ^{2,3}	135																	
Max, 3.0 Pa-s, test temperature, °C	135																	
Dynamic shear, T 315: ⁴	58			64			70			76			82					
G*/sin(δ), Min, 1.00 kPa	58			64			70			76			82					
Test temperature @ 10 rad/sec., °C	58			64			70			76			82					
Elastic recovery, D 6084, 50°F, % Min	—	—	30	—	—	30	50	—	30	50	60	30	50	60	70	50	60	70
ROLLING THIN-FILM OVEN (Tex-541-C)																		
Mass loss, Tex-541-C, Max, %	1.0																	
Dynamic shear, T 315:	58			64			70			76			82					
G*/sin(δ), Min, 2.20 kPa	58			64			70			76			82					
Test temperature @ 10 rad/sec., °C	58			64			70			76			82					
PRESSURE AGING VESSEL (PAV) RESIDUE (R 28)																		
PAV aging temperature, °C	100																	
Dynamic shear, T 315:	25	22	19	28	25	22	19	28	25	22	19	28	25	22	19	28	25	22
G*/sin(δ), Max, 5000 kPa	25	22	19	28	25	22	19	28	25	22	19	28	25	22	19	28	25	22
Test temperature @ 10 rad/sec., °C	25	22	19	28	25	22	19	28	25	22	19	28	25	22	19	28	25	22

Table 17 (continued)
Performance-Graded Binders

Property and Test Method	Performance Grade																	
	PG 58			PG 64			PG 70			PG 76			PG 82					
	-22	-28	-34	-16	-22	-28	-34	-16	-22	-28	-34	-16	-22	-28	-34	-16	-22	-28
Average 7-day max pavement design temperature, °C ¹	< 58			< 64			< 70			< 76			< 82					
Min pavement design temperature, °C ¹	>-22	>-28	>-34	>-16	>-22	>-28	>-34	>-16	>-22	>-28	>-34	>-16	>-22	>-28	>-34	>-16	>-22	>-28
Creep stiffness, T 313; ^{5,6} S, max, 300 MPa, m-value, min, 0.300 Test temperature @ 60 sec., °C	-12	-18	-24	-6	-12	-18	-24	-6	-12	-18	-24	-6	-12	-18	-24	-6	-12	-18
Direct tension, T 314; ⁶ Failure strain, min, 1.0% Test temperature @ 1.0 mm/min., °C	-12	-18	-24	-6	-12	-18	-24	-6	-12	-18	-24	-6	-12	-18	-24	-6	-12	-18

1. Pavement temperatures are estimated from air temperatures using an algorithm contained in a Department-supplied computer program, may be provided by the Department, or by following the procedures outlined in AASHTO MP 2 and PP 28.
2. This requirement may be waived at the Department's discretion if the supplier warrants that the asphalt binder can be adequately pumped, mixed, and compacted at temperatures that meet all applicable safety, environmental, and constructability requirements. At test temperatures where the binder is a Newtonian fluid, any suitable standard means of viscosity measurement may be used, including capillary (T 201 or T 202) or rotational viscometry (T 316).
3. Viscosity at 135°C is an indicator of mixing and compaction temperatures that can be expected in the lab and field. High values may indicate high mixing and compaction temperatures. Additionally, significant variation can occur from batch to batch. Contractors should be aware that variation could significantly impact their mixing and compaction operations. Contractors are therefore responsible for addressing any constructability issues that may arise.
4. For quality control of unmodified asphalt binder production, measurement of the viscosity of the original asphalt binder may be substituted for dynamic shear measurements of $G^*/\sin(\delta)$ at test temperatures where the asphalt is a Newtonian fluid. Any suitable standard means of viscosity measurement may be used, including capillary (T 201 or T 202) or rotational viscometry (T 316).
5. Silicone beam molds, as described in AASHTO TP 1-93, are acceptable for use.
6. If creep stiffness is below 300 MPa, direct tension test is not required. If creep stiffness is between 300 and 600 MPa, the direct tension failure strain requirement can be used instead of the creep stiffness requirement. The

m-value requirement must be satisfied in both cases.

02577.3. Equipment. Provide all equipment necessary to transport, store, sample, heat, apply, and incorporate asphalts, oils, and emulsions.

02577.4. Construction.

A. Typical Material Use. Table 18 shows typical materials used for specific applications. These are typical uses only. Circumstances may require use of other material.

Table 18
Typical Material Use

Material Application	Typically Used Materials
Hot-mixed, hot-laid asphalt mixtures	PG binders, A-R binders Types I and II
Surface treatment	AC-5, AC-10, AC-5 w/2% SBR, AC-10 w/2% SBR, AC-15P, AC-20-5TR, HFRS-2, MS-2, CRS-2, CRS-2H, HFRS-2P, CRS-2P, A-R binders Types II and III
Surface treatment (cool weather)	RS-1P, CRS-1P, RC-250, RC-800, RC-3000, MC-250, MC-800, MC-3000, MC-2400L
Precoating	AC-5, AC-10, PG 64-22, SS-1, SS-1H, CSS-1, CSS-1H
Tack coat	PG Binders, SS-1H, CSS-1H, EAP&T
Fog seal	SS-1, SS-1H, CSS-1, CSS-1H
Hot-mixed, cold-laid asphalt mixtures	AC-0.6, AC-1.5, AC-3, AES-300, AES-300P, CMS-2, CMS-2S
Patching mix	MC-800, SCM I, SCM II, AES-300S
Recycling	AC-0.6, AC-1.5, AC-3, AES-150P, AES-300P, recycling agent, emulsified recycling agent
Crack sealing	SS-1P, polymer mod AE crack sealant, rubber asphalt crack sealers (Class A, Class B)
Microsurfacing	CSS-1P
Prime	MC-30, AE-P, EAP&T, PCE
Curing membrane	SS-1, SS-1H, CSS-1, CSS-1H, PCE
Erosion control	SS-1, SS-1H, CSS-1, CSS-1H, PCE

B. Storage and Application Temperatures. Use storage and application temperatures in accordance with Table 19. Store and apply materials at the lowest temperature yielding satisfactory results. Follow the manufacturer's instructions for any agitation requirements in storage. Manufacturer's instructions regarding recommended application and storage temperatures supersede those of Table 19.

Table 19
Storage and Application Temperatures

Type–Grade	Application		Storage Maximum (°F)
	Recommended Range, °F	Maximum Allowable (°F)	
AC-0.6, AC-1.5, AC-3	200–300	350	350
AC-5, AC-10	275–350	350	350
AC-5 w/2% SBR, AC-10 w/2% SBR, AC-15P, AC-20-5TR	300–375	375	360
RC-250	125–180	200	200
RC-800	170–230	260	260
RC-3000	215–275	285	285
MC-30, AE-P	70–150	175	175
MC-250	125–210	240	240
MC-800, SCM I, SCM II	175–260	275	275
MC-3000, MC-2400L	225–275	290	290
HFRS-2, MS-2, CRS-2, CRS-2H, HFRS-2P, CRS-2P, CMS-2, CMS-2S, AES-300, AES-300S, AES-150P, AES-300P	120–160	180	180
SS-1, SS-1H, CSS-1, CSS-1H, PCE, EAP&T, SS-1P, RS-1P, CRS-1P, CSS-1P, recycling agent, emulsified recycling agent, polymer mod AE crack sealant	50–130	140	140
PG binders	275–350	350	350
Rubber asphalt crack sealers (Class A, Class B)	350–375	400	–
A-R binders Types I, II, and III	325–425	425	425

02577.5. MEASUREMENT AND PAYMENT

- A. When listed as a separate contract pay item, shall be measured in accordance with “Measurement and Basis of Payment” section or as shown on the Bid Proposal Form.
- B. When not listed as a separate contract pay item, shall be considered as incidental work, and the cost thereof shall be included in such contract pay item(s) as are provided in the proposal contract.
- C. Compensation, whether by contract pay item or incidental work will be for furnishing all materials, labor, equipment, tools and incidentals required for the work, all in accordance with the plans and these specifications.

END OF SECTION

SECTION 321221 – HOT MIX ASPHALT

(Referenced from 2004 TxDOT, ITEM 340 Dense-Graded Hot-Mix Asphalt (Method) – references made to any other Sections of the 2004 TxDOT Manual shall become part of the Contract to be followed)

02612.1. Description. Construct a pavement layer composed of a compacted, dense-graded mixture of aggregate and asphalt binder mixed hot in a mixing plant.

02612.2. Materials. Furnish uncontaminated materials of uniform quality that meet the requirements of the plans and specifications. Notify the Engineer of all material sources. Notify the Engineer before changing any material source or formulation. When the Contractor makes a source or formulation change, the Engineer will verify that the requirements of this Item are met and may require a new laboratory mixture design, trial batch, or both. The Engineer may sample and test project materials at any time during the project to verify compliance.

- A. Aggregate.** Furnish aggregates from sources that conform to the requirements shown in Table 1, and as specified in this Section, unless otherwise shown on the plans. Provide aggregate stockpiles that meet the definition in this Section for either coarse aggregate or fine aggregate. When reclaimed asphalt pavement (RAP) is allowed by plan note, provide RAP stockpiles in accordance with this Section. Aggregate from RAP is not required to meet Table 1 requirements unless otherwise shown on the plans. Supply mechanically crushed gravel or stone aggregates that meet the definitions in Tex-100-E. The Engineer will designate the plant or the quarry as the sampling location. Samples must be from materials produced for the project. The Engineer will establish the surface aggregate classification (SAC) and perform Los Angeles abrasion, magnesium sulfate soundness, and Micro-Deval tests. Perform all other aggregate quality tests listed in Table 1. Document all test results on the mixture design report. The Engineer may perform tests on independent or split samples to verify Contractor test results. Stockpile aggregates for each source and type separately. Determine aggregate gradations for mixture design and production testing based on the washed sieve analysis given in Tex-200-F, Part II. Do not add material to an approved stockpile from sources that do not meet the aggregate quality requirements of the Department's *Bituminous Rated Source Quality Catalog* (BRSQC) unless otherwise approved.

1. **Coarse Aggregate.** Coarse aggregate stockpiles must have no more than 20% material passing the No. 8 sieve. Provide aggregates from sources listed in the BRSQC. Provide aggregate from nonlisted sources only when tested by the Engineer and approved before use. Allow 30 calendar days for the Engineer to sample, test, and report results for nonlisted sources. Provide coarse aggregate with at least the minimum SAC shown on the plans. SAC requirements apply only to aggregates used on the surface of travel lanes, unless otherwise shown on the plans. The SAC for sources on the Department's AQMP is listed in the BRSQC.

Class B aggregate meeting all other requirements in Table 1 may be blended with blending Class A and B aggregates to meet a Class A requirement, ensure that at least 50% by weight of the material retained on the No. 4 sieve comes from the Class A aggregate source. Blend by volume if the bulk specific gravities of the Class A and B aggregates differ by more than 0.300. When blending, do not use Class C or D aggregates. For blending purposes, coarse aggregate from RAP will be considered as Class B aggregate.

2. **RAP.** RAP is salvaged, milled, pulverized, broken, or crushed asphalt pavement. Crush or break RAP so that 100% of the particles pass the 2-in. sieve.

RAP from either Contractor- or Department-owned sources, including RAP generated during the project, is permitted only when shown on the plans. Department-owned RAP, if allowed for use, will be available at the location shown on the plans. When RAP is used, determine asphalt content and gradation for mixture design purposes. Perform other tests on RAP when shown on the plans.

When RAP is allowed by plan note, use no more than 30% RAP in Type A or B mixtures unless otherwise shown on the plans. For all other mixtures, use no more than 20% RAP unless otherwise shown on the plans.

Do not use RAP contaminated with dirt or other objectionable materials. Do not use the RAP if the decantation value exceeds 5% and the plasticity index is greater than 8. Test the stockpiled RAP for decantation in accordance with the laboratory method given in Tex-406-A, Part I. Determine the plasticity index using

Tex-106-E if the decantation value exceeds 5%. The decantation and plasticity index requirements do not apply to RAP samples with asphalt removed by extraction. Do not intermingle Contractor-owned RAP stockpiles with Department-owned RAP stockpiles. Remove unused Contractor-owned RAP material from the project site upon completion of the project. Return unused Department-owned RAP to the designated stockpile location.

3. **Fine Aggregate.** Fine aggregates consist of manufactured sands, screenings, and field sands. Fine aggregate stockpiles must meet the gradation requirements in Table 2. Supply fine aggregates that are free from organic impurities. The Engineer may test the fine aggregate in accordance with Tex-408-A to verify the material is free from organic impurities. At most 15% of the total aggregate may be field sand or other uncrushed fine aggregate. With the exception of field sand, use fine aggregate from coarse aggregate sources that meet the requirements shown in Table 1, unless otherwise approved.

If 10% or more of the stockpile is retained on the No. 4 sieve, test the stockpile and verify that it meets the requirements in Table 1 for coarse aggregate angularity (Tex-460-A) and flat and elongated particles (Tex-280-F).

Table 1 Aggregate Quality Requirements

Property	Test Method	Requirement
Coarse Aggregate		
SAC	AQMP	As shown on plans
Deleterious material, %, max	Tex-217-F, Part I	1.5
Decantation, %, max	Tex-217-F, Part II	1.5
Micro-Deval abrasion, %, max	Tex-461-A	Note 1
Los Angeles abrasion, %, max	Tex-410-A	40
Magnesium sulfate soundness, 5 cycles, %, max	Tex-411- A	302
Coarse aggregate angularity, 2 crushed faces, %, min	Tex 460- A, Part I	853
Flat and elongated particles @ 5:1, %, max	Tex-280- F	10
Fine Aggregate		
Linear shrinkage, %, max	Tex-107- E	3
Combined Aggregate⁴		
Sand equivalent, %, min	Tex-203-F	45

- a. Not used for acceptance purposes. Used by the Engineer as an indicator of the need for further investigation.
- b. Unless otherwise shown on the plans.
- c. Unless otherwise shown on the plans. Only applies to crushed gravel.
- d. Aggregates, without mineral filler, RAP, or additives, combined as used in the job-mix formula (JMF).

Table 2 Gradation Requirements for Fine Aggregate

Sieve Size	% Passing by Weight or Volume
3/8"	100
#8	70–100
#200	0–30

- B. Mineral Filler.** Mineral filler consists of finely divided mineral matter such as agricultural lime, crusher fines, hydrated lime, cement, or fly ash. Mineral filler is allowed unless otherwise shown on the plans. Do not use more than 2% hydrated lime or cement, unless otherwise shown on the plans. The plans may require or disallow specific mineral fillers. When used, provide mineral filler that:
- is sufficiently dry, free-flowing, and free from clumps and foreign matter;
 - does not exceed 3% linear shrinkage when tested in accordance with Tex-107-E; and
 - meets the gradation requirements in Table 3.

Table 3 Gradation Requirements for Mineral Filler

Sieve Size	% Passing by Weight or Volume
#8	100
#200	55–100

- C. Baghouse Fines.** Fines collected by the baghouse or other dust-collecting equipment may be reintroduced into the mixing drum.
- D. Asphalt Binder.** Furnish the type and grade of performance-graded (PG) asphalt binder specified on the plans in accordance with Section 300.2.J, "Performance-Graded Binders."
- E. Tack Coat.** Unless otherwise shown on the plans or approved, furnish CSS-1H, SS-1H, or a PG binder with a minimum high-temperature grade of PG 58 for tack coat binder in accordance with Item 300, "Asphalts, Oils, and Emulsions."

Do not dilute emulsified asphalts at the terminal, in the field, or at any other location before use. If required, verify that emulsified asphalt proposed for use meets the minimum residual asphalt percentage specified in Item 300, "Asphalts, Oils, and Emulsions."

The Engineer will obtain at least 1 sample of the tack coat binder per project and test it to verify compliance with Item 300. The Engineer will obtain the sample from the asphalt distributor immediately before use.

- F. Additives.** When shown on the plans, use the type and rate of additive specified. Other additives that facilitate mixing or improve the quality of the mixture may be allowed when approved.

If lime or a liquid antistripping agent is used, add in accordance with Item 301, "Asphalt Antistripping Agents." Do not add lime directly into the mixing drum of any plant where lime is removed through the exhaust stream unless the plant has a baghouse or dust collection system that reintroduces the lime back into the drum.

02612.3. Equipment. Provide required or necessary equipment in accordance with Item 320, "Equipment for Asphalt Concrete Pavement."

02612.4. Construction. Design, produce, store, transport, place, and compact the specified paving mixture in accordance with the requirements of this Item. Unless otherwise shown on the plans, provide the mix design. The Department will perform quality assurance (QA) testing. Provide quality control (QC) testing as needed to meet the requirements of this Item.

A. Mixture Design.

- 1. Design Requirements.** Use a Level II specialist certified by a Department- approved hot-mix asphalt certification program to develop the mixture design. Have the Level II specialist sign the design documents. Unless otherwise shown on the plans, use the typical weight design example given in Tex-204-F, Part I, to design a mixture meeting the requirements listed in Tables 1 through 6. Use an approved laboratory to perform the Hamburg Wheel test and provide results with the mixture design, or provide the laboratory mixture and request that the Department perform the Hamburg Wheel test. The Construction Division maintains a list of approved laboratories. Furnish the Engineer with representative samples of all materials used in the mixture design. The Engineer will verify the mixture design. If the design cannot be verified by the Engineer, furnish another mixture design.

The Contractor may submit a new mixture design at any time

during the project. The Engineer will approve all mixture designs before the Contractor can begin production. Provide the Engineer with a mixture design report using Department-provided software. Include the following items in the report:

- the combined aggregate gradation, source, specific gravity, and percent of each material used;
- results of all applicable tests;
- the mixing and molding temperatures;
- the signature of the Level II person or persons who performed the design;
- the date the mixture design was performed; and
- a unique identification number for the mixture design.

Table 4 Master Gradation Bands (% Passing by Weight or Volume) and Volumetric Properties

Sieve Size	A Coarse Base	B Fine Base	C Coarse Surface	D Fine Surface	F Fine Mixture
1-1/2"	98.0–100.0	–	–	–	–
1"	78.0–94.0	98.0–100.0	–	–	–
3/4"	64.0–85.0	84.0–98.0	95.0–100.0	–	–
1/2"	50.0–70.0	–	–	98.0–100.0	–
3/8"	–	60.0–80.0	70.0–85.0	85.0–100.0	98.0–100.0
#4	30.0–50.0	40.0–60.0	43.0–63.0	50.0–70.0	80.0–86.0
#8	22.0–36.0	29.0–43.0	32.0–44.0	35.0–46.0	38.0–48.0
#30	8.0–23.0	13.0–28.0	14.0–28.0	15.0–29.0	12.0–27.0
#50	3.0–19.0	6.0–20.0	7.0–21.0	7.0–20.0	6.0–19.0
#200	2.0–7.0	2.0–7.0	2.0–7.0	2.0–7.0	2.0–7.0
Design VMA1, % Minimum					
–	12.0	13.0	14.0	15.0	16.0
Plant-Produced VMA, % Minimum					
–	11.0	12.0	13.0	14.0	15.0

1. Voids in Mineral Aggregates.

Table 5 Laboratory Mixture Design Properties

Property	Test Method	Requirement
Target laboratory-molded density, %	Tex-207-F	96.01
Tensile strength (dry), psi (molded to 93% ±1% density)	Tex-226-F	85–2002
Boil test ³	Tex-530-C	–

1. Unless otherwise shown on the plans.
2. May exceed 200 psi when approved and may be waived when approved.

3. Used to establish baseline for comparison to production results. May be waived when approved.

Table 6 Hamburg Wheel Test Requirements

High-Temperature Binder Grade	Minimum # of Passes² @ 0.5" Rut Depth, Tested @122°F
PG 64 or lower	10,000
PG 70	15,000
PG 76 or higher	20,000

1. Tested in accordance with Tex-242-F.
2. May be decreased or waived when shown on the plans.

B. Job-Mix Formula Approval. The job-mix formula (JMF) is the combined aggregate gradation and target asphalt percentage used to establish target values for mixture production. JMF is the original laboratory mixture design used to produce the trial batch. The Engineer and the Contractor will verify JMF based on plant-produced mixture from the trial batch unless otherwise approved. The Engineer may accept an existing mixture design previously used on a Department project and may waive the trial batch to verify JMF. If the JMF is not verified by the Engineer from the trial batch, adjust the JMF or redesign the mix and produce as many trial batches as necessary to verify the JMF. Provide the Engineer with split samples of the mixtures and blank samples used to determine the ignition oven correction factors. The Engineer will determine the aggregate and asphalt correction factors from the ignition oven using Tex-236-F.

The Engineer will use a Texas gyratory compactor calibrated in accordance with Tex-914-F in molding production samples. The Engineer will perform Tex-530-C and retain the tested sample for comparison purposes during production. The Engineer may waive the requirement for the boil test.

C. JMF Field Adjustments. Produce a mixture of uniform composition closely conforming to the approved JMF. If during initial days of production, the Contractor or Engineer determines that adjustments to the JMF are necessary to achieve the specified requirements, or to more nearly match the aggregate production, the Engineer may allow adjustment of the JMF within the tolerances of Table 7 without a laboratory redesign of the mixture.

The Engineer will adjust the asphalt content to maintain desirable laboratory density near the optimum value while achieving other mix requirements.

Table 7 Operational Tolerances

Description	Test Method	Allowable Difference from JMF Target
Individual % retained for #8 sieve and larger		±5.01
Individual % retained for sieves smaller than #8 and larger than #200	Tex-200-F or Tex-236-F	±3.01
% passing the #200 sieve		±2.01
Asphalt content, %	Tex-236-F	±0.31
Laboratory-molded density, %		±1.0
VMA, %, min	Tex-207-F	Note 2

1. When within these tolerances, mixture production gradations may fall outside the master grading limits; however, the percent passing the #200 sieve will be considered out of tolerance when outside the master grading limits.
2. Test and verify that Table 4 requirements are met.

D. Production Operations. Perform a new trial batch when the plant or plant location is changed. The Engineer may suspend production for noncompliance with this Item. Take corrective action and obtain approval to proceed after any production suspension for noncompliance.

1. **Operational Tolerances.** During production, do not exceed the operational tolerances in Table 7. Stop production if testing indicates tolerances are exceeded on:
 - 3 consecutive tests on any individual sieve,
 - 4 consecutive tests on any of the sieves, or
 - 2 consecutive tests on asphalt content. Begin production only when test results or other information indicate, to the satisfaction of the Engineer, that the next mixture produced will be within Table 7 tolerances.

1. **Storage and Heating of Materials.** Do not heat the asphalt binder above the temperatures specified in Item 300, "Asphalts, Oils, and Emulsions" or outside the manufacturer's recommended values. On a daily basis, provide the Engineer with the records of asphalt binder and hot-mix asphalt discharge temperatures in accordance with Item 320, "Equipment for Asphalt Concrete Pavement." Unless otherwise approved, do not store mixture for a period long enough to affect the quality of the mixture, nor in any case longer than 12 hr.
 2. **Mixing and Discharge of Materials.** Notify the Engineer of the target discharge temperature and produce the mixture within 25°F of the target. Monitor the temperature of the material in the truck before shipping to ensure that it does not exceed 350°F. The Department will not pay for or allow placement of any mixture produced at more than 350°F. Control the mixing time and temperature so that substantially all moisture is removed from the mixture before discharging from the plant.
- E. **Hauling Operations.** Before use, clean all truck beds to ensure mixture is not contaminated. When a release agent is necessary to coat truck beds, use a release agent on the approved list maintained by the Construction Division.
- F. **Placement Operations.** Prepare the surface by removing raised pavement markers and objectionable material such as moisture, dirt, sand, leaves, and other loose impediments from the surface before placing mixture. Remove vegetation from pavement edges. Place the mixture to meet the typical section requirements and produce a smooth, finished surface with a uniform appearance and texture. Offset longitudinal joints of successive courses of hot mix by at least 6 in. Place mixture so longitudinal joints on the surface course coincide with lane lines, or as directed. Ensure that all finished surfaces will drain properly. Place mixture within the compacted lift thickness shown in Table 8, unless otherwise shown on the plans or allowed.

Table 8 Compacted Lift Thickness and Required Core Height

Mixture Type	Compacted Lift Thickness	
	Minimum (in.)	Maximum (in.)

A	3.00	6.00
B	2.50	5.00
C	2.00	4.00
D	1.50	3.00
F	1.25	2.50

1. **Weather Conditions.** Place mixture when the roadway surface temperature is 60°F or higher unless otherwise approved. Measure the roadway surface temperature with a handheld infrared thermometer. Unless otherwise shown on the plans, place mixtures only when weather conditions and moisture conditions of the roadway surface are suitable in the opinion of the Engineer.
2. **Tack Coat.** Clean the surface before placing the tack coat. Unless otherwise approved, apply tack coat uniformly at the rate directed by the Engineer. The Engineer will set the rate between 0.04 and 0.10 gal. of residual asphalt per square yard of surface area. Apply a thin, uniform tack coat to all contact surfaces of curbs, structures, and all joints. Prevent splattering of tack coat when placed adjacent to curb, gutter, and structures. Roll the tack coat with a pneumatic-tire roller when directed. The Engineer may use Tex-243-F to verify that the tack coat has adequate adhesive properties. The Engineer may suspend paving operations until there is adequate adhesion.

G. Lay-Down Operations.

1. **Minimum Mixture Placement Temperatures.** Use Table 9 for suggested minimum mixture placement temperatures.
2. **Windrow Operations.** When hot mix is placed in windrows, operate windrow pickup equipment so that substantially all the mixture deposited on the roadbed is picked up and loaded into the paver.

Table 9 Suggested Minimum Mixture Placement Temperature

High-Temperature Binder Grade	Minimum Placement Temperature (Before Entering Paver)
PG 64 or lower	260°F
PG 70	270°F
PG 76	280°F
PG 82 or higher	290°F

- H. Compaction.** Use air void control unless ordinary compaction control is specified on the plans. Avoid displacement of the mixture. If

displacement occurs, correct to the satisfaction of the Engineer. Ensure pavement is fully compacted before allowing rollers to stand on the pavement. Unless otherwise directed, use only water or an approved release agent on rollers, tamps, and other compaction equipment. Keep diesel, gasoline, oil, grease, and other foreign matter off the mixture. Unless otherwise directed, operate vibratory rollers in static mode when not compacting, when changing directions, or when the plan depth of the pavement mat is less than 1-1/2 in.

Use tamps to thoroughly compact the edges of the pavement along curbs, headers, and similar structures and in locations that will not allow thorough compaction with the rollers. The Engineer may require rolling with a trench roller on widened areas, in trenches, and in other limited areas.

Allow the compacted pavement to cool to 160°F or lower before opening to traffic unless otherwise directed. When directed, sprinkle the finished mat with water or limewater to expedite opening the roadway to traffic.

1. **Air Void Control.** Compact dense-graded hot-mix asphalt to contain from 5% to 9% in-place air voids. Do not increase the asphalt content of the mixture to reduce pavement air voids.
2. **Ordinary Compaction Control.** Furnish the type, size, and number of rollers required for compaction, as approved. Furnish at least 1 medium pneumatic-tire roller (minimum 12-ton weight). Use the control strip method given in Tex-207-F, Part IV, to establish rolling patterns that achieve maximum compaction.
 - a. **Rollers.** Furnish the type, size, and number of rollers required for compaction, as approved. Use a pneumatic-tire roller to seal the surface, unless otherwise shown on the plans. Use additional rollers as required to remove any roller marks.
 - b. **Air Void Determination.** Unless otherwise shown on the plans, obtain 2 roadway specimens at each location selected by the Engineer for in-place air void determination. The Engineer will measure air voids in accordance with Tex-207-F and Tex-227-F. Before drying to a constant weight, cores may be predried using a Corelok or similar vacuum device to remove excess moisture. The Engineer will use the average air void content of the 2 cores to calculate the in-place air voids at the selected location.
 - c. **Air Voids Out of Range.** If the in-place air void content in the compacted mixture is below 5% or greater than 9%, change the production and placement operations to bring the

in-place air void content within requirements. The Engineer may suspend production until the in-place air void content is brought to the required level, and may require a test section as described in Section 340.4.H.1.d, "Test Section."

- d. **Test Section.** Construct a test section of 1 lane-width and at most 0.2 mi. in length to demonstrate that compaction to between 5% and 9% in-place air voids can be obtained. Continue this procedure until a test section with 5% to 9% in-place air voids can be produced. The Engineer will allow only 2 test sections per day. When a test section producing satisfactory in-place air void content is placed, resume full production.

Follow the selected rolling pattern unless changes that affect compaction occur in the mixture or placement conditions. When such changes occur, establish a new rolling pattern. Compact the pavement to meet the requirements of the plans and specifications.

When rolling with the 3-wheel, tandem or vibratory rollers, start by first rolling the joint with the adjacent pavement and then continue by rolling longitudinally at the sides. Proceed toward the center of the pavement, overlapping on successive trips by at least 1 ft., unless otherwise directed. Make alternate trips of the roller slightly different in length. On super elevated curves, begin rolling at the low side and progress toward the high side unless otherwise directed.

- I. **Irregularities.** Immediately take corrective action if surface irregularities, including but not limited to segregation, rutting, raveling, flushing, fat spots, mat slippage, color, texture, roller marks, tears, gouges, streaks, or uncoated aggregate particles, are detected. The Engineer may suspend production or placement operations until the problem is corrected. At the expense of the Contractor and to the satisfaction of the Engineer, remove and replace any mixture that does not bond to the existing pavement or that has other surface irregularities identified above.
- J. **Ride Quality.** Use Surface Test Type A to evaluate ride quality in accordance with Item 585, "Ride Quality for Pavement Surfaces," unless otherwise shown on the plans.

02612.5. MEASUREMENT AND PAYMENT

- A. When listed as a separate contract pay item, shall be measured in accordance with "Measurement and Basis of Payment" section or as shown on the Bid Proposal Form.
- B. When not listed as a separate contract pay item, shall be considered as incidental work, and the cost thereof shall be included in such contract pay item(s) as are provided in the proposal contract.
- C. Compensation, whether by contract pay item or incidental work will be for furnishing all materials, labor, equipment, tools and incidentals required for the work, all in accordance with the plans and these specifications.

END OF SECTION

SECTION 321313 – CONCRETE PAVING

(Referenced from 2004 TxDOT, ITEM 531 Sidewalks – references made to any other Sections of the 2004 TxDOT Manual shall become part of the Contract to be followed)

00531.1. DESCRIPTION.

Construct hydraulic cement concrete sidewalks.

00531.2. MATERIALS.

Furnish materials conforming to the following:

- Item 360, "Concrete Pavement"
- Item 420, "Concrete Structures"
- Item 421, "Hydraulic Cement Concrete"
- Item 440, "Reinforcing Steel."

Use Class A concrete or other concrete as specified. Use Grade 8 course aggregate for extruded Class A concrete. Use other grades if approved by the Engineer.

00531.3. CONSTRUCTION.

Shape and compact subgrade, foundation, or pavement surface to the line, grade, and cross-section shown on the plans. Lightly sprinkle subgrade or foundation material immediately before concrete placement. Hand-tamp and sprinkle foundation when placement is directly on subgrade or foundation materials. Remove and dispose of existing concrete in accordance with Item 104, "Removing Concrete." Provide a clean surface for concrete placement directly on the surface material or pavement. Mix and place concrete in accordance with the pertinent Items. Hand-finishing is allowed for any method of construction. Finish exposed surfaces to a uniform transverse broom finish surface. Curb ramps must include a detectable warning surface and conform to details shown on the plans.

Install joints as shown on the plans. Brush all exposed surfaces to a smooth and uniform surface. Ensure that abrupt changes in sidewalk elevation do not exceed 1/4 inch, sidewalk cross slope does not exceed 2%, curb ramp grade does not exceed 8.3%, and flares adjacent to the ramp do not exceed 10% slope. Where a sidewalk crosses a concrete driveway, ensure that the sidewalk

depth and reinforcement are not less than the driveway cross-sectional details shown on the plans.

Provide finished work with a well-compacted mass, a surface free from voids and honeycomb, and the required true-to-line shape and grade. Cure for at least 72 hr. in accordance with Item 420, "Concrete Structures."

- A. **Conventionally Formed Concrete.** Provide sidewalk sections separated by premold or board joint of the thickness shown on the plans in lengths greater than 8 ft. but less than 40 ft., unless otherwise directed. Terminate workday production at an expansion joint.
- B. **Extruded or Slipformed Concrete.** Provide any additional surface finishing immediately after extrusion or slip forming as required on the plans. Construct joints at locations as shown on the plans or as directed.

00531.4. MEASUREMENT AND PAYMENT

- A. When listed as a separate contract pay item, shall be measured in accordance with "Measurement and Basis of Payment" section or as shown on the Bid Proposal Form.
- B. When not listed as a separate contract pay item, shall be considered as incidental work, and the cost thereof shall be included in such contract pay item(s) as are provided in the proposal contract.
- C. Compensation, whether by contract pay item or incidental work will be for furnishing all materials, labor, equipment, tools and incidentals required for the work, all in accordance with the plans and these specifications.

END OF SECTION

SECTION 321613 – CONCRETE CURB, GUTTER, AND COMBINED CURB AND GUTTER

(Referenced from 2004 TxDOT, ITEM 529 Concrete Curb, Gutter, and Combined Curb and Gutter – references made to any other Sections of the 2004 TxDOT Manual shall become part of the Contract to be followed)

00529.1. DESCRIPTION. Construct hydraulic cement concrete curb, gutter, and combined curb and gutter.

00529.2. MATERIALS. Furnish materials conforming to:

- Item 360, "Concrete Pavement"
- Item 420, "Concrete Structures"
- Item 421, "Hydraulic Cement Concrete"
- Item 440, "Reinforcing Steel."

Use Class A concrete or material specified in the plans. Use Grade 8 coarse aggregate for extruded Class A concrete. Use other grades if approved by the Engineer.

529.3. CONSTRUCTION. Provide finished work with a well-compacted mass and a surface free from voids and honeycomb, in the required shape, line, and grade. Round exposed edges with an edging tool of the radius shown on the plans. Mix, place, and cure concrete in accordance with Item 420, "Concrete Structures." Construct joints at locations shown on the plans. Cure for at least 72 hr. Furnish and place reinforcing steel in accordance with Item 440, "Reinforcing Steel." Set and maintain a guideline that conforms to alignment data shown on the plans, with an outline that conforms to the details shown on the plans.

A. Conventionally Formed Concrete. Shape and compact subgrade, foundation, or pavement surface to the line, grade, and cross section shown on the plans. Lightly sprinkle subgrade or foundation material immediately before concrete placement. Pour concrete into forms, and strike off with a template 1/4 to 3/8 in. less than the dimensions of the finished curb unless otherwise approved. After initial set, plaster surface with mortar consisting of 1 part hydraulic cement and 2 parts fine aggregate. Brush exposed surfaces to a uniform texture.

Place curbs, gutters, and combined curb and gutters in 50-ft. maximum sections unless otherwise approved.

- B. Extruded or Slipformed Concrete.** Hand-tamp and sprinkle subgrade or foundation material before concrete placement. Provide clean surfaces for concrete placement. If required, coat cleaned surfaces with approved adhesive or coating at the rate of application shown on the plans or as directed. Place concrete with approved self-propelled equipment. The forming tube of the extrusion machine or the form of the slipform machine must be easily adjustable vertically during the forward motion of the machine to provide variable heights necessary to conform to the established gradeline.

Attach a pointer or gauge to the machine so that a continual comparison can be made between the extruded or slipform work and the grade guideline. Other methods may be used when approved.

Finish surfaces immediately after extrusion or slipforming.

00529.4. MEASUREMENT AND PAYMENT

- A. When listed as a separate contract pay item, shall be measured in accordance with "Measurement and Basis of Payment" section or as shown on the Bid Proposal Form.
- B. When not listed as a separate contract pay item, shall be considered as incidental work, and the cost thereof shall be included in such contract pay item(s) as are provided in the proposal contract.
- C. Compensation, whether by contract pay item or incidental work will be for furnishing all materials, labor, equipment, tools and incidentals required for the work, all in accordance with the plans and these specifications.

END OF SECTION

SECTION 32 17 23.13 – PAINTED PAVEMENT MARKINGS

1.00 GENERAL

1.01 SECTION INCLUDES

- A. Painted Pavement Marking.
- B. Painted curbs, guard posts and light pole bases.

1.02 RELATED SECTIONS

- A. Section 31 10 00 – Site Clearing
- B. Construction Drawings

1.03 PROJECT CONDITIONS

- A. Maintain access for vehicular and pedestrian traffic as required for other construction activities. Utilize flagmen, barricades, warning signs and warning light as required.

2.00 PRODUCTS

2.01 MATERIALS

- A. The paint shall be a non-bleeding, quick-drying, alkyd petroleum base paint suitable for traffic-bearing surface and shall meet FS TTP-85E and mixed in accordance with manufacturer's instructions before application.

3.00 EXECUTION

3.01 PREPARATION

- A. Sweep and clean surface to eliminate loose material and dust.
- B. Where existing pavement markings are indicated on the drawings to be removed or would interfere with the adhesion of new paint, a motorized abrasive device shall be used to remove the markings. The equipment employed shall not damage the existing paving or create a surface hazardous to vehicle or pedestrian traffic. In all areas within

public rights-of-way, the method of marking removal shall be approved by governing authority.

3.02 APPLICATION

- A. Apply two (2) coats of paint at manufacturer recommended rate without the addition of thinner, with a maximum of 100 square feet per gallon. Apply with mechanical equipment to produce uniform straight edges. At sidewalk curbs and crosswalks, use a straightedge to ensure a uniform, clean and straight stripe.
- B. The following items shall be painted with colors noted below:
 - 1. Pedestrian Crosswalks: White
 - 2. Exterior Sidewalk Curbs, Light Pole Bases and Guard posts: Yellow
 - 3. Fire Lanes: Red or per local code
 - 4. Lane striping where separating traffic in opposite directions: Yellow
 - 5. Lane striping where separating traffic in the same direction: White
 - 6. Handicap Symbols: Per local code
 - 7. Parking Stall Striping: White, unless otherwise noted on plans

END OF SECTION

SECTION 321723.23 – RAISED PAVEMENT MARKINGS

(Referenced from 2004 TxDOT, ITEM 666 Reflectorized Pavement Markings – references made to any other Sections of the 2004 TxDOT Manual shall become part of the Contract to be followed)

10007.1. Description. Furnish and place reflectorized pavement markings.

10007.2. Materials.

- A. Type I Marking Materials.** Furnish in accordance with DMS-8220, "Hot Applied Thermoplastic."
- B. Type II Marking Materials.** Furnish in accordance with DMS-8200, "Traffic Paint."
- C. Glass Traffic Beads.** Furnish drop-on glass beads conforming to DMS-8290, "Glass Traffic Beads."
 - 1. Type I Markings.** Furnish Type III drop-on glass beads. Furnish Type II or double-drop of Type II and Type III drop-on glass beads where each type bead is applied separately in equal portions (by weight), only when specified in the plans. When furnishing a double-drop system, apply the Type III beads before applying the Type II beads.
 - 2. Type II Markings.** Furnish Type III drop-on glass beads or other beads specified on the plans.
- D. Labeling.** Use clearly marked containers that indicate color, mass, material type, manufacturer, and batch number.

10007.3. Equipment.

- A. General Requirements.** Use equipment that:
 - is maintained in satisfactory condition,
 - meets or exceeds the requirements of the National Board of Fire Underwriters and the RRC for this application,
 - uses an automatic bead dispenser attached to the pavement marking equipment, and
 - can provide continuous mixing and agitation of the pavement marking material. Provide a hand-held thermometer capable of measuring the temperature of the marking material when applying Type I material.
- B. Material Placement Requirements.** Use equipment that can place:
 - at least 40,000 ft. of 4-in. solid or broken markings per day at the specified thickness;

- linear markings up to 8 in. wide in a single pass;
- markings other than solid or broken lines;
- a center-line and no-passing barrier-line configuration consisting of 1 broken line with 2 solid lines at the same time to the alignment, spacing, and thickness shown on the plans, for 3-line application;
- white line from both sides;
- lines with clean edges, uniform cross section and thickness, and reasonably square ends;
- skip lines between 10 and 10-1/2 ft., an approximate stripe-to-gap ratio of 1 to 3, and a stripe-gap cycle between 39-1/2 ft. and 40-1/2 ft., automatically;
- beads uniformly and almost instantly on the marking as the marking is being applied;
- beads uniformly during the application of all lines (each line must have an equivalent bead yield rate and embedment); and;
- double-drop bead applications using both Type II and Type III beads from separate independent bead applicators, if double-drop bead application is used.

10007.4. Construction. Place markings before opening to traffic unless short-term or work zone markings are allowed.

- A. General.** Obtain approval for the sequence of work and estimated daily production. On roadways already open to traffic, place markings with minimal interference to the operations of that roadway. Use traffic control as shown on the plans or as approved. Protect all markings placed under open-traffic conditions from traffic damage and disfigurement. Establish guides to mark the lateral location of pavement markings as shown on the plans or as directed, and have guide locations verified. Use material for guides that will not leave a permanent mark on the roadway.

Apply markings on pavement that is completely dry and passes the following tests:

- Type I Marking Application—Place a sample of Type I marking material on a piece of tarpaper placed on the pavement. Allow the material to cool to ambient temperature, and then inspect the underside of the tarpaper in contact with the pavement. Pavement will be considered dry if there is no condensation on the tarpaper.
- Type II Marking Application—Place a 1-sq. ft. piece of clear

plastic on the pavement, and weight down the edges. The pavement is considered dry if, when inspected after 15 min., no condensation has occurred on the underside of the plastic.

Apply markings:

- that meet the requirements of Tex-828-B,
- using widths and colors shown on the plans,
- at locations shown on the plans,
- in proper alignment with the guides without deviating from the alignment more than 1 in. per 200 ft. of roadway or more than 2 in. maximum,
- without abrupt deviations,
- free of blisters and with no more than 5% by area of holes or voids,
- with uniform cross section and thickness,
- with clean and reasonably square ends,
- that are reflectorized, and
- using personnel skilled and experienced with installation of pavement markings. Remove all applied markings that are not in alignment or sequence as stated in the plans or as stated in the specifications at the Contractor's expense in accordance with Item 677, "Eliminating Existing Pavement Markings and Markers," except for measurement and payment.

- B. Surface Preparation.** Unless otherwise shown on the plans, prepare surfaces in accordance with this section.
1. **Cleaning for New Asphalt Surfaces and Retracing of All Surfaces.** For new asphalt surfaces (less than 3 years old) and retracing of all surfaces, air-blast or broom the pavement surface to remove loose material, unless otherwise shown on the plans. A sealer for Type I markings is not required unless otherwise shown on the plans.
 2. **Cleaning for Old Asphalt and Concrete Surfaces (Excludes Retracing).** For old asphalt surfaces (more than 3 years old) and all concrete surfaces, clean in accordance with Item 678, "Pavement Surface Preparation for Markings," to remove curing membrane, dirt, grease, loose and flaking existing construction markings, and other forms of contamination.
 3. **Sealer for Type I Markings.** For asphalt surfaces more than 3 years old or for concrete, apply a pavement sealer before placing Type I markings on locations that do not have existing markings, unless otherwise approved. The pavement sealer may be either a Type II

marking or an acrylic or epoxy sealer unless otherwise shown on the plans. Follow the manufacturer's directions for application of acrylic or epoxy sealers. When the sealer becomes dirty after placement, clean by washing or in accordance with Section 666.4.B.1, "Cleaning for New Asphalt Surfaces and Retracing of All Surfaces," as directed. Place the sealer in the same configuration and color (unless clear) as the Type I markings unless otherwise shown on the plans.

- C. **Application.** Apply markings during good weather unless otherwise directed. If markings are placed at Contractor option when inclement weather is impending and the markings are damaged by subsequent precipitation, the Contractor is responsible for all costs associated with replacing the markings if required.
1. **Type I Markings.** Place the Type I marking after the sealer cures. Apply within the temperature limits recommended by the material manufacturer. If during a spray application, operations cease for 5 min. or longer, flush the spray head by spraying marking material into a pan or similar container until the material being applied is at the recommended temperature.
 2. Apply on clean, dry pavements passing the moisture test described in Section 666.4.A, "General," and with a surface temperature above 50°F when measured in accordance with Tex-829-B.

Apply Type I markings with a minimum thickness of:

- 0.100 in. (100 mils) for new markings and retracing water-based markings on surface treatments involving Item 316, "Surface Treatments," or Item 318, "Hot Asphalt-Rubber Surface Treatments,"
 - 0.060 in. (60 mils) for retracing on thermoplastic pavement markings, or
 - 0.090 in. (90 mils) for all other Type I markings. The maximum thickness for Type I markings is 0.180 in. (180 mils). Measure thickness for markings in accordance with Tex-854-B using the tape method.
1. **Type II Markings.** Apply on surfaces with a minimum surface temperature of 50°F. Apply at least 20 gal. per mile on concrete and asphalt surfaces and at least 22 gal. per mile on surface treatments for a solid 4-in. line. Adjust application rates proportionally for other widths. When Type II markings are used as a sealer for Type I markings, apply at least 15 gal. per mile using Type

- II drop-on beads.
2. **Bead Coverage.** For Type I and Type II markings, provide a uniform distribution of beads across the surface of the stripe, with 40 to 60% bead embedment.
- D. **Performance Period.** All markings and replacement markings must meet the requirements of Tex-828-B for at least 30 calendar days after installation. Unless otherwise directed, remove pavement markings that fail to meet requirements, and replace at the Contractor's expense. Replace failing markings within 30 days of notification.

10007.5. Measurement. This Item will be measured by the foot; by each word, symbol, or shape; or by any other unit shown on the plans. Each stripe will be measured separately.

This is a plans quantity measurement Item. The quantity to be paid is the quantity shown in the proposal unless modified by Article 9.2, "Plans Quantity Measurement." Additional measurements or calculations will be made if adjustments of quantities are required.

Acrylic or epoxy sealer, or Type II markings when used as a sealer for Type I markings, will be measured by the foot; by each word, symbol, or shape; or by any other unit shown on the plans.

10007.6. MEASUREMENT AND PAYMENT

- A. When listed as a separate contract pay item, shall be measured in accordance with "Measurement and Basis of Payment" section or as shown on the Bid Proposal Form.
- B. When not listed as a separate contract pay item, shall be considered as incidental work, and the cost thereof shall be included in such contract pay item(s) as are provided in the proposal contract.
- C. Compensation, whether by contract pay item or incidental work will be for furnishing all materials, labor, equipment, tools and incidentals required for the work, all in accordance with the plans and these specifications.

END OF SECTION

SECTION 32 17 23.33 – THERMOPLASTIC PAVEMENT MARKINGS

1.00 GENERAL

1.01 SECTION INCLUDES

- A. Thermoplastic Pavement Marking for crosswalks, stop lines, lane lines, and other types of traffic control.

1.02 RELATED SECTIONS

- A. Section 31 10 00 – Site Clearing
- B. Construction Drawings

1.03 PROJECT CONDITIONS

- A. Maintain access for vehicular and pedestrian traffic as required for other construction activities. Utilize flagmen, barricades, warning signs and warning light as required.

1.04 SUBMITTALS

- A. Product Data: Submit Manufacturer's literature indicating product specifications and instructions for handling, installation, and curing. Include performance test data sheets for each product.
- B. Submit material supplier's certification of compliance with specifications.
- C. Chemical Analysis: Submit infrared analysis of Type B resins for each manufacturer used.

2.00 PRODUCTS

2.01 MATERIALS

- A. General Requirements: Thermoplastic pavement marking material Type B for use on either asphaltic or Portland cement concrete surfaces. Clearly mark each container to indicate color, weight, type of material, and lot or batch number (consider lot or batch as each individual mix or blend that produces finished product ready for use).

Package material in either suitable corrugated containers or thermal degradable plastic bags to avoid sticking during shipment or storage.

- B. Thermoplastic markings shall not be slippery when wet, nor exhibit tacky, exposed surface. Cold ductility of material shall permit normal road surface expansion and contraction without chipping or cracking. Markings shall retain their original color, dimensions, and placement under normal traffic conditions at road surface temperatures of 158 F and below.
- C. Prime and filler pigments shall pass U.S. Standard sieve No. 230 (0.0024 inch opening) when washed free of resins by solvent washing, and meet following specific requirements for each pigment.
 - 1. Prime Pigments: White pigment shall be Rutile Titanium Dioxide.
 - 2. Filler Pigment: Filler pigment shall be calcium carbonate, 95% purity.
- D. Binder
 - 1. Type B - Alkyd: Use binder consisting of mixture of resins, at least one of which is solid at room temperature, and high boiling point plasticizers. At least one-third of binder compositions shall be a maleic-modified glyceryl ester 012 Rosin and shall be no less than 8% by weight of entire material formulation.
- E. Glass Traffic Beads: the total silica used in formulation shall be in form of glass traffic beads meeting the following requirements:
 - 1. Manufacture. Use glass traffic beads having the following characteristics:
 - a. Manufactured from glass;
 - b. Spherical in shape;
 - c. Free of sharp angular particles;
 - d. Free of particles showing milkiness, surface scoring, or surface scratching;
 - e. Water white in color.
 - 2. Contaminants. Use glass traffic beads having the following characteristics:
 - a. Containing less than 1/4 of 1% moisture by weight;
 - b. Free of trash, dirt, etc;
 - c. Showing no evidence of objectionable static electricity when flowing through regular traffic-bead dispenser.

3. Gradation: University of Houston Master Construction Specifications Insert Project Name AE Project Number: Thermoplastic Pavement Markings 32 17 23.33 – 3 Revision Date: 1/29/2014
 - a. Sieve Analysis. Glass traffic beads shall meet following gradation requirements:

Openings	U.S. Standard Sieves	Percent Passing
No. 20		95 - 100
No. 30		80 - 95
No. 50		15 - 35
No. 100		0 - 4
 - b. Irregular Particles: Glass traffic beads, retained on screen used to determine gradation requirements, shall not contain more than 30% (by weight) irregular particles.
4. Index of Refraction: Glass traffic beads, when tested by TxDOT Tex-822-B, using liquid immersion method at 25 C (77 F) shall show index of refraction within range of 1.50 to 1.53.
5. Wetting. Use glass traffic beads capable of being readily wet with water when tested in accordance with TxDOT Tex-826-B.
6. Stability. Use glass traffic beads showing no tendency toward decomposition, surface etching, change in retro reflective characteristics, or change in color after:
 - a. One hour exposure to concentrated hydrochloric acid at 25 C (77 F);
 - b. Twenty-four-hour exposure to weak alkali;
 - c. One hundred hours of Weather-O-Meter exposure, in accordance with ASTM G 152 and ASTM G 153.

2.02 FINISHED PRODUCT REQUIREMENTS

- A. Physical Characteristics. Finished thermoplastic pavement markings material shall be free flowing granular material, unless otherwise shown on Drawings. Material shall remain in free flowing state in storage at temperatures of 100 F or less. Materials shall be readily sprayed through nozzles commonly used on thermoplastic spray equipment at temperatures between 205 and 218 C (401 to 425 F).
- B. Toxicity. At temperatures up to and including 230 C (446 F), materials shall not give off fumes which are toxic and otherwise injurious to persons, animals, or property.

- C. Material shall not break down or deteriorate when held at 205 C (401 F) for 4 hours.
- D. Temperature versus viscosity characteristics of material in plastic state shall remain constant throughout up to four reheatings at 205 C (401 F) and from batch to batch.
- E. Material shall not be adversely altered by contact with sodium chloride, calcium chloride, or other similar chemicals on, or used on, roadway surface; by contact with oil content of pavement materials, or by contact from oil dropping from traffic.
- F. Softening Point. After heating thermoplastic materials for two hours at 204 C (400 F) Type B Alkyd material shall have softened point greater than 90 C (194 F) when tested in accordance with ASTM E 28-58T – Ball Ring Method.
- G. Color. CIE chromaticity coordinates of materials, when determined in accordance with TCDOT Tex-839-B, shall fall within area having following corner points and shall met the following luminosity requirements.

CIE CHROMATICITY COORDINATE CORNER POINTS

	Point 1		Point 2		Point 3		Point 4	
Color	X	Y	X	Y	X	Y	X	Y
Luminosity White								
{tc \12 0.290 - 0.315	0.310	- 0.295	0.350	- 0.340	0.330	- .360	Min 65	
"White}								

Material shall meet above specified color requirements, before and after 70 hours of exposure in Weather-O-Meter (Atlas, Sunshine Type) fitted with 18 – 108 (18 minutes of sunshine and rain and 102 minutes of sunshine) cyclic gear. Prepare panels for testing with material supplied.

- H. Abrasion. Thermoplastic pavement marking material shall have loss between 4.0 and 12.0 grams when tested for abrasion in accordance with TxDOT Tex-851-B. Test according to steps 1 through 8 procedure utilizing the following test parameters:

Test distance: 5 inches
Blast pressure: 40 psi

Sample Angle: 10 degrees and 122 gram blast media
Blast Media: 1200 grams

- I. Uniformity. Manufacture material so that, when sampled in accordance with TxDOT Manual of Testing Procedures, 100-gram sample will be representative of batch or lot of material.
- J. When applied 1/8 inch thick, setting time shall not exceed characteristic straight-line curve, lower limit of which is four minutes at 59 F road surface temperatures, and upper limit of which is ten minutes at 90 F road surface temperature. Both temperatures are to be measured at maximum relative humidity of 90%.

3.00 EXECUTION

3.01 PREPARATION

- A. Sweep and clean surface to eliminate loose material and dust and prepare in accordance with recommendations of thermoplastic material manufacturer and to the satisfaction of Engineer, prior to placement of markings. Surface scarification cannot be used without prior approval of Engineer.
- B. In all areas within public rights-of-way, the method of marking removal shall be approved by governing authority.
- C. Prepare Portland cement concrete surfaces further after cleaning by completely sealing with epoxy or methyl methacrylate sealer, as recommended by thermoplastic material manufacturer, Place sealer sufficiently in advance of thermoplastic to allow release of all solvents.
- D. Prime asphaltic surfaces with sealer, as recommended by thermoplastic material manufacturer based on surface conditions. Include adhesive or adhesion promoter when asphaltic surfaces exhibit polished aggregate.

3.02 APPLICATION

- A. Install in widths of 4, 6, 8, or 12 inches, or shaped otherwise as shown on drawings. Tolerances in width shall not exceed 1/8 inch. Tolerance shall not exceed 1/4 inch in case of undulation in pavement.

- B. Material shall not prohibit adhesion of other thermoplastic markings if, at some future time new markings are placed over existing material.
- C. Maintain uniform thickness of each pavement marking. Minimum thickness of markings, as measured above plane formed by pavement surface, shall not be less than 1/8 inch (125 mils), unless shown otherwise on Drawings. Maximum thickness shall be 3/16 inch. Supply device, approved by Engineer, to measure thickness of applied extruded markings.
- D. The following items shall be painted with colors noted below:
 - 1. Pedestrian Crosswalks: White
 - 2. Exterior Sidewalk Curbs, Light Pole Bases and Guard posts: Yellow
 - 3. Fire Lanes: Red or per local code
 - 4. Lane striping where separating traffic in opposite directions: Yellow
 - 5. Lane striping where separating traffic in the same direction: White
 - 6. Handicap Symbols: Per local code
 - 7. Parking Stall Striping: White, unless otherwise noted on plans

3.05 TESTING

- A. Maintain uniform cross section, density, quality, and thickness for markings. Markings shall be uniform throughout their thickness. Use applied markings that are 95% free of holes and voids, and free of blisters for minimum of 60 days after application.

END OF SECTION

SECTION 328000 - IRRIGATION

1.00 GENERAL

1.01 SYSTEM DESIGN

- A. The irrigation system outlined on the Drawings indicates areas to be irrigated, but the sprinkler and drip irrigation systems must be designed by a licensed professional.
- B. The Contractor must submit the credentials for said professional for approval prior to proceeding with irrigation systems design and installation.
- C. The design plans shall be prepared by the approved professional, signed, stamped, and submitted for approval. Once approved, the irrigation system construction may begin.

1.02 WORK INCLUDED

- A. Trenching and other excavation.
- B. Irrigation lines, valve control circuits and appurtenances.
- C. Irrigation controllers and remote control valves.
- D. Electrical service and service installation if required.
- E. Testing.
- F. Backfill and compaction of backfill.
- G. Dust alleviation and control.
- H. Cleanup and disposal.
- I. Supplying all labor, materials, equipment, and apparatus not specifically mentioned herein or noted on the plans, but which are incidental and necessary to complete the work specified.

1.03 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the general designation only.
- B. American Society for Testing and Materials (ASTM) Publications:
- C. D -1785, Pipe, Polyvinyl Chloride (PVC) Plastic Schedules 40, 80 and 120.
- D. D-1784, Pipe, Polyvinyl Chloride (PVC) Plastic Class 200.

1.04 QUALITY ASSURANCE

- A. Irrigation mains, lines and appurtenances shall be subject to successfully passing a leakage test as prescribed herein.
- B. Irrigation lines shall be installed after satisfactory completion of roadway or landscape subgrade.

- C. Submit catalogue cuts of irrigation valves, controllers, and associated equipment for approval.

1.05 JOB CONDITIONS

- A. Contractor shall conduct operations and schedule cleanup in a manner to cause the least possible obstruction and inconvenience to traffic, pedestrians, and any adjacent property owners or tenants.
- B. Locations for proposed irrigation controllers and/or electrical service points shown on the plans are approximate only and the exact locations for such shall be as established in the field by the Engineer.
- C. Damage resulting from movement of the sides or bottom of trenches or other excavation which is attributable to the Contractor's acts or omissions, whether sides are braced or not, and any portions of the area and work affected by such movement, shall be satisfactorily repaired or restored.
- D. Contractor shall supply and deliver the following equipment and information prior to acceptance of the work:
 - 1. Three (3) each (if applicable) quick coupler valve keys and hose swivel ells.
 - 2. Two (2) sets of various special wrenches or tools that may be required for adjustment of sprinkler heads or equipment.
 - 3. Three (3) (if applicable) keys or wheel handles required to operate hose bibs.
 - 4. Two (2) copies of the instruction manual for each irrigation controller.
- E. Comply and conform to conditions and requirements indicated under Section 02202, Trenching and Backfill, of these Specifications.

2.00 PRODUCTS

2.01 PIPE AND FITTINGS FOR IRRIGATION MAINS

- A. Pressure mains and non-pressure mains shall be polyvinyl chloride (PVC) Schedule 40 conforming to the requirements of ASTM Designation D1785 or Class 200 (ASTM D1784) and shall be provided with solvent weld joints and fittings.
- B. All plastic fittings shall be Schedule 40 polyvinyl chloride (PVC) conforming to the requirements of ASTM Designation D1785 or Class 200 (ASTM D1784) and shall be specifically made for the type of pipe used.
- C. All nipples and fittings for risers shall be Schedule 80 polyvinyl-chloride (PVC) conforming to the requirements of ASTM Designation D1785. Nipples, fittings and risers shall be same size as sprinkler head inlets.
- D. All polyvinyl chloride (PVC) pipe and fittings shall be free from

imperfections.

- E. Metallic nipples and fittings for above-ground installation of backflow preventer systems shall be Schedule 40 or Class 200 brass nipples and class 125# bronze fittings. All brass nipples and bronze fittings shall be factory threaded.

2.02 JOINTS FOR POLYVINYL CHLORIDE (PVC) PIPE

- A. Rubber ring seal joints shall be made in accordance with the manufacturer's instructions and as indicated on the plans.
- B. Solvent weld joints shall be made using P-70 primer as manufactured by "Weld-On" or approved equal and "Weld-On" 710 joint cement or approved equal.
- C. All threaded joints shall be factory formed. Field threading of pipe or fittings will not be permitted. Threaded joint connections shall be made with virgin teflon tape, or approved equal.

2.03 VALVES AND VALVE BOXES

- A. Gate valves, where required on the plans, shall be the same size as the main line and shall be as shown on plans or approved equal. Size and type of valve shall be as indicated on the plans.
- B. Quick coupling valves shall be as manufactured by "Rainbird", brass or bronze one piece body designed for a working pressure of 125 psi and equipped with metal covers, or approved equal. Contractor shall provide the Engineer with three (3) for each quick coupler keys and double lug hose swivel ells. Type and model of valve shall be as indicated on the plans.
- C. Remote control valves shall be as shown on plans, normally closed, diaphragm actuated, electrically operated from remote location by means of 18/24V, 50/60H, 7.5VA coil, with brass bleed plug for manual operation. Substitutions for irrigation controllers and/or remote control valves shall be at the sole option of the Engineer and shall require prior written consent. Remote control valve sizes shall be the same as the supply runs on which they are to be installed.
- D. Valve boxes for gate valves and remote control valves in turf, shrub and ground cover areas shall be fiberglass reinforced plastic, color green, as manufactured by "Ametek", "Carson" or approved equal.
- E. Gate Valves Box Covers to be factory marked "Irrigation Control Valve" and shall have a valve number permanently stenciled on it with white exterior paint.
- F. Remote Control Valve Boxes shall be rectangular with a minimum dimension of 10-1/2" x 17-1/4" at the base. Cover to be factory marked "RCV" and shall have a station number permanently stenciled on it with

white exterior paint.

- G. Valves shall be individually housed. Manifolding of valves in a single valve box shall not be permitted.

2.04 SPRINKLER HEADS

- A. All bubblers and stationary shrub sprays on risers, pop-up spray heads and gear-driven stream rotors for ground cover, shrubs and turf shall be as manufactured by "Toro" or approved equal. Type and model of such heads shall be as indicated on the plans.
- B. All pop-up spray heads and gear-driven stream rotors for ground cover, shrubs and turf shall be as manufactured by "Rainbird" or by "Hunter", or approved equal. Type and model of such heads shall be as indicated on the plans.

2.05 IRRIGATION LINE INSTALLATION

- A. Controllers for irrigation systems shall be solid state type controllers as manufactured by either Rainbird or Hunter or as shown. Controller installations shall consist of models to provide the required number of control valve stations to a maximum of twenty-four (24) stations per controller installation:
- B. Substitution for irrigation controllers on an "or equal" basis shall be at the sole option of, and shall require the prior written consent from the Engineer.
- C. Remote final strength shall be verified by the contractor in presence of the project inspector prior to final installation to determine the need of a high gain antenna assembly.
- D. Irrigation controllers shall be mounted as specified in the Detail Drawings.
- E. Controllers shall be 120V from a metered power supply, unless solar or battery operated systems are specified.
- F. All electrical wires and cables, shall be placed in conduits (1" minimum diameter).
- G. Controller enclosures shall be furnished with acceptable keyed locking mechanisms and furnished with keys.

2.06 BACKFLOW PREVENTION DEVICE

- A. Backflow prevention devices shall be as required by Section 1003 of the Uniform Plumbing Code, and as approved by the City/County Public Health Department. Model and details of such devices shall be as indicated on the plans.

2.07 CONTROL VALVE CIRCUITS

- A. Wire for valve control circuits shall be UL-approved for direct burial in ground, size #14-I. Common ground wire shall have white insulating jacket. Control wire shall have jacket of color other than white and the jacket color for any circuit shall be continuous between controller and valve. A circuit color code schedule shall be posted inside each controller enclosure.
- B. Splices shall be made with #2006-S "Buchanon" splice caps and 3M #3576 "Scotchloc" seal packs or approved equal.

2.08 THRUST BLOCKS FOR RUBBER RING SEAL JOINTS

- A. Thrust blocks shall be provided where necessary to resist pressure on rubber ring seal joints. Concrete for thrust blocking shall conform to the requirements of Section 02550 of these specifications.

2.09 PIPE COVER MATERIAL

- A. Shall be in conformance to Section 02202, Trenching and Backfill, of these Specifications.

3.00 EXECUTION

3.01 TRENCHING, BACKFILLING AND COMPACTION

- A. Shall be in conformance to Section 02202, Trenching and Backfill, of these Specifications.

3.02 IRRIGATION LINE INSTALLATION

- A. Pipe, valves, fittings, and appurtenances shall be installed as accurately as possible in accordance with the locations shown on the plans. All polyvinyl chloride (PVC) pipe shall be installed with identification markings facing upward, visible from the top of the trench. Cap or plug openings as pipeline is assembled to prevent entrance of dirt or obstructions. Remove caps or plugs only when necessary to continue assembly. Where pipes pass through sleeves, provide removable non-decaying plug at ends to prevent entrance of earth. No irrigation lines shall be constructed before subgrade for roadway and median areas have been satisfactorily completed.
- B. Depth of cover for pressure mains shall be twenty-four (24) inches below subgrade in areas to be paved and in landscape areas. Depth of cover

- for non-pressure lines shall be eighteen (18) inches below sub-grade in areas to be paved, eighteen (18) inches below subgrade for topsoil for mainlines and twelve (12) inches below subgrade for topsoil for lateral lines in landscape areas.
- C. Pipe, valves and fittings shall be carefully handled during hauling, unloading, and placing operations, so as to avoid breakage or damage. All polyvinylchloride (PVC) pipe shall be stored carefully, and protected from prolonged sunlight. Broken or damaged pipe or appurtenances will be rejected and shall be replaced.
 - D. Irrigation lines shall be installed as accurately as possible in accordance with the locations shown on the plans. The plans are diagrammatic only, and where irrigation lines on the plans are shown under paved areas but running parallel and adjacent to planted areas, the intent is to install the irrigation lines in the planted area. Irrigation lines shall have a minimum horizontal clearance of four (4) inches from each other, and a minimum horizontal clearance of twelve (12) inches from other underground lines (this requirement does not apply to any lines crossing at angles from 45 to 90 degrees with each other). A minimum of two (2) inches vertical clearance shall be maintained between lines which cross between these angles. No irrigation line shall be installed parallel to and directly over another line. Intermediate high spot along the irrigation line shall not be allowed.
 - E. All pipes shall be assembled free from dirt, shall be reamed and all burrs shall be removed. When pipe laying is not in progress, all open pipe ends shall be closed with watertight plugs in a manner satisfactory to the Engineer. Before installation of irrigation lines, the Contractor shall remove all stakes, debris, loose rock and other hard material from the bottom of the trench.
 - F. After the final positioning, the pipe shall be held in place in the trench with backfill material placed equally on both sides of the pipe at as many locations as are required to hold the pipe section in place. After joints are completed, the backfill material shall be redistributed and compacted as herein required.
 - G. At the end of each day and when work is not in progress, the open ends of pipe installed in the line shall be closed with watertight plugs, and openings for valves and other appurtenances shall be suitably covered.
 - H. Concrete thrust blocks of the form and dimensions shown or noted on the plans shall be provided as indicated on the plans. Form thrust blocks in such a manner to prevent any concrete from coming in contact with the pipe. Thrust blocks shall be constructed to completely fill the void between solid soil and the fitting, and shall be installed in strict conformance with the applicable details shown or noted on the plans.

3.03 JOINT AND FITTING INSTALLATION

A. Rubber Ring Seal Joints

1. Use factory made male ends or prepared field cut male end joints to exact specifications of factory made ends. Join lengths of pipe by means of integrally formed bell end on pipe using rubber ring seal. Carefully clean bell or coupling and insert rubber ring without lubricant. Position ring carefully according to manufacturer's instructions.
2. Lubricate male end according to manufacturer's instructions and insert male end to specified depth. Use hands only when inserting PVC pipe.
3. Thrust blocks shall be provided where necessary to resist system pressure on joints or fittings made with rubber ring seal joint pipe in accordance with the details shown on the plans.

B. Solvent Weld Joints Prepare joint by first making sure the pipe end is square, then deburring the pipe end and cleaning pipe of dirt, dust and moisture. Dry-insert pipe into fitting to check for proper sizing. Pipe should enter fitting 1/3 to 2/3 depth of socket. Coat the inside socket surface of the fitting and the external surface of the male end of the pipe with 711 primer manufactured by "Weld-On" or approved equal. Then, without delay, apply "Weld-On" 710 joint cement or approved equal liberally to the inside of the socket. At this time, apply a second coat of cement to the pipe end. Insert pipe immediately into fitting and turn 1/4 turn to distribute cement and remove air bubbles. The pipe must seat to the bottom of the socket and fitting. The fitting shall be properly aligned without strain. Hold joint still for approximately thirty (30) seconds and then wipe the excess cement from the pipe and fitting. Cure joint a minimum of thirty (30) minutes before handling and at least six (6) hours before allowing water in the pipe.

C. Threaded Joints

1. Field threading of plastic pipe or fittings is not permitted. Only factory formed threads and factory fabricated nipples or risers shall be permitted.
2. When assembling threaded plastic joints, take up joint no more than one full turn beyond hand tight.
3. Threaded joint connections shall be made up with virgin teflon tape, or approved equal.

3.04 VALVE AND VALVE BOX INSTALLATION

- #### A. Valve boxes shall be grouped and located in shrub and ground cover areas wherever possible. Valves shall be installed no farther than twelve (12) inches from the main line and no closer than twelve (12) inches

- from walk edges, buildings and walls.
- B. Thoroughly flush main line before installation. Valves shall be installed as indicated on the details shown on the plans.
 - C. All control valves shall be three (3) inches minimum and eight (8) inches maximum below finish grade to the top of the flow control stem.
 - D. Quick coupling valves shall be located as called for on the plans and installed as indicated on the details shown on the plans.
 - E. Valve boxes shall be set flush with finish grade in lawn areas and one and one-half (1-1/2) inches above grade in shrub areas.

3.05 SPRINKLER HEAD INSTALLATION

- A. Lawn heads shall be located with a minimum of one (1) inch, a maximum of two (2) inches, clear from adjacent paving or headers, and flush with them where a potential hazard may occur. Other lawn heads shall be installed as indicated on the details shown on the plans.
- B. Pop-up heads of approved design shall be installed at edges of landscaped areas adjoining paved areas as indicated on the details shown on the plans. Interior shrub heads shall be either pop-up heads set level with finish grade or fixed heads set six (6) inches above finish grade.
- C. Individual heads shall be adjusted as required to obtain uniform coverage without overthrow onto buildings, paving, main walks, or other structures.
- D. Each section of lateral pipe shall be thoroughly flushed out before the sprinkler heads are attached.
- E. Sprinkler heads shall be located and installed as shown on the plans.

3.06 IRRIGATION CONTROLLER INSTALLATION

- A. Controller enclosures shall be located, and irrigation controllers and enclosures shall be installed, as shown on the plans. The sprinkler controller chart shall be a photostatic reproduction of the sprinkler or irrigation plan, provided and installed by the Contractor. It shall be laminated permanently in plastic and securely attached to the inside lid of the controller cabinet and shall correctly relate each section to its respective system.

3.07 CONTROL WIRE INSTALLATION

- A. Connection of control lines to controller shall be in sequential arrangement according to assigned identification number of valve. Connections shall be made by crimping bare wires with brass connectors and sealing with epoxy resin sealer packs. Control lines shall

- be labeled at the controller with permanent non-fading labels indicating identification number of valve controlled.
- B. All control wiring shall be laid to minimum depth of eighteen (18) inches in common trenches with mainline piping wherever possible. Where control lines do not parallel mains, wires shall be strapped at intervals of at least ten (10) feet to the underside of two by four redwood boards.
 - C. Where control lines pass under paving, they shall pass through Schedule 40 PVC conduit sleeves. Where control wires pass through sleeves, Contractor shall provide removable non-decaying plug at ends of the sleeve to prevent entrance of earth.
 - D. Contractor shall loop a minimum of three (3) feet of extra wire in each valve box; both control wire and ground wire. All splices shall be made at a valve box only.

3.08 ELECTRICAL SERVICE INSTALLATION

- A. Make all electrical connections to 120 Volt service at each controller location. Install a disconnect switch inside the pedestal of the controller cabinet. All electrical work and materials shall comply with these specifications and any further requirements of the permit issued for the electrical service connection by the serving utility.

3.09 TESTING

- A. Hydrostatic and leakage tests shall be made only after the trenches have been backfilled sufficiently to hold the pipe firmly in position with no fittings being backfilled.
- B. All welded plastic pipe joints shall have cured for at least 24 hours. Provide all water necessary for filling and flushing at no additional expense to the Contract.
- C. Pressure irrigation mains shall be subjected to a hydrostatic test of 125 psi. Each section being tested shall be slowly filled with water, care being taken to expel all air from the pipe by such means as are necessary. The pipes must be flushed before testing to remove any foreign material. The test pressure shall be applied for not less than four (4) hours. Any leakage discovered in consequence of the pressure test shall be corrected and the test shall be repeated until satisfactory results are obtained. Any defective pipe, fittings, valves, or joints shall be repaired or replaced.
- D. Contractor shall provide water as necessary for hydrostatic testing.

END OF SECTION

SECTION 328412 – VEGETATIVE WATERING

(Referenced from 2004 TxDOT, ITEM 168 Vegetative Watering – references made to any other Sections of the 2004 TxDOT Manual shall become part of the Contract to be followed)

00168.1. Description. Provide and distribute water to promote growth of vegetation as directed.

00168.2. Materials. Use water that is clean and free of industrial wastes and other substances harmful to the growth of vegetation.

00168.3. Construction. Apply water when directed. Furnish and operate equipment to distribute water at a uniform and controllable rate. Ensure that watering does not erode soil or plantings. Apply water in the required quantity where shown on the plans or as directed.

00168.4. MEASUREMENT AND PAYMENT

- A. When listed as a separate contract pay item, shall be measured in accordance with "Measurement and Basis of Payment" section or as shown on the Bid Proposal Form.
- B. When not listed as a separate contract pay item, shall be considered as incidental work, and the cost thereof shall be included in such contract pay item(s) as are provided in the proposal contract.
- C. Compensation, whether by contract pay item or incidental work will be for furnishing all materials, labor, equipment, tools and incidentals required for the work, all in accordance with the plans and these specifications.

END OF SECTION

SECTION 328423 – SPRINKLING

(Referenced from 2004 TxDOT, ITEM 204 Sprinkling – references made to any other Sections of the 2004 TxDOT Manual shall become part of the Contract to be followed)

00204.1. Description. Apply water for dust control, earthwork, or base construction.

00204.2. Materials. Furnish water free of industrial wastes and other objectionable matter.

00204.3. Equipment. Use sprinklers and spray bars equipped with positive and rapidly working cut-off valves.

00204.4. Construction. Apply water at a uniform rate and in the required quantity, or as directed.

00204.5. MEASUREMENT AND PAYMENT

- A. When listed as a separate contract pay item, shall be measured in accordance with "Measurement and Basis of Payment" section or as shown on the Bid Proposal Form.
- B. When not listed as a separate contract pay item, shall be considered as incidental work, and the cost thereof shall be included in such contract pay item(s) as are provided in the proposal contract.
- C. Compensation, whether by contract pay item or incidental work will be for furnishing all materials, labor, equipment, tools and incidentals required for the work, all in accordance with the plans and these specifications.

END OF SECTION

SECTION 329000 – PLANTING

1.00 GENERAL

1.01 SCOPE

- A. Supply and installation of all approved materials, labor, equipment, transportation and services required and incidental thereto, in conformity with the plans and specifications, including but not limited to: vegetation protection/pruning, fine grading, earth mounding, bed excavation and preparation, bed edging, planting soil/mixes, fertilizer, mulch, trees, palms, shrubs, ground covers, staking, paving, clean-up, maintenance, and warranty.
- B. Related Sections:
 - 1. Irrigation – 32 80 00
 - 2. Lawns – 32 92 00

1.02 REFERENCE STANDARDS

- A. General: "Hortus Third," 1976
- B. Texas Association of Nurserymen, Grades and Standards for Nursery Stock
- C. Plant Material: "American Standard for Nursery Stock," ANSI Z60.1-1990
- D. National Arborist Association Standards

1.03 DEFINITIONS

- A. Specimen Plants: Plants having exceptional character, superiority in form and branching, and the best attributes of the species; all as determined by the Engineer, Landscape Designer or Owner.

1.04 QUALIFICATIONS

- A. Landscape work to be performed by a single firm specializing in commercial landscape work with a minimum of five (5) years' experience on similar type projects. Owner to review qualifications and approve subcontractor prior to commencing work.

1.05 SUBMITTALS

- A. Submittals shall be formatted in a three-ring binder or digitally with tabs identifying each section. Landscape submittals shall also include submittal requirements for Section 32 80 00-Irrigation, 32 14 13-Unit Pavers, and 32 92 00-Lawns. The following submittals are required for this section:
1. Landscape Construction Schedule
 2. Edging
 3. Post Emergent Herbicides
 4. Pre-Emergent Herbicides
 5. Soils, Compost and Mulch
 6. Sources of all Plant Materials (including address and telephone numbers)
 7. Product Data Material Safety Data Sheets
 8. Paving Materials
 9. Lawns (fertilizers, herbicides, maintenance)
 10. Irrigation Product Information
 11. Samples: One foot section of edging (as specified on plans), one pound bag sample of each; topsoil, lightweight planting mix, premium compost and mulch.
 12. Name of Subcontractor for pruning trees (Certified I.S.A Arborist)

1.06 PROTECTION

- A. Before commencing work, contractor shall place orange construction fencing around all vegetation labeled "to remain" on landscape plans. Fencing shall be placed squarely around each tree 6' x 6' and at least 60" in height or continuously around groups of vegetation as shown on plans. No work may begin until this requirement is fulfilled. All other vegetation not labeled "to remain" shall be cleared and grubbed including root systems.
- B. In order to avoid damage to roots, bark or lower branches, no truck or other equipment shall be driven or parked within the drip line of any tree, unless the tree overspreads a paved way.
- C. The Contractor shall use any and all precautionary measure when performing work around trees, walks, pavements, utilities, and any other features either existing or previously installed under this Contract.
- D. The Contractor shall adjust depth of earthwork and loaming when working immediately adjacent to any of the aforementioned features in order to prevent disturbing tree roots, undermining walks and pavements, and damage in general to any existing or newly incorporated item.

- E. Where excavating, fill or grading is required within the branch spread of trees that are to remain, the work shall be performed as follows:
1. Trenching: When trenching occurs around trees to remain, the tree roots shall not be cut but the trench shall be tunneled under or around the roots by careful hand digging and without injury to the roots.
 2. Raising Grades: When the existing grade at tree is below the now finished grade, and fill not exceeding sixteen (16") inches is required, clean, washed gravel graded from one to two inches (1" - 2") in size shall be placed directly around the tree trunk. The gravel shall extend out from trunk on all sides a minimum of eighteen (18") inches and finish approximately two (2") inches above the finished grade at tree. Install gravel before any earth fill is placed. New earth fill shall not be left in contact with the trunks of any trees requiring fill. Where fill exceeding sixteen (16") inches is required, a dry laid tree well shall be constructed around the trunk of the tree. The tree well shall extend out from the trunk on all sides a minimum of three (3') feet and to three (3") inches above finish grade. Coarse grade rock shall be placed directly around the tree well extending out the drip line of the tree. Clean, washed gravel graded from one to two (1" - 2") inches in size shall be placed directly over the coarse rock to the depth of three (3") inches. Approved backfill material shall be placed directly over the washed gravel to desired finished grade.
 3. Lowering Grades: Existing trees in areas where the now finished grade is to be lowered shall have grading work done by hand to elevation as indicated. Roots as required shall be cut cleanly three (3") inches below finished grade and scars covered with tree paint.
 4. Trees marked for preservation that are located more than six (6") inches above proposed grades shall stand on broad rounded mounds and be graded smoothly into the lower level. Trees located more than sixteen (16") inches above proposed grades shall have a dry laid stonewall, or other retaining structure as detailed on the plans, constructed a minimum of five (5') feet from the trunk. Exposed or broken roots shall be cut clean and covered with topsoil.
- F. Contractor is responsible for all protection measures listed above. If these procedures are not followed, contractor is responsible for replacement of existing trees and approved trees of equal caliper and height.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Packing and Shipping: Transport plant materials covered or in closed vehicles to protect from exposure to heat and wind. Spray trees and in full leaf with anti-desiccant as recommended by the manufacturer, before shipping. Take precautions to protect plant materials from desiccation and from damage to bark, branches and roots. Do not allow root balls to crack. Schedule shipments to coincide with planting work schedule.
- B. Storage and Protection: If planning is delayed after delivery, keep plants in a shaded area, cover roots with mulch or topsoil, and keep plants constantly watered until planted.

1.08 MAINTENANCE/WARRANTY

- A. Maintenance Requirements: Maintain the work of this Section for ninety (90) days after "substantial completion" and until final written acceptance by Owner. Notify the owner in writing of "substantial completion". Maintenance period begins after owner's written acceptance of "substantial completion".
- B. Maintenance Service: Perform the following maintenance operations at least one a week:
 - 1. Remove and replace dead plant material. Prune plants to remove dead wood and to maintain health of plants.
 - 2. Maintain all mulched areas at a two (2") inch depth. Remove weeds and grass from shrub and ground cover areas and from watering basins.
 - 3. Provide insect and disease control to maintain health of plants.
 - 4. Irrigation:
 - a. If the irrigation system is operating, program and monitor the system to provide adequate water for plants.
 - b. If the irrigation system is not operating, hand water plants. Deep water trees each week.
 - 5. Dispose of all maintenance debris/clippings off-site. Owner's dumpsters shall not be used.
 - 6. Keep all site areas tidy and free of grass clippings, mulch or other foreign materials.
 - 7. Submit receipts/dates of all maintenance operations to Owner/Engineer for approval.
 - 8. Remove staking materials at end of maintenance period and deliver to Owner.
- C. Warranty: Warranty shall cover all shrubs/groundcovers for a period of three (3) months and trees/palms for a period of one (1) year from the

date of final acceptance. Any plant material deemed dead or unrecoverable by the owner shall be replaced with similar species and size within two weeks of notification from owner.

1.09 RIGHT OF REJECTION

- A. The Owner/Engineer reserves the right to inspect and reject plants at any time and at any place.

2.00 PRODUCTS

2.01 MATERIALS

- A. Fertilizer: 13 13 13 Osmocote slow release fertilizer granules, or approve equal.
- B. Planting Tablets: Agraform 21 gram slow release fertilizer tablets, or approved equal.
- C. Compost: Premium grade compost (Earthwise Organics, or approved equal).
- D. Topsoil: Fertile, agricultural soil, typical for locality capable of sustaining vigorous plant growth, taken from drained site; free of subsoil, clay or impurities, plants, weeds, and roots; minimum pH value of 5.4 and maximum 7.0; organic matter to exceed 1.5%, magnesium to exceed 100 units; phosphorus to exceed 150 units; potassium to exceed 120 units; soluble salts/conductivity not to exceed 900 ppm/0.9 mmhos/cm in soil.
- E. Mulch:
 - 1. Shrub and Ground Cover Planting Areas: Grade A Shredded Hardwood; long, fibrous bark strands free from wood chips. Texas Natives, or approved equal.
 - 2. Watering Basins: Grade A Shredded Hardwood; long, fibrous bark strands free from wood chips. Texas Natives, or approved equal.
- F. Plants:
 - 1. General: Provide plant materials that are healthy and free from disease, insects, and larvae and without damage to bark, branches and roots. Refer to drawings for landscape type and set up.

2. Approval: All trees/palms must be inspected, approved and tagged by Owner at their place of origin or as directed in writing by Owner.
3. Sizes: Measured after pruning and in accordance with the plant schedule.
4. Root Treatment: As follows in accordance with the Reference Standards:
 - a. Palms: Balled and burlapped or containerized if they have been in the container for at least one growing season.
 - b. Trees, Shrubs, Ground Cover Plants: Container grown with a well-established fibrous root system.
5. Palms: All new palms shall be field dug or containerized material in specified sizes in plant schedule. All palms shall have good form (straight trunks) consistent of this species, free of scares/abrasions/burn marks and disease and insects, with large healthy root systems.

G. Staking Material:

1. Stakes shall be commercial grade T-Posts, 1.25 Gauge, 8' Ht., Green with orange safety caps on tops. Note: Do not drive through stakes through root balls.
2. Tree ties shall be Poly Chain Lock – 1" width, black, ProLock or approved equal.
3. Stakes shall be hardwood 2 x 2's or commercial grade T-Stakes (do not drive through rootball).

H. Edging:

1. Concrete Edging: Extruded, colored, fibermesh reinforced concrete edging (per details) Curb Appeal, or approved equal.
2. Tree Rings: 5" x 30" Black Anodized Aluminum tree rings (painted black or green). Dreamscapes, or approved equal.
3. Aluminum Edging: 5" commercial grade black anodized aluminum edging (black anodized). Dreamscapes, or approved equal.

2.02 PLANTING SOILS

- A. Planting Mix: 75% Sandy-Loam Topsoil; 25% Premium Compost; (3:1 ratio by volume); and specified fertilizer or planting tablets.
- B. Shrub and Ground Cover Areas:
 1. Where topsoil has been installed: Apply one (1") inch layer in planting bed; till into the top six inches of soil.

2. Where no topsoil has been installed: Remove twelve inches of existing soil and replace with ten inches of "Planting Mix" as described in Item "A" above.

3.00 EXECUTION

3.01 EXAMINATION

- A. Verification of Conditions: Examine the site and conditions under which landscape work is to be performed. Have the installer notify the Contractor in writing, with a copy of drawings if the site is unsatisfactory. Do not begin the work until unsatisfactory conditions have been corrected in a manner acceptable to installer. Beginning of work indicates acceptance of the site as satisfactory by the installer.

3.02 EXECUTION

- A. Site Preparation: Contractors must visit and review site prior to bidding. Compacted soils and sub-soils from construction activities must be ripped and tilled until a loose, friable and free-draining condition is met. All existing weeds, grass, stabilized sub-base material, rubble, excavated soil and other material shall be removed from the site and disposed of by the contractor prior to starting any new landscape work. Soil conditions around entire site must be approved by Owner prior to rough and finished grading operations. Contractor shall not install any fill or topsoil in landscape areas prior to site condition approval by Owner.
- B. Drainage: Landscape contractor shall follow grading as shown and specified on Civil Engineer's grading plans. Landscape Contractor shall coordinate grading operations with site contractor. Landscaper Contractor shall ensure final grades conform to the Civil Engineer's grading plan including grades around buildings, swales, sidewalk under drains/swales, roof drains, splash blocks and rock swales through planting beds.
- C. Vegetation Protection: Contractors are responsible for protection of existing vegetation labeled on plans "to remain". Protection of existing vegetation includes supply and installation of protective fencing around all existing planting areas.
- D. Bed Preparation and herbicide: All planting areas shall be free of weeds, grass insects, or any other deleterious material prior to bed

preparation. Contractor shall herbicide all planting areas with "Round-Up" or approved equal at least two times prior to installation of any new plants. Pre-emergent herbicide shall be applied after planting and before placement of mulch.

- E. Planting Beds: Excavate 12" of existing soil within planting beds and replace with 8" of imported topsoil and 2" of premium compost. Mechanically till into top six inches of bed until a loose, friable soil condition is met. Final grades within all planting beds shall be 2-3" below adjacent curbs to allow for mulch. Contractor to ensure positive drainage throughout entire landscape areas. Adjust grades as necessary to direct water away from planting beds. Report any discrepancies on all drainage issues in writing to Construction Manager or to the Engineer. Owner or Engineer will approve planting beds prior to planting operations.
- F. Edging: Edging shall be installed as shown on plans. Edging shall allow for tapered drainage points to ensure free drainage away from all structures and walkways. Edging shall be set flush with adjacent paving, sidewalks or driveways.
- G. Grass Areas: Scarify, float and fine grade all areas to receive sod or hydromulch for approval by Construction Manager prior to placement of sod or application of hydromulch. Supply additional topsoil as necessary to fill any/all low areas and ensure positive drainage away building/planting beds.
- H. Berms and Mounding: Supply topsoil and construct berms as indicated on plans. Berms shall have a maximum slope of 1:4. Owner or Engineer shall approve berms and mounding prior to planting operations.
- I. Planting:
 - 1. Installation:
 - a. Excavate planting pit to depth and width indicated on Drawings.
 - b. Set root ball on undisturbed or compacted soil in planting pit. Remove burlap, rope, wire, and all other wrapping material from top of ball. Remove any binding rope which is not biodegradable completely.
 - c. Fill planting pit 2/3 full with planting mix, soak with water and allow settling, and adding fertilizer tablets as detailed. Finish filling pit with planting mix and tamp lightly.

- d. Construct a watering basin as detailed and install 2" of mulch. Water-in to completely saturate the root ball and planting mix. Add planting mix where any settling or air pockets occur.
 - e. Stake all trees/palms immediately after planting as detailed.
2. Planting Holes: All planting holes shall be excavated with a diameter at least two times the rootball size and to the depth equal to the height of the rootball. The bottoms and sides of each hole shall be scarified with a pick to allow for free drainage and maximum root penetration. After plant placement, the hole shall be backfilled with mixture of excavated soil and premium compost mixture (Earthwise Organics "RGV" Mix, or approved equal. All holes shall be tested/inspected by Engineer for free drainage prior to installation of trees.
3. Watering Basins: Watering basins for all plants shall be constructed in a ring shape around each tree or palm trunk. This earthen berm shall be constructed 6" in height and 36" in diameter so as to hold water and allow infiltration around root ball. A minimum of 2 inches of cypress mulch shall be placed within the watering basin. Watering basins must be maintained and kept free of weeds during the entire maintenance period.
- J. Insect and Disease Control: Apply treatment as frequently as required during construction and 90-day maintenance period to prevent damage to plant material. Use only chemicals specifically approved by TCEQ.
- K. Pruning: All existing and new vegetation shall be pruned/trimmed by a certified ISA Arborist, as directed on site by Engineer.

3.03 CLEANUP AND PROTECTION

- A. Remove debris from landscaped areas daily and sweep clean adjacent pavements, if soiled by landscape activities.
- B. Provide temporary barriers or fences as required to protect landscaping from damage or theft until final acceptance.

3.04 CLOSE-OUT DOCUMENTS

- A. As-Built Drawings: Submit "As-Built" drawings before project close-out showing the landscape layout, including revised plant material, and other installation information.
- B. Warranty Letters: Submit warranty letters for trees / palms / shrubs / ground covers / amenities.

END OF SECTION

SECTION 329200 – LAWNS & HYDROMULCH

1.00 GENERAL

1.01 SUMMARY

- A. Section Includes: The establishment of a complete and uniform lawn including fine grading, sodding, and/or hydromulching.

1.03 QUALIFICATIONS

- A. Lawn work to be performed by a single firm specializing in commercial landscape work with a minimum of five (5) years' experience on similar type projects. Owner to review qualifications and approve subcontractor prior to commencing work.

1.02 SUBMITTALS

- A. Submittals shall be formatted in a three-ring binder (10 copies) with tabs identifying each section. Required submittal information for this section shall be included with the overall landscape submittal and shall be designated 'Section-20-Lawns/Fertilizer'. The following submittals are required for this section:
 - 1. Product Data: Manufacturer's specifications and application instructions for fertilizer.
 - 2. Certificates: Inspection certificate from Texas Department of Agriculture indicating sod has been found free of diseases, insects and larvae.
 - 3. Certificates: Breakdown of seed types, percentages, and mixture composition.
 - 4. Sod Delivery Tickets: One per truckload indicating sod species, nursery certification, date and time of cutting.

1.03 DELIVERY, STORAGE AND HANDLING

- A. Sod Delivery: Have sod delivered within twenty-four hours of cutting. Stack sod with roots to roots, protected from exposure to elements during shipment.

- B. Storage: Lay sod as soon as practicable after delivery. If installation is delayed more than four hours, store sod under shade and keep constantly moist. Sod must be laid within forty-eight hours of cutting. Do not pile more than two foot depth of sod. Do not tear, stretch or drop sod. Do not allow soil to break free of turf roots.

1.04 PROJECT CONDITIONS

- A. Utility Construction. Do not lay sod or begin hydro-mulching until all underlying utility work is complete, trenches backfilled, compacted and graded, and topsoil placed and fine grading.

1.05 MAINTENANCE/WARRANTY

- A. Maintenance Service: Maintain the work of this Section until the Date of Substantial Completion and ninety (90) days thereafter or until a complete and uniform lawn has been established and final acceptance has been approved by Owner or Engineer.
 - 1. Establish hydro-mulched or sodded lawns per planting plans. Reapply hydro-mulch or re-sod as necessary until full and uniform coverage is obtained.
 - 2. Mow lawns to maintain height of grass at 2 inches or as directed by Owner or Engineer
 - 3. Trim/edge all lawn areas adjacent to watering basins, pavements, driveways, walls, structures, curbs, planting beds, edges and island.
 - 4. Provide weed, insect and disease control to maintain health of grass.
 - 5. Fertilize with commercial grade lawn fertilizer until complete and uniform coverage is obtained.
 - 6. Irrigation:
 - a) If the irrigation system is operating, program and monitor the system to provide adequate water for grass.
 - b) If the irrigation system is not operating, hand water grass.
- B. Warranty: Warranty shall cover all lawn grasses for a period of three months from the date of substantial completion or until final acceptance by Owner. Final acceptance will not be approved until full and uniform lawns are completely established.

C. Maintenance Records: Contractor must provide Owner copies of all maintenance records including dates maintenance occurred, type of maintenance carried out, crew time on site and any issues such as problems with irrigation, etc.

2.00 PRODUCTS

2.01 MATERIALS

- A. Sod: (See schedule for type). Provide premium #1 certified sod grown in a sod nursery on sandy soil, at least 1 yr. old with a heavy top and a strong, well-knit root system, and not more than five percent weeds or foreign grasses.
- B. Hydro-mulch mixture: (See schedule for type). Lawn seed mixture shall be fresh, clean new, crop seed. Hydromulch mixture shall be composed of both hulled and unhulled seed with an appropriate percentage of Rye according to season of planting. The Contractor shall furnish the dealer's guaranteed statement of the composition of the mixture and the percentage of purity and germination of each variety for approval prior to beginning work. Any hydro-mulching applied before Engineers approval of the exact mixture will be subject to rejection and shall be re-done with approved mixture.
- C. Fertilizer: 12-4-8 (N-P-K), formulated for slow-release Nitrogen.

3.00 EXECUTION

3.01 EXAMINATION

- A. Verification of Conditions: Examine the site and conditions under which this work is to be performed. Have the installer notify the Contractor in writing, with a copy to the Engineer, if the site is unsatisfactory. Do not begin the work until unsatisfactory conditions have been corrected in a manner acceptable to installer. Beginning of work indicates acceptance of the site as satisfactory by the installer.

3.02 PREPARATION

- A. Site Preparation: Contractors must visit and review site prior to bidding. Compacted soils and sub-soils from construction activities must be ripped and tilled until a loose, friable and free-draining condition is met. All existing weeds, grass, stabilized sub-base material, rubble, excavated soil and other material shall be removed from the site and disposed of by the contractor prior to starting any new landscape work. Soil conditions around entire site must be approved by the Engineer prior to rough and finished grading operations. Contractor shall not install any fill or topsoil in landscape areas prior to site condition approval by the Engineer.

3.03 INSTALLATION- HYDROMULCH/SEED

- A. All exterior ground within the limit of contract, except surfaces occupied by structures and paving, except areas indicated to be undisturbed, shall be seeded, hydro-mulched or planted as shown on drawings. Furnish topsoil as required, finish grading, prepare seed bed, seed, hydro-mulch and maintain areas as indicated on the drawings.
- B. Lawn Area Preparations - Grade areas to finish grades, filling as needed or removing surplus material. Float all lawn areas to a smooth, uniform grade as indicated on Civil Engineer's grading plans. All lawn areas shall slope to drain away from structures, sidewalks, driveways and planting beds. Where no grades are shown, areas shall have a smooth and continual grade between existing or fixed controls (such as walks, curbs, catch basins/drain inlets, elevational steps or structures) and elevations shown on plans. Contractor to ensure proper drainage away from all structures. Adjust grades as necessary to direct water away from structures and planting beds. Report any discrepancies on all drainage issues in writing to the Engineer, and Owner or Owner's Representative.
- C. Roll, scarify, rake and level as necessary to obtain true, even lawn surfaces. All finish grades shall meet approval of the Engineer before seeding/hydro-mulching operations. Loosen soil to a depth of three inches (3") in lawn areas by approved method of scarification and grade to remove edges and depressions. Remove stones or foreign matter over one half inch (1/2") in diameter from the top three inches (3") of soil

Float lawn areas to finish grades.

- D. Lawn areas should be permitted to settle or should be firmed by rolling before seeding/hydromulching.
- E. Seeding/hydro-mulching shall not be performed in windy weather.
- F. Lawn areas shall be seeded by hydro-mulching evenly with an approved mechanical hydro-mulcher at the rate of a minimum of three (3) pounds per 1,000 square feet. In areas inaccessible to hydro-mulching equipment, the seeded ground shall be lightly raked with flexible rates and rolled with a water ballast roller. After rolling, seeded areas are to be lightly mulched with wheat straw or approved material.
- G. Water seeded/hydro-mulched areas daily or as necessary to keep ground and hydro-mulch moist. Do not excessively water so as to cause erosion or ponding. Continue this watering regime until full germination. After germination period water lawn areas only as required to maintain health and vigor of grass growth. The surface layer of soil for seeded/hydromulched areas must be kept moist during the germination period. After first cutting, water as specified above.
- H. Make daily inspections to determine the moisture content of the soil and adjust the watering schedule established by the irrigation system installer to fit conditions.
- I. 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 reseeded/hydro-mulched in accordance with the plans and as specified herein. Such areas and parts of areas shall be reseeded/hydro-mulched or sodded repeatedly until all areas are covered with a full and uniform stand of grass at no additional cost to the Owner.
- J. Watering shall be done in such a manner and as frequently as is deemed necessary by the contractor or Owner to assure continued growth of healthy grass. All areas of the site shall be watered in such a way as to prevent erosion due to excessive

quantities applied over small areas and to avoid damage to the finished surface due to the watering equipment.

- K. Water for the execution and maintenance of this work shall be provided by the Owner at no expense to the Contractor. The Contractor shall, however, furnish his own portable tanks, pumps, hose, pipe, connections, nozzles, and any other equipment required to transport the water from the available outlets and apply it to the lawn areas in an approved manner.
- L. Mowing of the seeded, hydromulched or sodded areas shall be initiated when the grass has attained a height of three to four inches (3" to 4"). For subsequent mowing Bermuda grass shall be maintained at a height of 2" and St. Augustine grass shall be maintained at a height of 3". Not more than one third (1/3) of the grass leaf shall be removed at any cutting and cutting shall not occur more than seven (7) days apart.
- M. When the amount of grass is heavy, it shall be removed to prevent destruction of the underlying turf. If weeds or other undesirable vegetation threaten 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 Owner.
- N. When the amount of grass is heavy, it shall be removed to prevent destruction of the underlying turf. If weeds or other undesirable vegetation threaten 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 Owner.
- O. Protect seeded/hydromulched areas against trespassing while the grass is germinating and growing-in. 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 at their expense.
- P. Remove all fences, signs, barriers or other temporary protective devices after final acceptance.

3.04 INSTALLATION-SOD

- A. Sod shall be installed to all areas as indicated on plans.
- B. Sod Bed Preparation - Grade areas to finish grade, filling as needed or removing surplus dirt, stone, debris, etc. and floating areas to a smooth, uniform grade as indicated on grading plans. All lawn areas are to slope to drain.
- C. Sod shall be cut and laid on site the same day. Only healthy vigorous growing sod is to be laid.
- D. Always lay sod across slope and tightly together so as to make a solid area.
- E. Roll or firmly but lightly tamp with suitable wooded or metal tamper all new sod sufficiently to set or press sod into underlying soil.
- F. Contractor to fill all gaps or seams in the sodded areas using clean sand.
- G. After sodding has been completed, clean up and thoroughly water in newly sodded areas.

3.05 FERTILIZING- GRASS

- A. Grass or sodded areas shall have fertilizer applied in two (2) applications with a thorough watering immediately following application. The first application shall be one (1) week before the hydro-seeding using a Starter Fertilizer 20-27-5 (N-P- K) at a rate of 3.5 lbs per 1,000 square feet and harrowed into the top two inches (2") of seedbed. The second application shall be done after grow-in using a Turf Builder fertilizer 12-4-8 (N-P-K) at the rate of 5 pounds per 1,000 square feet.

3.06 CLEANUP AND PROTECTION

- A. Remove debris from landscaped areas daily and sweep clean adjacent pavements, if soiled by landscape activities.

- B. Protect lawns from damage, theft or vandalism until final acceptance.

END OF SECTION

SECTION 329219 – SEEDING FOR EROSION CONTROL

(Referenced from 2004 TxDOT, ITEM 164 Seeding for Erosion Control – references made to any other Sections of the 2004 TxDOT Manual shall become part of the Contract to be followed)

00164.1. Description. Provide and install temporary or permanent seeding for erosion control as shown on the plans or as directed.

00164.2. Materials.

- A. Seed.** Provide seed from the previous season's crop meeting the requirements of the Texas Seed Law, including the testing and labeling for pure live seed (PLS = Purity x Germination). Furnish seed of the designated species, in labeled unopened bags or containers to the Engineer before planting. Use within 12 mo. From the date of the analysis. When Buffalograss is specified, use seed that is treated with KNO₃ (potassium nitrate) to overcome dormancy. Use Tables 1 through 4 to determine the appropriate seed mix and rates as specified on the plans.

Table 1
Permanent Rural Seed Mix

District and Planting Dates	Clay Soils		Sandy Soils	
	Species and Rates (lb. PLS/ac.)		Species and Rates (lb. PLS/ac.)	
1 (Paris) Feb. 1 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (Haskell)	3.2	Bermudagrass	1.5
	Bermudagrass	1.8	Bahiagrass (Pensacola)	6.0
	Little Bluestem (Native)	1.7	Sand Lovegrass	0.6
	Illinois Bundleflower	1.0	Weeping Lovegrass (Ersmelo)	0.8
			Partridge Pea	1.0
2 (Ft. Worth) Feb. 1 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (El Reno)	2.7	Sand Lovegrass	0.5
	Bermudagrass	0.9	Bermudagrass	1.8
	Little Bluestem (Native)	1.0	Weeping Lovegrass (Ersmelo)	0.8
	Blue Grama (Hachita)	0.9	Sand Dropseed	0.4
	Illinois Bundleflower	1.0	Partridge Pearl	1.0
3 (Wichita Falls) Feb. 1 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (El Reno)	2.7	Bermudagrass	1.2
	Bermudagrass	0.9	Sand Dropseed	0.4
	Buffalograss (Texoka)	1.6	Sand Bluestem	2.4
	Western Wheatgrass	2.1	Sand Lovegrass	0.3
	Blue Grama (Hachita)	0.6	Weeping Lovegrass (Ersmelo)	0.6
	Illinois Bundleflower	1.0	Purple Prairieclover	0.5
4 (Amarillo) Feb. 15 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (El Reno)	3.6	Weeping Lovegrass (Ersmelo)	0.8
	Blue Grama (Hachita)	1.2	Blue Grama (Hachita)	1.0
	Buffalograss (Texoka)	1.6	Sand Dropseed	0.3
	Illinois Bundleflower	1.0	Sand Bluestem	1.8
			Purple Prairieclover	0.5
5 (Lubbock) Feb. 15 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (El Reno)	3.6	Weeping Lovegrass (Ersmelo)	0.8
	Blue Grama (Hachita)	1.2	Blue Grama (Hachita)	1.0
	Buffalograss (Texoka)	1.6	Sand Dropseed	0.3
	Illinois Bundleflower	1.0	Sand Bluestem	1.8
			Purple Prairieclover	0.5

Table 1 (continued)
Permanent Rural Seed Mix

District and Planting Dates	Clay Soils		Sandy Soils	
	Species and Rates (lb. PLS/ac.)		Species and Rates (lb. PLS/ac.)	
6 (Odessa) Feb. 1 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (Haskell)	2.3	Blue Grama	0.8
	Blue Grama (Hachita)	0.8	Sand Dropseed	0.4
	Alkali Sacaton	0.4	Weeping Lovegrass (Emmelo)	0.6
	Galleta	2.1	Indian Ricegrass	3.0
	Illinois Bundleflower	1.0	Purple Prairieclover	0.5
7 (San Angelo) Feb. 1 – May 1	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (Haskell)	2.7	Sideoats Grama (Haskell)	2.7
	Buffalograss (Texoka)	1.6	Weeping Lovegrass (Emmelo)	0.6
	Little Bluestem (Native)	1.7	Sand Dropseed	0.4
	Blue Grama (Hachita)	0.9	Purple Prairieclover	0.5
	Galleta	1.6		
	Illinois Bundleflower	1.0		
8 (Abilene) Feb. 1 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (Haskell)	2.7	Sand Bluestem	3.0
	Blue Grama (Hachita)	0.9	Weeping Lovegrass (Emmelo)	1.2
	Galleta	1.6	Sand Dropseed	0.5
	Buffalograss (Texoka)	1.6	Purple Prairieclover	0.5
	Little Bluestem (Native)	1.7		
	Illinois Bundleflower	1.0		
9 (Waco) Feb. 1 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Bermudagrass	1.2	Bermudagrass	2.4
	Sideoats Grama (Haskell)	3.6	Sand Dropseed	0.5
	Little Bluestem (Native)	2.0	Weeping Lovegrass (Emmelo)	0.8
	Illinois Bundleflower	1.0	Partridge Pea	1.0
10 (Tyler) Feb. 1 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Bermudagrass	1.8	Bermudagrass	1.8
	Bahiagrass (Pensacola)	9.0	Bahiagrass (Pensacola)	9.0
	Sideoats Grama (Haskell)	2.7	Weeping Lovegrass (Emmelo)	0.5
	Illinois Bundleflower	1.0	Sand Lovegrass	0.5
			Lance-Leaf Coreopsis	1.0

Table 1 (continued)
Permanent Rural Seed Mix

District and Planting Dates	Clay Soils		Sandy Soils	
	Species and Rates (lb. PLS/ac.)		Species and Rates (lb. PLS/ac.)	
11 (Lufkin) Feb. 1 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Bermudagrass	1.8	Bermudagrass	2.1
	Bahiagrass (Pensacola)	9.0	Bahiagrass (Pensacola)	9.0
	Sideoats Grama (Haskell)	2.7	Sand Lovegrass	0.5
	Illinois Bundleflower	1.0	Lance-Leaf Coreopsis	1.0
12 (Houston) Jan. 15 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Bermudagrass	2.1	Bermudagrass	2.4
	Sideoats Grama (Haskell)	3.2	Bahiagrass (Pensacola)	10.5
	Little Bluestem (Native)	1.4	Weeping Lovegrass (Ernelo)	0.5
	Illinois Bundleflower	1.0	Lance-Leaf Coreopsis	1.0
13 (Yoakum) Jan. 15 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (Haskell)	3.6	Bermudagrass	1.8
	Bermudagrass	1.8	Bahiagrass (Pensacola)	6.0
	Little Bluestem (Native)	1.4	Sand Lovegrass	0.6
	Illinois Bundleflower	1.0	Weeping Lovegrass (Ernelo)	0.6
			Partridge Pea	1.0
14 (Austin) Feb. 1 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Bermudagrass	0.9	Bermudagrass	2.4
	Sideoats Grama (Haskell)	2.7	Weeping Lovegrass (Ernelo)	0.8
	Little Bluestem (Native)	1.0	Sand Lovegrass	0.8
	Blue Grama (Hachita)	0.9	Partridge Pea	1.0
	Illinois Bundleflower	1.0		
15 (San Antonio) Feb. 1 – May 1	Green Sprangletop	0.3	Green Sprangletop	0.3
	Bermudagrass	1.2	Bermudagrass	1.8
	Sideoats Grama (Haskell)	2.7	Lehmanns Lovegrass	0.6
	Little Bluestem (Native)	1.4	Sand Lovegrass	0.6
	Plains Bristlegrass	1.2	Buffelgrass (Common)	0.4
	Illinois Bundleflower	1.0	Partridge Pea	1.0
16 (Corpus Christi) Jan. 1 – May 1	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (Haskell)	2.7	Bermudagrass	1.8
	Bermudagrass	1.8	Buffelgrass (Common)	0.4
	Buffalograss (Texoka)	1.6	Sand Lovegrass	0.6
	Plains Bristlegrass	1.2	Lehmanns Lovegrass	0.6
	Illinois Bundleflower	1.0	Purple Prairieclover	0.5

Table 1 (continued)
Permanent Rural Seed Mix

District and Planting Dates	Clay Soils		Sandy Soils	
	Species and Rates (lb. PLS/ac.)		Species and Rates (lb. PLS/ac.)	
17 (Bryan) Feb. 1 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Bermudagrass	1.5	Bermudagrass	1.5
	Sideoats Grama (Haskell)	3.6	Bahiagrass (Pensacola)	7.5
	Little Bluestem (Native)	1.7	Weeping Lovegrass (Emmelo)	0.6
	Illinois Bundleflower	1.0	Sand Lovegrass	0.6
			Lance-Leaf Coreopsis	1.0
18 (Dallas) Feb. 1 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Bermudagrass	1.2	Bermudagrass	1.8
	Sideoats Grama (El Reno)	2.7	Weeping Lovegrass (Emmelo)	0.6
	Little Bluestem (Native)	2.0	Sand Lovegrass	0.6
	Buffalograss (Texoka)	1.6	Sand Dropseed	0.4
	Illinois Bundleflower	1.0	Partridge Pea	1.0
19 (Atlanta) Feb. 1 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Bermudagrass	2.4	Bermudagrass	2.1
	Sideoats Grama (Haskell)	4.5	Bahiagrass (Pensacola)	7.5
	Illinois Bundleflower	1.0	Sand Lovegrass	0.6
			Lance-Leaf Coreopsis	1.0
20 (Beaumont) Jan. 15 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Bermudagrass	2.7	Bermudagrass	2.1
	Sideoats Grama (Haskell)	4.1	Bahiagrass (Pensacola)	7.5
	Illinois Bundleflower	1.0	Sand Lovegrass	0.6
			Lance-Leaf Coreopsis	1.0
21 (Pharr) Jan. 15 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (Haskell)	3.6	Bermudagrass	1.8
	Plains Bristlegrass	1.2	Buffelgrass (Common)	0.4
	Buffalograss (Texoka)	1.6	Sand Dropseed	0.4
	Bermudagrass	1.2	Lehmans Lovegrass	0.6
	Illinois Bundleflower	1.0	Purple Prairieclover	0.5
22 (Laredo) Jan. 15 – May 1	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (Haskell)	3.6	Bermudagrass	1.8
	Bermudagrass	1.2	Buffelgrass (Common)	0.4
	Buffalograss (Texoka)	1.6	Sand Dropseed	0.4
	Plains Bristlegrass	1.2	Lehmans Lovegrass	0.6
	Illinois Bundleflower	1.0	Purple Prairieclover	0.5

Table 1 (continued)
Permanent Rural Seed Mix

District and Planting Dates	Clay Soils		Sandy Soils	
	Species and Rates (lb. PLS/ac.)		Species and Rates (lb. PLS/ac.)	
23 (Brownwood) Feb. 1 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (Haskell)	2.7	Bermudagrass	1.8
	Bermudagrass	0.6	Weeping Lovegrass (Ermele)	0.6
	Blue Grama (Hachita)	0.9	Sand Lovegrass	0.6
	Galleta	2.1	Sand Dropseed	0.4
	Illinois Bundleflower	1.0	Purple Prairieclover	0.5
24 (El Paso) Feb. 1 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (Butte)	2.7	Sand Dropseed	0.4
	Blue Grama (Hachita)	0.9	Lehmanns Lovegrass	0.9
	Galleta	2.1	Blue Grama (Hachita)	1.0
	Alkali Sacaton	0.4	Indian Ricegrass	1.6
	Illinois Bundleflower	1.0	Purple Prairieclover	0.5
25 (Childress) Feb. 1 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (El Reno)	2.7	Weeping Lovegrass (Ermele)	1.2
	Blue Grama (Hachita)	0.9	Sand Dropseed	0.5
	Western Wheatgrass	2.1	Sand Lovegrass	0.8
	Galleta	1.6	Purple Prairieclover	0.5
	Illinois Bundleflower	1.0		

Table 2
Permanent Urban Seed Mix

District and Planting Dates	Clay Soils Species and Rates (lb. PLS/ac.)	Sandy Soils Species and Rates (lb. PLS/ac.)
1 (Paris) Feb. 1 – May 15	Green Sprangletop 0.3 Bermudagrass 2.4 Sideoats Grama (Haskell) 4.5	Green Sprangletop 0.3 Bermudagrass 5.4
2 (Ft. Worth) Feb. 1 – May 15	Green Sprangletop 0.3 Sideoats Grama (El Reno) 3.6 Bermudagrass 2.4 Buffalograss (Texoka) 1.6	Green Sprangletop 0.3 Sideoats Grama (El Reno) 3.6 Bermudagrass 2.1 Sand Dropseed 0.3
3 (Wichita Falls) Feb. 1 – May 15	Green Sprangletop 0.3 Sideoats Grama (El Reno) 4.5 Bermudagrass 1.8 Buffalograss (Texoka) 1.6	Green Sprangletop 0.3 Sideoats Grama (El Reno) 3.6 Bermudagrass 1.8 Sand Dropseed 0.4
4 (Amarillo) Feb. 15 – May 15	Green Sprangletop 0.3 Sideoats Grama (El Reno) 3.6 Blue Grama (Hachita) 1.2 Buffalograss (Texoka) 1.6	Green Sprangletop 0.3 Sideoats Grama (El Reno) 2.7 Blue Grama (Hachita) 0.9 Sand Dropseed 0.4 Buffalograss (Texoka) 1.6
5 (Lubbock) Feb. 15 – May 15	Green Sprangletop 0.3 Sideoats Grama (El Reno) 3.6 Blue Grama (Hachita) 1.2 Buffalograss (Texoka) 1.6	Green Sprangletop 0.3 Sideoats Grama (El Reno) 2.7 Blue Grama (Hachita) 0.9 Sand Dropseed 0.4 Buffalograss (Texoka) 1.6
6 (Odessa) Feb. 1 – May 15	Green Sprangletop 0.3 Sideoats Grama (Haskell) 3.6 Blue Grama (Hachita) 1.2 Buffalograss (Texoka) 1.6	Green Sprangletop 0.3 Sideoats Grama (Haskell) 2.7 Sand Dropseed 0.4 Blue Grama (Hachita) 0.9 Buffalograss (Texoka) 1.6
7 (San Angelo) Feb. 1 – May 1	Green Sprangletop 0.3 Sideoats Grama (Haskell) 7.2 Buffalograss (Texoka) 1.6	Green Sprangletop 0.3 Sideoats Grama (Haskell) 3.2 Sand Dropseed 0.3 Blue Grama (Hachita) 0.9 Buffalograss (Texoka) 1.6

Table 2 (continued)
Permanent Urban Seed Mix

District and Planting Dates	Clay Soils Species and Rates (lb. PLS/ac.)	Sandy Soils Species and Rates (lb. PLS/ac.)
8 (Abilene) Feb. 1 – May 15	Green Sprangletop 0.3 Sideoats Grama (Haskell) 3.6 Blue Grama (Hachita) 1.2 Buffalograss (Texoka) 1.6	Green Sprangletop 0.3 Sand Dropseed 0.3 Sideoats Grama (Haskell) 3.6 Blue Grama (Hachita) 0.8 Buffalograss (Texoka) 1.6
9 (Waco) Feb. 1 – May 15	Green Sprangletop 0.3 Bermudagrass 1.8 Buffalograss (Texoka) 1.6 Sideoats Grama (Haskell) 4.5	Green Sprangletop 0.3 Buffalograss (Texoka) 1.6 Bermudagrass 3.6 Sand Dropseed 0.4
10 (Tyler) Feb. 1 – May 15	Green Sprangletop 0.3 Bermudagrass 2.4 Sideoats Grama (Haskell) 4.5	Green Sprangletop 0.3 Bermudagrass 5.4
11 (Lufkin) Feb. 1 – May 15	Green Sprangletop 0.3 Bermudagrass 2.4 Sideoats Grama (Haskell) 4.5	Green Sprangletop 0.3 Bermudagrass 5.4
12 (Houston) Jan. 15 – May 15	Green Sprangletop 0.3 Sideoats Grama (Haskell) 4.5 Bermudagrass 2.4	Green Sprangletop 0.3 Bermudagrass 5.4
13 (Yoakum) Jan. 15 – May 15	Green Sprangletop 0.3 Sideoats Grama (Haskell) 4.5 Bermudagrass 2.4	Green Sprangletop 0.3 Bermudagrass 5.4
14 (Austin) Feb. 1 – May 15	Green Sprangletop 0.3 Bermudagrass 2.4 Sideoats Grama (Haskell) 3.6 Buffalograss (Texoka) 1.6	Green Sprangletop 0.3 Bermudagrass 4.8 Buffalograss (Texoka) 1.6
15 (San Antonio) Feb. 1 – May 1	Green Sprangletop 0.3 Sideoats Grama (Haskell) 3.6 Bermudagrass 2.4 Buffalograss (Texoka) 1.6	Green Sprangletop 0.3 Bermudagrass 4.8 Buffalograss (Texoka) 1.6
16 (Corpus Christi) Jan. 1 – May 1	Green Sprangletop 0.3 Sideoats Grama (Haskell) 3.6 Bermudagrass 2.4 Buffalograss (Texoka) 1.6	Green Sprangletop 0.3 Bermudagrass 4.8 Buffalograss (Texoka) 1.6

Table 2 (continued)
Permanent Urban Seed Mix

District and Planting Dates	Clay Soils Species and Rates (lb. PLS/ac.)	Sandy Soils Species and Rates (lb. PLS/ac.)
17 (Bryan) Feb. 1 – May 15	Green Sprangletop 0.3 Bermudagrass 2.4 Sideoats Grama (Haskell) 4.5	Green Sprangletop 0.3 Bermudagrass 5.4
18 (Dallas) Feb. 1 – May 15	Green Sprangletop 0.3 Sideoats Grama (El Reno) 3.6 Buffalograss (Texoka) 1.6 Bermudagrass 2.4	Green Sprangletop 0.3 Buffalograss (Texoka) 1.6 Bermudagrass 3.6 Sand Dropseed 0.4
19 (Atlanta) Feb. 1 – May 15	Green Sprangletop 0.3 Bermudagrass 2.4 Sideoats Grama (Haskell) 4.5	Green Sprangletop 0.3 Bermudagrass 5.4
20 (Beaumont) Jan. 15 – May 15	Green Sprangletop 0.3 Bermudagrass 2.4 Sideoats Grama (Haskell) 4.5	Green Sprangletop 0.3 Bermudagrass 5.4
21 (Pharr) Jan. 15 – May 15	Green Sprangletop 0.3 Sideoats Grama (Haskell) 3.6 Buffalograss (Texoka) 1.6 Bermudagrass 2.4	Green Sprangletop 0.3 Buffalograss (Texoka) 1.6 Bermudagrass 3.6 Sand Dropseed 0.4
22 (Laredo) Jan. 15 – May 1	Green Sprangletop 0.3 Sideoats Grama (Haskell) 4.5 Buffalograss (Texoka) 1.6 Bermudagrass 1.8	Green Sprangletop 0.3 Buffalograss (Texoka) 1.6 Bermudagrass 3.6 Sand Dropseed 0.4
23 (Brownwood) Feb. 1 – May 15	Green Sprangletop 0.3 Sideoats Grama (Haskell) 3.6 Bermudagrass 1.2 Blue Grama (Hachita) 0.9	Green Sprangletop 0.3 Buffalograss (Texoka) 1.6 Bermudagrass 3.6 Sand Dropseed 0.4
24 (El Paso) Feb. 1 – May 15	Green Sprangletop 0.3 Sideoats Grama (Butte) 3.6 Blue Grama (Hachita) 1.2 Buffalograss (Texoka) 1.6	Green Sprangletop 0.3 Buffalograss (Texoka) 1.6 Sand Dropseed 0.4 Blue Grama (Hachita) 1.8
25 (Childress) Feb. 1 – May 15	Green Sprangletop 0.3 Sideoats Grama (El Reno) 3.6 Blue Grama (Hachita) 1.2 Buffalograss (Texoka) 1.6	Green Sprangletop 0.3 Sand Dropseed 0.4 Buffalograss (Texoka) 1.6 Bermudagrass 1.8

Table 3
Temporary Cool Season Seeding

Districts	Dates	Seed Mix and Rates (lb./ac.)
Paris (1), Amarillo (4), Lubbock (5), Dallas (18)	September 1 – November 30	Tall Fescue 4.5
		Western Wheatgrass 5.6
		Wheat (Red, Winter) 34
Odessa (6), San Angelo (7), El Paso (24)	September 1 – November 30	Western Wheatgrass 8.4
		Wheat (Red, Winter) 50
Waco (9), Tyler (10), Lufkin (11), Austin (14), San Antonio (15), Bryan (17), Atlanta (19)	September 1 – November 30	Tall Fescue 4.5
		Oats 24
		Wheat 34
Houston (12), Yoakum (13), Corpus Christi (16), Beaumont (20), Pharr (21), Laredo (22)	September 1 – November 30	Oats 72
Ft. Worth (2), Wichita Falls (3), Abilene (8), Brownwood (23), Childress (25)	September 1 – November 30	Tall Fescue 4.5
		Western Wheatgrass 5.6
		Cereal Rye 34

Table 4 Temporary Warm Season Seeding

Districts	Dates	Seed Mix and Rates (lb./ac.)
All	May 1 August 31	Foxtail Millet 34

- B. Fertilizer.** Use fertilizer in conformance with Article 166.2, "Materials."
- C. Vegetative Watering.** Use water that is clean and free of industrial wastes and other substances harmful to the growth of vegetation.
- D. Mulch.**
- Straw or Hay Mulch.** Use straw or hay mulch in conformance with Article 162.2.E, "Mulch."
 - Cellulose Fiber Mulch.** Use only cellulose fiber mulches that are on the approved list published in "Field Performance of Erosion Control Products," available from the Maintenance Division. Submit 1 full set of manufacturer's literature for the selected material. Keep mulch dry until applied. Do not use molded or rotted material.
- E. Tacking Methods.** Use a tacking agent applied in accordance with the manufacturer's recommendations or a crimping method on all straw or hay mulch operations. Tacking agents must be approved before use, or specified on the plans.

00164.3. Construction. Cultivate the area to a depth of 4 in. before placing the seed unless otherwise directed. When performing permanent seeding after an established temporary seeding, cultivate the seedbed to a depth of 4 in. or mow the area before placement of the permanent seed. Plant the seed specified and mulch, if required, after the area has been completed to lines and grades as shown on the plans.

- A. Broadcast Seeding.** Distribute the seed or seed mixture uniformly over the areas shown on the plans using hand or mechanical distribution or hydro-seeding on top of the soil. When seed and water are to be distributed as a slurry during hydro-seeding, apply the mixture to the area to be seeded within 30 min. of placement of components in the equipment. Roll the planted area with a light roller or other suitable equipment. Roll sloped areas along the contour of the slopes.
- B. Straw or Hay Mulch Seeding.** Plant seed according to Section 164.3.A, "Broadcast Seeding." Immediately after planting the seed or seed mixture, apply straw or hay mulch uniformly over the seeded area. Apply straw mulch at 2 to 2.5 tons per acre. Apply hay mulch at 1.5 to 2 tons per acre. Use a tacking method over the mulched area.
- C. Cellulose Fiber Mulch Seeding.** Plant seed according to Section 164.3.A, "Broadcast Seeding." Immediately after planting the seed or seed mixture, apply cellulose fiber mulch uniformly over the seeded area at the following rates:
- Sandy Soils with slopes of 3:1 or less—2500 lb. per acre.
 - Sandy Soils with slopes greater than 3:1—3000 lb. per acre.
 - Clay Soils with slopes of 3:1 or less—2000 lb. per acre.
 - Clay Soils with slopes greater than 3:1—2300 lb. per acre. Cellulose fiber mulch rates are based on dry weight of mulch per acre.

Mix cellulose fiber mulch and water to make a slurry and apply uniformly over the seeded area using suitable equipment.

- D. Drill Seeding.** Plant seed or seed mixture uniformly over the area shown on the plans at a depth of 1/4 to 1/3 in. using a pasture or rangeland type drill. Plant seed along the contour of the slopes.
- E. Straw or Hay Mulching.** Apply straw or hay mulch uniformly over the area as indicated on the plans. Apply straw mulch at 2 to 2.5 tons per acre. Apply hay mulch at 1.5 to 2 tons per acre. Use a tacking method over the mulched area.

Apply fertilizer in conformance with Article 166.3, "Construction." Seed

and fertilizer may be distributed simultaneously during "Broadcast Seeding" operations, provided each component is applied at the specified rate. When temporary and permanent seeding are both specified for the same area, apply half of the required fertilizer during the temporary seeding operation and the other half during the permanent seeding operation.

Water the seeded areas at the rates and frequencies as shown on the plans or as directed.

00164.4. MEASUREMENT AND PAYMENT

- A. When listed as a separate contract pay item, shall be measured in accordance with "Measurement and Basis of Payment" section or as shown on the Bid Proposal Form.
- B. When not listed as a separate contract pay item, shall be considered as incidental work, and the cost thereof shall be included in such contract pay item(s) as are provided in the proposal contract.
- C. Compensation, whether by contract pay item or incidental work will be for furnishing all materials, labor, equipment, tools and incidentals required for the work, all in accordance with the plans and these specifications.

END OF SECTION

SECTION 330513 – FIBERGLASS MANHOLES

1.00 GENERAL

1.01 GENERAL DESCRIPTION OF WORK:

- A. This work consists of materials for and the installation of manholes for sanitary sewer systems.
- B. Manholes shall be constructed in accordance with the design and details shown on the plans and as hereinafter provided.
- C. Invert elevations shall not vary more than 0.05 feet from the grade designated by the ENGINEER.
- E. Manholes will not be constructed with cast in place steps. Where steps are required by the ENGINEER, the steps will be installed after the manhole has been constructed. The step used shall be a 1/2" grade 60 steel reinforcing rod in capsulated in a co-polymer polypropylene as manufactured by M.A. Industries, Inc. (Model #P-2-PFS) or equal as approved by the ENGINEER. Installation of the steps shall be as recommended by the manufacturer.

2.00 PRODUCTS

2.01 GENERAL:

- A. All cement used shall by Type II Portland Cement.
- B. All manhole foundations or bases shall be concrete and constructed as shown on the plans and in no case shall the thickness be less than 6 inches.

2.02 BRICK MANHOLES:

- A. Unless otherwise specified, manholes described herein shall be constructed of grade MS Brick and Type M Concrete Mortar.

2.03 CONCRETE MANHOLES:

- A. Precast Manholes & Sections
 - 1. Construct eccentric or concentric top manholes as indicated of precast pipe on conformance with ASTM C-478 using Type II Portland Cement.
 - 2. Provide factory block-outs at base or cast-in-place rubber gasket for connection of required sewer line.
 - 3. Minimum wall thickness will be 1/2 inch.
 - 4. Concrete in foundation shall comply with Section 03300 - Cast-in-Place Concrete.
 - 5. Reinforcing steel shall comply with Section 03330 - Reinforcing Steel.
- B. Cast-in-Place Manholes

1. Concrete shall comply with Section 03300 - Cast-in-Place Concrete.
2. Reinforcing Steel shall comply with Section 03330 - Reinforcing Steel.
3. Minimum wall thickness will be 5 inches.
4. Provide cast-in-place rubber gasket for connection of required sewer line.

C. Precast Concrete Manhole Bases

1. Precast concrete manhole bases may be used when approved by the ENGINEER. If approved, it shall be with the understanding that the CONTRACTOR shall be responsible for placing the bases at the specified elevation, location, and alignment.
2. Precast bases shall be manufactured with cast-in-place sewer pipe gaskets, such as: "A-LOK" or approved equal.

2.04 COATING OF MANHOLES:

A. Exterior of Manholes

1. If required, the coating shall be a waterproofing type of bitumastic or asphaltic material, as approved by the ENGINEER.
2. Application shall be in accordance with the manufacturer's published recommendations.

B. Interior of Manhole

1. If required, drain manhole coating shall be an epoxy type material conforming to Section Polyurethane Protective Coatings.
2. All sanitary sewer manholes shall require two coating applications of Inertal Standard as manufactured by the Inertal Company, Inc. or equal as approved by ENGINEER.

C. Plastering of Manholes

1. The work shall include the coating of the surface of existing brick or block manholes with plaster as required on the plans or directed by the ENGINEER.

2.05 FRAMES, GRATES, RINGS AND COVERS:

A. Welded Steel

1. Welded steel grates and frames shall conform to the member, size, dimensions and details indicated and shall be welded into an assembly in accordance with those details.
2. Steel shall conform to the requirements of ASTM A 36.

B. Castings

1. Castings whether Gray Cast Iron or Ductile Iron shall conform to the shape and dimensions required and shall be clean substantial castings,

free from sand or blowholes or other defects. Surfaces of the castings shall be free from burnt on sand and shall be reasonably smooth.

2. Runners, risers, fins and other cast on pieces shall be removed from the castings and such areas ground smooth.
3. Bearing surfaces between manhole rings and covers or grates and frames shall be cast or machined with such precision that uniform bearing shall be provided throughout the perimeter area of contact.
4. Pairs of machined castings shall be match marked to facilitate subsequent identification at installation.
5. Steel castings shall conform to ASTM A 27, "Mild to Medium Strength Carbon Steel Castings or General Application." Grade 70-36 shall be furnished unless otherwise specified.
6. Cast iron castings shall conform to ASTM A 48, "Gray Iron Castings," Class 30.
7. Ductile Iron castings shall conform to ASTM A 536, "Ductile Iron Castings." Grade 60-40-18 shall be used unless otherwise specified.

C. Rings

1. Adjusting rings shall conform to ASTM A 536, "Gray Iron Castings."

D. Nuts and Bolts

1. Commercial grade galvanized nuts and bolts shall be as indicated. The zinc coating shall be uniform in thickness, smooth, and continuous.

E. Mortar

Mortar for bedding castings shall consist of 1 part cement and 3 parts sand meeting the requirements of fine aggregate Grade No. 1 in Section 03300 - Cast-In-Place Concrete.

F. Manhole Accessories

1. Manhole lid and cover:
 - a. Gray cast iron, with minimum clear opening 32-inches.
 - b. Use Neenah R-1916-F or approved equal for bolted covers.
 - c. Use Neenah R-1670-D or approved equal for lids not requiring bolting features.
 - d. Provide anchor bolt holes for exposed manhole tops.
2. Manhole Rings - provide minimum of three throat rings between cone and manhole lid and cover.

3.00 EXECUTION

3.01 GENERAL:

- A. Foundations shall be poured in place
- B. Construct manhole foundation and channel inverts integrally. See Plan details.

- C. Precast manhole sections may be installed after foundation concrete has attained 75% of design strength.
- D. Forms for cast-in-place manhole may be installed after foundation concrete has attained 75% of design strength.
- E. Manhole foundation and manhole may be installed simultaneously if manhole section is supported on concrete blocks and foundation concrete placed under and around bottom section.
- F. Completely fill joints with pre-formed plastic gasket.
- G. Heat materials in freezing weather and protect work from cold; maintain temperature of work at 40° F. for at least 24 hours after placing.
- H. Invert Channels:
 - 1. Form invert channel as required.
 - 2. Make changes in direction of flow with smooth curves of as large a radius as size of manhole permits.
 - 3. Make changes in size and grade smoothly and uniformly.
 - 4. Slope floor of manhole adjacent to channel and drain thereto.
 - 5. Finish channel bottom smoothly without roughness, irregularity, or pockets.
- I. Pipe Connections:
 - 1. Make watertight.
 - 2. Use rubber gasket.
 - 3. All connections shall be at flowline of manhole, unless otherwise required.
- J. Exterior Pipe Support:
 - 1. Support vitrified clay pipe on concrete cradle from manhole connection to first joint.
 - 2. Provide first pipe joint within 18 inches of manhole wall.
- K. Castings, frames, and fittings:
 - 1. If frames or fittings are to be set in concrete or cement mortar, all anchors or bolts shall be in place and position before the concrete or mortar is place.
 - 2. The unit shall be protected until mortar or concrete is set.
- L. Coatings shall be applied after ENGINEER's approval of structure.
- M. Soil foundations, one foot beyond perimeter of concrete to base shall be compacted to a depth of one foot to 95% maximum density of ASTM D 1557.

3.02 BRICK MANHOLES:

- A. Brick shall be clean, saturated surface dry before laying and shall be laid on a full mortar bed with "push joints."
- B. In no event will shushing or grouting of a joint be permitted nor shall a joint be made by working in mortar after the brick has been laid.
- C. Joints between the courses of bricks in manholes and other structures shall be as nearly as possible to a uniform thickness of 3/8 inch.
- D. The inside and outside of all brick sewer structures shall be neatly plastered with Type M mortar 1/2 inch thick and cured.
- E. Brick work shall not be laid upon a concrete foundation less than 24 hours after such foundation has been poured.
- F. No brick work shall be laid in water nor, except as prescribed for curing, shall water be allowed to stand or run on any brick work until the mortar has thoroughly set.
- G. Where new work is joined to existing unfinished work, the contact surfaces of the latter shall be thoroughly cleaned and moistened.

3.03 CONCRETE MANHOLES

- A. Manholes constructed of poured concrete (reinforced or non-reinforced) or precast reinforced concrete risers and tops shall comply with the requirements of ASTM C 478.
- B. Circular precast manhole sections shall be provided with a rubber or mastic gasket to seal joints between sections.
- C. All lifting holes, except Type "C" manhole cover lids, and gaps at joints shall be filled with a non-shrink grout.

3.04 ABANDONMENT OF MANHOLES:

- A. Abandonment of manhole, which is part of a sewer line being abandoned, shall entail the following work and materials.
 - 1. Manhole will not be removed but will be abandoned in place.
 - 2. All manhole inlet and outlet lines shall be plugged with a 12-inch long concrete mortar plug.
 - 3. Salvageable material shall be stockpiled on the job site. The CONTRACTOR shall contact the OWNER to inspect the materials for usability. Salvageable materials shall be transported for usability. Salvageable materials shall be transported by the CONTRACTOR to the OWNER'S storage yards. CONTRACTOR will receive a receipt for the turned-in materials. Receipts will be submitted to the ENGINEER prior to final acceptance of the Project.

4. Unusable material will be removed from the project site and properly disposed of by the CONTRACTOR.
5. Manhole bottom will be thoroughly pulverized, as directed by the ENGINEER.
6. The manhole shall be filled with cement treated base (CTB) material to the top of the proposed subgrade of the pavement or to the ground surface finished grade.
7. All labor, materials and equipment necessary to complete this work shall be furnished by the CONTRACTOR.

3.05 MANHOLE REHABILITATION IN REPLACEMENT WORK:

- A. The work under this item shall be to replace the existing manhole frame and cover and to place a concrete pad around the existing manhole as required per the construction plans.
- B. This work will be done when an existing manhole is encountered in the normal course of the replacement work that has a light weight, vented, multi-holed manhole cover.
- C. This work shall include the following:
 1. Remove any and all existing brick under frame and replace with new Grade MS brick as necessary to bring new frame and cover to street grade.
 2. Remove and replace existing concrete pad, or construct a new pad around the collar.
 3. Remove existing manhole steps and if manhole is greater than 10 feet deep, new steps will be installed.
 4. Remove and repair pavement.
 5. Excavation and compaction of backfill as required.
 6. All materials, labor and equipment necessary to do the work under this item shall be furnished by the CONTRACTOR.
- D. The work and materials under this item shall be done according to the manner set forth in the plan details and other sections of these specifications.
- E. Salvageable material shall be stockpiled on the job site. The CONTRACTOR shall contact the OWNER to inspect the materials for usability. Salvageable materials shall be transported by the CONTRACTOR to the OWNER's Storage Yards. CONTRACTOR will receive a receipt for the turned-in materials. Receipts will be submitted to the ENGINEER prior to final acceptance of the Project. Unusable materials will be properly disposed of by the CONTRACTOR.

3.06 MANHOLE DATA SHEET:

- A. Before this work is accepted, the CONTRACTOR shall provide to the ENGINEER a completed manhole data sheet for each new manhole constructed.

- B. Manhole data sheet as shown in Exhibit 02575-1 will be completed in accordance with the following instructions:
1. A Manhole Data Sheet will be prepared for each manhole constructed.
 2. The original copy of the Data Sheet will be filed with the ENGINEER. Distribution of copies will be made to all interested parties.
 3. The Manhole Number will be assigned by the OWNER.
 4. Manhole Type is the general description of the manhole, e.g.: 6 foot diameter Type C, or 4 foot diameter Type E as per plan details.
 5. Manhole cover Size is the nominal diameter of the manhole cover. Type, Model and Pattern refers to the manufacturer, material made of, model number and design pattern to identify the identical manhole cover for replacement.
 6. Section 3 requires the name of the CONTRACTOR, the name of the foreman, and the name of the inspector actually responsible for the construction of the manhole.
 7. Under "Project Name" is the work order number under this contract.
 8. Date Warranty Begins is the official date of acceptance of the Project or portion of the Project of which this manhole was a part.
 9. Data Warranty expires is the expiration date under the Contract for requiring warranty repairs.
 10. Street Location: Give both blocks number and street name. For manholes in intersections give both streets. The "Remarks" section may be used for further clarification of manhole location.
 11. Disregard the section on coordinate location. To be filled in by the OWNER at a later date.
 12. All applicable items on the Manhole Data Sheet should be filled in. However, accuracy is more important than filling in blank spaces. Therefore, if an item is unknown and cannot be determined, leave the space blank.

EXHIBIT 02575 - 1

MANHOLE DATA SHEET

SECTION 1

Manhole Number:
Manhole Type:
Date Installed:
Project Name:

SECTION 2

Manhole Cover Size:
Manhole Cover Type & Model:
Manhole Pattern:
Number of Rings Used:

SECTION 3

Contractor's Name:
Foreman's Name:
City Inspector's Name:

SECTION 4

Date Warranty Begins:
Date Warranty Expires:

SECTION 5

Street Location:
Intersection Location:

SECTION 6

Rim Elevation:
Invert Elevation:

Remarks:

SECTION 7 (To be completed by owner)

COORDINATE LOCATION

POINT	X (East) Departure	Y (North) Departure	Z Elevation
Center Manhole Invert:			
Center Manhole Cover:			
Electronic Marker Disc:			

4.00 MEASUREMENT AND PAYMENT

4.01 MEASUREMENT:

A. New Manholes

1. Manholes of specified diameters with depths of 6 feet or less shall be measured per each.
2. Manholes of specified diameters with depths greater than 6 feet shall be measured per each. In addition, manholes for diameters specified shall be each measured per vertical linear foot of depth over 6 feet.
3. Measurements will be made to the nearest foot and will be from the manhole rim elevation to the manhole invert elevation.

B. Elevation Adjustments

1. When a new manhole is installed, no measurement or payment will be made for rim elevation adjustments to conform to proposed surface grades.
2. The following measurements for rim elevation adjustments on existing manholes will be made as follows:
 - a. Adjustment to a manhole frame by the addition of adjustment rings (s) will be measured per each manhole adjusted.
 - b. Leveling brick adjustment will be measured per each manhole adjusted.
 - c. Adjustment of manhole cone or barrel will be measured by the manhole diameter per vertical foot.

C. Manhole Coating

1. If required, exterior coating of manholes will not be measured and will be considered incidental to the appropriate manhole.
2. Plastering of the interior of manholes will be measured per each manhole of specified diameter.
3. Polyurethane protective coatings will be measured as provided in Section Polyurethane Protective Coatings.
4. Protective Inertial coatings for sanitary sewer manholes shall not be measured for payment.

D. Manhole Steps

1. If required, manhole steps will not be measured and will be considered incidental to the appropriate manhole.

E. Abandonment of Manholes

1. Abandonment of manholes will be measured per each for the work specified.

F. Manhole Rehabilitation

1. Manhole rehabilitation will be measured per each for the work specified.

4.02 PAYMENT:

A. New Manholes

1. Manholes of specified diameters with depths of 6 feet or less shall be paid for at the contract unit price per each manhole.
2. Manholes of specified diameters with depths greater than 6 feet shall be paid for at the contract unit price per each manhole as in 4.02 A.1 above. Additional payment shall be made at the contract unit price per each vertical linear foot of depth in excess of 6 feet for manholes of specified diameters.
3. Payment for manholes of any diameter and depth will include: excavation, compacted backfilling, shelving, cover or cone, leveling bricks, frame and cover, and concrete pad or collar.

B. Elevation Adjustments

1. The following payments for accepted quantities of rim elevation adjustments on existing manholes will be as follows:
 - a. Adjustment of a manhole frame by addition of adjustment ring(s) will be paid for at the unit contract price per each manhole adjusted.
 - b. Leveling brick adjustment will be paid for at the unit contract price per each manhole adjusted.
 - c. Adjustment of manhole cone or barrel will be paid for at the unit contract price per manhole diameter per vertical foot.

C. Manhole Coating

1. If required, no direct payment shall be made for coating of the exterior of manholes and will be considered incidental to the appropriate manhole.
2. Plastering of the interior of manholes will be paid for at the unit contract price per manhole.
3. Polyurethane protective coatings will be paid for as provided in Section Polyurethane Protective Coatings.

D. Manhole Steps

1. If required no direct payment shall be made for manhole steps, where required, and will be considered incidental to the appropriate manhole.

E. Payment for abandonment of manholes will be paid for at the unit price per each for the work specified.

F. Payment for manhole rehabilitation will be paid for at the unit price per each for the work specified.

- G. If required, the following items will be included in the unit price per appropriate adjustment: pavement removal and repair, excavation, compacted backfill, concrete collar or pad, leveling bricks, adjusting rings, and frame and cover.
- H. Compensation will be for furnishing all materials, labor, equipment, tools and incidentals required including polyurethane protective coating if not included as a separate pay item in this contract. All in accordance with the plans and specifications herein.

END OF SECTION

33 11 00 - WATER TRANSMISSION LINES AND/OR PRESSURE SEWER LINES

1.00 GENERAL

1.01 RELATED REQUIREMENTS SPECIFIED ELSEWHERE:

- A. Trenching, Backfilling and Compacting: Section 02221.
- B. Pipe Boring and Jacking: Section 02224.
- C. Water Valves: Section 02558.

1.02 SUBMITTALS:

- A. Conform to requirements of Section 01300 - Submittals.
- B. Manufacturer's Literature: Manufacturer's descriptive literature and recommended method of installation.
- C. Certificates: Manufacturer's certification that products meet specification requirements.
- D. Submit shop drawings showing design of pipe and fittings indicating alignment and grade, laying dimensions, fabrication, fitting, flange, and special details. Show station numbers for pipe and fittings corresponding to Drawings. Production of pipe and fittings prior to review by City Engineer is at Contractor's risk.

1.03 PRODUCT DELIVERY, STORAGE, AND HANDLING:

- A. Deliver materials on manufacturer's original skids or in original unopened protective packaging. OWNER reserves the right to reject material left from another job.
- B. Store materials to prevent physical damage.
- C. Protect materials during transportation and installation to avoid physical damage.

1.04 GENERAL DESCRIPTION OF WORK COVERED:

- A. Furnish and install all pipe, fittings, structures and accessories required for water transmission line and/or pressure sewer lines.

1.05 QUALITY ASSURANCE:

- A. Comply with the latest published edition of American Water Works Association (AWWA) Standards:
 - 1. AWWA C110 & C110a - Gray Iron and Ductile-Iron Fittings, 2 inch through 48 inch for water and other liquids.
 - 2. AWWA C111 - Rubber Gasket Joints for Cast Iron Pressure Pipe and Fittings.
 - 3. AWWA C150 - Thickness Design of Ductile-Iron Pipe.
 - 4. AWWA C151 - Ductile-Iron Pipe, centrifugally cast in metal mold or sand lined molds, for water or other liquids.
 - 5. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe 4 inch through 12 inch for water.
 - 6. AWWA C905 - Polyvinyl Chloride (PVC) Pressure Pipe 14 inch through 48 inch for water.
 - 7. AWWA C301-99 - Prestressed Concrete Pressure Pipe - Steel Cylinder Type, for water and other liquids.
- B. Comply with the latest published editions of the American Society for Testing and Materials (ASTM) Standards:
 - 1. D 2241 - Polyvinyl Chloride (PVC) Plastic Pipe (SDR-PR).
 - 2. D 3139 - Joints for PVC Pressure Pipes using Flexible Elastomeric Seals.

2.00 PRODUCTS

2.01 GENERAL REQUIREMENTS:

- A. Pipe furnished may be either Polyvinyl Chloride (PVC), Steel Cylinder (SCP) or Ductile Iron (DI) as specified herein for water mains unless shown otherwise on the plans or bid documents.
- B. Use PVC pipe for all pressure sewer lines unless shown otherwise on the plans.
- C. All pipe shall be marked in accordance with the applicable standard specification under which the pipe is manufactured unless otherwise specified and shall be National Sanitation Foundation (NSF) approved stamped.
- D. Steel cylinder pipe manufactured shall have had a successful experience record in the design and manufacture of steel cylinder pipe with substantial footage in successful operation for at least five years.
- E. The quality of materials, the process of manufacture, and the finished pipe shall be subject to inspection and approval by the Engineer at the pipe manufacturing plant and at the project site prior to and during installation. All water distribution pipe and fittings shall be listed in the Fire Protection Equipment Directory

published by the Underwriter's Laboratories, Inc. or shall be Factory Mutual approved for fire service.

2.02 POLYVINYL CHLORIDE PIPE (PVC):

- A. Waterlines 12" and less may be constructed of PVC water pipe, pressure pipe, in accordance with AWWA standard C900 (latest version) for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4-inches through 12-inches, for Water Distribution. All pipe should be designed and installed with a minimum of four foot cover.
- B. Waterlines 14 inches through 48 inches may be constructed of PVC water pipe, pressure pipe, in accordance with AWWA standard C905 (latest version) for PVC Water Transmission Pipe and Fabricated Fittings. All pipe should be designed and installed with a minimum of four foot cover.
- C. Provide push-on joints with bell integrally cast into pipe or with coupling of same material as pipe.
- D. Use elastomeric gaskets, as provided in AWWA C900 or ASTM D3139.
- E. Provide either cast-iron or PVC 1120 fittings as indicated or required. Use long radius fittings where possible.
- F. Provide fittings with materials and pressure class equal to or greater than that specified for pipe.
- G. Provide sleeve type or anchored coupling where indicated or required to join pipe or provide restraint to offset internal or hydrostatic test pressures.
- H. Provide pipe marked to indicate the following:
 - 1. Nominal Pipe Size.
 - 2. Material Code Designation.
 - 3. Standard Dimension Ratio.
 - 4. Pressure Rating.
 - 5. Manufacturer's name or trademark.
 - 6. National Sanitation Foundation Seal.
 - 7. Appropriate ASTM designation number.

2.03 STEEL CYLINDER PIPE (SCP):

Provide pipe as specified in specification 02557 with a minimum working pressure of 200 psi or as shown on the plans or in the specifications.

2.04 DUCTILE IRON PIPE (DIP):

- A. Pipelines ranging in size from 12 inches through 36 inches in diameter shall comply with the latest published edition of AWWA as modified herein:
1. AWWA C104/A21.4-95 - ANSI Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
 2. AWWA C105/A21.5-93 - ANSI Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems
 3. AWWA C110-98 - ANSI Standard for Ductile-Iron and Gray-Iron Fittings, 3-inches through 48-inches (76 mm through 1,219 mm), for Water and Other Liquids
 4. AWWA C111/A21.11-95 - ANSI Standard for Rubber Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
 5. AWWA C115/A21.15-94 - ANSI Standard for Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges
 6. AWWA C150/A21.50-96 - ANSI Standard Thickness Design of Ductile-Iron Pipe
 7. AWWA C151/A.21.51-96 - ANSI Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids
 8. ANSI B 16.1 - Cast Iron Pipe Flanges and Flanged Fittings.
 9. ASTM D 1248 - Polyethylene Plastics Molding and Extrusion Materials.
 10. ASTM G 62 - Test Methods for Holiday Detection in Pipeline Coatings.
 11. AWWA C 600 - Standard for Installation of Ductile Iron Water Mains and Their Appurtenances.
 12. SSPC-SP 6 - Steel Structures Painting Council, Commercial Blast Cleaning.
- B. Ductile-iron push-on and mechanical joint pipe shall meet all requirements of standard AWWA C151.
- C. Joint Types include ANSI A21.11 push-on; ANSI A21.11 mechanical joint; or ANSI A21.15 flanged end. Provide push-on joints unless otherwise indicated on the Drawings or required by these specifications. For bolted joints, bolts shall conform to requirements of AWWA C111. Threaded- or grooved-type joints which reduce pipe wall thickness below minimum required are not acceptable.
- D. Provide manufacturer's certifications that all ductile iron pipe and fittings meet provisions of this Section and have been hydrostatically tested at factory and meet requirements of ANSI A21.51.
- E. Provide certifications that all pipe joints have been tested and meet requirements of ANSI A21.11.
- F. Ductile-iron flanged pipe shall meet all requirements of standard AWWA C115. Barrels shall have a nominal thickness required by Table 1 of AWWA C115, which thickness corresponds to Special Class 53 in sizes through 54-inch, and Class 350 in 60 and 64 inch sizes. Flanges shall be ductile-iron (gray-iron is not acceptable) they shall be Class 125 flanges as shown in ANSI/ASME B16.1; and

shall conform to dimensions shown in Table 2 and Figure 1 of AWWA C115. Flanges shall be fabricated and attached to the pipe barrels by U.S. fabricators using flanges and pipe barrels of U.S. manufacture. If fabrication is to be by other than the pipe barrel manufacturer, a complete product submittal and approval by the Water and Wastewater Utility will be required. Additionally, such fabricator shall furnish certification that each fabricated joint has been satisfactorily tested hydrostatically at a minimum pressure of 300 psi.

- G. Where ductile iron water main is cathodically protected from corrosion, bond rubber gasketed joints as shown on Drawings to provide electrical continuity along entire pipeline, except where insulating flanges are required by Drawings. Do not use polyethylene wrap with a cathodic protection system.
- H. Where restrained joints for buried service are required by Drawings, provide one of the following, or equal:

1. Super-Lock Joint by Clow Corporation.
2. Flex-Ring or Lok-Ring by American Cast Iron Pipe Company.
3. TR-Flex Joint by U.S. Pipe and Foundry Company.

Provide for restrained joints designed to meet test pressures required under Part 3.04 of this section.

- I. Linings and Coating: Interior surfaces of all ductile-iron water pipe shall be cement-mortar lined and seal coated as required by AWWA C104. Pipe exteriors shall be coated as required by the applicable pipe specification. The type and brand of interior lining shall be clearly marked on the outside of the pipe and fittings. Except as authorized by the E/A, only one type and brand of pipe lining shall be used on a given project.
- J. Exterior: Prime coat and outside asphaltic coating conforming to ANSI A 21.10, ANSI A 21.15, or ANSI A 21.51 for pipe and fittings in open cut excavation and in casings. Pipe to be installed in potentially contaminated areas shall have coatings and linings recommended by the manufacturer as resistant to the contaminants identified.
- K. Except as described above for flanged pipe (Thickness Class 53) and where not otherwise indicated, ductile-iron pipe shall be minimum Pressure Class 250 as defined by ANSI/AWWA C150/A21.50-current; all ductile-iron pipe and flanges shall meet the following minimum physical requirements:

Grade 60-42-10:

Minimum tensile strength: 60,000 psi (414 MPa)

Minimum yield strength: 42,000 psi (290 MPa)

Minimum elongation: 10 percent

- L. The flanges for AWWA C115 pipe may also be made from:

Grade 70-50-05:

Minimum tensile strength: 70,000 psi (483 MPa)

Minimum yield strength: 50,000 psi (345 MPa)

Minimum elongation: 5 percent

M. Joint Materials:

1. Gaskets for mechanical joints shall conform to ANSI/AWWA A21.11/C-111.
2. Furnish, when no contaminant is identified, plain rubber (SBR) gasket material; for flanged joints 1/8-inch-thick gasket in accordance with ANSI A 21.15.
3. Pipes to be installed in potentially contaminated areas, especially where free product is found near the elevation of the proposed pipeline, shall have the following gasket materials for the noted contaminants:

Contaminant	Gasket Material Required
Petroleum (diesel, gasoline)	Nitrile Rubber
Other contaminants	As recommended by the pipe manufacture

4. Joining of slip joint iron pipe shall, without exception, be accomplished with the natural or synthetic rubber gaskets of the manufacturer of that particular pipe being used. A joint lubricant shall be used and applicable recommendations of the manufacturer shall be followed.
5. Gaskets for flanged joints shall be continuous full face gaskets, of 1/8 inch minimum thickness of natural or synthetic rubber, cloth reinforced rubber or neoprene material, preferably of deformed cross section design and shall meet all applicable requirements of ANSI/AWWA A21.11/C-111 for gaskets. They shall be manufactured by, or satisfy all recommendations of, the manufacturer of the pipe/fittings being used and be fabricated for use with Class 125 ANSI B16.1 flanges.
6. Tee-head bolts, nuts, and washers for mechanical joints shall be high strength, low alloy, corrosion resistant steel stock equal to "COR-TEN A" having UNC Class 2 rolled threads or alloyed ductile-iron conforming to ASTM A 536; either shall be fabricated in accordance with ASTM B18.2 with UNC Class 2 rolled threads.
7. Hex-head bolts and nuts shall satisfy the chemical and mechanical requirements of ASTM A449 SAE Grade 5 plain, and shall be fabricated in accordance with ASTM B 18.2 with UNC Class 2 rolled threads.
8. Either Tee-head or Hex-head bolts, nuts, and washers as required, shall be protected with bonded fluoropolymer corrosion resistant coating where specifically required by the E/A.
9. All threaded fasteners shall be marked with a readily visible symbol cast, forged or stamped on each nut and bolt, which will identify the fastener material and grade. The producer and the supplier shall provide adequate

literature to facilitate such identification; painted markings are not acceptable.

N. Polyethylene Film Wrap:

1. All iron pipe, fittings, and accessories including polyurethane coated pipe shall be wrapped with standard 8-mil (minimum) low density polyethylene film or r-fill (minimum) cross laminated high-density polyethylene conforming to AWWA C105, with all edges overlapped and taped securely with duct tape to provide a continuous wrap to prevent contact between the piping and the surrounding backfill. Repair all punctures of the polyethylene, including those caused in the placement of bedding aggregates, with duct tape to restore the continuous protective wrap before backfilling.
 2. For flanged joints in buried service, provide petrolatum wrapping system, Denso, or equal, for the complete joint and alloy steel fasteners. Alternatively, provide bolts made of Type 304 stainless steel.
0. Fittings. Each pipe joint and fitting shall be marked as required by the applicable AWWA specification. This includes in all cases: Manufacturer's identification, Country where cast, year of casting, and "DUCTILE" or "DI". Barrels of flanged pipe shall show thickness class; others shall show pressure class. The flanges of pipe sections shall be stamped with the fabricators identification; fittings shall show pressure rating, the nominal diameter of openings and the number of degrees for bends. Painted markings are not acceptable.
1. Use fittings of same size as pipe. Reducers are not permitted to facilitate an off-size fitting. Reducing bushings are also prohibited. Make reductions in piping size by reducing fittings. Line and coat fittings as specified for pipe they serve.
 2. Push-on Fittings: ANSI A 21.10; ductile iron ANSI A 21.11 joints, gaskets, and lubricants; pressure rated at 250 psig.
 3. Flanged Fittings: ANSI A 21.10; ANSI B 16.1 cast or ductile iron. Flanges: ANSI B 16.1, Class 125; pressure rated at 250 psig.
 4. Mechanical Joint Fittings: ANSI A 21.11 (AWWA C110); pressure rated at 250 psi.

2.05 DUCTILE IRON PIPE FITTINGS:

- A. Fittings shall be push-on, flanged, or mechanical joint as indicated or approved, with pressure rating of not less than that specified for adjacent pipe and shall meet all requirements of standards as follows:

Sizes 4-inch and larger: AWWA C110

- B. Shall be compatible with joint type of adjacent pipe.

- C. All specials, taps, plugs, flanges and wall fittings shall be as required.

D. Interior surfaces of all iron water pipe fittings shall be lined with cement-mortar and seal coated as required by AWWA C104. Interior surfaces of all iron wastewater and force main fittings shall be coated with a non-corrosive lining material acceptable to Owner.

E. Fitting exteriors shall be coated as required by the applicable pipe specifications.

2.06 VALVES, HYDRANTS, METERS AND APPURTENANCES:

A. For valve requirements refer to Section 02558 (Water Valves).

B. Valve Boxes:

1. Provide for all buried valves.
2. Use nominal 6 inch cast-iron sliding type pipe shaft with cover and base casting.
3. Set box top at finished grade.
4. Furnish drop cover appropriately marked "WATER".

C. Corporation Stops:

1. Conform with AWWA C800.
2. Use 3/4 inch unless indicated otherwise.

D. Hydrants:

1. Design: latest edition of AWWA C502, traffic model with break flange.
2. Mueller Centurion - A423
 - a. American-Darling - B-84-B
 - b. Kennedy Guardian - K-81A
 - c. U.S. Pipe - Metropolitan
 - d. Others as approved by OWNER in writing
3. Provide 6 inch inlet, 2 - 2" inch hose nozzles, 1 - 4" inch pumper.
4. Provide compression type main valve, minimum size 5" inches.
5. Pentagon operating nut.
6. Design to open counterclockwise.
7. Provide mechanical joint bell on footpiece.
8. Furnish depth as noted on plans.
9. Furnish National (American) Standard Fire Hose Coupling Screw Thread (NH).

E. Polyethylene Wrapping:

1. Material: AWWA C105.
2. Thickness: 8 mils.

F. Polyethylene Plastic Pipe (PE):

1. Material: ASTM D2737.
2. Fittings: ASTM D2683.
3. Size: 3/4 inch unless shown otherwise on plans.

G. Copper Pipe (CU):

1. Material: seamless, Type K, ATM B88.
2. Fittings: wrought copper solder joint or flared.
3. Size: 3/4 inch unless shown otherwise on plans.

3.00 EXECUTION

3.01 GENERAL:

- A. Provide all labor, equipment and materials and install all pipe fittings, special and appurtenances as indicated or specified.

3.02 PIPE INSTALLATION:

A. Handling:

1. Handle in a manner to insure installation in sound and undamaged condition.
 - a. Do not drop or bump.
 - b. Use slings, lifting lugs, hooks and other devices designed to protect pipe, joint elements, and coatings.
2. Ship, move and store with provisions to prevent movement or shock contact with adjacent units.
3. Handle with equipment capable of work with adequate factor of safety against overturning or other unsafe procedures.

B. Installation:

1. Utilize equipment, methods, and materials insuring installation to lines and grades as indicated.
 - a. Do not lay on blocks unless pipe is to receive total concrete encasement.

C. Accomplish horizontal and vertical curve alignments of ductile iron pipe with bends, bevels or deflection joints.

1. Limit joint deflection with ductile iron pipe to conform with AWWA C600.
2. Use short specials preceding curves as required.
3. Obtain approval of ENGINEER of method proposed or transfer of line and grade from control to the work.

4. Install pipe of size, material, strength class, and joint type with embedment as shown on plans or specified herein.
5. Clean interior of all pipe, fittings, and joints prior to installation. Exclude entrance of foreign matter during discontinuance of installation.
 - a. Close open ends of pipe with snug fitting closures.
 - b. Do not let water fill trench. Include provisions to prevent flotation should water control measures prove inadequate.
 - c. Remove water, sand, mud and usher undesirable materials from trench before removal of end cap.
6. Pipe shall be inspected prior to installation to determine if any pipe defects are present.
7. Brace or anchor as required to prevent displacement after establishing final position.
8. Perform only when weather and trench conditions are suitable.
 - a. Do not lay in water.
9. Observe extra precaution when hazardous atmospheres might be encountered.
10. Sanitary sewer relation to water mains:
 - a. Maintain 9 feet horizontal separation whenever possible.
 - b. When conditions prevent a lateral separation of 9 feet, sewer may be installed closer to a water main if:
 - (1) sewer constructed of PVC pipe meeting AWWA Specifications and having a minimum working pressure rating of 150 psi or greater and equipped with pressure type joints, and
 - (2) the sewer line and water main are separated by a minimum vertical distance of 2 feet and a minimum horizontal distance of 4 feet, measured between the nearest outside diameters of the pipes.
 - c. When a sanitary sewer crosses a water line and that portion of the sewer is constructed as described is 3.02 B.9.b.(1), the sewer may be placed no closer than 6 inches from the water line. The separation distance must be measured between the nearest outside pipe diameters. The sewer line shall be located at a lower elevation than the water line whenever possible and one length of the sewer pipe must be centered on the water line.
11. Separation of water mains from sewer manholes:
 - a. No water pipe shall pass through or come in contact with any part of a sewer manhole.
 - b. A minimum horizontal separation of 9 feet shall be maintained.
12. Construct service lines where shown on plans in accordance with Standard Detail Drawing. Use pipe material specified on plans or in contract documents.
13. Wrap pipe, fittings and tie rods with polyethylene where shown on plans in accordance with AWWA C105.

D. Jointing:

1. General requirements:

- a. Locate joint to provide for differential movement at changes in type of pipe embedment, at changes from rock to soil trench bottom, and structures.
 - (1) Not more than 18 inches from structure wall, or
 - (2) Support pipe from wall to first joint with concrete cradle structurally continuous with base slab or footing of structure.
 - b. Perform in accordance with manufacturer's recommendations.
 - c. Clean and lubricate all joint and gasket surfaces with lubricant recommended.
 - d. Utilize methods and equipment capable of fully homing or making up joints without damage.
 - e. Check joint opening and deflection for specification limits.
2. Special provisions for jointing cast-iron and ductile iron:
- a. Conform to AWWA C600.
 - b. Visually examine while suspended and before lowering into trench.
 - (1) Paint bell, spigot, or other suspected portions with turpentine and dust with cement to check for cracks invisible to the eye.
 - (2) Remove turpentine and cement by washing when test is satisfactorily completed.
 - (3) Reject all defective pipe.
3. Special provisions for jointing and laying PVC pipe:
- a. Conform to AWWA C600 and ASTM D2321.
 - b. Allow pipe to reach trench soil temperature prior to installation in ditch.
4. Special provisions for jointing steel cylinder pipe:
- a. Before laying each joint, the bell and spigot rings shall be cleaned by wire brush and wiped clean and dry.
 - b. Inside cement mortar joint:
 - (1) the inside joint recess shall be filled immediately prior to placing the pipe together by buttering the bell end with mortar.
 - (2) the joint mortar of pipe 18 inch diameter and smaller shall be smoothed and cleaned with a swab.
 - (3) the joint mortar of pipe diameters larger than 18 inches shall be finished off smooth by hand trowel.
 - c. Outside cement mortar joint:
 - (1) encircle joint with wrapper after joint found satisfactory.
 - (2) leave enough space between wrapper ends to allow cement mortar to be poured.
 - (3) the entire joint shall be poured with cement mortar and consolidated and rodded or agitated to eliminate voids.

E. Cutting:

- 1. Cut in neat workmanlike manner without damage to pipe.
- 2. Cut cast-iron with Carborundum saw or other approved method.

- a. Smooth cut by power grinding to remove burrs and sharp edges.
- b. Repair lining as required and approved by ENGINEER.

F. Closure Pieces:

1. Connect two segments of pipelines or a pipeline segment and existing structure with short sections of pipe fabricated for the purpose.
2. Observe specifications regarding location of joints, type of joints and pipe materials and strength classifications.
3. May be accomplished with sleeve coupling for water pipe:
 - a. Of length such that gaskets are not less than 3 inches from pipe ends.
 - b. Include spacer ring identical to pipe end such that clear space does not exceed 1/4 inch.

G. Temporary Plugs:

1. Install whenever installed pipe is left unattended.
2. Use water-tight plug.

H. Thrust Blocks:

1. Provide for all horizontal or vertical turns utilizing fittings.
2. Use on all dead-end and tee fittings.
3. Install as indicated on Standard Detail Drawing
4. Construct to undisturbed edge of trench for bearing.
5. Provide minimum bearing area in S.F. as follows based on 150 psi test pressure and 2000 psf soil bearing: Pipe Tee/ 11<0 22>0 45⁰ 90⁰

Size	Deadends	Bend	Bend	Bend	Bend
4"	1.0	0.5	0.5	0.8	1.3
6"	2.2	0.5	0.9	1.6	3.0
8"	3.8	0.8	1.5	2.9	5.3
10"	6.0	1.2	2.3	4.5	8.4
12"	8.5	1.7	3.3	6.5	12.1
14"	11.6	2.3	4.5	8.9	16.4
16"	15.2	3.0	5.9	11.6	21.4

3.03 VALVE AND APPURTENANCE INSTALLATION:

A. Valves:

1. Install with stems vertical when installation is horizontal.
2. Set valves on concrete thrust block having four (4) square feet of bearing area on undisturbed earth.

B. Valve Boxes:

1. Center on valves.
2. Carefully tamp earth around each valve box to a distance of 4 feet on all sides of box or to undisturbed trench face, if less than 4 feet.

C. Hydrants:

1. Set hydrants where shown on plans in accordance with Standard Detail Drawing.
2. Install gravel, blocks and anchors in accordance with Standard Detail Drawing.
3. Set reference elevation 3 inches above existing grade or to elevation established by ENGINEER (not to exceed 6 inches).
4. Break-a-way flange to be either ground level where applicable or between 3 inches and 6 inches above curb as established by ENGINEER.

3.04 ACCEPTANCE TESTS FOR PRESSURE MAINS:

A. Perform hydrostatic pressure and leakage test.

1. Conform to AWWA C600 procedures.
 - a. As modified herein.
 - b. Shall apply to all pipe materials specified.
2. Perform after backfilling.

B. Test separately in segments between sectionalizing valves, between a sectionalizing valve and a test plug, or between test plugs.

1. CONTRACTOR to furnish and install test plugs, including all anchors, braces and other temporary or permanent devices to withstand hydrostatic pressure on plugs, at no additional cost to the OWNER.
2. CONTRACTOR responsible for any damage to public or private property caused by failure of plugs.

C. Limit fill rate of line to available venting capacity. Fill rate shall be regulated to limit velocity in lines when flowing full to not more than 1 fps.

D. OWNER will make water for testing available to contractor at nearest source. Valves of existing system will at all times be operated by City personnel only.

E. Pressure test:

1. Conduct at pressure at least 1.5 times than normal working pressure (not less than 150 psi test pressure).
2. Maintain pressure for a minimum of two (2) hours.
3. Test pressure shall not vary by more than +5 psi

F. Leakage Test:

1. Conduct concurrently with the pressure test.
2. Maintain pressure for a minimum of two (2) hours.
3. Acceptable when leakage does not exceed that determined by the following formula:

$$L = \frac{ND(P)^{1/2}}{7400}$$

L = Maximum permissible leakage in gallons per hour.

N = Number of pipe joints in segment under test.

D = Nominal internal diameter of pipe being tested in inches.

P = Average actual leakage test pressure, psig.

4. Repeat leakage test as necessary.
 - a. After location of leaks and repair or replacement of defective joints, pipe or fittings.
 - b. Until satisfactory performance of test.
 - c. At no increase in cost to the OWNER.

G. Refit and replace all pipe not meeting the leakage or pressure requirements. Repair clamp is not permitted.

H. Repair all visible leaks regardless of the amount of leakage.

I. OWNER or ENGINEER will observe all tests.

3.05 DISINFECTION OF PIPELINES FOR CONVEYING POTABLE WATER:

A. CONTRACTOR provide all equipment and materials and perform in accordance with AWWA C601.

1. As modified herein.
2. Include chlorination and final flushing.

B. Add chlorine to attain an initial concentration of 50 mg/l chlorine with 10 mg/l remaining after 24 hours.

C. Flush main until concentration is 2 mg/l or less prior to placing main in service.

D. Obtain approval of materials and methods proposed for use.

E. May be conducted in conjunction with acceptance tests.

F. Dispose of flushing water without damage to public or private property.

- G. Repeat disinfection procedure should initial treatment fail to yield satisfactory results.
 - 1. At no additional cost to the OWNER.
 - 2. OWNER will provide water under terms specified for acceptance tests.
- H. Do not exceed 500 gpm rate in flushing.
- I. Provide safe bacterial sample results before placing main into service.

4.00 MEASUREMENT AND PAYMENT

4.01 PRESSURE LINES:

- A. Line shall be measured along the center of the pipe without considering fittings or other pipe connections. The line will be paid at the contract bid price per linear feet.
- B. Compensation will be for furnishing all materials, labor, equipment, tools and incidental work required by the construction of the pressure line, all in accordance with the plans and these specifications.
- C. If pressure line fails any test procedure, trouble spot is to be corrected all as incidental to the construction of the pressure line.

END OF SECTION

SECTION 334100 – STORM SEWER STRUCTURES

1.00 GENERAL

1.01 GENERAL DESCRIPTION OF WORK:

- A. This work shall consist of furnishing and installing appurtenances except manholes, for storm sewers in accordance with details on the plans, as specified herein, and as directed by the ENGINEER.
- B. The various types of structures such as inlets, headwalls, energy dissipaters, etc. are designated on the plans by letters or by numbers indicating the particular design of each. Each type shall be constructed in accordance with the details indicated and to the depth required by the profiles and schedules given.

2.00 PRODUCTS

2.01 GENERAL:

- A. The construction plans will specify the size and material for the pipe between the storm sewer main and structure.
- B. The various types of storm inlets and their relation to curb and gutter, or valley gutter, are shown on the plan details. Construction plans will identify the type to be constructed.
- C. Grating size, material, and configuration shall conform to the plan details.

2.02 MATERIALS:

- A. Concrete
 - 1. Concrete for cast-in-place structures shall be Class A concrete.
 - 2. Concrete for precast structures shall be 4000 psi at 28 days and comply with the applicable requirements of ASTM C 478.
- B. Mortar:
 - 1. Mortar shall be composed of 1 part Portland Cement and 2 parts clean, sharp mortar sand suitably graded for the purpose by conforming in other respects to the provisions of Section 03300 - Cast In Place Concrete for fine aggregate.

2. Hydrated lime or lime putty may be added to the mix, but in no case shall it exceed 10 percent by weight of the total dry mix.
- C. Brick:
1. Bricks shall be of first quality, sound, hard-burned brick. Shale bricks, if used, shall be homogeneous, thoroughly and uniformly burned.
 2. Bricks shall not absorb more than 17 percent of water by weight submerged in water for 24 hours, having been in a completely dry state prior to placing in water.
 3. Clay brick shall conform to the requirements of ASTM C 62, Grade SW. Concrete brick meeting the requirements of ASTM C 55, Grade A, shall be acceptable.
- D. Concrete Block: Concrete blocks shall conform to ASTM C 139.
- E. Miscellaneous Items:
Cast iron for supports, steps and inlet units shall conform to the shape and dimensions indicated. The casting shall be clean and perfect, free from sand or blow holes or other defects. Cast iron casting shall meet the requirements of ASTM A 48, Class 30. Steel for temporary covers when used with Stage Construction shall be adequate for the trench loads imposed.

3.00 EXECUTION

3.01 INSTALLATION OF DRAINAGE FACILITIES:

- A. Excavation and backfilling for the storm inlet shall be accomplished in accordance with Section 02218.
- B. Trenching, backfilling, and compaction for the connecting pipe between the storm sewer main and the storm inlet shall conform to the specifications contained in Section 02221 - Trench Excavation and Compaction. Pipe shall be installed in accordance with Section 02571 - Sanitary and Storm Sewers.
- C. All pipe and structures shall be installed per location and elevations, as shown on the construction plans. If an underground obstruction is

encountered during installation (i.e., existing utility line), the work shall stop and the ENGINEER shall be immediately notified.

- D. Direct connection to a storm sewer main will be permitted if:

(I.D.)	Connecting Line	Sewer Main
	Not more than 12" (I.D.)	Not less than 36"
(I.D.)	Not more than 18" (I.D.)	Not less than 48"

For connecting lines sized greater than those specified above, the connection to the main will be made with a manhole or a factory constructed wye. Connection to the main will comply with the plan details.

- E. Removal of curb and gutter, and sidewalk for installation of a storm inlet shall be made at a scored or full depth joint.
- F. No width greater than 1/2 inch will be permitted between the inlet grate and the inlet frame.
- G. Private drainage facility installations, which are to be constructed under an authorization of "Drainage Facilities within Public Right-of-Way," shall comply with the standard details and specifications.
- H. The construction of inlets shall be completed as soon as is practical after storm sewer lines are connected to the inlet. All storm sewers shall be cut neatly at the inside face of the walls of the inlet and pointed up with mortar.
- I. Bases for cast-in-place inlets may be placed prior to or at the CONTRACTOR'S option after the sewer is constructed.
- J. The inverts passing out of or through an inlet shall be shaped and grouted across the floor of the inlet as indicated. This shaping may be accomplished by adding shaping mortar or concrete after the base is cast or by placing the required additional shaping material with the base.
- K. All miscellaneous storm sewer structures shall be completed in accordance with the plan details. Backfilling to original ground elevation shall be in accordance with the provisions of the appropriate items and as directed by the ENGINEER.

4.00 MEASUREMENT AND PAYMENT

4.01 MEASUREMENT:

- A. Pavement removal and repair will be measured by the square yard.
- B. Trench excavation, backfill, and compaction will not be measured nor paid, but will be considered incidental work to the appropriate items.
- C. Frame, grates, rings and covers will not be measured or paid, but will be considered incidental work to the appropriate items.
- D. Storm sewer inlets shall be measured per each for the type and size specified.
- E. All miscellaneous storm sewer structures satisfactorily completed in accordance with the plans and specifications will be measured per each complete unit.

4.02 PAYMENT:

- A. The accepted quantities of pavement removal and repair shall be paid for at the contract unit price per square yard per type of repair.
- B. The accepted quantities of storm inlets will be paid at the contract unit price per each per type of storm inlet, and shall include: the contract structure, grating, excavation, backfilling and compaction, and curb removal and replacement.
- C. The accepted quantities of complete special storm sewer structures shall be paid at the unit price per each.
- D. Compensation, whether by contract pay item or incidental work, will be for furnishing all material, labor, equipment, tools and incidentals required for the work, all in accordance with the plans and these specifications.

END OF SECTION

SECTION 334110- SITE DRAINAGE

1.00 GENERAL

1.01 RELATED DOCUMENTS

- A. The General Conditions of the Contractor for Construction and the Supplementary Conditions to the General Conditions of the Contract for the Construction shall be considered as part of this section of the specifications.
- B. Each Bidder shall be responsible for determining during the bidding period the extent that any addendum issued during the bidding period may affect this section of the specifications.
- C. Reference Instructions to Bidders for requirements regarding substitutions of materials and products.
- D. Where conflicts occur between the drawings and specifications, between different drawings, between different portions of this section of the specifications, or between different sections of the specifications, the more stringent requirements and the greater quantity shall apply.

1.02 WORK INCLUDED

- A. Provide and install storm sewer piping, collection boxes, grates, manholes, culverts, inlets and headwalls as indicated in the Architectural drawings and as specified herein.
- B. Related trenching, pipe bedding, backfill, and compaction as indicated in the Civil and MEP documents drawings and specified herein.
- C. Trench safety in accordance with OSHA requirements and as specified **under Trench Safety Section**.

1.03 QUALITY ASSURANCE

- A. Piping indicated on plumbing drawings.
- B. Site clearing, grading and filling.

1.04 SUBMITTALS

- A. PRODUCT DATA: Submit manufacturer's literature for piping precast drainage structures and grates illustrating performance, fabrication procedures, materials and sizes.

2.00 PRODUCTS

2.01 MATERIALS

- A. CONCRETE SEWER PIPING: Extra strength tongue and groove pipe conforming to ASTM C-76, Class III for reinforced pipe.
- B. JOINT SEALS:
 - 1. Under 42" diameter: Provide Talcote Asphalt Primer No. 041 and Talcote Cold Plastic No. 052 joint compound.
 - 2. 42" diameter and larger: Bell and rubber gasketed joints.
- C. CONCRETE: Minimum compressive strength of 2,500 psi. Conform to requirements of Cast in Place Concrete Section 3.
- D. POLYVINYL CHLORIDE (PVC) SDR 26 PIPING: Provide PVC piping where indicated on the drawings. Jointing shall be solvent weld or bell and gasket meeting requirements of ASTM 3212. Piping shall meet requirements of ASTM D-3034.
- E. INLETS:
 - 1. Precast concrete, cast in place concrete or brick collection boxes as indicated in the drawings. Brooks Products or equivalent. Form both inner and outer walls for cast-in-place items.
 - 2. Brick: ASTM C-32 sewer brick, Grade SS, 2- $\frac{1}{4}$ " x 3- $\frac{3}{4}$ " x 8".
 - 3. Gratings, Covers and Frames: Cast iron, McKinley, Neenah or approved equal; heavy duty in paving; medium duty in walks; light duty in grass or planting areas.

3.00 EXECUTION

3.01 INSTALLATION

A. INLETS:

1. All storm sewer inlets shall be constructed to the line and grade and at location shown on the drawings. Inlets shall be constructed in strict accordance with details as indicated in the drawings.
2. When the box section of the inlet has been completed, the floor of the inlet shall be shaped by filling with one-two mortar to conform to the section shown on the detail drawings.
3. Cast iron inlet frames and grates shall be accurately adjusted to line, grade and slope and grouted in place with mortar consisting of one part Portland cement to two parts sand.

B. PIPING:

1. Inspection: Review drawings and job conditions and verify all inverts before trenching to avoid conflict with other below grade utilities either planned or existing. Immediately notify Engineer of any apparent conflicts before beginning work.
2. Trenching: Provide trenching in strict compliance with current OSHA regulations and in accordance with **Trench Safety Section**. **Do not trench ahead of pipe laying unless trench is protected.**
3. Begin excavation work at the lower end of flow line and proceed to higher flow line. Avoid over-excavating; return over-excavated bed to grade and thoroughly compact. Remove large rocks, foreign or organic material; return bed to grade and thoroughly compact.
4. Lay all pipe on required bedding to a true line slope as indicated in the drawings. Hand excavate at joints to ensure that full length of pipe lays on a solid bed. Install tongue end of pipes facing direction of drainage flow.
5. Bedding and backfilling of pipe:
 - a. Bed and backfill all piping in accordance with the details indicated on the drawings. Where local or other applicable codes require more stringent specifications, those codes shall

- govern.
- b. All piping located in County Flood Control District right of way shall be bedded and backfilled with cement stabilized sand in accordance with Flood Control District requirements.
 - c. Cement stabilized sand shall be a homogeneous mixture of 1½" sacks Portland cement per cu. yd. of mixed material. Provide greater cement content where required by City or County Requirements.

END OF SECTION

SECTION 341416 – TRAFFIC CONTROL EQUIPMENT

(Referenced from 2004 TxDOT, ITEM 502 Barricades, Signs and Traffic Handling – references made to any other Sections of the 2004 TxDOT Manual shall become part of the Contract to be followed)

09100.1. Description. Provide, install, move, replace, maintain, clean, and remove upon completion of work all barricades, signs, cones, lights, and other traffic control devices used for traffic handling as indicated on the plans and as directed.

09100.2. Construction. Provide traffic control devices that conform to details shown on the plans and the TMUTCD.

- A. **Implementation.** Before beginning work, designate in writing a Contractor's Responsible Person (CRP) to be the representative of the Contractor who is responsible for taking or directing corrective measures of installation and maintenance deficiencies as soon as possible. The CRP must be accessible by phone and able to respond to emergencies 24 hours per day.

Follow the traffic control plan (TCP) and install traffic control devices as shown on the plans and/or as directed by ENGINEER. Install traffic control devices straight and plumb. Do not make changes to the location of any device or implement any other changes to the TCP without the approval of the Engineer. Minor adjustments to meet field constructability and visibility are allowed.

Submit Contractor-proposed TCP changes, signed and sealed by a licensed professional engineer (as required), to the Engineer for approval. The Engineer may develop, sign, and seal Contractor-proposed changes. Changes must conform to guidelines established in the TMUTCD.

Maintain traffic control devices by taking corrective action as soon as possible. Corrective action includes but is not limited to cleaning, replacing, straightening, covering, or removing devices. Maintain the devices such that they are properly positioned, spaced, and legible, and that retroreflective characteristics meet requirements during darkness and rain.

- B. **Flaggers.** Provide a Contractor representative who has been certified as a flagging instructor through courses offered by the

Texas Engineering Extension Service, the American Traffic Safety Services Association, the National Safety Council, or other approved organizations. Provide the certificate indicating course completion when requested. This representative is responsible for training and assuring that all flaggers are qualified to perform flagging duties. A qualified flagger must be independently certified by one of the organizations listed above or trained by the Contractor's certified flagging instructor. Provide the Engineer with a current list of qualified flaggers before beginning flagging activities. Use only flaggers on the qualified list.

Flaggers must be courteous and able to effectively communicate with the public. When directing traffic, flaggers must use standard attire, flags, signs, and signals and follow the flagging procedures set forth in the TMUTCD.

- C. **Removal.** Upon completion of work, remove all barricades, signs, cones, lights, and other traffic control devices used for work-zone traffic handling, unless otherwise shown on the plans.

09100.3. MEASUREMENT AND PAYMENT

- A. When listed as a separate contract pay item, shall be measured in accordance with "Measurement and Basis of Payment" section or as shown on the Bid Proposal Form.
- B. When not listed as a separate contract pay item, shall be considered as incidental work, and the cost thereof shall be included in such contract pay item(s) as provided in the proposal contract.
- C. Compensation, whether by contract pay item or incidental work will be for furnishing all materials, labor, equipment, tools and incidentals required for the work, all in accordance with the plans and these specifications.

END OF SECTION

SECTION 21 22 00- CLEAN-AGENT FIRE-EXTINGUISHING 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 APPLICABLE STANDARDS AND PUBLICATIONS

- A. The design, installation, testing and maintenance of the Clean Agent Extinguishing System shall be in accordance with the applicable requirements set forth in the latest edition of the following codes, standards, and third party approval agencies:

1. NFPA 2001: Standard on Clean Agent Fire Extinguishing Systems
2. NFPA 70: National Electrical Code
3. NFPA 72: National Fire Alarm and Signaling Code
4. Factory Mutual (FM)
5. Underwriters Laboratories (UL)
6. Requirements of the local Authority Having Jurisdiction (AHJ)

1.3 SUMMARY

- A. Section Includes:

1. Piping and piping specialties.
2. Extinguishing-agent containers.
3. Extinguishing agent.
4. Detection and alarm devices.
5. Releasing control panel.
6. Accessories.
7. Connection devices for and wiring between system components.
8. Connection devices for power and integration into building's fire-alarm system.

- B. Section Excludes:

1. Power supply (120/240 VAC) to system control panel.
2. Interface (conduit and wiring) to HVAC units, dampers, electric power supplies, relays, or shunt-trip breakers.
3. Interface (conduit and wiring) to local/remote fire alarm system
4. Connection to listed central station fire alarm system.
5. Room sealing, other than penetrations made by the suppression system contractor during system installation. Suppression system contractor shall coordinate room sealing requirements with project's General contractor and all sub-contractors.

1.4 DEFINITIONS

- A. AHJ: Authority Having Jurisdiction.
- B. ATS: Acceptance Testing Specifications.
- C. EPO: Emergency Power Off.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

- B. Shop Drawings:

1. Prepared by persons with the following qualifications:
 - a. Trained and certified by the manufacturer of the Clean Agent Suppression system.
 - b. NICET certified Fire-Alarm Technician, Level III minimum.
2. Comply with recommendations in the "Working Plans" Section of the "System Design" Chapter in NFPA 2001.
3. Comply with the recommendations in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72.
4. Include plans, elevations, sections, details, and attachments to other work.
5. Include design calculations: Enclosure volume, agent quantity, backup battery, voltage drop, detector spacing, etc.
6. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
7. Specifier Note: Retain subparagraph below for projects where routing of cable and conduit is critical.
8. Include plans to indicate mounting location of field devices, including size and routing of cable and conduits.
9. Specifier Note: Retain subparagraph below if submittals are required to be sealed by a PE.

10. Submittals shall be signed and sealed by a qualified professional engineer prior to submitting them to the Authority Having Jurisdiction.

11. Specifier Note: Retain subparagraph below if a construction permit is required prior to commencing the Work of this Section.

12. Submittals shall be approved by the Authority Having Jurisdiction prior to submitting them to Architect.

C. Delegated-Design Submittal: For clean-agent fire-extinguishing system signed and sealed by the qualified professional engineer.

1. Indicate compliance with performance requirements and design criteria, including analysis data.

2. Include design calculations for selecting the spacing and sensitivity of detection devices, complying with NFPA 72.

3. Include design calculations for weight, volume, and concentration of extinguishing agent required for each hazard area.

4. Include design calculations for enclosure pressure relief/venting as required to avoid structural damage to the hazard enclosure, equipment, or building.

5. Indicate the Following on Reflected Ceiling Plans:

a. Ceiling penetrations and ceiling-mounted items.

b. Extinguishing-agent containers if mounted above floor, piping and discharge nozzles, detectors, and accessories.

c. Method of attaching hangers to building structure.

d. Other ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, and access panels.

6. Indicate the Following on Occupied Work Area Plans:

a. Controls and alarms.

b. Extinguishing-agent containers, piping and discharge nozzles if mounted in space, detectors, and accessories.

c. Equipment and furnishings.

7. Indicate the Following on Access Floor Space Plans:

a. Extinguishing-agent containers, piping and discharge nozzles, detectors, and accessories.

b. Method of supporting piping.

8. Indicate the Following on Ceiling Plans:

a. Extinguishing-agent containers, piping and discharge nozzles, detectors, and accessories.

b. Method of supporting piping.

c. Other equipment located in the ceiling space that is being protected including sprinkler piping, HVAC equipment, raceways, or conduit.

1.6 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:

1. Domestic water piping.

2. Items Penetrating Finished Ceiling Include the Following:

a. Lighting fixtures.

b. Air outlets and inlets.

B. Permit Approved Drawings: Working plans, prepared according to NFPA 2001, that have been approved by authorities having jurisdiction. Include design calculations.

C. Seismic Qualification Certificates: For extinguishing-agent containers and control panels 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.

D. Field quality-control reports.

E. Installer Qualifications:

1. Authorized distributor of the system manufacturer. Shall maintain an inventory of replacement parts.

2. Trained by the system manufacturer to design, install, test, and maintain the clean agent extinguishing system.

3. Provide proof of emergency service available on a twenty-four hour, seven-days-a-week basis.

4. Maintain or have access to a recharging station capable of recharging the largest suppression system within 72 hours after a discharge.

5. Minimum five (5) years' experience in the design, installation, and testing of clean-agent fire extinguishing systems. A list of systems of similar nature and scope shall be provided upon request.

6. Shall employ a NICET Level IV certified special hazard designer, who will be responsible for this project.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For special agent system to include in emergency, operation, and maintenance manuals.
- B. Deliver copies to Authorities Having Jurisdiction and include the following:
 - 1. Comply with the "Records" Section of the "Inspections, Testing and Maintenance" Chapter of NFPA 72.
 - 2. Provide "Record of Completion Documents" according to NFPA 72 article "Permanent Records" in the "Records" section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
 - 3. Record copy of site-specific software.
 - 4. Provide "Maintenance, Inspection and Testing Records" according to NFPA 72 article of the same name and include the following:
 - a. Frequency of testing of installed components.
 - b. Frequency of inspection of installed components.
 - c. Requirements and recommendations related to results of maintenance.
 - d. Manufacturer's user training manuals.
 - 5. Manufacturer's required maintenance related to system warranty requirements.
 - 6. Abbreviated operating instructions for mounting at the control panel.
 - 7. Specifier Note: Retain subparagraph below when project contain water-based sprinkler systems.
 - 8. Copy of NFPA 25.
- C. As-built Drawings: Indicate actual installation configuration at time of project completion including all equipment locations, pipe routing, conduit routing, room configurations, etc.

1.8 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. Deliver extra materials to Owner.
 - 1. Detection Devices: Not less than 20 percent of amount of each type installed.
 - 2. Container Valves: Not less than 10 percent of amount of each size and type installed.
 - 3. Nozzles: Not less than 20 percent of amount of each type installed.
 - 4. Extinguishing Agent: Not less than 100 percent of amount installed in largest hazard area. Include pressure-rated containers with valves.

1.9 QUALITY ASSURANCE

- 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. Specifier Note: Retain "FM Global Compliance" Paragraph below if FM-Approved components are required.
- C. FM Global Compliance: Provide components that are FM Approved and that are listed in FM Global's "Approval Guide."
- D. UL Compliance: Provide equipment listed in UL's "Fire Protection Equipment Directory."
- E. All devices, components, and equipment shall be new, standard products of the manufacturer's latest design and suitable to perform the functions intended. The name of the manufacturer, part number, and serial number shall appear on all major components.
- F. Locks for all cabinets shall be keyed alike.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide a HFC-227ea or FM200 or comparable product by one of the following manufacturers:
 - 1. Chemetron Fire Systems; a UTC Fire & Security company.
 - 2. Ansul.
 - 3. Pem All Fire Extinguisher Corporation; a division of Pem Systems Inc.
 - 4. Siemens Building Technologies, Inc.; Fire Safety Division.
 - 5. DuPont.

2.2 Description: Clean-agent fire-extinguishing system shall be an engineered system for total flooding of the hazard of LAN/TELCO room GAF-13 as shown on plans.

- A. Delegated Design: Design clean-agent fire-extinguishing system and obtain approval from authorities having jurisdiction. Design system for Class A and C fires as appropriate for areas being protected, and include safety factor. Use clean agent indicated and in concentration suitable for normally occupied areas.
- B. Specifier Note: Retain one of three "Performance Requirements" paragraphs below. Verify agent concentration, holding time, and other requirements with authorities having jurisdiction.
- C. Performance Requirements: (HFC-227ea per NFPA 2001).
 - 1. Minimum design concentration: 10% by volume in all areas and/or protected spaces at the minimum anticipated temperature within the protected area.

2. Per NFPA 2001, the system design shall not exceed a maximum exposure limit concentration level of 10.5% by volume, unless provisions for room evacuation before agent release are provided. All personnel should be able to leave the protected space prior to the discharge or at least within 5 minutes of the commencement of discharge.
- D. Verified Detection: Devices located in single zone. Sound alarm on activating single-detection device, and discharge extinguishing agent on actuating second-detection device.
- E. Single Detector Release: Devices located in a single zone. Sound alarm on activating single-detection device, and discharge extinguishing agent.

2.3 SYSTEM OPERATING SEQUENCE

- A. Cross-Zone or Verified Detection:
 1. Actuating First Detector (Alarm):
 - a. Visual and audible indication on control panel.
 - b. Visual indication on optional annunciator panel.
 - c. Energize audible and visual alarms inside the protected hazard area (unique pattern).
 - d. Transfer relays to shut down air-conditioning and ventilating systems serving protected area, close doors in protected area, and send signal to fire-alarm system.
 2. Actuating Second Detector (Pre-discharge):
 - a. Visual and audible indication on control panel.
 - b. Visual indication on optional annunciator panel.
 - c. Energize audible and visual alarms inside the protected hazard area (unique pattern).
 - d. Transfer relays to shut down power to protected equipment.
 - e. Start time delay for extinguishing-agent discharge for [30] seconds.
 - f. Initiate system abort sequence.
 3. Extinguishing-agent discharge (Release): Pre-discharge time delay expires or manual release switch is operated.
 - a. Visual and audible indication on control panel.
 - b. Visual indication on optional annunciator panel.
 - c. Energize audible and visual alarms inside and outside the protected area (unique pattern).
 - d. Release clean agent suppression system agent.
 - e. Specifier Note: Include actuation of sprinkler systems only if coordinated with Section 211313 "Wet-Pipe Sprinkler Systems" and Section 211316 "Dry-Pipe Sprinkler Systems."
 - f. Release pre-action valve to allow water to fill sprinkler system.
- B. System Operating Sequence: Single Detector Release.
 1. Actuating First Detector (Pre-discharge):
 - a. Visual and audible indication on control panel.
 - b. Visual indication on optional annunciator panel.
 - c. Energize audible and visual alarms inside the protected hazard area (unique pattern).
 - d. Transfer relays to shut down air-conditioning and ventilating systems serving protected area, close doors in protected area, and send signal to fire-alarm system.
 - e. Transfer relays to shut down power to protected equipment.
 - f. Start time delay for extinguishing-agent discharge for [30] seconds.
 - g. Initiate system abort sequence.
 2. Extinguishing-agent discharge (Release):
 - a. Visual and audible indication on control panel.
 - b. Visual indication on optional annunciator panel.
 - c. Energize audible and visual alarms inside and outside the protected area (unique pattern).
 - d. Discharge extinguishing agent upon expiration of the discharge time delay.
 - e. Specifier Note: Include actuation of sprinkler systems only if coordinated with Section 211313 "Wet-Pipe Sprinkler Systems" and Section 211316 "Dry-Pipe Sprinkler Systems."
 - f. Release pre-action valve to allow water to fill sprinkler system.
- C. Supervisory signal initiation shall be by one or more of the following devices and systems:
 1. Clean agent container low pressure switch.
- D. 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 primary power at fire-alarm control unit.
 4. Ground or a single break in fire-alarm control unit internal circuits.
 5. Abnormal AC voltage at fire-alarm control unit.
 6. Break in standby battery circuitry.
 7. Failure of battery charging.
 8. Abnormal position of any switch at fire-alarm control unit or annunciator.

- E. System Supervisory and Trouble Signal Actions:
 - 1. Visual and audible indication on control panel.
 - 2. Visual indication on optional annunciator panel.
 - 3. Transfer relays to send signal to fire-alarm system.
 - F. Operating manual release switches will cause the immediate discharge of the extinguishing agent, overriding the system's discharge time delay and abort functions. Panel operation shall duplicate the extinguishing-agent discharge sequence described in the previous paragraphs.
 - 1. Electric manual release switches shall be located at each hazard exit.
 - 2. Push button actuators shall be located on extinguishing agent container solenoid actuator. Requires a discharge pressure switch to be mounted on the discharge piping. Switch shall be wired to the control panel to indicate system activation when actuator is pressed.
 - G. Operating abort switches will delay extinguishing-agent discharge while being activated. Release of hand pressure on the switch will cause agent discharge if the discharge time delay has expired.
 - H. Specifier Note: Retain paragraph below only if emergency power off is applicable to project.
 - I. EPO: Will terminate power to protected equipment immediately on actuation.
 - J. Low-Agent Pressure Switch: Initiate trouble alarm if sensing less than set pressure.
- 2.4 PIPING MATERIALS
- A. See "Writing Guide" Article in the Evaluations for a discussion on the Section Text's organization and the most efficient way to revise the Section Text. See "Manufacturer's Installation Manual" Article for applications of pipe, tube, fitting, and joining materials.
 - B. Piping, Valves, and Discharge Nozzles: Comply with types and standards listed in NFPA 2001, Section 4.2 "Distribution," for charging pressure of system.
- 2.5 PIPE AND FITTINGS
- A. Steel Pipe: ASTM A-106, Seamless, [Grade A] ; ASTM A-106, Seamless, Grade C; ASTM A-53, ERW, [Grade A]; Schedule 40.
 - 1. Threaded Fittings:
 - a. Malleable-Iron Fittings: ASME B16.3, Class 300.
 - b. Flanges and Flanged Fittings: ASME B16.5, Class 300.
 - c. Specifier Note: HFC-227ea systems are usually 360-psig (2482-kPa) charging-pressure systems. Verify system charging pressure.
 - d. Fittings Working Pressure: **416 psig (2868 kPa)** minimum.
 - e. Threaded malleable or ductile iron: Class 300
 - f. Flanged Joints: Class 300 minimum.
 - 2. Steel, Grooved-End Fittings: FM Approved and NRTL listed, ASTM A 47/A 47M malleable iron or ASTM A 536 ductile iron, with dimensions matching steel pipe and ends factory grooved according to AWWA C606.
 - B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos-free, **1/8-inch (3.2-mm)** maximum thickness unless thickness or specific material is indicated.
 - C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel.
 - D. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
 - E. Steel, Keyed Couplings: UL 213, AWWA C606, approved or listed for clean-agent service, and matching steel-pipe dimensions. Include ASTM A 536, ductile-iron housing, rubber gasket, and steel bolts and nuts.
- 2.6 VALVES
- A. General Valve Requirements:
 - 1. UL listed or FM Approved for use in fire-protection systems.
 - 2. Compatible with type of clean agent used.
 - 3. Automatic excessive pressure relief provision.
 - 4. Low pressure gauge.
 - B. Container Valves: With fast acting rupture disc with solenoid actuator and manual-release lever, capable of immediate and total agent discharge and suitable for intended flow capacity.
 - C. Valves in Sections of Closed Piping and Manifolds: Fabricate to prevent entrapment of liquid, or install valve and separate pressure relief device.
 - D. Valves in Manifolds: Check valve; installed to prevent loss of extinguishing agent when container is removed from manifold.

2.7 EXTINGUISHING-AGENT CONTAINERS

- A. Description: High strength alloy steel tanks complying with ASME Boiler and Pressure Vessel Code: Section VIII, for unfired pressure vessels. Include minimum working-pressure rating that matches system charging pressure, valve, pressure switch, and pressure gage.
 - 1. Specifier Note: Retain one of two options in first subparagraph below.
 - 2. Finish: Manufacturer's standard color, enamel or epoxy paint.
 - 3. Specifier Note: Retain one of two "Manifold" subparagraphs below or delete as required for arrangement.
 - 4. Manifold: Fabricate with valves, pressure switches, and connections for multiple storage containers, as indicated.
 - 5. Manifold: Fabricate with valves, pressure switches, selector switch, and connections for main- and reserve-supply banks of multiple storage containers.
 - 6. Storage-Tank Brackets: Factory- or field-fabricated retaining brackets consisting of steel straps and channels; suitable for container support, maintenance, and tank refilling or replacement.
- B. Location: Located within hazard area, or as near as possible to reduce the required amount of pipe and fittings.

2.8 FIRE-EXTINGUISHING CLEAN AGENT

- A. HFC-227ea Clean Agent: Heptafluoropropane.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Fike®; HFC-227ea or comparable product by one of the following:
 - a. DuPont.
 - b. Great Lakes Chemical Corporation; a Chemtura company.

2.9 DISCHARGE NOZZLES

- A. Equipment manufacturer's standard one-piece brass or aluminum alloy of type, size, discharge pattern, and capacity required for application.

2.10 MANIFOLD AND ORIFICE UNIONS

- A. Description: NRTL-listed device with minimum 2175-psig (15-MPa) pressure rating, to control flow and reduce pressure of IG-55 gas in piping.
 - 1. NPS 2 (DN 50) and Smaller: Piping assembly with orifice, sized for system design requirements.
 - 2. NPS 2-1/2 (DN 65) and Larger: Piping assembly with nipple, sized for system design requirements.

2.11 CONTROL PANELS

- A. Description: FM Approved or NRTL listed, including equipment and features required for testing, supervising, and operating fire-extinguishing system. Listed and approved for releasing service, and suitable for deluge/pre-action sprinkler service.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Fike®; SHP-PRO® or comparable product by one of the following:
- B. Power Requirements: [120] V ac; with electrical contacts for connection to system components and fire-alarm system, and transformer or rectifier as needed to produce power at voltage required for initiating devices, notification appliances, trouble signals, supervisory signals, digital alarm communicator transmitter, and auxiliary power.
 - 1. Alarm current draw of the entire clean agent suppression system shall not exceed 80 percent of the control panel's power supply rating.
- C. Enclosure: NEMA ICS 6, Type 1, steel cabinet.
 - 1. Mounting: Surface.
 - 2. Finish: [Red]baked on enamel finish
- D. Supervised Circuits: Wired NFPA 72, [Class A]
 - 1. Two detection circuits; capable of cross zone; sequential; single detector release actuation methods.
 - 2. Three initiating device circuits; capable of monitoring contact closure devices.
 - 3. Three notification appliance circuits.
 - 4. Agent release circuit capable of actuating suppression system.
 - 5. Solenoid release circuit capable of actuating suppression system or sprinkler solenoids.
 - 6. Auxiliary power circuit (resettable/non-resettable) for field devices.
 - 7. Three Form-C relay contacts for auxiliary control functions.
 - 8. Eight additional Form-C relay contacts with addition of supplemental relay cards.
- E. Control-Panel Features:
 - 1. Specifier Note: Verify availability and applicability of control-panel features.
 - 2. Microprocessor controlled.
 - 3. Ten LED indicators to provide positive indication of system status.
 - 4. Diagnostic LED indicator to display system and trouble events.
 - 5. Configurable via dip-switches.
 - 6. Automatic switchover to standby power at loss of primary power.
 - 7. Storage container, low-pressure indicator.

8. Service disconnect to interrupt system operation for maintenance with visual status indication on the panel.
9. Silence and reset switch.
10. 120 VAC or 240 VAC power input.
11. Five optional abort types.
12. Simultaneous monitoring and release of clean agent and sprinkler suppression systems.
- F. Annunciator Panel: Graphic type showing protected, hazard-area plans, as well as locations of detectors and abort, EPO, and manual stations. Include lamps to indicate device-initiating alarm, electrical contacts for connection to control panel, and stainless-steel or aluminum enclosure.
- G. Standby Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.
 1. Batteries: Sealed lead calcium, sized to operate system for [24] hours and alarm for minimum of [15] minutes.
- H. Optional Cards: Cards mount directly to and receive their operational power from the SHP PRO® control board.
 1. Class A Input Module: Converts all five initiating devices circuits to NFPA 72, Class A wiring.
 2. Class A Output Module: Converts all three notification appliance and releasing circuits to NFPA 72, Class A wiring.
 3. Relay Module: Provides four additional Form-C relay contacts for auxiliary control functions.

2.12 SYSTEM SMOKE DETECTORS

- A. General Requirements:
 1. Comply with NFPA 2001, NFPA 72, and UL 268.
 2. 24-V dc, nominal.
 3. Two-wire type.
 4. Self-restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
 5. Integral Visual-Indicating Light: LED type, indicating detector has operated and power-on status.
- B. Ionization Detectors: Dual-chamber type, having sampling and referencing chambers, with smoke-sensing element.
- C. Photoelectric Detectors: LED light source and silicon photodiode receiving element.
- D. Base Mounting: Detector shall be mounted on a twist-lock, fixed base.
 1. Select according to operational characteristics: Verified detection, Cross-zone detection, and Single-detector release.
 2. Base provides terminals for connection to control unit.
- E. Signals to the Central Fire Alarm Control Panel: Any type of local system Alarm, Trouble, or Supervisory event is reported to the central fire alarm control panel as a composite signal for each event type.

2.13 HEAT DETECTORS

- A. General Requirements:
 1. Comply with NFPA 2001, NFPA 72, and UL 521.
 2. 24-V dc nominal.
 3. Two-wire type.
 4. Self-restoring: Detectors do not require resetting after actuation to restore them to normal operation.
 5. Integral Visual-Indicating Light: LED type, indicating detector has operated and power on status.
- B. Fixed Temperature Type: Actuated by a temperature that exceeds a fixed temperature of 190 deg F.
- C. Combination Type: Actuated by either a fixed temperature of 190 deg. F or a rate of rise that exceeds 12 deg F (11 deg C) per minute unless otherwise indicated.
- D. Base Mounting: Detector shall be mounted on a twist-lock, fixed base.
 1. Select according to operational characteristics: Verified detection, Cross-zone detection, and Single-detector release.
 2. Base provides terminals for connection to control unit.

2.14 LINEAR HEAT DETECTION

- A. General Requirements:
 1. Comply with NFPA 2001, NFPA 72, and UL 521.
 2. Temperature Rating: Actuated by a temperature that exceeds a fixed temperature of 155 deg F.
- B. Connects to the control panels detection and input circuits; providing a contact closure input.

2.15 SWITCHES

- A. General Description: [Surface] FM Approved or NRTL listed, low voltage, includes contacts for connection to control panel.
- B. Manual Release Switch: Unit can manually discharge extinguishing agent with operating device that remains engaged until unlocked.
 1. Stainless steel faceplate.
 2. Dual-action requiring two distinct operations to initiate suppression system release.
 3. Red plastic release button, keyed reset.
 4. "MANUAL RELEASE" caption.

- C. Abort Switch: Unit can manually prevent the release of the suppression system while pressed.
 - 1. Stainless steel faceplate.
 - 2. Red plastic abort button, momentary contact (dead-man type).
 - 3. Available with key-operated switch.
 - 4. "SYSTEM ABORT" caption.
- D. Main-Reserve Switch: Unit allows transfer of release circuit signal from main supply to reserve supply.
 - 1. Stainless steel faceplate.
 - 2. Black plastic selector button (main/reserve)
 - 3. "CONTAINER SELECT" caption.
- E. EPO Switch: "EPO" caption, with yellow finish.
- F. Low-Agent Pressure Switches: Installed on extinguishing agent container; pneumatic operation.
- G. Suppression Disconnect Switches: Unit enables releasing circuit (i.e., clean agent or sprinkler) to be disconnected from the control panel.
 - 1. Stainless steel faceplate.
 - 2. Key operated selector switch (armed/disarmed).
 - 3. LEDs to provide indication of switch status (armed/disarmed).
 - 4. "SUPPRESSION DISCONNECT" caption.
- H. Discharge Pressure Switches: Installed on suppression piping to provide indication of manual actuation of the clean agent suppression system back to the control panel.

2.16 ALARM DEVICES

- A. General Requirements: Listed and labeled by an NRTL or FM Approved, low voltage, and surface mounting.
- B. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly. Connected to notification appliance signal circuits, equipped for mounting as indicated and with screw terminals for system connections.
- C. Bells, comply with UL 464: High dBA output; 120-V ac; vibrating type; minimum 6-inch (150-mm) diameter. Bells shall produce a sound-pressure level of 90 dBA minimum, measured 10 feet (3 m) from horn.
- D. Horns, comply with UL 464: Electric-vibrating-polarized type, 24-V dc. Horns shall produce a sound-pressure level of 90 dBA minimum, measured 10 feet (3 m) from horn.
- E. Visible Notification Appliances, comply with UL 1971: Xenon strobe lights with translucent lens, with "FIRE" or similar caption.
 - 1. Rated Light Output:
 - a. Indicated on drawings.
 - b. 15/30/75/110 cd, selectable in the field.
 - 2. Mounting: Indicated on Drawings.
 - 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 finish, red.

2.17 INFORMATIONAL SIGNAGE

- A. Provide informational signs as required to comply with NFPA 2001 for the specific agent.

2.18 ANNUNCIATOR PANEL

- A. Description: Annunciator shall provide a graphic display of the protected area, and shall provide LEDs to indicate the location of system detectors.
 - 1. Mounting: Steel enclosure; black finish; flush or surface mounted.

2.19 DIGITAL ALARM COMMUNICATOR TRANSMITTER

- A. Digital alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL 632 and be listed and labeled by an NRTL.
- B. Features:
 - 1. 100 event history buffer.
 - 2. Communication Protocols: Modem IIIa², SIA, and 4/2
 - 3. LEDs for heartbeat, system trouble, and telephone line trouble (one per line).
 - 4. Dual telephone line interface.
 - 5. Self-Test: Conducted automatically every 10 minutes with report transmitted to central station.
 - 6. Communication failure indication.
 - 7. Operating Power: 24-V dc continuous power from control panel.
- C. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from the control panel and automatically capture one telephone line(s) and dial a preset number for a remote central station. When contact is made with the central station, signals shall be transmitted. If service on either line is interrupted for longer than 36 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.

- D. Mounting: Digital alarm communicator transmitter must be mounted adjacent to the control panel within 20 feet (6.1 m) with interface wiring in conduit.
- E. Secondary Power: Auxiliary power supply with integral rechargeable battery and automatic charger; UL listed for Fire Protective Signaling System service.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with hazard-area leakage requirements, installation tolerances, and other conditions affecting work performance.
 - 1. The general contractor shall be responsible for sealing and securing the protected enclosure against agent loss and/or leakage during the required agent "hold" period.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PIPING APPLICATIONS

- A. Flanged pipe and fittings and flanged joints may be used to connect to specialties and accessories and where required for maintenance.
- B. **NPS 2 (DN 50)** and Smaller: Schedule 40, steel pipe; malleable-iron threaded fittings; and threaded joints.
- C. **NPS 2-1/2 (DN 65)** and Larger: Schedule 40, steel pipe;

3.3 PIPING APPLICATIONS

- A. Piping between Storage Containers and Orifice Union: Schedule [80] , steel pipe;
- B. Piping Downstream from Orifice Union: Schedule [40]

3.4 CLEAN-AGENT PIPING INSTALLATION

- A. Install clean-agent extinguishing piping and other components level and plumb, according to manufacturers' written instructions.
- B. Each pipe section shall be cleaned internally after preparation and before assembly by means of swabbing, using a suitable nonflammable cleaner. Pipe network shall be free of particulate matter and oil residue before installing nozzles or discharge devices.
- C. Grooved Piping Joints: Groove pipe ends according to AWWA C606 dimensions. Assemble grooved-end steel pipe and steel, grooved-end fittings with steel, keyed couplings and lubricant according to manufacturer's written instructions.
- D. Install extinguishing-agent containers anchored to substrate.
- E. All pipe threads shall be sealed with Teflon tape pipe sealant applied to the male threads only.
- F. Install pipe and fittings, valves, and discharge nozzles according to requirements listed in NFPA 2001, Section 4.2 "Distribution."
 - 1. Install valves designed to prevent entrapment of liquid, or install pressure relief devices in valved sections of piping systems.
 - 2. Support piping using supports and methods according to NFPA 13.
 - 3. Install seismic restraints for extinguishing-agent containers and piping systems.

3.5 DETECTION, ACTUATION, ALARM, AND CONTROL SYSTEMS INSTALLATION

- A. Install control panels, detection system components, alarms, and accessories, complying with requirements of NFPA 72 and NFPA 2001, Section "Detection, Actuation, and Control Systems," as required for supervised system application.
- B. Smoke or Heat Detector Spacing:
 - 1. Comply with NFPA 72, "Smoke-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for smoke detector spacing.
 - 2. Comply with NFPA 72, "Heat-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for heat detector spacing.
 - 3. Specifier Note: Retain first subparagraph below to indicate how Contractor shall determine detector spacing.
 - 4. Smoke ceiling spacing shall not exceed 30 feet (9 m).
 - 5. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Appendix A in NFPA 72.
 - 6. HVAC: Locate detectors not closer than 3 feet (1 m) from air-supply diffuser or return-air opening.
 - 7. Lighting Fixtures: Locate detectors not closer than 12 inches (300 mm) from any part of a lighting fixture.
- C. Audible Alarm-Indicating Devices: Wall mounted with tops above the finished floor not less than 90 inches (2.29 m), and below the ceiling not less than 6 in. (150 mm). Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille.

- D. Visible Alarm-Indicating Devices: Wall mounted with entire lends not less than 80 in. (2.03 m) and not greater than 96 in. (2.44 m) above the finished floor. Where ceiling height does not permit mounting at minimum height, mount within 6 inches (150 mm) of the ceiling.
- E. Combination Audible-Visual Devices: Where combination audible and visual devices are used, mount devices according to Visual Alarm-Initiating Device requirements.
- F. Control Unit: [Surface] [Flush] mount, with top of cabinet not more than 72 inches (1830 mm) above the finished floor.
- G. Annunciator: Install with top of panel not more than 72 inches (1830 mm) above the finished floor.

3.6 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to equipment, allow space for service and maintenance.
- C. Connect electrical devices to control panel and to building's fire-alarm system.

3.7 IDENTIFICATION

- A. Identify system components, equipment, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- B. Identify piping, extinguishing-agent containers, other equipment, and panels according to NFPA 2001.
- C. Install signs at entry doors for protected areas to warn occupants that they are entering a room protected with a clean-agent fire-extinguishing system.
- D. Specifier Note: Revise paragraph below to include warning devices that are to be installed.
- E. Install signs at entry doors to advise persons outside the room the meaning of the horn(s), bell(s), and strobe light(s) outside the protected space.
- F. Install framed operating instructions in a location visible from control unit.

3.8 SYSTEM WIRING

- A. Wiring shall be installed by qualified individuals, in a neat and workmanlike manner in accordance with the National Electrical Code (NEC), Article 725 and 760, except as otherwise permitted for limited energy circuits as described in NFPA 72. Installation shall meet all local, state, province and/or country codes.
- B. All wiring shall be installed in electrical metallic tubing (EMT) or conduit, and must be kept separate from all other building wiring. Runs of conduit shall be straight, neatly arranged, properly supported and installed parallel and perpendicular to walls and partitions.
- C. Conductors shall be sized according to the design documents and color coded to allow easy circuit identification.
- D. All wires shall be tagged at all junction boxes.
- E. All wires shall be tested for the presence of opens, shorts and grounds prior to connection to control panel. Final wire terminations to control panel shall be made under the direct supervision of a factory trained representative.
- F. All system components shall be securely supported independent of the wiring.
- G. Ground control panel and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to control panel.

3.9 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Specifier Note: Retain first paragraph below to require a factory-authorized service representative to perform inspections, tests, and adjustments.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- D. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- E. Submit test plan for review and approval by the owner or owner's designated representative prior to performing tests.
- F. Detection, Actuation, Alarm, and Control Systems Tests:
 - 1. Visual Inspection: Conduct the visual inspection prior to testing.
 - a. Inspection shall be based on completed Record Drawings and system documentation that is required by NFPA 72 in it "Completion Documents, Preparation" Table in the "Documentation" Section of the "Fundamental of Fire Alarm Systems" Chapter.
 - b. Comply with "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. Operational Test: After electrical circuitry has been energized, apply power to control panel and confirm proper unit operation. Comply with "Test Methods" Table in the "Testing" Section of the "Inspection, Testing, and Maintenance" Chapter in NFPA 72.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- G. Clean-Agent Fire Extinguishing Systems Test:

1. Flow Test: Using nitrogen or other inert gas, perform a flow test on the piping network to verify that flow is continuous and unobstructed through piping and nozzles.
 2. Pressure/Leak Test: pneumatically test the piping in a closed circuit for a period of 10 minutes at 40 psi (276 kPa). At the end of 10 minutes, the pressure drop shall not exceed 20 percent of the test pressure. Repair leaks and retest until no leaks exist.
 3. Room Pressurization Test: After all construction work is complete, conduct a room pressurization test in accordance with NFPA 2001 in each clean agent suppression system hazard area. Test shall confirm enclosures ability to retain the agent concentration level for the required hold time. If the test fails, the suppression system contractor shall coordinate room sealing with the general contractor. Additional tests shall be conducted until successful test results are achieved. Include final test results in project 'Closeout Submittals'.
- H. System will be considered defective if it does not pass tests and inspections.
- I. Prepare test and inspection reports: Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.

3.10 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain the clean-agent fire-extinguishing systems.

3.11 SERVICE CONTRACT

- A. Suppression system installing contractor shall provide two (2) inspections of the systems installed under this contract, during the manufacturer's one-year warranty period. The first inspection shall be at the six month interval, and the second shall be at the twelve month interval after system acceptance.
- B. Inspections shall be conducted in accordance with the equipment manufacturer's guidelines and the recommendations of NFPA 72 and NFPA 2001. Use forms provided in NFPA 72 for initial tests and inspections.
- C. Prepare and submit test and inspection reports.

3.12 WARRANTY

- A. Clean Agent System manufacturer shall guarantee all components furnished under this contract against defects in design, materials, and workmanship for no less than one (1) year from the date of system acceptance.

END OF SECTION

SECTION 21 13 13 - WET-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Includes But Not Limited To:
 - 1. Furnish and install complete wet-pipe fire sprinkler system as specified in Contract Documents.
 - 2. Furnish and install Firestop Penetration Systems for fire sprinkler system penetrations as described in Contract Documents.

1.2 REFERENCES

- A. Association Publications:
 - 1. Underwriters Laboratories, Inc.:
 - a. UL Directory B, 'Fire Protection Equipment Directory' (2011).
- B. Reference Standards:
 - 1. American National Standards Institute / American Society of Mechanical Engineers:
 - a. ANSI/ASME B1.20.1-1983(R2006), 'Pipe Threads, General Purpose (Inch)'.
 - b. ANSI/ASME B16.1-2010, 'Cast Iron Pipe Flanges and Flanged Fittings'.
 - c. ANSI/ASME B16.3-2011, 'Malleable Iron Threaded Fittings: Classes 150 and 300'.
 - d. ANSI/ASME B16.4-2011, 'Gray Iron Threaded Fittings, Classes 125 and 250'.
 - e. ANSI/ASME B16.5-2009, 'Pipe Flanges and Flanged Fittings'.
 - 2. American National Standards Institute / American Water Works Association:
 - a. ANSI/AWWA C606-11, 'Grooved and Shouldered Joints'.
 - 3. American National Standards Institute / American Welding Society:
 - a. ANSI/AWA B2.1/B2.1M-2009, 'Specification for Welding Procedure and Performance Qualification'.
 - 4. ASTM International:
 - a. ASTM A53/A53M-12, 'Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless'.
 - b. ASTM A135/A135M-09, 'Standard Specification for Electric-Resistance-Welded Steel Pipe'.
 - c. ASTM A234/A234M-11a, 'Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service'.
 - d. ASTM A395/A395M-99(2009), 'Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures'.
 - e. ASTM A536-84(2009), 'Standard Specification for Ductile Iron Castings'.
 - f. ASTM A795/A795M-08, 'Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use'.
 - 5. National Fire Protection Association / American National Standards Institute:
 - a. NFPA 13: 'Standard for the Installation of Sprinkler Systems', (2010 Edition).
 - b. NFPA 24: 'Installation of Private Fire Service Mains and their Appurtenances', (2010 Edition).
 - c. NFPA 25: 'Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems', (2011 Edition).
 - d. NFPA 101: 'Life Safety Code', (2012 Edition).

1.3 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings:
 - a. Size sprinkler system by one of following methods:

- 1) Hydraulic calculation design method based on water supply evaluation performed at building site.
 - b. On submittals, refer to sprinkler heads by sprinkler identification or model number published in appropriate agency listing or approval. Trade names and other abbreviated designations are not acceptable.
 - c. Submittal Procedure:
 - 1) After award of Contract and before purchase of equipment, submit seven sets of shop drawings with specifications and hydraulic calculations to Architect and two sets to local jurisdiction having authority for fire prevention for review.
 - 2) After integrating Architect's and AHJ's comments into drawings, licensed certified fire protection engineer of record who designed fire protection system shall stamp, sign, and date each sheet of shop drawings and first page of specifications and calculations.
 - 3) Submit stamped documents to Owner and to AHJ for fire prevention for final approval.
 - 4) After final approval, submit four copies of approved stamped documents to Architect.
 - 5) Failure of system to meet requirements of authority having jurisdiction and/or approved stamped construction documents shall be corrected at no additional cost to Owner.
- B. Informational Submittals:
 1. Qualification Statement:
 - a. Licensed fire protection engineers or fire protection system designer:
 - 1) Licensed for area of Project.
 - 2) Certified by NICET to level three minimum.
 - 3) Provide Qualification documentation if requested by Architect or Owner.
 - b. Installer:
 - 1) Provide Qualification documentation if requested by Architect or Owner.
- C. Closeout Submittals:
 1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
 - a. Operations and Maintenance Data:
 - 1) Maintenance and instructions.
 - a) List of system components used to indicate name and model of each item.
 - b) Manufacturer's maintenance instructions for each component installed in Project.
 - c) Instructions shall include installation instructions, parts numbers and lists, operation instructions of equipment, and maintenance and lubrication instructions.
 - b. Warranty Documentation:
 - 1) Include copies of required warranties.
 - c. Record Documentation:
 - 1) Include copies of approved shop drawings.
 - 2) Provide master index showing items included.
 - 3) Provide name, address, and phone number of Architect, Architect's Fire Sprinkler Consultant, General Contractor, and Fire Protection subcontractor.
 - 4) Provide operating instructions to include:
 - a) General description of fire protection system.
 - b) Step by step procedure to follow for shutting down system or putting system into operation.
 - 5) Provide copy of system's above ground and below ground hydrostatic tests. Provide separate copies for Architect and Owner.
 - 6) Provide copy of 'Contractor's Material and Testing Certificate for Above Ground Piping' NFPA 13, Figure 24.1 (2010 edition).
 2. Inspection:
 - a. Provide Owner with latest version of NFPA 25.
- D. Maintenance Material Submittals;
 1. Extra Stock Materials:
 - a. Spare sprinkler heads in the quantity recommended by NFPA 13 selected in representative proportion to quantity used in Project and in accordance with NFPA 13 (Six (6) spare sprinkler heads minimum).
 - b. Provide spare heads in cabinet with sprinkler head wrench for each type of head used. After approval of cabinet and contents, mount cabinet in convenient location in Riser Room.

1.4 QUALITY ASSURANCE

- A. Requirements of Regulatory Agencies:
 - 1. Unless noted otherwise, system shall conform to:
 - a. NFPA 13, 'Light & Ordinary Hazard Occupancies'.
 - b. NFPA 24, 'Service Mains and Their Appurtenances, Private'.
 - c. NFPA 25, 'Inspection, Testing, and Maintenance'.
 - d. NFPA 101, 'Life Safety Code'.
 - e. Requirements of local water department and local authority having jurisdiction for fire protection.
 - f. Underwriters Laboratories Publication, UL Directory B, 'Fire Protection Equipment Directory', current edition at time of Pre-Bid Meeting.
 - g. Comply with backflow prevention requirements and, if required, include device in hydraulic calculations.
 - h. Applicable rules, regulations, laws, and ordinances.
- B. Qualifications:
 - 1. Licensed fire protection engineer or fire protection system designer certified by NICET to level three minimum and engaged in design of fire protection systems. Engineer / designer shall:
 - a. Licensed for area of Project.
 - b. Minimum five (5) years experience in fire protection system installations.
 - c. Minimum five (5) satisfactorily completed installations in past three (3) years of projects similar in size, scope, and complexity required for this project before bidding.
 - d. Be responsible for overseeing preparation of shop drawings, hydraulic calculations where applicable, and system installation.
 - e. Make complete inspection of installation.
 - f. Provide corrected record drawings to Owner with letter of acceptance.
 - g. Certify that installation is in accordance with Contract Documents.
 - h. Upon request, submit documentation.
 - 2. Installer:
 - a. Licensed for area of Project.
 - b. Minimum five (5) years experience in fire protection system installations.
 - c. Minimum five (5) satisfactorily completed installations in past three (3) years of projects similar in size, scope, and complexity required for this project before bidding.
 - d. Upon request, submit documentation.

PART 2 - PRODUCTS

2.1 SYSTEM

- A. Manufacturers:
 - 1. Manufacturer Contact List:
 - a. Croker Corp, Elmsford, NY www.croker.com.
 - b. Gruvlock by Anvil International, Portsmouth, NH www.anvilintl.com.
 - c. HO Trerice Company, Oak Park, MI www.hotco.com.
 - d. Kennedy Valve, Elmira, NY www.kennedyvalve.com.
 - e. Milwaukee Valve Co, New Berlin, WI www.milwaukeevalve.com.
 - f. Mueller Company, Decatur, IL www.muellerflo.com.
 - g. Nibco Inc, Elkhart, IN www.nibco.com.
- B. Description:
 - 1. Automatic wet-pipe fire sprinkler system starting at flange in Fire Riser Room and extending throughout heated portions of building.
 - 2. Dry sprinkler heads preferred over and into Vestibules.
- C. Performance:
 - 1. Design Criteria:

- a. Area of Application and Corresponding Design Density:
 - 1) Serving Area and Mechanical, Electrical, and Janitorial Areas:
 - a) Ordinary Hazard Group 1.
 - b) Design density = 0.15 gpm per sq ft over 1,500 sq ft (140 sq m).
 - 2) Storage Areas:
 - a) Ordinary Hazard Group 2.
 - b) Design density = 0.20 gpm per sq ft over 1,500 sq ft (140 sq m).
 - 3) All Other Areas:
 - a) Light Hazard.
 - b) Design density = 0.10 gpm per sq ft over 1,500 sq ft (140 sq m).
 - 4) Increase remote areas by 30 percent where ceiling / roof is sloped more than 2 inches (50 mm) per ft.
 - 5) Remote areas may be reduced within parameters indicated in NFPA 13 for use of quick response sprinklers throughout.
 - b. Maximum Coverage per Sprinkler Head:
 - 1) Ordinary Hazard Areas: 130 sq ft (12.1 sq meters).
 - 2) Attic Areas: 120 sq ft (11.2 sq meters).
 - 3) Light Hazard Areas: 225 sq ft (20.1 sq meters).
 - c. Design Area shall be hydraulically most remote area in accordance with NFPA 13.
 - 1) Provide a 10 PSI safety allowance under adjusted water flow supply curve.
 - d. Maximum velocity of water flow within piping: 20 feet (6.1 m) per sec.
- D. Components:
1. General: Use only domestically manufactured cast iron pipe fittings, valves, sprinkler heads, and other components.
 - a. Pipe of foreign manufacture that meets ASTM Standards is acceptable.
 - b. Ductile iron fittings of foreign manufacture are acceptable.
 2. Pipe:
 - a. Schedule 40 Welded Steel:
 - 1) Exterior, Above Ground: Schedule 40 hot-dip galvanized welded steel meeting requirements of ASTM A53/A53M, ASTM A135/A135M or ASTM A795/A795M.
 - 2) Interior, Above Ground: Schedule 40 black welded steel meeting requirements of ASTM A53/A53M, ASTM A135/A135M or ASTM A795/A795M.
 - 3) Connections:
 - a) 2 inches (50 mm) And Smaller: Screwed, flanged, or roll grooved coupling system.
 - b) 2-1/2 inches (64 mm) And Larger: Flanged or roll grooved coupling system.
 3. Fittings:
 - a. Usage:
 - 1) 2 inches (50 mm) And Smaller: Welded, screwed, flanged, or roll grooved coupling system. For use with schedule 40 carbon steel pipe.
 - 2) 2-1/2 inches (64 mm) And Larger: Welded, flanged, or roll grooved coupling system.
 - b. Types And Quality:
 - 1) Screwed:
 - a) Cast iron meeting requirements of ANSI B16.4 or ductile iron meeting requirements of ANSI B16.3 and ASTM A536, Grade 65-45-12.
 - b) Threaded fittings and pipe shall have threads cut to ANSI B1.20.1.
 - c) Do not extend pipe into fittings to reduce waterway.
 - d) Ream pipe after cutting to remove burrs and fins.
 - 2) Flanged: Steel meeting requirements of ANSI B16.5.
 - 3) Welded:
 - a) Carbon steel meeting requirements of ASTM A234/A234M.
 - b) Weld pipe using methods complying with AWS B2.1, level AR-3. Welding procedures and performance of welders shall comply with AWS B2.1, level AR3.
 - 4) Roll Grooved Pipe Coupling System:
 - a) Ductile iron meeting requirements of ASTM A395/A395M and ASTM A536, and UL listed.
 - b) Grooved products used on Project shall be from same manufacturer. Grooving tools shall be as recommended by manufacturer of grooved products.
 - c) Category Four Approved Products: See Section 01 6200 for definition of Categories:

	Gruvlok	Tyco (Grinnell)	Victaulic
Rigid Couplings	7401	772	Style 005
Flexible Couplings ¹	7000	705	Style 75
Flange Adaptors ²	7012	71	Style 744
Grooved Coupling Gaskets ³	'E' EPDM	Grade 'E' EPDM	'E' EPDM ⁴

¹ Use in locations where vibration attenuation, stress relief, thermal expansion, or seismic design is required / needed.

² Class 125 or 150.

³ Temperature rated **30 to 150 deg F (minus one to plus 65 deg C)**. NSF-61 certified.

⁴ Grade 'A'.

- c. Use of saddle or hole cut type mechanical tees is NOT APPROVED.
- 4. Valves:
 - a. Butterfly Valves:
 - 1) Design Criteria:
 - a) UL / CASA approved.
 - b) Indicating type.
 - 2) Category Four Approved Products: See Section 01 6200 for definitions of Categories:
 - a) Milwaukee:
 - (1) Model BB-SCS02 threaded ends with tamper switch **one inch (25 mm)** to **2 inches (50 mm)**.
 - (2) Model BBVSCS02 Grooved ends with tamper switch **2 inches (50 mm)** to **2-1/2 inch (64 mm)**.
 - b) Nibco:
 - (1) Model WD3510-8 Wafer type with valve tamper switch.
 - (2) Model GD4765-8N Grooved type with valve tamper switch, **2-1/2 inches (64 mm)** to **8 inches (200 mm)**.
 - c) Tyco (Grinnell):
 - (1) Model BFV-N wafer.
 - (2) Model BFV-N grooved.
 - d) Victaulic: Series 705W Grooved end type with internal supv. switches.
 - e) Kennedy:
 - (1) Model 01W wafer.
 - (2) Model G300 grooved.
 - b. Gate Valves:
 - 1) Design Criteria:
 - a) UL / CASA approved.
 - b) Outside Screw and Yoke Type (O.S.&Y).
 - c) Class 150 psi.
 - 2) Category Four Approved Products: See Section 01 6200 for definitions of Categories:
 - a) Nibco:
 - (1) T-104-0 with Threaded Ends **1/2 inch (12.7 mm)** to **2 inches (50 mm)**.
 - (2) F-637-31 Flanged Ends.
 - b) Mueller: R-2360-6 Flanged Ends.
 - c) Victaulic: Series 771 Grooved Ends
 - c. Ball Valves:
 - 1) Design Criteria:
 - a) UL / CASA approved.
 - b) Valve tamper switch.
 - 2) Category Four Approved Products: See Section 01 6200 for definitions of Categories:
 - a) Milwaukee: BB-SCS02 with threaded ends.
 - b) Nibco: KT-505 with threaded ends.
 - c) Nibco: KG-505 with grooved ends.
 - d) Victaulic: Series 728 with grooved or threaded ends.
 - d. Swing Check Valves:
 - 1) **1/2 to 3 inch (13 to 75 mm)** horizontal check.
 - a) Design Criteria:
 - (1) Regrinding type.

- (2) Renewable disk.
 - (3) Bronze Class 125 with threaded ends.
 - b) Category Four Approved Products: See Section 01 6200 for definitions of Categories:
 - (1) Nibco: KT-403-W.
 - (2) Victaulic: Series 712.
 - (3) Viking: G-1 Grooved ends.
 - 2) 2 to 4 inch (50 to 100 mm) Horizontal check:
 - a) Design Criteria:
 - (1) Grooved ends.
 - (2) Ductile iron body.
 - (3) Rated 300 psi (2.07 MPa).
 - b) Category Four Approved Products: See Section 01 6200 for definitions of Categories:
 - (1) Tyco (Grinnell): CV-1F Grooved ends.
 - (2) Victaulic: Series 712.
 - (3) Viking: G-1 Grooved ends.
 - 3) 3 to 12 inch (76 to 300 mm) Horizontal check:
 - a) Design Criteria:
 - (1) Bolted bonnet.
 - (2) Raised face flanges.
 - (3) Bronze mounted with ductile iron body.
 - (4) 125 lb (56.7 kg) Class A.
 - b) Category Four Approved Products: See Section 01 6200 for definitions of Categories:
 - (1) Nibco: F-938-31.
 - (2) Mueller: A-2120-6.
 - (3) Viking: F-1 grooved and flanged.
- e. Wafer Type Check Valves:
 - 1) Design Criteria:
 - a) 4 to 8 inch (100 to 300 mm) cast iron body.
 - b) 175 psi (1.21 MPa) minimum working pressure.
 - c) Rubber Seat.
 - 2) Category Four Approved Products: See Section 01 6200 for definitions of Categories:
 - a) Nibco: KW-900-W.
 - b) Mueller: A-2102.
 - c) Kennedy: Fig.706.
- f. Grooved-End Check Valves:
 - 1) Design Criteria:
 - a) UL / CASA listed and approved to 250 psi (1.72 MPa) maximum operating pressure.
 - b) 2-1/2 to 12 inch (64 to 300 mm) ductile iron body.
 - c) Disc And Seat:
 - (1) 2-1/2 And 3 Inch (64 to 75 mm): Aluminum bronze disc with mounted elastomer seal and PPS (polyphenylene sulfide) coated seat.
 - (2) 4 Inch (100 mm) And Larger: Elastomer encapsulated ductile iron disc with welded in nickel seat.
 - (3) Viking: Model VK462.
 - 2) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - a) Nibco: KG-900-W grooved ends.
 - b) Victaulic: Series 717.
 - c) Kennedy: Fig.426.
- g. Alarm Check Valves:
 - 1) Category Four Approved Products: See Section 01 6200 for definitions of Categories:
 - a) Reliable: E with gauges and drain.
 - b) Tyco (Grinnell): Model AV-1-300.
 - c) Victaulic: Series 751 with gauges and drain.
 - d) Viking: J-1 with gauges and drain.
- h. Backflow Preventer: Make and model shown on Drawings or as required by local codes.
- i. Retard Chamber:
 - 1) Design Criteria:
 - a) Self-draining.
 - 2) Category Four Approved Products: See Section 01 6200 for definitions of Categories:

- a) Reliable: E-1.
 - b) Victaulic: Series 752.
 - c) Viking: C-1.
 - j. Inspector's Test Valve:
 - 1) Design Criteria:
 - a) Bronze body with threaded or grooved ends.
 - b) Combination sight glass / orifice.
 - 2) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - a) Tyco (Grinnell): Model F350.
 - b) Victaulic: Testmaster Alarm Test Module Style 720.
5. Sprinkler Heads:
- a. Concealed Pendant:
 - 1) Design Criteria:
 - a) Adjustable cover.
 - b) UL / CASA listed and approved.
 - c) Coordinate concealed cover finish with Architect.
 - 2) Type One Acceptable Products:
 - a) Wet Pendant, Flat Profile:
 - (1) Reliable: F4FR.
 - (2) Victaulic: Model 3802.
 - (3) Viking: Model VK462.
 - (4) Tyco (Grinnell): Model RF11.
 - (5) Equal as approved by Architect before bidding. See Section 01 6200.
 - b) Dry Pendant:
 - (1) Flat Profile:
 - (a) Tyco (Grinnell): DS-C.
 - (b) Victaulic: V3618.
 - (2) Equal as approved by Architect before bidding. See Section 01 6200.
 - b. Horizontal Sidewall Sprinkler:
 - 1) Design Criteria:
 - a) UL / CASA listed and approved.
 - b) Recess adjustable.
 - c) Where guards are required, use chrome plated sprinkler guards that are listed, that are approved by Sprinkler Manufacturer for use with head, and that are supplied by Sprinkler Manufacturer.
 - 2) Type One Acceptable Products:
 - a) Wet System:
 - (1) Reliable: F1FR.
 - (2) Tyco (Grinnell): Model TY-FRB.
 - (3) Victaulic: Model V2710.
 - (4) Viking: VK305.
 - (5) Equal as approved by Architect before bidding. See Section 01 6200.
 - b) Dry System:
 - (1) Reliable: F3QR.
 - (2) Tyco (Grinnell): DS-1.
 - (3) Victaulic: Model V3610.
 - (4) Viking: VK162.
 - (5) Equal as approved by Architect before bidding. See Section 01 6200.
 - c. Attic Sprinklers, Upright:
 - 1) Design Criteria:
 - a) UL / CASA listed and approved.
 - b) Approved for use in roof structures, combustible and non-combustible, with ceiling below.
 - 2) Category Four Approved Products: See Section 01 6200 for definitions of Categories:
 - a) Tyco: BB, SD, or HIP.
 - d. Pendant Sprinklers:
 - 1) Design Criteria:
 - a) UL / CASA listed and approved.

- b) Where guards or escutcheons are required, use chrome plated sprinkler guards and escutcheons that are listed, that are approved by Sprinkler Manufacturer for use with head, and that are supplied by Sprinkler Manufacturer.
 - 2) Type One Acceptable Products:
 - a) Reliable: F1FR.
 - b) Tyco: TY-FRB.
 - c) Victaulic: Model V2704.
 - d) Viking: VK302.
 - e) Equal as approved by Architect before bidding. See Section 01 6200.
 - e. Upright Sprinklers:
 - 1) Design Criteria:
 - a) UL / CASA listed and approved.
 - 2) Type One Acceptable Products:
 - a) Reliable: F1FR.
 - b) Tyco: TY-FRB.
 - c) Victaulic: Models V2704.
 - d) Viking: VK300.
 - e) Equal as approved by Architect before bidding. See Section 01 6200.
6. Water Flow Alarm:
 - a. Electric Flow Alarm:
 - 1) Design Criteria:
 - a) UL / CASA listed and approved.
 - 2) Category Four Approved Products: See Section 01 6200 for definitions of Categories:
 - a) Potter Electric: Horn Strobe, SASH-120, 120VAC.
 - b) System Sensor: Horn Strobe, P2RHK-120, 120 VAC.
7. Waterflow Detectors:
 - a. Electrical Water Flow Switch:
 - 1) Design Criteria:
 - a) UL / CASA listed.
 - b) Switch activates with flow of 10 gpm (37.85 lpm) or more.
 - c) Two single pole double throw switches.
 - d) Automatic reset.
 - 2) Category Four Approved Products: See Section 01 6200 for definitions of Categories:
 - a) Potter-Roemer: Model 6201 thru 6208.
 - b) System Sensor: WFD20 thru WFD80.
 - c) Viking: VSR-F.
8. Tamper Switch
 - a. Weather and Tamper Resistant Switch.
 - 1) Design Criteria:
 - a) UL / CASA listed.
 - b) Mount to monitor valve and not interfere with operation.
 - c) Shall operate in horizontal and vertical position.
 - 2) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - a) Control Valves, Butterfly Valves, Post Indicator Valves:
 - (1) Potter Electric: Model PCVS.
 - (2) Notifier: Model PIBV2.
 - (3) System Sensor: Model PIBV2.
 - b) O.S. & Y Valves:
 - (1) Potter Electric: Model OSYSU.
 - (2) System sensor: Model OSY2.
9. Automatic Drain Device:
 - a. Design Criteria:
 - 1) Straight Design, 3/4 inch: (19 mm).
 - b. Category Four Approved Products: See Section 01 6200 for definitions of Categories:
 - 1) Nibco: Ball-Drip.
 - 2) Potter-Roemer: Figure 5982.
 - 3) Viking: B-1.
10. Fire Department Connection:
 - a. One Way Inlet with 5" Stortzguard Cap:

- 1) Class One Quality Standards: See Section 01 6200:
 - a) Round 'AUTO SPKR' identification plate, red enamel finish aluminum plate:
 - (1) Croker: Fig 6766.
 - (2) Potter-Roemer Fig. 5966.
 - 2) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - a) Rough chrome plated:
 - (1) Croker: 6405-RC.
 - (2) Potter-Roemer: Fig. 5710-C.
 - b) Caps and Chains:
 - (1) Croker: 6747 RC.
 - (2) Potter-Roemer: 4625.
11. Indicating Post Valve:
 - a. Design Criteria:
 - 1) As specified in Section 33 1119: 'Fire Suppression Water Distribution Piping'.
 - 2) Prefer exposed parts non-brass, for theft protection.
 - 3) Supervisory switch.
 - b. Category Four Approved Products: See Section 01 6200 for definitions of Categories:
 - 1) As required by Authority Having Jurisdiction (AHJ).
12. Riser Manifold Assembly:
 - a. Design Criteria:
 - 1) Groove x Groove Manifold Body.
 - 2) Water Flow Alarm Switch, VSC with Vane, UL / CASA listed and approved.
 - 3) 300 psi (2.07 MPa) Water Pressure Gauge.
 - 4) Test and Drain Valve with Manifold Drain Trim and 1/2 inch (12.7 mm) diameter test Orifice.
 - 5) Pressure Relief Valve, 175 psi (1.21 MPa), non adjustable, pipe discharge to test Drain Valve.
 - b. Category Four Approved Products: See Section 01 6200 for definitions of Categories:
 - 1) Tyco: Model 513.
 - 2) Victaulic: Style 747P.

2.2 ACCESSORIES

A. Manufacturers:

1. Manufacturer Contact List:
 - a. Anvil International, Portsmouth, NH www.anvilintl.com.
 - b. Cooper B-Line, Highland, IL www.b-line.com.

B. Hangers, Rods, And Clamps:

1. Design Criteria:
 - a. Galvanized, unless specified otherwise, and UL / CASA approved for service intended.
2. Class One Quality Standard:
 - a. Hangers and accessories shall be Anvil numbers specified or equals by Cooper B-Line.
 - b. Pipe Ring Hangers: Equal to Anvil Fig 69.
 - c. Riser Clamps: Equal to Anvil Fig. 261.

C. Posted System Diagram:

1. Provide single, color-coded floor plan diagram showing total system. Color antifreeze pipe system elements BLUE and wet pipe system elements RED. Indicate locations of antifreeze system drains and sample test station.
2. Include following information on diagram sheet:
 - a. Explanation of how to test an antifreeze system.
 - b. Step by step shut down procedure.
 - c. Step by step system drainage procedure.
 - d. Step by step start-up procedure.
 - e. Step by step procedure for protection of system from freezing.
3. Laminate diagram with plastic and mat or frame suitable for hanging near riser.

D. Steel Deck Bracket:

1. Class Two Quality Standard: See Section 01 6200.

- a. Unistrut P1000 with clamp nut, minimum 6 inch (150 mm) length.

PART 3 - EXECUTION

3.1 INSTALLERS

- A. Acceptable Installers. See Section 01 4301:
 1. Meet Quality Assurance Installer Qualifications as specified in Part 1 of this specification.

3.2 EXAMINATION

- A. Drawings:
 1. Fire Protection Drawings show general arrangement of piping. Follow as closely as actual building construction and work of other trades will permit. Install system so it drains.
 2. Consider Architectural and Structural Drawings part of this work insofar as these drawings furnish information relating to design and construction of building. These Drawings take precedence over Fire Protection Drawings.
 3. Because of small scale of Drawings, it is not possible to indicate all offsets, fittings, and accessories that may be required. Investigate structural and finish conditions affecting this work and arrange work accordingly, providing such fittings, valves, and accessories required to meet conditions and to enable system to drain.

3.3 INSTALLATION

- A. Interface With Other Work: Provide inserts for attaching hangers in concrete floor construction at time floors are placed.
- B. Connect system to flange provided under Section 33 1119. After installation of riser, fill annular space between pipe and slab with flexible mastic.
- C. Install sprinkler systems in accordance with requirements of latest editions of NFPA 13 and as specified below:
 1. Provide maintenance access to equipment
 2. Conceal sprinkler lines installed in occupied areas. In Mezzanine areas, route pipe to side or underneath Mezzanine walkway. Do not impede egress from Attic.
 3. Install to enable drainage of system.
 - a. Install main drain from riser according to NFPA 13, paragraph 8.17.4.
 4. Install piping system, except for dry heads, so it will not be exposed to freezing temperatures.
 5. Do not use dropped, damaged, or used sprinkler heads.
 6. Install tamper switches and flow detectors where located by Architect.
 7. Except for Siamese connection, install automatic ball drip device in lowest point of piping to fire department connection and drain to floor drain or to exterior of building.
 8. Brace and support system to meet seismic zone requirements for building site.
 9. Inspector's Test and Drain to be placed in a location approved by the architect.
- D. Flush system at full design flow rate for minimum five minutes. Route water to outside of building. Protect landscaping and other exterior elements from damage during flow tests.

3.4 FIELD QUALITY CONTROL

- A. Field Tests:
 1. Pressure Test:

- a. Hydrostatically test system to **200 psi (1.38 MPa)** minimum for 2 hours as required by 'Contractor's Material And Testing certificate for Above Ground Piping' NFPA-13, Figure Figure 24.1 (2010 Edition).
 - b. If system or part of system is to have a glycol solution, hydrostatic test is to be performed using approved glycol solution. Do not hydrostatically test any section of system that is to be filled with a glycol solution with plain water.
2. Water Flow Test:
 - a. Test to determine static and residual pressures and corresponding flow rate at point of connection to utility water main.
 - b. Adjust water flow test data for seasonal fluctuations and future growth as recommended by Water Utility and AHJ.
 - c. At point of connection to utility water main, combine inside and outside hose stream allowances.
3. Check piping in relation to insulation envelope to be certain piping and auxiliary drains are properly enclosed inside building insulation envelope. Report unsatisfactory conditions to Architect.
4. Tests shall be witnessed by Architect and representative of local jurisdiction over fire prevention.

3.5 CLOSE-OUT ACTIVITIES

A. Instruction of Owner:

1. Instruction Sessions:
 - a. Instruct Owner's personnel in operation and maintenance of system utilizing 'Operation And Maintenance Manual' when so doing. Minimum instruction period shall be four (4) hours.
 - 1) Include antifreeze system requirement to be tested at least once a year.
 - b. Instruction sessions shall occur after Substantial Completion inspection when system is properly working and before final payment is made.
 - c. Provide Owner with latest version of NFPA 25.

B. Training:

1. Installer required to provide FM Training from latest version of NFPA 25 with checklist and brief explanation of following inspections:
 - a. Weekly Inspection.
 - b. Monthly Inspection.
 - c. Quarterly Inspection.
 - d. Semi-Annual Inspection.
 - e. Annual Inspection.

END OF SECTION

SECTION 22 00 00 - SUMMARY OF PLUMBING WORK

PART 1 - GENERAL

1.1 WORK COVERED BY CONTRACT DOCUMENTS

- A. The following Summary of Work is intended as an aid to achieve an understanding of the various elements of work included in the project, as is not intended to be all-inclusive. Detailed descriptions of work and requirements are given in drawings and specifications.
- B. Plumbing Contract Documents were prepared for the Project by:

Trinity MEP Engineering, LLC
3533 Moreland Dr. Ste. A
Weslaco, Texas 78596
Phone Number: (956) 973-0500
Contact Person: Leonardo Munoz, P.E.

- C. General Scope of Work:

- 1. Install systems and equipment as shown on the contract documents. Refer to drawings for schedule of equipment that will be installed. After installing equipment, connect all water, sewer, and/or power to fixtures.
- 2. Provide all materials and labor associated with a complete operational installation of new systems including, but not limited to:
 - Fixtures for facility
 - Piping for Sanitary Sewer and Vent Systems
 - Piping for Domestic water and Hot Water Systems.

1.2 COORDINATION

- A. All plumbing work shall be done under sub-contract to a General Contractor. Plumbing Contractor shall coordinate all work through General Contractor, even in areas where only plumbing work is to take place.
- B. Coordination between all trades shall take place on a regular basis to avoid conflicts between disciplines and equipment clearances.
- C. Work shall take place with minimal disruption to Owner's operations in areas surrounding the new building.
- D. Cooperate fully with other contractors so that work under those contracts may be carried out smoothly, without interfering with or delaying work under this Contract.
- E. Fully coordinate with electrical contractor for providing power to plumbing equipment.

1.3 UTILITIES

- 1. Coordinate with power, water, telephone, cable and gas utilities to locate all utilities prior to digging in any area.
- 2. Obtain any approvals required from utilities to relocate utilities.
- 3. Cost of relocating or bypassing utilities indicated on drawings shall be included in Base Bid.

1.4 CONTRACTOR USE OF PREMISES

- A. Use of the Site: Limit use of the premises to work in areas indicated. Confine operations to areas within contract limits indicated. Do not disturb portions of the site beyond the areas in which the Work is indicated.
 - 1. Owner Occupancy: Allow for Owner occupancy and use by the public.
 - 2. Driveways and Entrances: Keep driveways and entrances serving the premises, clear and available to the Owner, the Owner's employees, and emergency vehicles at all time. Do not use these areas for parking or storage of materials. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
- B. Site Safety: Take every precaution to ensure the site does not present a threat to the safety of occupants and/or workers. Minimal safety requirements include, but are not limited to the following:
 - 1. Temporary fencing around construction areas.
 - 2. Yellow caution tape and construction barricades along open trenches during the day. Trenches shall be covered at night and warning lights provided on construction barricades.

3. Temporary fencing around equipment while site work is in progress.

1.5 SUBMITTALS

1. All equipment and fixtures shall be provided with a submittal.
2. To expedite the submittal process more efficiently, DO NOT piece-meal the submittals. Submit entire plumbing or in a bound enclosure. This will eliminate delays in the submittal process.

END OF SECTION

SECTION 22 05 00 - COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 SUMMARY

- A. Includes But Not Limited To:
 - 1. Common requirements and procedures for plumbing systems.
 - 2. Responsibility for proper operation of electrically powered equipment furnished under this Division.
 - 3. Furnish and install sealants relating to installation of systems installed under this Division.
 - 4. Furnish and install Firestop Penetration Systems for plumbing systems penetrations as described in Contract Documents.
- B. Products Furnished But Not Installed Under This Section:
 - 1. Sleeves, inserts, supports, and equipment for plumbing systems installed under other Sections.

1.2 SUBMITTALS

- A. Action Submittals:
 - 1. Product Data:
 - a. Manufacturer's catalog data for each manufactured item.
 - 1) Provide section in submittal for each type of item of equipment. Include Manufacturer's catalog data of each manufactured item and enough information to show compliance with Contract Document requirements. Literature shall show capacities and size of equipment used and be marked indicating each specific item with applicable data underlined.
 - 2) Include name, address, and phone number of each supplier.
- B. Informational Submittals:
 - 1. Qualification Statement:
 - a. Plumbing Subcontractor:
 - 1) Provide Qualification documentation if requested by Architect or Owner.
 - b. Installer:
 - 1) Provide Qualification documentation if requested by Architect or Owner.
- C. Closeout Submittals:
 - 1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
 - a. Operations and Maintenance Data (Modify and add to requirements of Section 01 7800):
 - 1) At beginning of PLUMBING section of Operations And Maintenance Manual, provide master index showing items included:
 - a) Provide name, address, and phone number of Architect, Architect's Mechanical Engineer, General Contractor, and Plumbing subcontractor.
 - b) Identify maintenance instructions by using same equipment identification used in Contract Drawings. Maintenance instructions shall include:
 - (1) List of plumbing equipment used indicating name, model, serial number, and nameplate data of each item together with number and name associated with each system item.
 - (2) Manufacturer's maintenance instructions for each piece of plumbing equipment installed in Project. Instructions shall include name of vendor, installation instructions, parts numbers and lists, operation instructions of equipment, and maintenance instructions.
 - c) Provide operating instructions to include:
 - (1) General description of fire protection system.

- (2) Step by step procedure to follow for shutting down system or putting system into operation.

b. Warranty Documentation:

- 1) Include copies of warranties required in individual Sections of Division 22.

1.3 QUALITY ASSURANCE

A. Regulatory Agency Sustainability Approvals:

1. Perform work in accordance with applicable provisions of Plumbing Codes applicable to Project. Provide materials and labor necessary to comply with rules, regulations, and ordinances.
2. In case of differences between building codes, laws, local ordinances, utility company regulations, and Contract Documents, the most stringent shall govern. Notify Architect in writing of such differences before performing work affected by such differences.
3. Identification:
 - a. Motor and equipment name plates as well as applicable UL / ULC and AGA / CGA labels shall be in place when Project is turned over to Owner.

B. Qualifications.

1. Plumbing Subcontractor:
 - a. Company specializing in performing work of this section.
 - 1) Minimum five (5) years experience in plumbing installations.
 - 2) Minimum five (5) satisfactorily completed installations in past three (3) years of projects similar in size, scope, and complexity required for this project before bidding.
 - b. Upon request, submit documentation.
2. Installer:
 - a. Licensed for area of Project.
 - b. Designate one (1) individual as project foremen who shall be on site at all times during installation and experienced with installation procedures required for this project.
 - c. Upon request, submit documentation.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Delivery And Acceptance Requirements:

1. Accept valves on site in shipping containers with labeling in place.
2. Provide temporary protective coating on cast iron and steel valves.
3. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

B. Storage And Handling Requirements:

1. In addition to requirements specified within, stored material shall be readily accessible for inspection by Architect/engineer until installed.
2. Store items subject to moisture damage in dry, heated spaces.

1.5 WARRANTY

A. Manufacturer Warranty:

1. Provide certificates of warranty for each piece of equipment made out in favor of Owner.

B. Special Warranty:

1. Guarantee plumbing systems to be free from noise in operation that may develop from failure to construct system in accordance with Contract Documents.
2. If plumbing sub-contractor with offices located more than 150 miles (240 km) from Project site is used, provide service / warranty work agreement for warranty period with local plumbing sub-contractor approved by Architect. Include copy of service / warranty agreement in warranty section of Operation And Maintenance Manual.

PART 2 - PRODUCTS

2.1 COMPONENTS

- A. Components shall bear Manufacturer's name and trade name. Equipment and materials of same general type shall be of same make throughout work to provide uniform appearance, operation, and maintenance.
- B. Pipe And Pipe Fittings:
1. Weld-O-Let and Screw-O-Let fittings are acceptable.

2. Use domestic made pipe and pipe fittings on Project, except non-domestic made cast iron pipe and fittings by MATCO-NORCA are acceptable.

C. Sleeves:

1. General:

- a. Two sizes larger than bare pipe or insulation on insulated pipe.

2. In Concrete And Masonry:

- a. Sleeves through outside walls, interior shear walls, and footings shall be schedule 80 black steel pipe with welded plate.

3. In Framing And Suspended Floor Slabs:

- a. Standard weight galvanized iron pipe, Schedule 40 PVC, or 14 ga (2 mm) galvanized sheet metal.

D. Valves:

1. Valves of same type shall be of same manufacturer.

PART 3 - EXECUTION

3.1 INSTALLERS

A. Acceptable Installers:

3.2 Meet Quality Assurance Installer Qualifications as specified in Part 1 of this specification.

3.3 EXAMINATION

A. Drawings:

1. Plumbing Drawings show general arrangement of piping, equipment, etc. Follow as closely as actual building construction and work of other trades will permit.
2. Consider Architectural and Structural Drawings part of this work insofar as these drawings furnish information relating to design and construction of building. These drawings take precedence over Plumbing Drawings.
3. Because of small scale of Drawings, it is not possible to indicate all offsets, fittings, and accessories that may be required. Investigate structural and finish conditions affecting this work and arrange work accordingly, providing such fittings, valves, and accessories required to meet conditions.

B. Verification Of Conditions:

1. Examine premises to understand conditions that may affect performance of work of this Division before submitting proposals for this work. Examine adjoining work on which plumbing work is dependent for efficiency and report work that requires correction.
2. Ensure that items to be furnished fit space available. Make necessary field measurements to ascertain space requirements including those for connections and furnish and install equipment of size and shape so final installation shall suit true intent and meaning of Contract Documents. If approval is received by Addendum or Change Order to use other than originally specified items, be responsible for specified capacities and for ensuring that items to be furnished will fit space available.
3. Check that slots and openings provided under other Divisions through floors, walls, ceilings, and roofs are properly located. Perform cutting and patching caused by neglecting to coordinate with Divisions providing slots and openings at no additional cost to Owner.

3.4 No subsequent allowance for time or money will be considered for any consequence related to failure to examine site conditions.

3.5 PREPARATION

A. Demolition Requirements:

B. Changes Due To Equipment Selection:

1. Where equipment specified or otherwise approved requires different arrangement or connections from that shown in Contract Documents, submit drawings showing proposed installations.
2. If proposed changes are approved, install equipment to operate properly and in harmony with intent of Contract Documents. Make incidental changes in piping, ductwork, supports, installation, wiring, heaters, panelboards, and as otherwise necessary.
3. Provide additional motors, valves, controllers, fittings, and other equipment required for proper operation of systems resulting from selection of equipment.
4. Be responsible for proper location of rough-in and connections provided under other Divisions.

3.6 INSTALLATION

A. Interface With Other Work:

1. Furnish exact location of electrical connections and complete information on motor controls to installer of electrical system.
2. Furnish sleeves, inserts, supports, and equipment that are to be installed by others in sufficient time to be incorporated into construction as work proceeds. Locate these items and confirm that they are properly installed.
3. Furnish inserts for attaching hangers that are to be cast in concrete floor construction at time floors are poured.

B. Cut carefully to minimize necessity for repairs to previously installed or existing work. Do not cut beams, columns, or trusses.

C. Locating Equipment:

1. Arrange pipes and equipment to permit ready access to valves, cocks, unions, traps, and to clear openings of doors and access panels.
2. Adjust locations of pipes, equipment, and fixtures to accommodate work to interferences anticipated and encountered.
3. Install plumbing work to permit removal of equipment and parts of equipment requiring periodic replacement or maintenance without damage to or interference with other parts of equipment or structure.
4. Determine exact route and location of each pipe before fabrication.
 - a. Right-Of-Way:
 - 1) Lines that pitch shall have right-of-way over those that do not pitch. For example, plumbing drains shall normally have right-of-way.
 - 2) Lines whose elevations cannot be changed shall have right-of-way over lines whose elevations can be changed.
 - b. Offsets, Transitions, and Changes in Direction:
 - 1) Make offsets, transitions, and changes in direction in pipes as required to maintain proper head room and pitch of sloping lines whether or not indicated on Drawings.
 - 2) Furnish and install all traps, air vents, sanitary vents, and devices as required to effect these offsets, transitions, and changes in direction.

D. Penetration Firestops:

1. Install Penetration Firestop System appropriate for penetration at plumbing systems penetrations through walls, ceilings, roofs, and top plates of walls.

E. Sealants:

1. Seal openings through building exterior caused by penetrations of elements of plumbing systems.
2. Furnish and install acoustical sealant to seal penetrations through acoustically insulated walls and ceilings.

F. Furnish and install complete system of piping, valved as indicated or as necessary to completely control entire apparatus:

1. Pipe drawings are diagrammatic and indicate general location and connections. Piping may have to be offset, lowered, or raised as required or directed at site. This does not relieve this Division from responsibility for proper installation of plumbing systems.
2. Arrange piping to not interfere with removal of other equipment, ducts, or devices, or block access to doors, windows, or access openings:
 - a. Arrange so as to facilitate removal of tube bundles.
 - b. Provide accessible flanges or ground joint unions, as applicable for type of piping specified, at connections to equipment and on bypasses.
 - 1) Make connections of dissimilar metals with di-electric unions.
 - 2) Install valves and unions ahead of traps and strainers. Provide unions on both sides of traps.
 - c. Do not use reducing bushings, bull head tees, close nipples, or running couplings. Street elbows are allowed only on potable water pipe $\frac{3}{4}$ inch (19 mm) in diameter and smaller.
 - d. Install piping systems so they may be easily drained
 - e. Install piping to insure noiseless circulation.
 - f. Place valves and specialties to permit easy operation and access. Valves shall be regulated, packed, and glands adjusted at completion of work before final acceptance.

3. Do not install piping in shear walls.
4. Cut piping accurately to measurements established at site. Remove burr and cutting slag from pipes.
5. Work piping into place without springing or forcing. Make piping connections to pumps and other equipment without strain at piping connection. Remove bolts in flanged connections or disconnect piping to demonstrate that piping has been so connected, if requested.
6. Make changes in direction with proper fittings.
7. Expansion of Thermoplastic Pipe:
 - a. Provide for expansion in every 30 feet of straight run.
 - b. Provide 12 inch offset below roof line in each vent line penetrating roof.
8. Expansion of PEX Pipe: Allow for expansion and contraction of PEX pipe as recommended by Pipe Manufacturer.

G. Sleeves:

1. Do not place sleeves around soil, waste, vent, or roof drain lines passing through concrete slabs on grade (unless noted on plans).
2. Provide sleeves around pipes passing through concrete or masonry floors, walls, partitions, or structural members. Seal sleeves with specified sealants. Follow Pipe Manufacturer's recommendations for PEX pipe (if used) penetrations through studs and floor slabs.
3. Sleeves through floors shall extend 1/4 inch above floor finish in mechanical equipment rooms above basement floor. In other rooms, sleeves shall be flush with floor.
4. Sleeves through floors and foundation walls shall be watertight.

H. Escutcheons:

1. Provide spring clamp plates where pipes run through walls, floors, or ceilings and are exposed in finished locations of building. Plates shall be chrome plated heavy brass of plain pattern and shall be set tight on pipe and to building surface.

3.7 REPAIR / RESTORATION

- A. Each Section of this Division shall bear expense of cutting, patching, repairing, and replacing of work of other Sections required because of its fault, error, tardiness, or because of damage done by it:
1. Patch and repair walls, floors, ceilings, and roofs with materials of same quality and appearance as adjacent surfaces unless otherwise shown.
 2. Surface finishes shall exactly match existing finishes of same materials.

3.8 FIELD QUALITY CONTROL

A. Field Tests:

1. Perform tests on plumbing piping systems. Furnish devices required for testing purposes.

B. Non-Conforming Work:

1. Replace material or workmanship proven defective with sound material at no additional cost to Owner.
2. Repeat tests on new material, if requested.

3.9 CLEANING

A. Remove dirt, grease, and other foreign matter from each length of piping before installation:

1. After each section of piping used for movement of water or steam is installed, flush with clean water, except where specified otherwise.
2. Arrange temporary flushing connections for each section of piping and arrange for flushing total piping system.
3. Provide temporary cross connections and water supply for flushing and drainage and remove after completion of work.

B. Clean exposed piping, equipment, and fixtures. Remove stickers from fixtures and adjust flush valves.

3.10 CLOSEOUT ACTIVITIES

A. Instruction of Owner:

1. Instruct building maintenance personnel in operation and maintenance of plumbing systems utilizing Operation And Maintenance Manual when so doing.
2. Conduct instruction period after Substantial Completion inspection when systems are properly working and before final payment is made.

3.11 PROTECTION

- A. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system. Cap or plug open ends of pipes and equipment to keep dirt and other foreign materials out of system. Do not use plugs of rags, wool, cotton waste, or similar materials.

END OF SECTION

SECTION 22 05 29 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Includes But Not Limited To:
 - 1. Common hanger and support requirements and procedures for plumbing systems.
- B. Products Installed But Not Furnished Under This Section:
 - 1. Paint identification for gas piping used in HVAC equipment.

1.2 SUBMITTALS

- A. Action Submittals:
 - 1. Product Data:
 - a. Manufacturer's catalog data for each manufactured item.

PART 2 - PRODUCTS

2.1 ASSEMBLIES

- A. Manufacturers:
 - 1. Manufacturer Contact List:
 - a. Anvil International,
 - b. Cooper B-Line,
 - c. Unistrut, Wayne,
- B. Materials:
 - 1. Hangers, Rods, And Inserts
 - a. Galvanized and UL approved for service intended.
 - b. Support horizontal piping from hangers or on roller assemblies with channel supports, except where trapeze type hangers are explicitly shown on Drawings. Hangers shall have double nuts.
 - 1) Support insulated pipes **2 inches** in diameter and smaller with adjustable swivel ring hanger with insulation protection shield. Gauge and length of shield shall be in accordance with Anvil design data.
 - 2) Type Two Acceptable Products:
 - (1) Swivel Ring Hanger: Anvil Fig. 69.
 - (2) Insulation Protection Shield: Anvil Fig. 167.
 - (3) Equals by Cooper B-Line.
 - 3) Support insulated pipes **2-1/2 inches** in diameter and larger with clevis hanger or roller assembly with an insulation protection shield. Gauge and length of shield shall be according to Anvil design data.
 - a) Type Two Acceptable Products:
 - (1) Clevis Hanger: Anvil Fig. 260.
 - (2) Roller Assembly: Anvil Fig. 171.
 - (3) Insulation Protection Shield: Anvil Fig. 167.
 - (4) Equals by Cooper B-Line.
 - 4) Support uninsulated copper pipe **2 inches** in diameter and smaller from swivel ring hanger, copper plated and otherwise fully suitable for use with copper tubing. Support non-copper uninsulated pipes from swivel ring hanger.
 - a) Type Two Acceptable Products:
 - (1) Swivel Ring Hanger For Copper Pipe: Anvil Fig. CT-69.
 - (2) Swivel Ring Hanger For Other Pipe: Anvil Fig. 69.
 - (3) Equals by Cooper B-Line.
 - 5) Support uninsulated copper pipe **2-1/2 inches** in diameter and larger from clevis hanger, copper plated hangers and otherwise fully suitable for use with copper tubing. Support non-copper uninsulated pipes from clevis hanger.
 - a) Type Two Acceptable Products:
 - (1) Clevis Hanger For Copper Pipe: Anvil Fig. CT-65.
 - (2) Clevis Hanger For Other Pipe: Anvil Fig. 260.
 - (3) Equals by Cooper B-Line.

- c. Support rods for single pipe shall be in accordance with following table:

Rod Diameter	Pipe Size
3/8 inch	2 inches and smaller
1/2 inch	2-1/2 to 3-1/2 inches
5/8 inch	4 to 5 inches
3/4 inch	6 inches
7/8 inch	8 to 12 inches

- d. Support rods for multiple pipe supported on steel angle trapeze hangers shall be in accordance with following table:

Rods		Number of Pipes per Hanger for Each Pipe Size						
Number	Diameter	2 Inch	2.5 Inch	3 Inch	4 Inch	5 Inch	6 Inch	8 Inch
2	3/8 Inch	Two	0	0	0	0	0	0
2	1/2 Inch	Three	Three	Two	0	0	0	0
2	5/8 Inch	Six	Four	Three	Two	0	0	0
2	5/8 Inch	Nine	Seven	Five	Three	Two	Two	0
2	5/8 Inch	Twelve	Nine	Seven	Five	Three	Two	Two

- 1) Size trapeze angles so bending stress is less than 10,000 psi
- e. Riser Clamps For Vertical Piping:
 - 1) Type Two Acceptable Products:
 - a) Anvil Fig. 261.
 - b) Equals by Cooper B-Line.
- f. Concrete Inserts:
 - 1) Individual Inserts:
 - a) Suitable for special nuts size 3/8 inch through 7/8 inch with yoke to receive concrete reinforcing rods, and with malleable iron lugs for attaching to forms.
 - b) Type Two Acceptable Products:
 - (1) Anvil Fig. 282.
 - (2) Equals by Cooper B-Line.
 - 2) Continuous Inserts:
 - a) Class Two Quality Standard: Equal to Unistrut P-3200 series.
- g. Steel Deck Bracket:
 - 1) Class Two Quality Standard: Equal to Unistrut P1000 with clamp nut, minimum 6 inch length.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Interface With Other Work: If project contains concrete structural system.
 1. Furnish inserts for attaching hangers that are to be cast in concrete floor construction at time floors are poured.
- B. Piping:
 1. Properly support piping and make adequate provisions for expansion, contraction, slope, and anchorage.
 - a. Except for underground pipe, suspend piping from roof trusses or clamp to vertical walls using Unistrut and clamps. Do not hang pipe from other pipe, equipment, or ductwork. Laying of piping on any building element is not allowed.
 - b. Supports For Horizontal Piping:
 - 1) Support metal piping at 96 inches on center maximum for pipe 1-1/4 inches or larger and 72 inches on center maximum for pipe 1-1/8 inch or less.
 - 2) Support thermoplastic pipe at 48 inches on center maximum.
 - 3) Support PEX pipe at 32 inches minimum on center.

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

- 4) Provide support at each elbow. Install additional support as required.
- c. Supports for Vertical Piping:
 - 1) Place riser clamps at each floor or ceiling level.
 - 2) Securely support clamps by structural members, which in turn are supported directly from building structure.
 - 3) Provide clamps as necessary to brace pipe to wall.
- d. If Structural concrete systems are used: Install supports from inserts cast into concrete floor system, including concrete joists and floor slabs. Where inserts cannot be used, provide expansion shields and support hangers from angles held in place by expansion bolts, never directly from expansion bolt itself. Provide calculations necessary to determine number of expansion bolts required to equal capacity of cast-in-place insert.
- e. Attach Unistrut to structural steel roof supporting structure. Spacing and support as described above.
- f. Insulate hangers for copper pipe from piping by means of at least two layers of Scotch 33 plastic tape.
- 2. Gas piping Identification:
 - a. Apply paint identification for gas piping used with HVAC equipment as specified in Section 23 0553.

END OF SECTION

SECTION 22 05 53 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:

1. Furnish and install identification of plumbing piping and equipment as described in Contract Documents.

PART 2 - PRODUCTS

2.1 SYSTEM

A. Materials:

1. Labels:

a. Equipment Identification:

- 1) Black formica, with white reveal when engraved.
- 2) Lettering to be 3/16 inch high minimum.

2. Paint:

a. One Coat Primer:

- 1) 6-2 Quick Drying Latex Primer Sealer over fabric covers.
- 2) 6-205 Metal Primer under dark color paint.
- 3) 6-6 Metal Primer under light color paint.

b. Finish Coats: Two coats 53 Line Acrylic Enamel.

c. Type Two Acceptable Products.

- 1) Paint of equal quality from following Manufacturers may be submitted for Architect's approval before use.
Maintain specified colors, shades, and contrasts.
 - a) Benjamin Moore,
 - b) ICI Dulux,
 - c) Sherwin Williams,

PART 3 - EXECUTION

3.1 APPLICATION

A. Labels:

1. Identify following items with specified labels fastened to equipment with screws (unless noted otherwise):
2. Water Heaters.
3. Engrave following data from Equipment Schedules on Drawings onto labels:
 - a. Equipment mark.
 - b. Room(s) served.
 - c. Panel and breaker from which unit is powered.

B. Painting:

1. Only painted legends, directional arrows, and color bands are acceptable.
2. Locate identifying legends, directional arrows, and color bands at following points on exposed piping of each piping system:
 - a. Adjacent to each item of equipment.
 - b. At point of entry and exit where piping goes through wall.
 - c. On each riser and junction.
 - d. Every 25 feet on long continuous lines.
 - e. Stenciled symbols shall be one inch high and black.

3.2 ATTACHMENTS

A. Schedules:

1. Pipe Identification Schedule:

a. Apply stenciled symbols as follows:

Pipe Use	Abbreviation
Domestic Cold Water	CW
Domestic Hot Water	HW

END OF SECTION

SECTION 22 07 19 - PLUMBING PIPING INSULATION

PART1- GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:

1. Furnish and install insulation on hot and cold water lines, fittings, valves, and accessories as described in Contract Documents.
2. Furnish and install insulation on roof drain piping as described in Contract Documents.

B. Related Requirements:

1. Section 22 1116: 'Domestic Water Piping'.
2. Section 22 1400: 'Facility Storm Drainage'.(if provided on plans)

1.2 SUBMITTALS

A. Informational Submittals:

1. Identify thermal conductivity, thickness, and jackets (both factory and field applied, if any), for each type of product indicated.

1.3 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: As determined by testing materials identical to those specified in this Section according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and sealer and cement material containers with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread rating of 25 or less, and smoke-developed rating of 50 or less.
2. Insulation Installed Outdoors: Flame-spread rating of 75 or less, and smoke-developed rating of 150 or less.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Ship insulation materials in containers marked by manufacturer with appropriate ASTM specification designation, type and grade, and maximum use temperature.

Service Water Temperature	Pipe Sizes		
	Up to 1-1/4 In	1-1/2 to 2 In	Over 2 In
170 - 180 Deg F	One In	1-1/2 In	2 In
140 - 160 Deg F	1/2 In	One In	1-1/2 In
45 - 130 Deg F	1/2 In	1/2 In	One In

1.5 COORDINATION

- A. Coordinate size and location of supports, hangers, and insulation shields specified Section "Hangers and Supports."
- B. Coordinate clearance requirements with piping Installer for insulation application.
- C. Coordinate installation and testing of steam or electric heat tracing.

1.6 SCHEDULING

- A. Schedule insulation application after testing piping systems and, where required, after installing and testing heat-trace tape. Insulation application may begin on segments of piping that have satisfactory test results.

PART 2 - PRODUCTS

2.1 COMPONENTS

A. Manufacturers:

1. Manufacturer Contact List:

- a. Armacell, Mebane, NC www.armacell.com.
- b. Childers Products Co, Eastlake, OH www.fosterproducts.com.
- c. IMCOA, Youngsville, NC www.nomacokflex.com.
- d. Johns-Manville, Denver, CO www.jm.com.
- e. Knauf, Shelbyville, IN www.knauffiberglass.com.
- f. Manson, Brossard, PQ, Canada www.isolationmanson.com.
- g. Nomaco Inc, Yopungville, NC www.nomacokflex.com.

- h. Owens-Corning, Toledo, OH www.owenscorning.com.
- i. Speedline Corp, Solon, OH www.speedlinepvc.com.
- j. CertainTeed Manson.
- k. Knauf FiberGlass GmbH.
- l. Owens-Corning Fiberglas Corp.
- m. Schuller International, Inc.
- n. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.
- o. Armstrong World Industries, Inc.
- p. Rubatex Corp.

B. Materials:

1. Above Grade Metal Piping:

a. Insulation For Piping:

- 1) Snap-on glass fiber or melamine foam pipe insulation, or heavy density pipe insulation with factory vapor jacket.
- 2) Insulation Thickness:
- 3) Performance Standards: Fiberglas ASJ by Owens-Corning.
- 4) Type One Acceptable Manufacturers:
 - a) Childers Products.
 - b) Knauf.
 - c) Manson.
 - d) Owens-Corning.
 - e) Johns-Manville.
 - f) Equal as approved by Architect before bidding. See Section 01 6200.

b. Fitting, Valve, And Accessory Covers:

- 1) PVC.
- 2) Performance Standard: Zeston by Johns-Manville.
- 3) Type One Acceptable Manufacturers:
 - a) Knauf.
 - b) Speedline.
 - c) Johns-Manville.
 - d) Equal as approved by Architect before bidding. See Section 01 6200.

2. Below Grade Metal Piping:

a. Insulation:

- 1) **1/2 inch (13 mm)** thick.
- 2) Category Four Acceptable Products. See Section 01 6200 for definition of Categories:
 - a) SS Tubolit by Armacell.
 - b) ImcoLock by Imcoa.
 - c) Nomalock or Therma-Cel by Nomaco.

b. Joint Sealant:

- 1) Category Four Acceptable Products. See Section 01 6200 for definition of Categories:
 - a) Armacell 520.
 - b) Nomaco K-Flex R-373.

3. Pex Piping, Above And Below Grade:

a. Insulation:

- 1) **1/2 inch (13 mm)** thick.
- 2) Category Four Acceptable Products. See Section 01 6200 for definition of Categories:
 - a) SS Tubolit
 - b) by Armacell.
 - c) ImcoLock by Imcoa.
 - d) Nomalock or Therma-Cel by Nomaco.

b. Joint Sealant:

- 1) Category Four Acceptable Products. See Section 01 6200 for definition of Categories:
 - a) Armacell 520.
 - b) Nomaco K-Flex R-373.
 - c)
4. PP-R Piping, Above And Below Grade:
 - a. Insulation:
 - 1) 1/2 inch (13 mm) thick.
 - 2) Category Four Acceptable Products. See Section 01 6200 for definition of Categories:
 - a) SS Tubolit by Armacell.
 - b) ImcoLock by Imcoa.
 - c) Nomalock or Therma-Cel by Nomaco.
 - b. Joint Sealant:
 - 1) Category Four Acceptable Products. See Section 01 6200 for definition of Categories:
 - a) Armacell 520.
 - b) Nomaco K-Flex R-373.
5. PVC or ABS Piping, Above And Below Grade - Facility Storm Drain:
 - a. Insulation:
 - 1) 1/2 inch (13 mm) thick.
 - 2) Category Four Acceptable Products. See Section 01 6200 for definition of Categories:
 - a) SS Tubolit by Armacell.
 - b) ImcoLock by Imcoa.
 - c) Nomalock or Therma-Cel by Nomaco.
 - b. Joint Sealant:
 - 1) Category Four Acceptable Products. See Section 01 6200 for definition of Categories:
 - a) Armacell 520.
 - b) Nomaco K-Flex R-373.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Above Grade Piping:
 1. Apply insulation to clean, dry piping with joints tightly butted.
 2. Install insulation in manner to facilitate removal for repairs. Place sections or blocks so least possible damage to insulation will result from inspection or repairs of piping or equipment.
 3. Piping up to 1-1/4 inch Diameter:
 - a. Adhere 'factory applied vapor barrier jacket lap' smoothly and securely at longitudinal laps with white vapor barrier adhesive.
 - b. Adhere 3 inch wide self-sealing butt joint strips over end joints.
 4. Piping 1-1/2 inches Diameter And Larger:
 - a. Use broken-joint construction in application of two-layer covering.
 - b. Fill cracks and depressions with insulating cement mixed to thick plastic paste.
 - 1) Apply by hand in several layers to make up total specified thickness.
 - 2) Final layer shall have smooth uniform finish before application of covering.
 5. Fittings, Valves, And Accessories:
 - a. Do not apply insulation over flanged joints or victaulic couplings until piping has been brought up to operating temperature and flange bolts have been fully tightened. Insulate valves so wheel, stem, and packing nut are exposed.
 - b. Insulate with same type and thickness of insulation as pipe, with ends of insulation tucked snugly into throat of fitting and edges adjacent to pipe insulation tufted and tucked in.
 - c. Piping Up To 1-1/4 Inch Diameter:
 - 1) Cover insulation with one piece fitting cover secured by stapling or taping ends to adjacent pipe covering.
 - 2) Alternate Method:

- a) Insulate fittings, valves, and accessories with one inch of insulating cement and vapor seal with two **1/8 inch** wet coats of vapor barrier mastic reinforced with glass fabric extending **2 inches** onto adjacent insulation.
- d. Piping **1-1/2 inches To 2 Inches** :
 - 1) Insulate with hydraulic setting insulating cement or equal, to thickness equal to adjoining pipe insulation.
 - 2) Apply final coat of fitting mastic over insulating cement.
- e. Piping **2-1/2 inch And Larger**:
 - 1) Insulate with segments of molded insulation securely wired in place and coated with skim coat of insulating cement.
 - 2) Apply fitting mastic, fitting tape and finish with final coat of fitting mastic.
- 6. Pipe Hangers:
 - a. Do not allow pipes to come in contact with hangers.
 - b. Pipe Shield:
 - 1) Provide schedule 40 PVC by **6 inch** long at each clevis and/or unistrut type hanger.
 - 2) Provide **16 ga** by **6 inch** long galvanized shields at each pipe hanger to protect pipe insulation from crushing by clevis hanger.
 - 3) Provide **22 ga** by **6 inch** long galvanized shield at each pipe hanger to protect insulation from crushing by Unistrut type hanger.
 - c. At Pipe Hangers:
 - 1) Provide rigid calcium silicate insulation (**100 psi** compressive strength) at least **2 inches** beyond shield.
- 7. Protect insulation wherever leak from valve stem or other source might drip on insulated surface, with aluminum cover or shield rolled up at edges and sufficiently large in area and of shape that dripping will not splash on surrounding insulation.
- B. Below Grade Piping:
 - 1. Slip underground pipe insulation onto pipe and seal butt joints.
 - 2. Where slip-on technique is not possible, slit insulation, apply to pipe, and seal seams and joints.

3.2 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 PREPARATION

- A. Surface Preparation: Clean and dry pipe and fitting surfaces. Remove materials that will adversely affect insulation application.

3.4 GENERAL APPLICATION REQUIREMENTS

- A. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.
- B. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each piping system.
- C. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Apply insulation with longitudinal seams at top and bottom of horizontal pipe runs.
- E. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- F. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.
- G. Keep insulation materials dry during application and finishing.
- H. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.
- I. Apply insulation with the least number of joints practical.
- J. Apply insulation over fittings, valves, and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated. Refer to special instructions for applying insulation over fittings, valves, and specialties.
- K. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic.

1. Apply insulation continuously through hangers and around anchor attachments. Insulation around hanger or pipe clamp will not be acceptable.
2. For insulation application where vapor retarders are indicated, extend insulation on anchor legs at least 12 inches (300 mm) from point of attachment to pipe and taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
3. Install insert materials and apply insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by the insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect the jacket from tear or puncture by the hanger, support, and shield.
- L. Insulation Terminations: For insulation application where vapor retarders are indicated, taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
- M. Apply adhesives and mastics at the manufacturer's recommended coverage rate.
- N. Apply insulation with integral jackets as follows:
 1. Pull jacket tight and smooth.
 2. Circumferential Joints: Cover with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip and spaced 4 inches (100 mm) o.c.
 3. Longitudinal Seams: Overlap jacket seams at least 1-1/2 inches (40 mm). Apply insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches (100 mm) o.c.
 - a. Exception: Do not staple longitudinal laps on insulation having a vapor retarder.
 4. Vapor-Retarder Mastics: Where vapor retarders are indicated, apply mastic on seams and joints and at ends adjacent to flanges, unions, valves, and fittings.
 5. At penetrations in jackets for thermometers and pressure gages, fill and seal voids with vapor-retarder mastic.
- O. Roof Penetrations: Apply insulation for interior applications to a point even with top of roof flashing.
 1. Seal penetrations with vapor-retarder mastic.
 2. Apply insulation for exterior applications tightly joined to interior insulation ends.
 3. Extend metal jacket of exterior insulation outside roof flashing at least 2 inches (50 mm) below top of roof flashing.
 4. Seal metal jacket to roof flashing with vapor-retarder mastic.
- P. Exterior Wall Penetrations: For penetrations of below-grade exterior walls, terminate insulation flush with mechanical sleeve seal. Seal terminations with vapor-retarder mastic.
- Q. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and floors.
- R. Fire-Rated Wall and Partition Penetrations: Apply insulation continuously through penetrations of fire-rated walls and partitions.
 1. Firestopping and fire-resistive joint sealers are specified in Section "Firestopping."

3.5 MINERAL-FIBER INSULATION APPLICATION

- A. Apply insulation to straight pipes and tubes as follows:
 1. Secure each layer of preformed pipe insulation to pipe with wire, tape, or bands without deforming insulation materials.
 2. Where vapor retarders are indicated, seal longitudinal seams and end joints with vapor-retarder mastic. Apply vapor retarder to ends of insulation at intervals of 15 to 20 feet (4.5 to 6 m) to form a vapor retarder between pipe insulation segments.
 3. For insulation with factory-applied jackets, secure laps with outward clinched staples at 6 inches (150 mm) o.c.
 4. For insulation with factory-applied jackets with vapor retarders, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by the insulation material manufacturer and seal with vapor-retarder mastic.

3.6 Apply insulation to flanges as follows:

1. Apply preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation segment the same as overall width of the flange and bolts, plus twice the thickness of the pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.

4. Apply canvas jacket material with manufacturer's recommended adhesive, overlapping seams at least 1 inch (25 mm), and seal joints with vapor-retarder mastic.
- B. Apply insulation to fittings and elbows as follows:
 1. Apply premolded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
 2. When premolded insulation elbows and fittings are not available, apply mitered sections of pipe insulation, or glass-fiber blanket insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire, tape, or bands.
 3. Cover fittings with standard PVC fitting covers.
- C. Apply insulation to valves and specialties as follows:
 1. Apply premolded segments of cellular-glass insulation or glass-fiber blanket insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. For check valves, arrange insulation for access to strainer basket without disturbing insulation.
 2. Apply insulation to flanges as specified for flange insulation application.
 3. Use preformed standard PVC fitting covers for valve sizes where available. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-retarder mastic.
 4. For larger sizes where PVC fitting covers are not available, seal insulation with canvas jacket and sealing compound recommended by the insulation material manufacturer.

3.7 CLOSED-CELL PHENOLIC-FOAM INSULATION APPLICATION

- A. Apply insulation to straight pipes and tubes as follows:
 1. Secure each layer of insulation to pipe with wire, tape, or bands without deforming insulation materials.
 2. Where vapor retarders are indicated, seal longitudinal seams and end joints with vapor-retarder mastic.
 3. For insulation with factory-applied jackets, secure laps with outward clinched staples at 6 inches o.c.
 4. For insulation with factory-applied jackets with vapor retarders, do not staple longitudinal tabs but secure with additional adhesive as recommended by the insulation material manufacturer and seal with vapor-retarder mastic.
- B. Apply insulation to flanges as follows:
 1. Apply preformed pipe insulation to outer diameter of pipe flange.
 2. Make width of insulation segment the same as overall width of the flange and bolts, plus twice the thickness of the pipe insulation.
 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of block insulation of the same thickness as pipe insulation.
 4. Apply canvas jacket material with manufacturer's recommended adhesive, overlapping seams at least 1 inch (25 mm), and seal joints with vapor-retarder mastic.
- C. Apply insulation to fittings and elbows as follows:
 1. Apply premolded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
 2. When premolded sections of insulation are not available, apply mitered sections of phenolic-foam insulation. Secure insulation materials with wire, tape, or bands.
 3. Cover fittings with heavy PVC fitting covers. Overlap PVC covers on pipe insulation jackets at least 1 inch (25 mm) at each end. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-retarder mastic.
- D. Apply insulation to valves and specialties as follows:
 1. Apply premolded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
 2. When premolded sections of insulation are not available, apply mitered sections of phenolic-foam insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. For check valves, arrange insulation for access to strainer basket without disturbing insulation.
 3. Apply insulation to flanges as specified for flange insulation application.
 4. Use preformed heavy PVC fitting covers for valve sizes where available. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-retarder mastic.

5. For larger sizes where PVC fitting covers are not available, seal insulation with canvas jacket and sealing compound recommended by the insulation material manufacturer.

3.8 FLEXIBLE ELASTOMERIC THERMAL INSULATION APPLICATION

- A. Apply insulation to straight pipes and tubes as follows:
 1. Follow manufacturer's written instructions for applying insulation.
 2. Seal longitudinal seams and end joints with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.
- B. Apply insulation to flanges as follows:
 1. Apply pipe insulation to outer diameter of pipe flange.
 2. Make width of insulation segment the same as overall width of the flange and bolts, plus twice the thickness of the pipe insulation.
 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of the same thickness as pipe insulation.
 4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.
- C. Apply insulation to fittings and elbows as follows:
 1. Apply mitered sections of pipe insulation.
 2. Secure insulation materials and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.
- D. Apply insulation to valves and specialties as follows:
 1. Apply preformed valve covers manufactured of the same material as pipe insulation and attached according to the manufacturer's written instructions.
 2. Apply cut segments of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. For check valves, fabricate removable sections of insulation arranged to allow access to stainer basket.
 3. Apply insulation to flanges as specified for flange insulation application.
 4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.

3.9 FIELD-APPLIED JACKET APPLICATION

- A. Apply glass-cloth jacket, where indicated, directly over bare insulation or insulation with factory-applied jackets.
 1. Apply jacket smooth and tight to surface with 2-inch (50-mm) overlap at seams and joints.
 2. Embed glass cloth between two 0.062-inch- (1.6-mm-) thick coats of jacket manufacturer's recommended adhesive.
 3. Completely encapsulate insulation with jacket, leaving no exposed raw insulation.
- B. Foil and Paper Jackets: Apply foil and paper jackets where indicated.
 1. Draw jacket material smooth and tight.
 2. Apply lap or joint strips with the same material as jacket.
 3. Secure jacket to insulation with manufacturer's recommended adhesive.
 4. Apply jackets with 1-1/2-inch (40-mm) laps at longitudinal seams and 3-inch- (75-mm-) wide joint strips at end joints.
 5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-retarder mastic.
- C. Apply metal jacket where indicated, with 2-inch (50-mm) overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches (300 mm) o.c. and at end joints.

3.10 PIPING SYSTEM APPLICATIONS

- A. Insulation materials and thicknesses are specified in schedules at the end of this Section.
- B. Items Not Insulated: Unless otherwise indicated, do not apply insulation to the following systems, materials, and equipment:
 1. Flexible connectors.
 2. Fire-suppression piping.
 3. Drainage piping located in crawl spaces, unless otherwise indicated.

4. Below-grade piping, unless otherwise indicated.
5. Chrome-plated pipes and fittings, unless potential for personnel injury.
6. Air chambers, unions, strainers, check valves, plug valves, and flow regulators.

3.11 INTERIOR INSULATION APPLICATION SCHEDULE

- A. Service: Domestic water piping.
 1. Operating Temperature: 60 to 80 deg F
 2. Insulation Material: Mineral Fiber
 3. Insulation Thickness: 1" thick.
 4. Field-Applied Jacket: Foil and Paper(ASJ)
 5. Vapor Retarder Required: Yes.
 6. Finish: None.
- B. Service: Domestic hot and recirculated hot water.
 1. Operating Temperature: 60 to 140 deg F (15 to 60 deg C).
 2. Insulation Material: Mineral fiber
 3. Insulation Thickness: 1" thick
 4. Field-Applied Jacket: Foil and Paper(ASJ)
 5. Vapor Retarder Required: No
 6. Finish: None.
- C. Service: Condensate and equipment drain piping.
 1. Operating Temperature: 40 to 60 deg F
 2. Insulation Material: Flexible elastomeric, only on first ten feet of pipe from trap.
 3. Insulation Thickness: 3/4"
 4. Field-Applied Jacket: None.
 5. Vapor Retarder Required: No.
 6. Finish: Two coats of the insulation manufacturer's recommended protective coating.
- D. Service: Refrigerant suction and hot-gas piping.
 1. Operating Temperature: 35 to 50 deg F
 2. Insulation Material: Flexible elastomeric.
 3. Insulation Thickness: 1" thick.
 4. Field-Applied Jacket: Aluminum Jacket on building exterior application only.
 5. Vapor Retarder Required: Yes.
 6. Finish: None.
- E. Service: For obtaining fire/smoke rating in return air plenum (calbes, PE, PB, PP, ABS, PVC, CPVC, etc).
 1. Operating Temperature: 35 to 90 deg F
 2. Insulation Material: 3M Fire Barrier Plenum Wrap 5 A or equal.
 3. Insulation Thickness: larger of 1" or mfr's recommendations.
 4. Field-Applied Jacket: scrim reinforced foil
 5. Vapor Retarder Required: None.
 6. Finish: None.

3.12 EXTERIOR INSULATION APPLICATION SCHEDULE

- A. Service: Domestic water.
 1. Operating Temperature: 60 to 140 deg F (15 to 60 deg C).
 2. Insulation Material: Mineral fiber.
 3. Insulation Thickness: Apply the following insulation thicknesses: 1"
 4. Field-Applied Jacket: Aluminum.
 5. Vapor Retarder Required: Yes.
 6. Finish: None.
- B. Service: Refrigerant suction.
 1. Operating Temperature: 35 to 50 deg F (2 to 10 deg C).
 2. Insulation Material: Flexible elastomeric.

3. Insulation Thickness: Apply the following insulation thicknesses: ½"
4. Field-Applied Jacket: Aluminum
5. Vapor Retarder Required: Yes.
6. Finish: None.

END OF SECTION

SECTION 22 11 16 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Includes But Not Limited To:
 - 1. Perform excavating and backfilling required by work of this Section.
 - 2. Furnish and install potable water piping complete with necessary valves, connections, and accessories inside building and connect with outside utility lines **5 feet** from building perimeter as described in Contract Documents.

1.2 PERFORMANCE REQUIREMENTS

- A. Provide components and installation capable of producing domestic water piping systems with the following minimum working-pressure ratings, unless otherwise indicated:
 - 1. Domestic Water Distribution Piping: 125 psig..

1.3 SUBMITTALS

- A. Action Submittals:
 - 1. Product Data: For pipe, tube, fittings, and couplings.
 - 2. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
- B. Informational Submittals:
 - 1. Test And Evaluation Reports:
 - b. Written report of sterilization test.
- C. Shop Drawings:
 - b. Piping Layout:
 - 1) Provide as-built drawings at end of project.

1.4 QUALITY ASSURANCE

- A. Regulatory Agency Sustainability Approvals:
 - 1. Meet NSF International Standards for materials or products that come into contact with drinking water, drinking water treatment chemicals, or both for chemical contaminants and impurities that are indirectly imparted to drinking water from products, components, and materials used in drinking water systems.
 - 2. California only: California Assembly Bill 1953 (AB1953) Compliant for Lead Free.
- B. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- C. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic, potable domestic water piping and components.
- D. Comply with NSF 61, "Drinking Water System Components-Health Effects; Sections 1 through 9," for potable domestic water piping and components.

PART 2 - PRODUCTS

2.1 SYSTEMS

A. Manufacturers:

1. Manufacturer Contact List:

- b. Aquatherm, Inc.,
- c. Cash Acme,
- d. Cla-Val Company,
- e. Conbraco Industries Inc,
- f. Hammond Valve,
- g. Handy & Harmon Products Div,
- h. Honeywell Inc,
- i. Leonard Valve Co,
- j. Milwaukee Valve Co,
- k. Nibco Inc,
- l. Rehau,
- m. Sloan Valve Co,
- n. Spence Engineering Co,
- o. Symmons Industries, Braintree,
- p. Uponor Inc,
- q. Viega ProPress, Wic
- r. Watts Regulator Co,
- s. Wilkins (Zurn Wilkins),
- t. Zurn PEX, Inc.

B. Materials:

1. Design Criteria:

- b. All drinking water products, components, and materials above and below grade used in drinking water systems must meet NSF International Standards for Lead Free.
- c. No CPVC allowed.

2. Pipe:

b. Copper:

3) Above-Grade:

- a) Meet requirements of ASTM B88, Type K & L.
- b) Hard Copper Tube: ASTM B 88, Types K and L, water tube, drawn tempered.
- c) Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
- d) Bronze Flanges: ASME B16.24, Class 150, with solder-joint end. Furnish Class 300 flanges if required to match piping.
- e) Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends.
- f) Copper, Grooved-End Fittings: ASTM B 75 (ASTM B 75M) copper tube or ASTM B 584 bronze castings.
- g) Copper-Tubing, Keyed Couplings: Copper-tube dimensions and design similar to AWWA C606. Include ferrous housing sections, gasket suitable for hot water, and bolts and nuts.

4) Below-Grade:

- a) Meet requirements of ASTM B88, Type K. **3/4 inch** minimum under slabs.
- b) **2 inches** And Smaller: Annealed soft drawn.
- c) **2-1/2 inches** And Larger: Hard Drawn.

- 5) Fittings:
 - a) For Copper Pipe: Wrought copper.
- 3. Connections For Copper Pipe:
 - b. Above-Grade:
 - 3) Sweat copper type with 95/5 or 96/4 Tin-Antimony solder, Bridgit solder, or Silvabrite 100 solder. Use only lead-free solder.
 - 4) Viega ProPress System
 - c. Below Grade:
 - 3) Brazed using following type rods:
 - a) Copper to Copper Connections:
 - 2) AWS Classification BCuP-4 Copper Phosphorus (6 percent silver).
 - 3) AWS Classification BCuP-5 Copper Phosphorus (15 percent silver).
 - 4) Copper to Brass or Copper to Steel Connections: AWS Classification BAg-5 Silver (45 percent silver).
 - 5) Do not use rods containing Cadmium.
 - 6) Brazing Flux:
 - a) Approved Products:
 - 1) Stay-Silv white brazing flux by Harris Product Group.
 - 2) High quality silver solder flux by Handy & Harmon.
 - 7) Joints under slabs acceptable only if allowed by local codes.
- 4. Ball Valves:
 - b. Use ball valves exclusively unless otherwise specified. Ball valves shall be by single manufacturer from approved list below.
 - c. Valves shall be two-piece, full port for 150 psi SWP.
 - 3) Operate with flow in either direction, suitable for throttling and tight shut-off.
 - 4) Body: Bronze, 150 psig wsp at 350 deg F and 400 psig wog.
 - 5) Seat: Bubble tight at 100 psig under water.
 - d. Class One Quality Standard: Nibco T585 or S585.
 - 3) Equal by Conbraco 'Apollo,' Hammond, Milwaukee, or Watts.
- 5. Combination Pressure Reducing Valve / Strainer:
 - b. Integral stainless steel strainer, or separate 'Y' strainer installed upstream of pressure reducing valve.
 - c. Built-in thermal expansion bypass check valve.
 - d. Class One Quality Standard: Watts LFU5B:
 - 3) Equal by Cash Acme, Cla-Val Hi Capacity, Conbraco 36C, Honeywell-Braukmann, Spence Hi Capacity, Watts, or Wilkins. See Section 01 6200.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Below Grade:
 - 1. Install piping under slabs without joints where possible.
 - 2. Insulate water piping buried within building perimeter.
 - 3. Bury water piping 6 inches minimum below bottom of slab and encase in 2 inches minimum of sand.
- B. Locate cold water lines a minimum of 6 inches from hot water line.

3.2 FIELD QUALITY CONTROL

- A. Field Tests:
 - 1. Before pipes are covered, test systems in presence of Architect/Engineer at 125 psig hydrostatic pressure for four (4) hours and show no leaks.

2. Disconnect equipment not suitable for 125 psig pressure from piping system during test period.

3.3 ADJUSTING

- A. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
 1. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide flow of hot water in each branch.
 2. Adjust calibrated balancing valves to flows indicated.

3.4 CLEANING

- A. Clean and disinfect potable domestic water piping as follows:
 1. Purge new piping and parts of existing domestic water piping that have been altered, extended, or repaired before using.
 2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction or, if methods are not prescribed, procedures described in either AWWA C651 or AWWA C652 or as described below:
 - b. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - c. Fill and isolate system according to either of the following:
 - 3) Fill system or part thereof with water/chlorine solution with at least 50 ppm (50 mg/L) of chlorine. Isolate with valves and allow to stand for 24 hours.
 - 4) Fill system or part thereof with water/chlorine solution with at least 200 ppm (200 mg/L) of chlorine. Isolate and allow to stand for three hours.
 - d. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
 - e. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- B. Prepare and submit reports of purging and disinfecting activities.
- C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.
- D. Water system will not be accepted until negative bacteriological test is made on water taken from system. Repeat dosing as necessary until such negative test is accomplished.

END OF SECTION

SECTION 22 11 19 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Includes But Not Limited To:
 - 1. Balancing valves.
 - 2. Washer-supply outlets.
 - 3. Key-operation hydrants.
 - 4. Trap seal primer valves.
 - 5. Drain valves.
 - 6. Miscellaneous piping specialties.
 - 7. Sleeve penetration systems.
 - 8. Flashing materials.

1.2 QUALITY ASSURANCE

- A. Regulatory Agency Sustainability Approvals:
 - 1. Meet NSF International Standards for materials or products that come into contact with drinking water, drinking water treatment chemicals, or both for chemical contaminants and impurities that are indirectly imparted to drinking water from products, components, and materials used in drinking water systems.

PART 2 - PRODUCTS

2.1 BALANCING VALVES

- A. Calibrated Balancing Valves: Adjustable, with two readout ports and memory setting indicator. Include manufacturer's standard hoses, fittings, valves, differential pressure meter, and carrying case.
- B. Manufacturers:
 - 1. Armstrong Pumps, Inc.
 - 2. Flow Design, Inc.
 - 3. ITT Industries; Bell & Gossett Div.
 - 4. Taco, Inc.
 - 5. Watts Industries, Inc.; Water Products Div.
 - 6. 2" and Smaller: Bronze body with brass ball, adjustment knob, calibrated nameplate, and threaded or solder-joint ends.
 - 7. 2" and Smaller: Bronze, Y-pattern body with adjustment knob and threaded ends.
 - 8. 2.5" and Larger: Cast-iron, Y-pattern body with bronze disc and flanged or grooved ends.
- C. B. Memory-Stop Balancing Valves, NPS 2 (DN 50) and smaller: MSS SP-110, ball valve, rated for 400-psig (2760-kPa) minimum CWP. Include two-piece, copper-alloy body with full-port, chrome-plated brass ball, replaceable seats and seals, threaded or solder-joint ends, and vinyl-covered steel handle with memory-stop device.
- D. Manufacturers:
 - 1. Conbraco Industries, Inc.
 - 2. Crane Co., Crane Valve Group; Crane Valves.
 - 3. Grinnell Corporation.
 - 4. NIBCO INC.
 - 5. Red-White Valve Corp.

2.2 STRAINERS

- A. Strainers: Y-pattern, unless otherwise indicated, and full size of connecting piping. Include ASTM A 666, Type 304, stainless-steel screens with 3/64-inch (1.2-mm) round perforations, unless otherwise indicated.
 - 1. Pressure Rating: 125-psig (860-kPa) minimum steam working pressure, unless otherwise indicated.
 - 2. NPS 2 (DN 50) and Smaller: Bronze body, with female threaded ends.

3. NPS 2-1/2 (DN 65) and Larger: Cast-iron body, with interior AWWA C550 or FDA-approved, epoxy coating and flanged ends.

2.3 OUTLET BOXES

- A. Manufacturers:
 1. Acorn Engineering Company.
 2. Gray, Guy Manufacturing Co., Inc.
 3. Symmons Industries, Inc.
- B. General: Recessed-mounting outlet boxes with supply fittings complying with ASME A112.18.1M. Include box with faceplate, services indicated for equipment connections, and wood-blocking reinforcement.
- C. Clothes Washer Outlet Boxes: With hot- and cold-water hose connections, drain, and the following:
 1. Box and Faceplate: [Stainless steel] [Enameled or epoxy-painted steel].
 2. Shutoff Fitting: Two hose bibbs.
 3. Supply Fittings: Two NPS 1/2 (DN 15) gate, globe, or ball valves and NPS 1/2 (DN 15) copper, water tubing.
 4. Drain: NPS 2 (DN 50) standpipe, P-trap, and direct waste connection to drainage piping.
 5. Inlet Hoses: Two ASTM D 3571, 60-inch- (1500-mm-) long, rubber household clothes washer inlet hoses with female hose-thread couplings.
 6. Drain Hose: One 48-inch- (1200-mm-) long, rubber household clothes washer drain hose with hooked end.
- D. Icemaker Outlet Boxes: With hose connection and the following:
 1. Box and Faceplate: Stainless steel.
 2. Shutoff Fitting: Hose bibb.
 3. Supply Fitting: NPS 1/2 (DN 15) gate, globe, or ball valve and NPS 1/2 (DN 15) copper, water tubing.

2.4 KEY-OPERATION HYDRANTS

- A. Manufacturers:
 1. Josam Co.
 2. Smith, Jay R. Mfg. Co.
 3. Woodford Manufacturing Co.
- B. General: ASME A112.21.3M, key-operation hydrant with pressure rating of 125 psig.
 1. Inlet: 3/4 " or NPS 1" threaded or solder joint.
 2. Outlet: ASME B1.20.7, garden-hose threads.
 3. Operating Keys: One with each key-operation hydrant.
- C. Moderate-Climate, Concealed-Outlet Wall Hydrants: ASSE 1019, self-drainable with flush-mounting box with cover, integral nonremovable hose-connection vacuum breaker, and concealed outlet.
 1. Classification: Type A, for automatic draining with hose removed or Type B, for automatic draining with hose removed or with hose attached and nozzle closed.
- D. Hot and Cold, Nonfreeze Concealed-Outlet Wall Hydrants: With deep flush-mounting box with cover; hot- and cold-water casings and operating rods to match wall thickness; concealed outlet; wall clamps; and factory- or field-installed, nonremovable and manual drain-type, hose-connection vacuum breaker complying with ASSE 1011.

2.5 ROOF HYDRANTS

- A. Design Criteria:
 1. Provide dual check backflow preventer.
 2. Non-freeze.
 3. Drain port - connect to drain

2.6 TRAP SEAL PRIMER VALVES

- A. Supply-Type Trap Seal Primer Valves: ASSE 1018, water-supply-fed type, with the following characteristics:
- B. Manufacturers:
 1. Josam Co.
 2. MIFAB Manufacturing, Inc.
 3. Precision Plumbing Products, Inc.
 4. Smith, Jay R. Mfg. Co.
 5. 125-psig (860-kPa) minimum working pressure.

6. Bronze body with atmospheric-vented drain chamber.
7. Inlet and Outlet Connections: NPS 1/2 (DN 15) threaded, union, or solder joint.
8. Gravity Drain Outlet Connection: NPS 1/2 (DN 15) threaded or solder joint.
9. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

2.7 MISCELLANEOUS PIPING SPECIALTIES

- A. Water Hammer Arresters: ASSE 1010 or PDI-WH 201, metal-bellows type with pressurized metal cushioning chamber. Sizes indicated are based on ASSE 1010 or PDI-WH 201, Sizes A through F.
- B. Manufacturers:
 1. Josam Co.
 2. Smith, Jay R. Mfg. Co.
 3. Tyler Pipe; Wade Div.
 4. Zurn Industries, Inc.; Specification Drainage Operation.
- C. Hose Bibbs: Bronze body with replaceable seat disc complying with ASME A112.18.1M for compression-type faucets. Include NPS 1/2 or NPS 3/4 (DN 15 or DN 20) threaded or solder-joint inlet, of design suitable for pressure of at least 125 psig (860 kPa); integral [or field-installed,] nonremovable, drainable hose-connection vacuum breaker; and garden-hose threads complying with ASME B1.20.7 on outlet.
- D. Roof Flashing Assemblies: Manufactured assembly made of [4-lb/sq. ft. (20-kg/sq. m), 0.0625-inch- (1.6-mm-)] [6-lb/sq. ft. (30-kg/sq. m), 0.0938-inch- (2.4-mm-)] thick, lead flashing collar and skirt extending at least [6 inches (150 mm)] [8 inches (200 mm)] [10 inches (250 mm)] from pipe with galvanized steel boot reinforcement, and counterflashing fitting.
- E. Floor-Drain Inlet Fittings: Cast iron, with threaded inlet and threaded or spigot outlet, and trap seal primer valve connection.
- F. Fixed Air-Gap Fittings: Manufactured cast-iron or bronze drainage fitting with semiopen top with threads or device to secure drainage inlet piping in top and bottom spigot or threaded outlet larger than top inlet. Include design complying with ASME A112.1.2 that will provide fixed air gap between installed inlet and outlet piping.
- G. Stack Flashing Fittings: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
- H. Vent Caps: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and set-screws to secure to vent pipe.
- I. Vent Terminals: Commercially manufactured, shop- or field-fabricated, frost-proof assembly constructed of galvanized steel, copper, or lead-coated copper. Size to provide 1-inch (25-mm) enclosed air space between outside of pipe and inside of flashing collar extension, with counterflashing.
- J. Expansion Joints: ASME A112.21.2M, assembly with cast-iron body with bronze sleeve, packing gland, and packing; of size and end types corresponding to connected piping.

2.8 SLEEVE PENETRATION SYSTEMS

- A. Manufacturers:
 1. ProSet Systems, Inc.
- B. Description: UL 1479, through-penetration firestop assembly consisting of sleeve and stack fitting with firestopping plug.
 1. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
 2. Stack Fitting: ASTM A 48 (ASTM A 48M), gray-iron, hubless-pattern, wye-branch stack fitting with neoprene O-ring at base and gray-iron plug in thermal-release harness in branch. Include PVC protective cap for plug.
 3. Special Coating: Include corrosion-resistant interior coating on fittings for plastic chemical waste and vent stacks.

2.9 FLASHING MATERIALS

- A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:
 1. General Use: 4-lb/sq. ft. (20-kg/sq. m), 0.0625-inch (1.6-mm) thickness.
 2. Vent Pipe Flashing: 3-lb/sq. ft. (15-kg/sq. m), 0.0469-inch (1.2-mm) thickness.
 3. Burning: 6-lb/sq. ft. (30-kg/sq. m), 0.0938-inch (2.4-mm) thickness.

- B. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil (1.01-mm) minimum thickness.
- C. Fasteners: Metal compatible with material and substrate being fastened.
- D. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.
- E. Solder: ASTM B 32, lead-free alloy.
- F. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.
 - 1. Not required to meet NSF International Standards for Lead Free.
 - 2. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - 1) Jay R. Smith: 5907.
 - 2) Prier: P-RH2.
 - 3) Woodford: RHY2-MS.
 - 3. Water Hammer Arrestors:
 - 1. Design Criteria:
 - 1) Meet NSF International Standards for Lead Free.
 - 2) Nesting type, air pre-charged bellows with casing.
 - 3) Bellows constructed of stabilized 18-8 stainless steel.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install pressure regulators with inlet and outlet shutoff valves and balance valve bypass. Install pressure gages on inlet and outlet.
- B. Install strainers on supply side of each control valve, pressure regulator, and solenoid valve.
- C. Install trap seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.
- D. Install backwater valves in building drain piping. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.
- E. Install expansion joints on vertical risers, stacks, and conductors if indicated.

3.2 CONNECTIONS

- A. Install piping adjacent to equipment to allow service and maintenance.
- B. Ground equipment.
- 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 and UL 486B.
- D. Connect plumbing specialties and devices that require power.

3.3 FLASHING INSTALLATION

- A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
 - 1. Lead Sheets: Burn joints of lead sheets 6-lb/sq. ft. (30-kg/sq. m), 0.0938-inch (2.4-mm) thickness or thicker. Solder joints of lead sheets 4-lb/sq. ft. (20-kg/sq. m), 0.0625-inch (1.6-mm) thickness or thinner.
- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
 - 1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches (250 mm), and skirt or flange extending at least 8 inches (200 mm) around pipe.
 - 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around sleeve.
 - 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around specialty.
- C. Set flashing on floors and roofs in solid coating of bituminous cement.
- D. Secure flashing into sleeve and specialty clamping ring or device.
- E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to "Sheet Metal Flashing and Trim."
- F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled trap seal primer systems and their installation, including piping and electrical connections. Report results in writing.
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new units, and retest.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

END OF SECTION

SECTION 22 13 13 - FACILITY SANITARY SEWERS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:

1. Furnish and install soil, waste, and vent piping systems within building and connect with outside utility lines **5 feet** out from building where applicable.
2. Perform excavation and backfill required by work of this Section.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Pre-Cover Observation.

1. Contact Architect/Engineer prior to covering any section of pipe.
2. All piping all be under pressure during observation

1.3 REFERENCES

A. Reference Standards:

1. International Code Council:
 - a. ICC IPC-2012, 'International Plumbing Code'.

1.4 PERFORMANCE REQUIREMENTS

A. Provide components and installation capable of producing piping systems with the following minimum working-pressure ratings, unless otherwise indicated:

1. Soil, Waste, and Vent Piping: 10-foot head of water (30 kPa).

1.5 SUBMITTALS

- A. Product Data: For pipe, tube, fittings, and couplings.
- B. Shop Drawings: For solvent drainage system, include plans, elevations, sections, and details.
- C. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

1.6 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 PVC PIPING

- A. PVC Pipe: ASTM D 2665, solid-wall drain, waste, and vent.
 1. PVC Socket Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain, waste, and vent patterns.
- B. PVC Special Fittings: ASTM F 409, drainage-pattern tube and tubular fittings with ends as required for application.
- C. Plenum Vent Lines: In areas of building with a return air plenum.
 1. Approved Types:
 - a. Service weight, single-hub or no-hub type cast iron soil pipe meeting requirements of ASTM A74.
 - b. Vent lines **2-1/2 inches** or smaller may be Schedule 40 galvanized steel.
 - c. Joint Material:
 - 1) Single-Hub: Rubber gaskets meeting requirements of ASTM C564.
 - 2) No-Hub Pipe: Neoprene gaskets with stainless steel cinch bands.
 - d. Fittings:
 - e. Cast Iron Pipe: Hub and spigot, except fittings for no-hub pipe shall be no-hub, and meet requirements of ASTM A74.
 - 1) Joint Material: Rubber gaskets meeting requirements of ASTM C564.
 - 2) Galvanized Pipe: Screwed Durham tarred drainage type.

2.2 EXECUTION

2.3 PIPING INSTALLATION

- A. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.
- B. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight.
- C. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep ¼ bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8- bend fittings if 2 fixture are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- D. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- E. Re-verify building drainage piping slope before covering pipe in trench if left uncovered over a 24 hour period of subjected to exterior water. If slope of piping has changed, provide new shoring material to maintain original slope after trench has been covered.
- F. Install soil and waste drainage and vent piping at the code required minimum slopes, unless otherwise indicated:
- G. Install engineered soil and waste drainage and vent piping systems in locations indicated and as follows:
 - 1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
 - 2. Cast-Iron, Sovent, Single Stack: Comply with ASSE 1043 and sovent fitting manufacturer's written installation instructions.
 - 3. Reduced-Size Venting: Comply with standards of authorities having jurisdiction.
- H. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.
- I. Install PVC soil and waste drainage and vent piping according to ASTM D 2665.
- J. Install underground PVC soil and waste drainage piping according to ASTM D 2321.
- K. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

2.4 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect drainage and vent piping to the following:
 - 1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code. Refer to Section "Plumbing Fixtures."
 - 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
 - 3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
 - 4. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 (DN 65) and larger

2.5 FIELD QUALITY CONTROL

- A. Field Tests:
 - 1. Conduct tests for leaks and defective work. Notify Architect before testing.
 - 2. Thermoplastic Pipe System:
 - a. Before backfilling and compacting of trenches, Fill waste and vent system with water to roof level or 10 feet minimum, and show no leaks for two hours. Correct leaks and defective work.
 - b. After backfilling and compacting of trenches is complete but before placing floor slab, re-test as specified above. Uncover pipe and correct leaks and defective work. Re-backfill and compact and re-test.

- B. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- C. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- D. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- E. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 - 2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - 3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water (30 kPa). From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
 - 4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg (250 Pa). Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
 - 5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 - 6. Prepare reports for tests and required corrective action.

2.6 CLEANING

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION

SECTION 22 13 19 - SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Products Furnished But Not Installed Under this Section as described in Contract Documents.
 - 1. Cleanouts.
 - 2. Floor drains.

1.2 PERFORMANCE REQUIREMENTS

- A. Provide components and installation capable of producing piping systems with following minimum working-pressure ratings, unless otherwise indicated:
 - 1. Sanitary Waste and Vent Piping: 10-foot head of water.
 - 2. Storm Drainage Piping: 10-foot head of water.

1.3 SUBMITTALS

- A. Product Data: Include rated capacities and shipping, installed, and operating weights. Indicate materials, finishes, dimensions, required clearances, and methods of assembly of components; and piping and wiring connections for the following:
 - 1. Cleanouts, floor drains, and roof drains.
 - 2. Roof flashing assemblies.
 - 3. Grease interceptors(if applicable)
 - 4. Sleeve penetration systems.

PART 2 - PRODUCTS

2.1 SLEEVE PENETRATION SYSTEMS

- A. Manufacturers:
 - 1. ProSet Systems, Inc.
- B. Description: UL 1479, through-penetration firestop assembly consisting of sleeve and stack fitting with firestopping plug.
 - 1. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
 - 2. Stack Fitting: ASTM A 48 (ASTM A 48M), gray-iron, hubless-pattern, wye-branch stack fitting with neoprene O-ring at base and gray-iron plug in thermal-release harness in branch. Include PVC protective cap for plug.
 - a. Special Coating: Include corrosion-resistant interior coating on fittings for plastic chemical waste and vent stacks.

2.2 FLASHING MATERIALS

- A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:
 - 1. General Use: 4-lb/sq. ft. (20-kg/sq. m), 0.0625-inch (1.6-mm) thickness.
 - 2. Vent Pipe Flashing: 3-lb/sq. ft. (15-kg/sq. m), 0.0469-inch (1.2-mm) thickness.
 - 3. Burning: 6-lb/sq. ft. (30-kg/sq. m), 0.0938-inch (2.4-mm) thickness.
- B. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil (1.01-mm) minimum thickness.
- C. Fasteners: Metal compatible with material and substrate being fastened.
- D. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.
- E. Solder: ASTM B 32, lead-free alloy.
- F. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

2.3 CLEANOUTS

- A. Cleanouts: Comply with [ASME A112.36.2M] [ASME A112.3.1] <Insert other>.
 - 1. Application: [Floor cleanout] [Wall cleanout] [For installation in exposed piping].
 - 2. Products:

- a. Josam Co.
- b. Mifab
- c. Smith, Jay R. Mfg. Co.
- d. Tyler Pipe, Wade Div.
- e. Zurn Industries, Inc., Specification Drainage Operation.

2.4 FLOOR DRAINS

A. Floor Drains.

- 1. Products:
 - a. Josam Co.
 - b. Mifab
 - c. Smith, Jay R. Mfg. Co.
 - d. Tyler Pipe, Wade Div.
 - e. Zurn Industries, Inc.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install trap seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.
- B. Install backwater valves in building drain piping. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.
- C. Install expansion joints on vertical risers, stacks, and conductors if indicated.
- D. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
 - 1. Size same as drainage piping up to NPS 4 (DN 100). Use NPS 4 (DN 100) for larger drainage piping unless larger cleanout is indicated.
 - 2. Locate at each change in direction of piping greater than 45 degrees.
 - 3. Locate at minimum intervals of 50 feet (15 m) for piping NPS 4 (DN 100) and smaller and 100 feet (30 m) for larger piping.
 - 4. Locate at base of each vertical soil and waste stack.
- E. Install cleanout deck plates with top flush with finished floor, for floor cleanouts for piping below floors.
- F. Install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall, for cleanouts located in concealed piping.
- G. Install flashing flange and clamping device with each stack and cleanout passing through floors with waterproof membrane.
- H. Install vent flashing sleeves on stacks passing through roof. Secure over stack flashing according to manufacturer's written instructions.
- I. Install frost-proof vent caps on each vent pipe passing through roof. Maintain 1-inch (25-mm) clearance between vent pipe and roof substrate.
- J. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
 - 1. Position floor drains for easy access and maintenance.
 - 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
 - a. Radius, 30 Inches (750 mm) or Less: Equivalent to 1 percent slope, but not less than 1/4-inch (6.35-mm) total depression.
 - b. Radius, 30 to 60 Inches (750 to 1500 mm): Equivalent to 1 percent slope.
 - c. Radius, 60 Inches (1500 mm) or Larger: Equivalent to 1 percent slope, but not greater than 1-inch (25-mm) total depression.
 - 3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
 - 4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

- K. Install roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions.
 - 1. Install roof-drain flashing collar or flange so no leakage occurs between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
 - 2. Position roof drains for easy access and maintenance.
- L. Install interceptors, including trapping, venting, and flow-control fitting, according to authorities having jurisdiction and with clear space for servicing.
 - 1. Flush with In-Ground Installation: Set unit and extension, if required, with cover flush with finished grade.
 - 2. Install cleanout immediately downstream from interceptors not having integral cleanout on outlet.
- M. Fasten wall-hanging plumbing specialties securely to supports attached to building substrate if supports are specified and to building wall construction if no support is indicated.
- N. Fasten recessed-type plumbing specialties to reinforcement built into walls.
- O. Install wood-blocking reinforcement for wall-mounting and recessed-type plumbing specialties.
- P. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

3.2 CONNECTIONS

- A. Install piping adjacent to equipment to allow service and maintenance.
- B. Ground equipment.
- 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 and UL 486B.
- D. Connect plumbing specialties and devices that require power according to Division Sections.
- E. Interceptor Connections: Connect piping, flow-control fittings, and accessories.
 - 1. Grease Interceptors: Connect inlet and outlet to unit, and flow-control fitting and vent to unit inlet piping.

3.3 FLASHING INSTALLATION

- A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
 - 1. Lead Sheets: Burn joints of lead sheets 6-lb/sq. ft. (30-kg/sq. m), 0.0938-inch (2.4-mm) thickness or thicker. Solder joints of lead sheets 4-lb/sq. ft. (20-kg/sq. m), 0.0625-inch (1.6-mm) thickness or thinner.
- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
 - 1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches (250 mm), and skirt or flange extending at least 8 inches (200 mm) around pipe.
 - 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around sleeve.
 - 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around specialty.
- C. Set flashing on floors and roofs in solid coating of bituminous cement.
- D. Secure flashing into sleeve and specialty clamping ring or device.
- E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings.
- F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled trap seal primer systems and their installation, including piping and electrical connections. Report results in writing.
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new units, and retest.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.5 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION

SECTION 22 33 00 - ELECTRIC DOMESTIC WATER HEATERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Includes But Not Limited To:
 - 1. Furnish and install electric water heater as specified in Contract Documents.
- B. Related Requirements:
 - 1. Section 22 0501: 'Common Plumbing Requirements'.
 - 2. Section 22 1116: 'Domestic Water Piping'.

1.2 REFERENCES

- A. Reference Standard:
 - 1. NSF International Standard / American National Standards Institute:
 - a. NSF/ANSI 61-2012, 'Drinking Water System Components - Health Effects'.
 - b. NSF/ANSI 372-2011, 'Drinking Water System Components - Lead Content'.

B. SUBMITTALS

- C. Closeout Submittals:
 - 1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
 - a. Operations and Maintenance Data:
 - 1) Maintenance and operational instructions.
 - b. Warranty Documentation:
 - 1) Final, executed copy of Warranty.
 - c. Record Documentation:
 - 1) Manufacturers documentation:
 - a) Manufacturer's literature or cut sheet.

1.3 QUALITY ASSURANCE

- A. Regulatory Agency Sustainability Approvals:
 - 1. Meet NSF International Standards for materials or products that come into contact with drinking water, drinking water treatment chemicals, or both for chemical contaminants and impurities that are indirectly imparted to drinking water from products, components, and materials used in drinking water systems.
 - 2. California only: California Assembly Bill 1953 (AB1953) Compliant for Lead Free.

1.4 WARRANTY

- A. Special Warranty:
 - 1. Three-year non-prorated warranty on water heaters of 20 gallon capacity and larger.

PART 2 - PRODUCTS

2.1 ASSEMBLIES

- A. Manufacturers:
 - 1. Manufacturer Contact List:
 - a. A O Smith Water Products Co,
 - b. Bradford-White Corp, Ambler,.
 - c. Rheem / Ruud Water Heater Div
 - d. Ruud Manufacturing Co.,
 - e. State Industries Inc,
- B. Materials:
 - 1. Design Criteria:
 - a. All (wetted) drinking water products, components, and materials used in drinking water systems must meet NSF International Standards for Lead Free.
 - b. All water heaters require 'Tempered Water Temperature Control' (mixing valves) as specified in Section 22 1116.
 - 2. 30 Gallon to 50 Gallon Regular Height:
 - a. Glass lined storage tank pressure tested and rated for 125 psi (862 kPa) working pressure.

- b. Water heaters shall each have ASME rated temperature-pressure relief valve rated at MBH input of heater minimum set to relieve at 120 psi (827 kPa).
- c. 9 Kw.
- d. 3 inches (75 mm) minimum glass fiber or polyurethane foam insulation.
- e. Complete with two stage thermostat, magnesium anode, electric sheath rod type heating element, and high limit control.
- f. Heater shall be pre-wired and entire unit bear UL label.
- g. Manufactures
 - 1) American:
 - 2) A O Smith:
 - 3) Bradford White:
 - 4) Rheem
 - 5) State Industries: SB6-40.

2.2 ACCESSORIES

- A. Anchoring Components:
 - 1. One inch (25 mm) by 18 ga (1.2 mm) galvanized steel straps.
 - 2. No. 10 by 2-1/2 inch (64 mm) screws.
- B. Thermal Expansion Absorbers:
 - 1. Bladder type for use with potable water systems.
- C. Type One Acceptable Products.
 - a. Therm-X-Trol ST-12-C by Amtrol Inc, West Warwick, RI www.amtrol.com.
 - b. Equal as approved by Architect before bidding.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install temperature-pressure relief valve on hot water heater and pipe discharge to directly above funnel of floor drain.

3.2 ADJUSTING

- A. Set discharge water temperature at 140 deg F (60 deg C). Final hot water temperature shall be 110 deg F (43 deg C) after mixing valve. If no mixing valve set discharge temperature at 110 deg F (43 deg C).

END OF SECTION

SECTION 22 42 00 - COMMERCIAL PLUMBING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes plumbing fixtures and related components.

1.3 DEFINITIONS

- A. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.
- B. Fitting: Device that controls flow of water into or out of plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.

1.4 SUBMITTALS

- A. Product Data: Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports and indicate materials and finishes, dimensions, construction details, and flow-control rates for each type of fixture indicated.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.
 - 1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.
- B. Regulatory Requirements: Comply with requirements in U.S. Architectural & Transportation Barriers Compliance Board's "Uniform Federal Accessibility Standards (UFAS), 1985-494-187" about plumbing fixtures for people with disabilities.
- C. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.
- D. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- E. TAS: Texas Accessibility Standards.

1.6 COORDINATION

- A. Coordinate roughing-in and final plumbing fixture locations, and verify that fixtures can be installed to comply with original design and referenced standards.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. For fixture descriptions in other Part 2 articles where the subparagraph titles "Products," and "Manufacturers" introduce a list of manufacturers and their products or manufacturers only, the following requirements apply for product selection:
 - 1. Products: Subject to compliance with requirements, provide one of the products specified in other Part 2 articles.

2.2 LAVATORY FAUCETS

- A. Lavatory Faucet: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes and outlet with spout and fixture receptor.
 - 1. Products:
 - a. American Standard.
 - b. Eljer.
 - c. Kohler.

2.3 SINK FAUCETS

- A. Sink Faucet: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes and outlet with spout and fixture receptor.

- 1. Manufacturers:

- a. American Standard.
 - b. Eljer
 - c. Kohler

2.4 TOILET SEATS

- A. Toilet Seat: Solid plastic.

- 1. Manufacturers:

- a. Bemis.
 - b. Beneke.
 - c. Centoco.
 - d. Church.

2.5 PROTECTIVE SHIELDING GUARDS

- A. Protective Shielding Guard, Manufactured, plastic enclosure for covering for hot- and cold-water supplies and trap and drain piping and complying with ADA requirements.

- 1. Manufacturers:

- a. Engineered Brass Co.
 - b. Plumerex
 - c. Truebro.

2.6 FIXTURE SUPPORTS

- A. Water-Closet Support: Water-closet combination carrier designed for accessible and standard mounting heights. Include single or double, vertical or horizontal, hub-and-spigot or hubless waste fitting as required for piping arrangement; faceplates; couplings with gaskets; feet; and fixture bolts and hardware matching fixture. Include additional extension coupling, faceplate, and feet for installation in wide pipe space.

- 1. Manufacturers:

- a. Mifab
 - b. Josam.
 - c. Wade.
 - d. Zurn

- B. Urinal Support: Not required

- C. Lavatory Support: Not required

- D. Sink Support: Type II, sink carrier with hanger plate, bearing studs, and tie rod. Include steel uprights with feet.

- 1. Manufacturers:

- a. Josam.
 - b. J.R. Smith
 - c. Zurn.

2.7 WATER CLOSETS

- A. Water Closets: Accessible, wall-hanging, back-outlet, vitreous-china fixture designed for flushometer valve operation.

- 1. Products:

- 2. American Standard, Inc.
 - 3. Kohler Co.
 - 4. TOTO USA, Inc.

- B. Water Closets: Ligature Resistant Institutional Combination Lavatory/Toilet

- 1. Products:

- a. ACORN
 - b. All others shall be submitted for pre-approval prior to bid date.

2.8 LAVATORIES, SINKS

A. Lavatories,: Accessible, counter top, vitreous-china fixture.

1. Products:

- a. American Standard, Inc.
- b. Kohler Co.
- c. Toto
- d. CRANE

2.9 SINKS

A. Sinks: Commercial, counter-mounting, stainless-steel fixture.

1. Products:

- a. Elkay Manufacturing Co.
- b. Just Manufacturing Co.

2.10 SERVICE SINKS

A. Service/Mop Sinks: Floor-mounting, enameled, sink with front apron, raised back, and coated, wire rim guard.

1. Products:

- a. Commercial Enameling Co.
- b. Kohler Co.
- c. Fiat

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for water soil and for waste piping systems and supports to verify actual locations and sizes of piping connections and that locations and types of supports match those indicated, before plumbing fixture installation. Use manufacturer's roughing-in data if roughing-in data are not indicated.
- B. Examine walls, floors, and cabinets for suitable conditions where fixtures are to be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FIXTURE INSTALLATION

- A. Assemble fixtures, trim, fittings, and other components according to manufacturers' written instructions.
- B. For wall-hanging fixtures, install off-floor supports affixed to building substrate.
 - 1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
 - 2. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.
- C. Install back-outlet, wall-hanging fixtures onto waste fitting seals and attach to supports.
- D. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.
- E. Install wall-hanging fixtures with tubular waste piping attached to supports.
- F. Install floor-mounting, back-outlet water closets attached to building floor substrate and wall bracket and onto waste fitting seals.
- G. Install counter-mounting fixtures in and attached to casework.
- H. Install fixtures level and plumb according to manufacturers' written instructions and roughing-in drawings.
- I. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
 - 1. Exception: Use ball, gate, or globe valve if stops are not specified with fixture. Refer to Division 15 Section "Valves" for general-duty valves.
- J. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.
- K. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.
- L. Install flushometer valves for accessible water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.
- M. Install toilet seats on water closets.
- N. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- O. Install water-supply, flow-control fittings with specified flow rates in fixture supplies at stop valves.
- P. Install faucet, flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.

- Q. Install traps on fixture outlets.
- R. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for escutcheons.
- S. Seal joints between fixtures and walls, floors, and counters using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Refer to Division 7 Section "Joint Sealants" for sealant and installation requirements.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect water supplies from water distribution piping to fixtures.
- C. Connect drain piping from fixtures to drainage piping.
- D. Supply and Waste Connections to Plumbing Fixtures: Connect fixtures with water supplies, stops, risers, traps, and waste piping. Use size fittings required to match fixtures. Connect to plumbing piping.
- E. Supply and Waste Connections to Fixtures and Equipment Specified in Other Sections: Connect fixtures and equipment with water supplies, stops, risers, traps, and waste piping specified. Use size fittings required to match fixtures and equipment. Connect to plumbing piping.
- F. Ground equipment.
 - 1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 FIELD QUALITY CONTROL

- A. Verify that installed fixtures are categories and types specified for locations where installed.
- B. Check that fixtures are complete with trim, faucets, fittings, and other specified components.
- C. Inspect installed fixtures for damage. Replace damaged fixtures and components.
- D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

3.5 ADJUSTING

- A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.
- B. Adjust water pressure at faucets, shower valves, and flushometer valves to produce proper flow and stream.
- C. Replace washers and seals of leaking and dripping faucets and stops.

3.6 CLEANING

- A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:
 - 1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
 - 2. Remove sediment and debris from drains.

3.7 PROTECTION

- A. Provide protective covering for installed fixtures and fittings.
- B. Do not allow use of fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION

SECTION 22 47 13 - DRINKING FOUNTAINS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Drinking fountains.
 - 2. Self-contained water coolers.
 - 3. Fixture supports.

1.3 DEFINITIONS

- A. Accessible Drinking Fountain and Water Cooler: Fixture that can be approached and used by people with disabilities.
- B. Drinking Fountain: Fixture with nozzle for delivering stream of water for drinking.
- C. Fitting: Device that controls flow of water into or out of fixture.
- D. Fixture: Drinking fountain or water cooler, unless one is specifically indicated.
- E. Water Cooler: Electrically powered fixture for generating and delivering cooled drinking water.

1.4 SUBMITTALS

- A. Product Data: Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories for each type of fixture indicated.
- B. Shop Drawings: Diagram power, signal, and control wiring and differentiate between manufacturer-installed and field-installed wiring.
- C. Maintenance Data: For fixtures to include in maintenance manuals specified in Division.

1.5 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. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities" about fixtures for people with disabilities.
- C. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- D. ARI Standard: Comply with ARI 1010, "Self-Contained, Mechanically Refrigerated Drinking-Water Coolers," for water coolers and with ARI's "Directory of Certified Drinking Water Coolers" for type and style classifications.
- E. TAS: Texas Accessibility Standards.

1.6 COORDINATION

- A. Coordinate roughing-in and final fixture locations, and verify that fixtures can be installed to comply with original design and referenced standards.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified below.
 - 1. Elkay.
 - 2. Halsey Taylor.
 - 3. Haws Corporation.

2.2 DRINKING FOUNTAINS

- A. Drinking Fountains,: Accessible, Style W, wall-hanging fixture made of stainless steel.
 - 1. Receptor Shape: Rectangular.
 - 2. Back Panel: Stainless-steel wall plate behind drinking fountain.
 - 3. Bubblers: Two, with automatic stream regulator, located on deck.
 - 4. Control: Push button.

5. Supply: NPS 3/8 (DN 10) with ball, gate, or globe valve.
6. Drain: Grid with NPS 1-1/4 (DN 32) minimum horizontal waste and trap complying with ASME Standards.
7. Support: Type I, water-cooler carrier. Refer to "Fixture Supports" Article.

2.3 SELF-CONTAINED WATER COOLERS

- A. Water Coolers: Accessible, ARI 1010, Type PB, pressure with bubbler, Style W, wall-hanging fixture.
 1. Cabinet: Bilevel with two attached cabinets, enameled steel with stainless-steel top.
 2. Bubbler: One, with automatic stream regulator, located on each cabinet deck.
 3. Control: Push button.
 4. Supply: NPS 3/8 (DN 10) with ball, gate, or globe valve and filter.
 5. Drain: Grid with NPS 1-1/4 (DN 32) minimum horizontal waste and trap complying with ASME Standards.
 6. Cooling System: Electric, with hermetically sealed compressor, cooling coil, air-cooled condensing unit, corrosion-resistant tubing, refrigerant, corrosion-resistant-metal storage tank, and adjustable thermostat.
 - a. Capacity: 8 gph (0.0084 L/s) of 50 deg F (10 deg C) cooled water from 80 deg F (27 deg C) inlet water and 90 deg F (32 deg C) ambient air temperature.
 - b. Electrical Characteristics: 1/5 hp; 120-V ac; single phase; 60 Hz.
 7. Support: Type II, water-cooler carrier. Refer to "Fixture Supports" Article.

2.4 FIXTURE SUPPORTS

- A. Off-Floor, Plumbing Fixture Supports: ASME A112.6.1M, water-cooler carriers. Include vertical, steel uprights with feet and tie rods and bearing plates with mounting studs matching fixture to be supported.
 1. Available Manufacturers:
 2. Manufacturers:
 - a. Josam Co.
 - b. Smith, Jay R. Mfg. Co.
 - c. Tyler Pipe; Wade Div.
 - d. Zurn Specifications Drainage Operation.
 3. Type I: Hanger-type carrier with two vertical uprights.
 4. Type II: Bilevel, hanger-type carrier with three vertical uprights.
 5. Supports for Accessible Fixtures: Include rectangular, vertical, steel uprights instead of steel pipe uprights.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for water and waste piping systems to verify actual locations of piping connections before fixture installation. Verify that sizes and locations of piping and types of supports match those indicated.
- B. Examine walls and floors for suitable conditions where fixtures are to be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Use carrier off-floor supports for wall-hanging fixtures, unless otherwise indicated.
- B. Use chrome-plated brass or copper tube, fittings, and valves in locations exposed to view. Plain copper tube, fittings, and valves may be used in concealed locations.

3.3 INSTALLATION

- A. Install off-floor supports affixed to building substrate and attach wall-hanging fixtures, unless otherwise indicated.
- B. Install mounting frames affixed to building construction and attach recessed water coolers to mounting frames, unless otherwise indicated.
- C. Install fixtures level and plumb.
- D. Install water-supply piping with shutoff valve on supply to each fixture to be connected to water distribution piping. Use ball, gate, or globe valve. Install valves in locations where they can be easily reached for operation. Refer to Division Section "Valves" for general-duty valves.
- E. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.
- F. Install pipe escutcheons at wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding pipe fittings. Refer to Division Section "Basic Mechanical Materials and Methods" for escutcheons.
- G. Seal joints between fixtures and walls and floors using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Refer to Division for sealant and installation requirements.

3.4 CONNECTIONS

- A. Piping installation requirements are specified in other Division Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect water supplies from water distribution piping to fixtures.
- C. Connect drain piping from fixtures to drainage piping.
- D. Ground equipment.
 - 1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

END OF SECTION

SECTION 23 00 00 - HEATING, VENTILATION AND AIR-CONDITIONING (HVAC)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions

1.2 WORK COVERED BY CONTRACT DOCUMENTS

- A. The following Summary of Work is intended as an aid to achieve an understanding of the various elements of work included in the project, as is not intended to be all-inclusive. Detailed descriptions of work and requirements are given in drawings and specifications.
- B. Mechanical Contract Documents were prepared for the Project by:

Trinity MEP Engineering, LLC
3533 Moreland Dr. Ste. A
Weslaco, Texas 78596
Phone Number: (956) 973-0500
Contact Person: Leonardo Munoz, P.E.

C. General Scope of Work:

1. Install AC equipment and ductwork as shown on the contract documents. Refer to drawings for schedule of equipment that will be installed. After installing equipment, connect power to unit.
2. HVAC: Provide all materials and labor associated with a complete operational installation of new HVAC systems including, but not limited to:
 - DX Split System A/C Units
 - Exhaust fans
 - Sheet metal, Ductwork
 - Diffusers and Grilles
 - Duct accessories, including grilles, and louvers
 - Air Test and Balance

1.3 COORDINATION

- A. All mechanical work shall be done under sub-contract to a General Contractor. Mechanical Contractor shall coordinate all work through General Contractor, even in areas where only mechanical work is to take place.
- B. Coordination between all trades shall take place on a regular basis to avoid conflicts between disciplines and equipment clearances.
- C. Work shall take place with minimal disruption to Owner's operations in areas surrounding the new building.
- D. Cooperate fully with other contractors so that work under those contracts may be carried out smoothly, without interfering with or delaying work under this Contract.
- E. Fully coordinate with electrical contractor for providing power to mechanical equipment.
- F. Mechanical Contractor is responsible for all control wiring including thermostat(s). This includes all conduit, wire, and accessories both low voltage and source voltage for the controls' system. Mechanical Contractor will provide all the necessary actuators, relays, software, hardware, and all necessary accessories required for a fully functional controls' system.

1.4 UTILITIES

1. Coordinate with power, water, telephone, cable and gas utilities to locate all utilities prior to digging in any area.
2. Obtain any approvals required from utilities to relocate utilities.
3. Cost of relocating or bypassing utilities indicated on drawings shall be included in Base Bid.

1.5 CONTRACTOR USE OF PREMISES

- A. Use of the Site: Limit use of the premises to work in areas indicated. Confine operations to areas within contract limits indicated. Do not disturb portions of the site beyond the areas in which the Work is indicated.
 - 1. Owner Occupancy: Allow for Owner occupancy and use by the public.
 - 2. Driveways and Entrances: Keep driveways and entrances serving the premises, clear and available to the Owner, the Owner's employees, and emergency vehicles at all time. Do not use these areas for parking or storage of materials. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
 - B. Site Safety: Take every precaution to ensure the site does not present a threat to the safety of occupants and/or workers. Minimal safety requirements include, but are not limited to the following:
 - 1. Temporary fencing around construction areas.
 - 2. Yellow caution tape and construction barricades along open trenches during the day. Trenches shall be covered at night and warning lights provided on construction barricades.
 - 3. Temporary fencing around equipment while site work is in progress.
- 1.6 SUBMITTALS
- 1. To expedite the submittal process more efficiently, DO NOT piece-meal the submittals. Submit entire mechanical or plumbing in a bound enclosure. This will eliminate delays in the submittal process.

END OF SECTION

SECTION 23 05 00 - COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

1.2 SUMMARY

- A. This Section includes the following basic mechanical materials and methods to complement other Sections.

1. Piping materials and installation instructions common to most piping systems.
2. Concrete base construction requirements.
3. Escutcheons.
4. Dielectric fittings.
5. Flexible connectors.
6. Mechanical sleeve seals.
7. Equipment nameplate data requirements.
8. Nonshrink grout for equipment installations.
9. Field-fabricated metal and wood equipment supports.
10. Installation requirements common to equipment specification sections.
11. Cutting and patching.
12. Touchup painting and finishing.

1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawl spaces, 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 duct shafts.
- 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.
- F. The following are industry abbreviations for plastic materials:
- G. PVC: Polyvinyl chloride plastic.
- H. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene propylene diene terpolymer rubber.

1.4 SUBMITTALS

- A. Product Data: For dielectric fittings, flexible connectors, mechanical sleeve seals, and identification materials and devices.
- B. Coordination Drawings: Detail major elements, components, and systems of mechanical equipment and materials in relationship with other systems, installations, and building components. Show space requirements for installation and access. Indicate if sequence and coordination of installations are important to efficient flow of the Work. Include the following:
1. Planned piping layout, including valve and specialty locations and valve-stem movement.
 2. Clearances for servicing and maintaining equipment, accessories, and specialties, including space for disassembly required for periodic maintenance.
 3. Sizes and location of required concrete pads and bases.
 4. Floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.

5. Reflected ceiling plans to coordinate and integrate installation of air outlets and inlets, light fixtures, communication system components, sprinklers, and other ceiling-mounted items.

1.5 QUALITY ASSURANCE

- A. Comply with ASME A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.
- B. Equipment Selection: Equipment of higher electrical characteristics, physical dimensions, capacities, and ratings may be furnished provided such proposed equipment is approved in writing and connecting mechanical and electrical services, circuit breakers, conduit, motors, bases, and equipment spaces are increased. Additional costs shall be approved in advance by appropriate Contract Modification for these increases. If minimum energy ratings or efficiencies of equipment are specified, equipment must meet design and commissioning requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and prevent entrance of dirt, debris, and moisture.
- B. Protect stored pipes, ductwork, equipment, and tubes from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor, if stored inside.
- C. Protect flanges, fittings, and piping specialties from moisture and dirt.
- D. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 SEQUENCING AND SCHEDULING

- A. Coordinate mechanical equipment installation with other building components.
- B. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction to allow for mechanical installations.
- C. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components, as they are constructed.
- D. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Coordinate installation of large equipment requiring positioning before closing in building.
- E. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.
- F. Coordinate requirements for access panels and doors if mechanical items requiring access are concealed behind finished surfaces. Access panels and doors are specified in architectural section.
- G. Coordinate installation of identifying devices after completing covering and painting, if devices are applied to surfaces. Install identifying devices before installing acoustical ceilings and similar concealment.

1.8 OPERATION PRIOR TO ACCEPTANCE

- A. When any equipment is operable, and it is to the advantage of the Contractor to operate the equipment, he may do so provided that he properly supervises the operation, and retains full responsibility for the equipment operated.
- B. Regardless of whether or not the equipment has or has not been operated, the Contractor shall clean the equipment properly, make required adjustments, and complete punch list items before final acceptance by the Owner.
- C. The date of acceptance by the Engineer, for beneficial use by the Owner, shall be the beginning date of the warranty period.

1.9 SPACE AND EQUIPMENT ARRANGEMENT

- A. The size of each item of mechanical equipment shown on the Drawings is based on the dimensions of a particular manufacturer as indicated. While other manufacturers may be acceptable, it shall be the responsibility of the Contractor to determine whether or not the equipment he proposes to furnish will fit into the space. Shop drawings shall be prepared when required by the engineer to indicate a suitable arrangement.
- B. Install equipment in a manner to permit access to all surfaces. Install valves, motors, drives, lubricating devices, filters, and other accessory items in a position to allow removal for service without requiring the disassembly of another part.
- C. Provide access panels acceptable to the Engineer for equipment that is concealed above ceiling space.
- D. Large equipment assemblies or components which will be installed in the building, and which are too large to permit access through doorways, stairways or shafts, shall be brought to the site and placed in the appropriate spaces before the enclosing structure is completed. Provisions shall be implemented by the Contractor to insure that the equipment will not be damaged in any way during the associated construction procedures.

1.10 START-UP OF EQUIPMENT AND SYSTEMS

- A. Whenever the manufacturer of a particular item of equipment or a particular system makes available a start-up service after completion of the installation, such manufacturer's start-up service (rendered by the manufacturer or his authorized representative) shall be provided.
- B. Witnessing and explanations of start-up services shall be included as part of the "Instruction of Owner's Personnel" as specified below.

1.11 INSTRUCTION OF OWNER'S PERSONNEL

- A. Provide the services of competent engineers or technicians acceptable to the Engineer to instruct representatives of the Owner in complete and detailed operation and maintenance of each item of equipment, and each system. These instructions shall be provided for whatever periods may be necessary to accomplish the desired results. Upon completion of these instructions, the Contractor shall obtain a letter of release, acknowledged by the Owner or his authorized representative, stating the dates on which the various kinds of instruction were given, and the personnel to whom the instructions were given.
- B. The Contractor shall be fully responsible for proper maintenance of equipment and systems until the instructions have been given to the Owner's personnel and the letter of release acknowledged.
- C. In providing the instructions to the Owner's personnel, the written operating and maintenance manuals shall be followed in all instances, and the Owner's personnel shall be familiarized with such manuals. Operating and maintenance manuals used for instructions shall include piping diagrams, valve identification charts, control and interlocking wiring diagrams, manufacturers' operation and maintenance manuals, parts lists (with sources identified), and other data as appropriate for each system, and as required elsewhere in the Specifications to be furnished to the Owner prior to final acceptance of the project.
- D. Provide the Owner with three (3) complete sets of all maintenance manuals, pamphlets, brochures or instructions. This material shall be catalogued, indexed and bound into books.

1.12 ACCEPTABLE MANUFACTURERS

- A. A. Provide equipment and materials from listed manufacturers listed within this specification. Deviations from this specification will not be acceptable. When one manufacturer is listed, alternate materials and equipment may be provided "equal to" the listed. When more than one manufacturer is listed, equipment and material must be provided by one of the listed manufacturers.

PART 2 - PRODUCTS

2.1 STANDARD PRODUCTS

- A. Each item of equipment furnished under this Division of the Specifications shall be essentially the standard product of the manufacturer. Where two or more units of the same kind or class of equipment are required, these shall be the products of a single manufacturer; however, the component parts of the equipment need not be the products of one manufacturer.
- B. Materials and equipment shall be of the base quality normally used in good commercial practice, and shall be the products of reputable domestic manufacturers unless otherwise specified. Each major component shall bear a nameplate giving the name and address of the manufacturer, and the catalog number or designation of the component.

2.2 QUALITY AND CLASSIFICATION OF MATERIALS

- A. Materials and equipment shall be new and of the quality specified, and shall be free from defects at the time of installation. Materials or equipment damaged in shipment or otherwise damaged prior to installation shall not be repaired at the job site, but shall be replaced with new materials or equipment identical with those damaged.
- B. Wherever a UL standard has been established for a particular type of material or equipment, each such material or equipment provided on this project shall meet the requirements of the UL standard in every way and shall be UL listed and labeled.

2.3 LOCAL PARTS AND SERVICE

- A. Each item of equipment furnished on this project shall have local representation, factory-authorized service, and an adequate stock of repair parts. "Local" shall be defined, for this purpose, as "within 50 miles of the project site."

2.4 FLAME SPREAD PROPERTIES OF MATERIALS

- A. Materials used for insulation, acoustical linings, adhesives, jackets and coatings, and combinations of these materials, shall each have a flame spread rating of 25 or less, and a smoke developed rating of 50 or less, as determined by an independent testing laboratory in accordance with NFPA-255.

2.5 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 1. Dielectric Unions:
 - a. Watts Industries, Inc.; Water Products Div.
 - b. Zurn Industries, Inc.; Wilkins Div.
- 2. Mechanical Sleeve Seals:
 - a. Calpico, Inc.
 - b. Metraflex Co.
 - c. Thunderline/Link-Seal.

2.6 MECHANICAL SLEEVE SEALS

- A. Description: Modular design, with interlocking rubber links shaped to continuously fill annular space between pipe and sleeve. Include connecting bolts and pressure plates.

2.7 PIPING SPECIALTIES

- A. Sleeves: The following materials are for wall, floor, slab, and roof penetrations:
 - 1. Steel Sheet Metal: 0.0239-inch minimum thickness, galvanized, round tube closed with welded longitudinal joint.
 - 2. Steel Pipe: ASTM A 53, Type E, Grade A, Schedule 40, galvanized, plain ends.
 - 3. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
 - 4. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - a. Underdeck Clamp: Clamping ring with set screws.
- B. Escutcheons: Manufactured wall, ceiling, and floor plates; deep-pattern type if required to conceal protruding fittings and sleeves.
 - 1. ID: Closely fit around pipe, tube, and insulation of insulated piping.
 - 2. OD: Completely cover opening.
 - 3. Cast Brass: One piece, with set screw.
 - a. Finish: Rough brass.
 - b. Finish: Polished chrome-plate.
 - 4. Cast-Iron Floor Plate: One-piece casting.

2.8 GROUT

- A. Nonshrink, Nonmetallic Grout: ASTM C 1107, Grade B.
 - 1. Characteristics: Post-hardening, volume-adjusting, dry, hydraulic-cement grout, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psig, 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. General: Install piping as described below, unless piping Sections specify otherwise. Individual Sections specify unique piping installation requirements.
- B. General Locations and Arrangements: 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 at indicated slope.
- D. Install components with pressure rating equal to or greater than system operating pressure.

- E. Install piping in concealed interior and exterior locations, except in equipment rooms and service areas.
- F. Install piping free of sags and bends.
- G. Install exposed interior and exterior piping at right angles or parallel to building walls. Diagonal runs are prohibited, unless otherwise indicated.
- H. Install piping tight to slabs, beams, joists, columns, walls, and other building elements. Allow sufficient space above removable ceiling panels to allow for ceiling panel removal.
- I. Install piping to allow application of insulation plus 1-inch clearance around insulation.
- J. Locate groups of pipes parallel to each other, spaced to permit valve servicing.
- K. Install fittings for changes in direction and branch connections.
- L. Install couplings according to manufacturer's written instructions.
- M. Install pipe escutcheons for pipe penetrations of concrete and masonry walls, wall board partitions, and suspended ceilings according to the following:
 - 1. Chrome-Plated Piping: Cast brass, one piece, with set screw, and polished chrome-plated finish.
 - 2. Uninsulated Piping Wall Escutcheons: Cast brass or stamped steel, with set screw.
 - 3. Uninsulated Piping Floor Plates in Utility Areas: Cast-iron floor plates.
 - 4. Insulated Piping: Cast brass or stamped steel; with concealed hinge, spring clips, and chrome-plated finish.
 - 5. Piping in Utility Areas: Cast brass or stamped steel, with set-screw or spring clips.
- N. Sleeves are not required for core drilled holes.
- O. Install sleeves for pipes passing through concrete and masonry walls, and concrete floor and roof slabs.
- P. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 - 2. Build sleeves into new walls and slabs as work progresses.
 - 3. Install sleeves large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials: Steel Pipe Sleeves: For pipes smaller than 6-inch NPS.
 - b. Steel, Sheet-Metal Sleeves: For pipes 6-inch NPS and larger, penetrating gypsum-board partitions.
 - 4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using elastomeric joint sealants.
 - 5. Use Type S, Grade NS, Class 25, Use O, neutral-curing silicone sealant, unless otherwise indicated.
- Q. Aboveground, Exterior-Wall, Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeve for 1-inch annular clear space between pipe or pipe insulation 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 in diameter and larger.
 - 3. Assemble and install mechanical sleeve seals according to manufacturer's written instructions. Tighten bolts that cause rubber sealing elements to expand and make watertight seal.
- R. Underground, Exterior-Wall, Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Size sleeve for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - 1. Assemble and install mechanical sleeve seals according to manufacturer's written instructions. Tighten bolts that cause rubber sealing elements to expand and make watertight seal.
- S. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestopping materials.
- T. Verify final equipment locations for roughing-in.
- U. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.
- V. Piping Joint Construction: Join pipe and fittings as follows and as specifically required in individual piping specification Sections:
 - 1. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

2. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
 3. Soldered Joints: Construct joints according to AWS's "Soldering Manual," Chapter "The Soldering of Pipe and Tube"; or CDA's "Copper Tube Handbook."
 4. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
 5. 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:
 - a. Note internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
 - b. Apply appropriate tape or thread compound to external pipe threads, unless dry seal threading is specified.
 - c. Align threads at point of assembly.
 - d. Tighten joint with wrench. Apply wrench to valve end into which pipe is being threaded.
 - e. 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.
 6. Welded Joints: Construct joints according to AWS D10.12, "Recommended Practices and Procedures for Welding Low Carbon Steel Pipe," using qualified processes and welding operators according to "Quality Assurance" Article.
 7. Flanged Joints: Align flange surfaces parallel. Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly using torque wrench.
 8. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join pipe and fittings according to the following:
 - a. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - b. PVC Nonpressure Piping: ASTM D 2855.
 - c. PVC to ABS Nonpressure Transition Fittings: Procedure and solvent cement according to ASTM D 3138.
 9. Plastic Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657 procedures and manufacturer's written instructions.
 - a. Plain-End Pipe and Fittings: Use butt fusion.
 - b. Plain-End Pipe and Socket Fittings: Use socket fusion.
- W. Piping Connections: Make connections according to the following, unless otherwise indicated:
1. Install unions, in piping 2-inch NPS and smaller, adjacent to each valve and at final connection to each piece of equipment with 2-inch NPS or smaller threaded pipe connection.
 2. Install flanges, in piping 2-1/2-inch NPS and larger, adjacent to flanged valves and at final connection to each piece of equipment with flanged pipe connection.
 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.

3.2 EQUIPMENT AND MATERIAL INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment and material to provide maximum possible headroom, if mounting heights are not indicated.
- B. Install equipment according to approved submittal data. Portions of the Work are shown only in diagrammatic form. Refer conflicts to Architect.
- C. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- D. Install mechanical 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.
- E. Install equipment and ductwork giving right of way to piping installed at required slope.
- F. Install flexible connectors on equipment side of shutoff valves, horizontally and parallel to equipment shafts if possible.

3.3 PAINTING AND FINISHING

- A. Refer to paint materials, surface preparation, and application of paint.
- B. Do not paint piping specialties with factory-applied finish.
- C. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.4 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit. Follow supported equipment manufacturer's setting templates for anchor bolt and tie locations. Use 3000-psi, 28-day compressive-strength concrete and reinforcement or as specified.

3.5 ERECTION OF METAL SUPPORTS AND ANCHORAGE

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.
- B. Field Welding: Comply with AWS D1.1, "Structural Welding Code--Steel."

3.6 CUTTING AND PATCHING

- A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces necessary for mechanical installations. Perform cutting by skilled mechanics of trades involved.
- B. Repair cut surfaces to match adjacent surfaces.

3.7 GROUTING

- A. Install nonmetallic, nonshrink, grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors. Mix grout according to manufacturer's written instructions.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placing of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases to provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout according to manufacturer's written instructions.

END OF SECTION

SECTION 23 05 39 - HANGER & SUPPORTS FOR HVAC PIPING & EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

- .1 Section includes:

- .1 Concrete housekeeping pads, hangers and supports for mechanical piping, ducting and equipment.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 21 – Construction/Demolition Waste Management and Disposal
- .3 Section 03 30 00 - Cast-in-Place Concrete.
- .4 Section 05 12 23 - Structural Steel for Buildings.
- .5 Section 05 50 00 - Metal Fabrications.

1.3 REFERENCES

- .1 American National Standards Institute/ American Society of Mechanical Engineers (ANSI/ASME)
 - .1 ANSI/ASME B31.1, Power Piping, (SI Edition).
- .2 American Society for Testing and Materials (ASTM)
 - .1 ASTM A125, Specification for Steel Springs, Helical, Heat-Treated.
 - .2 ASTM A307, Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - .3 ASTM A563, Specification for Carbon and Alloy Steel Nuts.
- .3 Factory Mutual (FM)
- .4 Health Canada / Workplace Hazardous Materials Information System (WHMIS).
 - .1 Materials Safety Data Sheets (MSDS).
- .5 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)
 - .1 MSS SP-58, Pipe Hangers and Supports - Materials, Design and Manufacture.
 - .2 ANSI/MSS SP-69, Pipe Hangers and Supports - Selection and Application.
 - .3 MSS SP-89, Pipe Hangers and Supports - Fabrication and Installation Practices.
- .6 Underwriter's Laboratories of Canada (ULC)

1.4 SYSTEM DESCRIPTION

- .1 Design Requirements
 - .1 Construct pipe hanger and support to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.
 - .2 Base maximum load ratings on allowable stresses prescribed by MSS SP58 or ASME B31.1.
 - .3 Ensure that supports, guides, anchors do not transmit excessive quantities of heat to building structure.
 - .4 Design hangers and supports to support systems under all conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into pipework or connected equipment.
 - .5 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment to be in accordance with MSS SP58.
- .2 Performance Requirements
 - .1 Design supports, platforms, catwalks, hangers, to withstand seismic events for location as per the National Building Code

1.5 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop drawings: submit drawings stamped and signed for approval by Owner's Representative.
- .3 Submit shop drawings and product data for following items:
 - .1 Bases, hangers and supports.
 - .2 Connections to equipment and structure.
 - .3 Structural assemblies.

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

- .4 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Instructions: submit manufacturer's installation instructions.
 - .1 Owner's Representative will make available 1 copy of systems supplier's installation instructions.
- .5 Closeout Submittals:
 - .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals

1.6 QUALITY ASSURANCE

- .1 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.7 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Waste Management and Disposal:
 - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 GENERAL

- .1 Fabricate hangers, supports and sway braces in accordance with ANSI B31.1 and MSS SP-58 and SP-89.
- .2 Use components for intended design purpose only. Do not use for rigging or erection purposes.

2.2 PIPE HANGERS

- .1 Finishes:
 - .1 Pipe hangers and supports: galvanized painted with zinc-rich paint after manufacture.
 - .2 Use electro-plating galvanizing process or hot dipped galvanizing process.
 - .3 Ensure steel hangers in contact with copper piping are copper plated or epoxy coated.
- .2 Upper attachment structural: Suspension from lower flange of I-Beam.
 - .1 Cold piping NPS 2 maximum: malleable iron C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip.
 - .1 Rod: 9 mm UL listed, 13 mm FM approved.
 - .2 Cold piping NPS 2 1/2 or greater, hot piping: Malleable iron beam clamp, eye rod, jaws and extension with carbon steel retaining clip, tie rod, nuts and washers, UL listed, FM approved where required to MSS-SP58 and MSS-SP69.
- .3 Upper attachment structural: Suspension from upper flange of I-Beam.
 - .1 Cold piping NPS 2 maximum: Ductile iron top-of-beam C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip, UL listed FM approved where required to MSS SP69.
 - .2 Cold piping NPS 2 1/2 or greater, all hot piping: Malleable iron top-of-beam jaw-clamp with hooked rod, spring washer, plain washer and nut UL listed, FM approved where required.
- .4 Upper attachment to concrete.
 - .1 Ceiling: Carbon steel welded eye rod, clevis plate, clevis pin and cotters with weldless forged steel eye nut. Ensure eye 6 mm minimum greater than rod diameter.
 - .2 Concrete inserts: wedge shaped body with knockout protector plate UL listed FM approved where required to MSS SP-69.
- .5 Shop and field-fabricated assemblies.
 - .1 Trapeze hanger assemblies: MSS SP-89.

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

- .2 Steel brackets: MSS SP-89.
- .3 Sway braces for seismic restraint systems: to MSS SP-89.
- .6 Hanger rods: threaded rod material to MSS SP-58.
 - .1 Ensure that hanger rods are subject to tensile loading only.
 - .2 Provide linkages where lateral or axial movement of pipework is anticipated.
 - .3 Do not use 22 mm or 28 mm rod.
- .7 Pipe attachments: material to MSS SP-58.
 - .1 Attachments for steel piping: carbon steel galvanized.
 - .2 Attachments for copper piping: copper plated black steel.
 - .3 Use insulation saddles for hot pipework.
 - .4 Oversize pipe hangers and supports for insulated pipes.
- .8 Adjustable clevis: material to MSS SP-69, UL listed FM approved, where required clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.
 - .1 Ensure "U" has hole in bottom for rivetting to insulation shields.
- .9 Yoke style pipe roll: carbon steel yoke, rod and nuts with cast iron roll, to MSS SP-69.
- .10 U-bolts: carbon steel to MSS SP-69 with 2 nuts at each end to ASTM A563.
 - .1 Finishes for steel pipework: galvanized.
 - .2 Finishes for copper, glass, brass or aluminum pipework: black with formed portion plastic coated or epoxy coated.
- .11 Pipe rollers: cast iron roll and roll stand with carbon steel rod to MSS SP-69.

2.3 RISER CLAMPS

- .1 Steel or cast iron pipe: galvanized black carbon steel to MSS SP-58, type 42, UL listed FM approved where required.
- .2 Copper pipe: carbon steel copper plated to MSS SP-58, type 42.
- .3 Bolts: to ASTM A307.
- .4 Nuts: to ASTM A563.

2.4 INSULATION PROTECTION SHIELDS

- .1 Insulated cold piping:
 - .1 64 kg/m³ density insulation plus insulation protection shield to: MSS SP-69, galvanized sheet carbon steel. Length designed for maximum 3 m span.
- .2 Insulated hot piping:
 - .1 Curved plate 300 mm long, with edges turned up, welded-in centre plate for pipe sizes NPS 12 and over, carbon steel to comply with MSS SP-69.

2.5 CONSTANT SUPPORT SPRING HANGERS

- .1 Springs: alloy steel to ASTM A125, shot peened, magnetic particle inspected, with +/-5% spring rate tolerance, tested for free height, spring rate, loaded height and provided with Certified Mill Test Report(CMTR).
- .2 Load adjustability: 10 % minimum adjustability each side of calibrated load. Adjustment without special tools. Adjustments not to affect travel capabilities.
- .3 Provide upper and lower factory set travel stops.
- .4 Provide load adjustment scale for field adjustments.
- .5 Total travel to be actual travel + 20%. Difference between total travel and actual travel 25 mm minimum.
- .6 Individually calibrated scales on each side of support calibrated prior to shipment, complete with calibration record.

2.6 VARIABLE SUPPORT SPRING HANGERS

- .1 Vertical movement: 13 mm minimum, 50 mm maximum, use single spring pre-compressed variable spring hangers.
- .2 Vertical movement greater than 50 mm: use double spring pre-compressed variable spring hanger with 2 springs in series in single casing.
- .3 Variable spring hanger to be complete with factory calibrated travel stops. Provide certificate of calibration for each hanger.

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

- .4 Steel alloy springs: to ASTM A125, shot peened, magnetic particle inspected, with +/-5 % spring rate tolerance, tested for free height, spring rate, loaded height and provided with CMTR.

2.7 EQUIPMENT SUPPORTS

- .1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel meeting requirements of Section 05 12 23 - Structural Steel for Buildings. Submit calculations with shop drawings.

2.8 EQUIPMENT ANCHOR BOLTS AND TEMPLATES

- .1 Provide templates to ensure accurate location of anchor bolts.

2.9 PLATFORMS AND CATWALKS

- .1 To Section 05 50 00 - Metal Fabrication.

2.10 HOUSE-KEEPING PADS

- .1 For base-mounted equipment: Concrete, at least 100 mm high, 50 mm larger all around than equipment, and with chamfered edges.
- .2 Concrete: to Section 03 30 00 - Cast-in-place Concrete by Division 3.

2.11 OTHER EQUIPMENT SUPPORTS

- .1 From structural grade steel meeting requirements of Section 05 12 23 - Structural Steel for Buildings.
- .2 Submit structural calculations with shop drawings.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 INSTALLATION

- .1 Install in accordance with:
 - .1 Manufacturer's instructions and recommendations.
- .2 Vibration Control Devices:
 - .1 Install on piping systems at pumps, boilers, chillers, cooling towers, elsewhere as indicated.
- .3 Clamps on riser piping:
 - .1 Support independent of connected horizontal pipework using riser clamps and riser clamp lugs welded to riser.
 - .2 Bolt-tightening torques to be to industry standards.
 - .3 Steel pipes: Install below coupling or shear lugs welded to pipe.
 - .4 Cast iron pipes: Install below joint.
- .4 Clevis plates:
 - .1 Attach to concrete with 4 minimum concrete inserts, one at each corner.
- .5 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.
- .6 Use approved constant support type hangers where:
 - .1 vertical movement of pipework is 13 mm or more,
 - .2 transfer of load to adjacent hangers or connected equipment is not permitted.
- .7 Use variable support spring hangers where:
 - .1 transfer of load to adjacent piping or to connected equipment is not critical.
 - .2 variation in supporting effect does not exceed 25 % of total load.

3.3 HANGER SPACING

- .1 Plumbing piping: most stringent requirements of Canadian Plumbing Code
- .2 Fire protection: to applicable fire code.
- .3 Gas and fuel oil piping: up to NPS 1/2: every 1.8 m.
- .4 Copper piping: up to NPS 1/2: every 1.5 m.
- .5 Hydronic, steam, condensate, rigid, and flexible joint roll groove pipe: in accordance with table below, but not less than one hanger at joints.

Maximum Pipe Size: NPS	Maximum Spacing: Steel	Maximum Spacing: Copper
up to 1-1/4	2.1 m	1.8 m
1-1/2	2.7 m	2.4 m
2	3.0 m	2.7 m
2-1/2	3.6 m	3.0 m
3	3.6 m	3.0 m
3-1/2	3.9 m	3.3 m
4	4.2 m	3.6 m
5	4.8 m	
6	5.1 m	
8	5.7 m	
10	6.6 m	
12	6.9 m	

- .6 Within 300 mm of each elbow.
- .7 Pipework greater than NPS 12: to MSS SP69.

3.4 HANGER INSTALLATION

- .1 Install hanger so that rod is vertical under operating conditions.
- .2 Adjust hangers to equalize load.
- .3 Support from structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members, comprised of angel iron or c-channel.

3.5 HORIZONTAL MOVEMENT

- .1 Angularity of rod hanger resulting from horizontal movement of pipework from cold to hot position not to exceed 4 degrees from vertical.
- .2 Where horizontal pipe movement is less than 13 mm, offset pipe hanger and support so that rod hanger is vertical in the hot position.

3.6 FINAL ADJUSTMENT

- .1 Adjust hangers and supports:
 - .1 Ensure that rod is vertical under operating conditions.
 - .2 Equalize loads.
- .2 Adjustable clevis:
 - .1 Tighten hanger load nut securely to ensure proper hanger performance.
 - .2 Tighten upper nut after adjustment.
- .3 C-clamps:
 - .1 Follow manufacturer's recommended written instructions and torque values when tightening C-clamps to bottom flange of beam.
- .4 Beam clamps:
 - .1 Hammer jaw firmly against underside of beam.

END OF SECTION

SECTION 23 05 53 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions.

1.2 SUMMARY

- A. This Section includes the following mechanical identification materials and their installation:
 - 1. Equipment nameplates.
 - 2. Equipment markers.
 - 3. Access panel and door markers.
 - 4. Pipe markers.
 - 5. Duct markers.
 - 6. Valve tags.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.

1.4 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with location of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT IDENTIFICATION DEVICES

- A. Equipment Nameplates: Metal, with data engraved or stamped, for permanent attachment on equipment.
 - 1. Data:
 - a. Manufacturer, product name, model number, and serial number.
 - b. Capacity, operating and power characteristics, and essential data.
 - c. Labels of tested compliances.
 - 2. Location: Accessible and visible.
 - 3. Fasteners: As required to mount on equipment.
- B. Equipment Markers: Engraved, color-coded laminated plastic. Include contact-type, permanent adhesive.
 - 1. Terminology: Match schedules as closely as possible.
 - 2. Data:
 - a. Name and plan number.
 - b. Equipment service.
 - c. Design capacity.
 - d. Other design parameters such as pressure drop, entering and leaving conditions, and speed.
 - 3. Size: **2-1/2 by 4 inches (64 by 100 mm)** for control devices, dampers, and valves; **4-1/2 by 6 inches (115 by 150 mm)** for equipment.
 - 4. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.

2.2 PIPING IDENTIFICATION DEVICES

- A. Manufactured Pipe Markers, General: Preprinted, color-coded, with lettering indicating service, and showing direction of flow.
 - 1. Colors: Comply with ASME A13.1, unless otherwise indicated.
 - 2. Lettering: Use piping system terms indicated and abbreviate only as necessary for each application length.
 - 3. Pipes with OD, Including Insulation, Less Than **6 Inches (150 mm)**: Full-band pipe markers extending 360 degrees around pipe at each location.
 - 4. Pipes with OD, Including Insulation, **6 Inches (150 mm)** and Larger: Either full-band or strip-type pipe markers at least three times letter height and of length required for label.

5. Arrows: Integral with piping system service lettering to accommodate both directions; or as separate unit on each pipe marker to indicate direction of flow.
- B. Pretensioned Pipe Markers: Precoiled semirigid plastic formed to cover full circumference of pipe and to attach to pipe without adhesive.
- C. Shaped Pipe Markers: Preformed semirigid plastic formed to partially cover circumference of pipe and to attach to pipe with mechanical fasteners that do not penetrate insulation vapor barrier.
- D. Self-Adhesive Pipe Markers: Plastic with pressure-sensitive, permanent-type, self-adhesive back.
- E. Plastic Tape: Continuously printed, vinyl tape at least **3 mils (0.08 mm)** thick with pressure-sensitive, permanent-type, self-adhesive back.
 1. Width for Markers on Pipes with OD, Including Insulation, Less Than **6 Inches (150 mm)**: **3/4 inch (19 mm)** minimum.
 2. Width for Markers on Pipes with OD, Including Insulation, **6 Inches (150 mm)** or Larger: **1-1/2 inches (38 mm)** minimum.

2.3 DUCT IDENTIFICATION DEVICES

- A. Duct Markers: Engraved, color-coded laminated plastic. Include direction and quantity of airflow and duct service (such as supply, return, and exhaust). Include contact-type, permanent adhesive.

2.4 VALVE TAGS

- A. Valve Tags: Stamped or engraved with **1/4-inch (6.4-mm)** letters for piping system abbreviation and **1/2-inch (13-mm)** numbers, with numbering scheme [approved by Architect] <Insert other>. Provide **5/32-inch (4-mm)** hole for fastener.
 1. Material: **3/32-inch- (2.4-mm-)** thick laminated plastic with 2 black surfaces and white inner layer.
 2. Valve-Tag Fasteners: Brass wire-link or beaded chain; or S-hook.

PART 3 - EXECUTION

3.1 APPLICATIONS, GENERAL

- A. Products specified are for applications referenced in other Divisions. If more than single-type material, device, or label is specified for listed applications, selection is Installer's option.

3.2 EQUIPMENT IDENTIFICATION

- A. Install and permanently fasten equipment nameplates on each major item of mechanical equipment that does not have nameplate or has nameplate that is damaged or located where not easily visible. Locate nameplates where accessible and visible. Include nameplates for the following general categories of equipment:
 1. Pumps, compressors, chillers, condensers, and similar motor-driven units.
 2. Heat exchangers, coils, evaporators, and similar equipment.
 3. Fans, blowers, primary balancing dampers, and mixing boxes.
 4. Packaged HVAC central-station and zone-type units.
- B. Install equipment markers with permanent adhesive on or near each major item of mechanical equipment. Data required for markers may be included on signs, and markers may be omitted if both are indicated.
 1. Letter Size: Minimum **1/4 inch (6.4 mm)** for name of units if viewing distance is less than **24 inches (600 mm)**, **1/2 inch (13 mm)** for viewing distances up to **72 inches (1830 mm)**, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 2. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
 3. Locate markers where accessible and visible. Include markers for the following general categories of equipment:
 - a. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
 - b. Fire department hose valves and hose stations.
 - c. Meters, gages, thermometers, and similar units.
 - d. Pumps, compressors, chillers, condensers, and similar motor-driven units.
 - e. Heat exchangers, coils, evaporators, and similar equipment.
 - f. Fans, blowers, primary balancing dampers, and mixing boxes.
 - g. Packaged HVAC central-station and zone-type units.
 - h. Strainers, filters, humidifiers, water-treatment systems, and similar equipment.

- C. Install equipment signs with screws or permanent adhesive on or near each major item of mechanical equipment. Locate signs where accessible and visible.
 - 1. Identify mechanical equipment with equipment markers in the following color codes:
 - a. Green: For cooling equipment and components.
 - b. Yellow: For heating equipment and components.
 - c. Orange: For combination cooling and heating equipment and components.
 - 2. Letter Size: Minimum **1/4 inch (6.4 mm)** for name of units if viewing distance is less than **24 inches (600 mm)**, **1/2 inch (13 mm)** for viewing distances up to **72 inches (1830 mm)**, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 - 3. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
 - 4. Include signs for the following general categories of equipment:
 - a. Main control and operating valves, including safety devices.
 - b. Pumps, compressors, chillers, condensers, and similar motor-driven units.
 - c. Heat exchangers, coils, evaporators, and similar equipment.
 - d. Fans, blowers, primary balancing dampers, and mixing boxes.
 - e. Packaged HVAC central-station and zone-type units.
 - f. Tanks and pressure vessels.
 - g. Strainers, filters, humidifiers, water-treatment systems, and similar equipment.
- D. Install access panel markers with screws on equipment access panels.

3.3 PIPING IDENTIFICATION

- A. Install manufactured pipe markers indicating service on each piping system. Install with flow indication arrows showing direction of flow.
 - 1. Pipes with OD, Including Insulation, Less Than **6 Inches (150 mm)**: Pretensioned pipe markers. Use size to ensure a tight fit.
 - 2. Pipes with OD, Including Insulation, **6 Inches (150 mm)** and Larger: Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, at least **1-1/2 inches (38 mm)** wide, lapped at least **3 inches (75 mm)** at both ends of pipe marker, and covering full circumference of pipe.
- B. Locate pipe markers and color bands where piping is exposed in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior nonconcealed locations as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - 3. Near penetrations through walls, floors, ceilings, and nonaccessible enclosures.
 - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 5. Near major equipment items and other points of origination and termination.
 - 6. Spaced at maximum intervals of **50 feet (15 m)** along each run. Reduce intervals to **25 feet (7.6 m)** in areas of congested piping and equipment.
 - 7. On piping above removable acoustical ceilings. Omit intermediately spaced markers.

3.4 DUCT IDENTIFICATION

- A. Install duct markers with permanent adhesive on air ducts in the following color codes:
 - 1. Green: For cold-air supply ducts.
 - 2. Blue: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
 - 3. ASME A13.1 Colors and Designs: For hazardous material exhaust.
 - 4. Letter Size: Minimum **1/4 inch (6.4 mm)** for name of units if viewing distance is less than **24 inches (600 mm)**, **1/2 inch (13 mm)** for viewing distances up to **72 inches (1830 mm)**, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- B. Locate markers near points where ducts enter into concealed spaces and at maximum intervals of **50 feet (15 m)** in each space where ducts are exposed or concealed by removable ceiling system.

3.5 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; plumbing fixture supply stops; shutoff valves; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
 - B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following:
 - 1. Valve-Tag Size and Shape:
 - a. Cold Water: 1-1/2 inches (38 mm), round.
 - b. Hot Water: 1-1/2 inches (38 mm), round.
 - c. Fire Protection: 2 inches (50 mm), round.
 - C. Valve-Tag Color:
 - a. Cold Water: Green.
 - b. Hot Water: Yellow.
 - c. Fire Protection: Red.
 - 2. Letter Color:
 - a. Cold Water: White.
 - b. Hot Water: White.
 - c. Fire Protection: White.
- 3.6 VALVE-SCHEDULE INSTALLATION
- A. Mount valve schedule on wall in accessible location in each major equipment room.
- 3.7 ADJUSTING
- A. Relocate mechanical identification materials and devices that have become visually blocked by other work.
- 3.8 CLEANING
- A. Clean faces of mechanical identification devices and glass frames of valve schedules.

END OF SECTION

SECTION 23 05 93 - TESTING, ADJUSTING & BALANCING FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes testing, adjusting, and balancing HVAC systems to produce design objectives, including the following:
 - 1. Balancing airflow within distribution systems, including submains, branches, and terminals, to indicated quantities according to specified tolerances.
 - 2. Adjusting total HVAC systems to provide indicated quantities.
 - 3. Measuring electrical performance of HVAC equipment.
 - 4. Setting quantitative performance of HVAC equipment.
 - 5. Verifying that automatic control devices are functioning properly.
 - 6. Reporting results of the activities and procedures specified in this Section.
- B. Related Sections include the following:
 - 1. Testing and adjusting requirements unique to particular systems and equipment are included in the Sections that specify those systems and equipment.
 - 2. Field quality-control testing to verify that workmanship quality for system and equipment installation is specified in system and equipment Sections.

1.2 DEFINITIONS

- A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.
- B. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to design quantities.
- C. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.
- D. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.
- E. Report Forms: Test data sheets for recording test data in logical order.
- F. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.
- G. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.
- H. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
- I. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.
- J. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.
- K. Test: A procedure to determine quantitative performance of a system or equipment.
- L. Testing, Adjusting, and Balancing Agent: The entity responsible for performing and reporting the testing, adjusting, and balancing procedures.
- M. AABC: Associated Air Balance Council.
- N. CTI: Cooling Tower Institute.
- O. NEBB: National Environmental Balancing Bureau.
- P. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association.

1.3 SUBMITTALS

- A. Quality-Assurance Submittals: Within 30 days from the Contractor's Notice to Proceed, submit 2 copies of evidence that the testing, adjusting, and balancing Agent and this Project's testing, adjusting, and balancing team members meet the qualifications specified in the "Quality Assurance" Article below.
- B. Certified Testing, Adjusting, and Balancing Reports: Submit 2 copies of reports prepared, as specified in this Section, on approved forms certified by the testing, adjusting, and balancing Agent.

- C. Warranty: Submit 2 copies of special warranty specified in the "Warranty" Article below.

1.4 QUALITY ASSURANCE

- A. Agent Qualifications for larger projects: Engage a testing, adjusting, and balancing agent certified by AABC.
- B. Agent Qualifications for smaller projects: Engage a testing, adjusting, and balancing agent certified by NEBB.
- C. Certification of Testing, Adjusting, and Balancing Reports: Certify the testing, adjusting, and balancing field data reports. This certification includes the following:
 - 1. Review field data reports to validate accuracy of data and to prepare certified testing, adjusting, and balancing reports.
 - 2. Certify that the testing, adjusting, and balancing team complied with the approved testing, adjusting, and balancing plan and the procedures specified and referenced in this Specification.
- D. Testing, Adjusting, and Balancing Reports: Use standard forms from AABC's "National Standards for Testing, Adjusting, and Balancing."
- E. Testing, Adjusting, and Balancing Reports: Use standard forms from NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems."
- F. Instrumentation Type, Quantity, and Accuracy: As described in AABC national standards.
- G. Instrumentation Type, Quantity, and Accuracy: As described in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," Section II, "Required Instrumentation for NEBB Certification."
- H. Instrumentation Calibration: Calibrate instruments at least every 6 months or more frequently if required by the instrument manufacturer.

1.5 PROJECT CONDITIONS

- A. Partial Owner Occupancy: The Owner may occupy completed areas of the building before Substantial Completion. Cooperate with the Owner during testing, adjusting, and balancing operations to minimize conflicts with the Owner's operations.

1.6 COORDINATION

- A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist testing, adjusting, and balancing activities.
- B. Notice: Provide 7 days' advance notice for each test. Include scheduled test dates and times.
- C. Perform testing, adjusting, and balancing after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

1.7 WARRANTY

- A. General Warranty: The national project performance guarantee specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine Contract Documents to become familiar with project requirements and to discover conditions in systems' designs that may preclude proper testing, adjusting, and balancing of systems and equipment.
 - 1. Contract Documents are defined in the General and Supplementary Conditions of the Contract.
 - 2. Verify that balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- B. Examine approved submittal data of HVAC systems and equipment.
- C. Examine project record documents described in specifications.
- D. Examine Architect's and Engineer's design data, including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine equipment performance data, including fan and pump curves. Relate performance data to project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause

reduced capacities in all or part of a system. Calculate system effect factors to reduce the performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.

- F. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Specification Sections have been performed.
- G. Examine system and equipment test reports.
- H. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- I. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.
- J. Examine air-handling equipment to ensure clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- K. Examine terminal units, such as variable-air-volume boxes and mixing boxes, to verify that they are accessible and their controls are connected and functioning.
- L. Examine equipment for installation and for properly operating safety interlocks and controls.
- M. Examine automatic temperature system components to verify the following:
 - 1. Dampers, valves, and other controlled devices operate by the intended controller.
 - 2. Dampers and valves are in the position indicated by the controller.
 - 3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in multizone units, mixing boxes, and variable-air-volume terminals.
 - 4. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.
 - 5. Sensors are located to sense only the intended conditions.
 - 6. Sequence of operation for control modes is according to the Contract Documents.
 - 7. Controller set points are set at design values. Observe and record system reactions to changes in conditions. Record default set points if different from design values.
 - 8. Interlocked systems are operating.
 - 9. Changeover from heating to cooling mode occurs according to design values.
- N. Report deficiencies discovered before and during performance of testing, adjusting, and balancing procedures.

3.2 PREPARATION

- A. Complete system readiness checks and prepare system readiness reports. Verify the following:
 - 1. Permanent electrical power wiring is complete.
 - 2. Automatic temperature-control systems are operational.
 - 3. Equipment and duct access doors are securely closed.
 - 4. Balance, fire dampers are open.
 - 5. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
 - 6. Windows and doors can be closed so design conditions for system operations can be met.

3.3 GENERAL TESTING AND BALANCING PROCEDURES

- A. Perform testing and balancing procedures on each system according to the procedures contained in AABC national standards and this Section.
- B. Perform testing and balancing procedures on each system according to the procedures contained in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and this Section.
- C. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to the insulation Specifications for this Project.
- D. Mark equipment settings with paint or other suitable, permanent identification material, including damper-control positions, valve indicators, fan-speed-control levers, and similar controls and devices, to show final settings.

3.4 FUNDAMENTAL AIR SYSTEMS' BALANCING PROCEDURES

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. For variable-air-volume systems, develop a plan to simulate diversity.
- D. Check the airflow patterns from the outside-air louvers and dampers and the return- and exhaust-air dampers, through the supply-fan discharge and mixing dampers.
- E. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- F. Verify that motor starters are equipped with properly sized thermal protection.
- G. Check dampers for proper position to achieve desired airflow path.
- H. Check for airflow blockages.
- I. Check condensate drains for proper connections and functioning.
- J. Check for proper sealing of air-handling unit components.

3.5 CONSTANT-VOLUME AIR SYSTEMS' BALANCING PROCEDURES

- A. The procedures in this Article apply to constant-volume supply-, return-, and exhaust-air systems.
- B. Adjust fans to deliver total design airflows within the maximum allowable rpm listed by the fan manufacturer.
 - 1. Measure fan static pressures to determine actual static pressure as follows:
 - a. Measure outlet static pressure as far downstream from the fan as practicable and upstream from restrictions in ducts such as elbows and transitions.
 - b. Measure static pressure directly at the fan outlet or through the flexible connection.
 - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from flexible connection and downstream from duct restrictions.
 - 2. Measure static pressure across each air-handling unit component.
 - a. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.
 - 3. Compare design data with installed conditions to determine variations in design static pressures versus actual static pressures. Compare actual system effect factors with calculated system effect factors to identify where variations occur. Recommend corrective action to align design and actual conditions.
 - 4. Adjust fan speed higher or lower than design with the approval of the Architect. Make required adjustments to pulley sizes, motor sizes, and electrical connections to accommodate fan-speed changes.
 - 5. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure no overload will occur. Measure amperage in full cooling, full heating, and economizer modes to determine the maximum required brake horsepower.
- C. Adjust volume dampers for main duct, submain ducts, and major branch ducts to design airflows within specified tolerances.
 - 1. Measure static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.
 - a. Where sufficient space in submains and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
 - 2. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submains and branch ducts to design airflows within specified tolerances.
- D. Measure terminal outlets and inlets without making adjustments.
 - 1. Measure terminal outlets using a direct-reading hood or the outlet manufacturer's written instructions and calculating factors.
- E. Adjust terminal outlets and inlets for each space to design airflows within specified tolerances of design values. Make adjustments using volume dampers rather than extractors and the dampers at the air terminals.
 - 1. Adjust each outlet in the same room or space to within specified tolerances of design quantities without generating noise levels above the limitations prescribed by the Contract Documents.
 - 2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.6 MOTORS

- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
 - 1. Manufacturer, model, and serial numbers.
 - 2. Motor horsepower rating.

3. Motor rpm.
 4. Efficiency rating if high-efficiency motor.
 5. Nameplate and measured voltage, each phase.
 6. Nameplate and measured amperage, each phase.
 7. Starter thermal-protection-element rating.
 - B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass for the controller to prove proper operation. Record observations, including controller manufacturer, model and serial numbers, and nameplate data.
- 3.7 CONDENSING UNITS
- A. Verify proper rotation of fans and measure entering- and leaving-air temperatures. Record compressor data.
- 3.8 HEAT-TRANSFER COILS
- A. Electric-Heating Coils: Measure the following data for each coil:
 1. Nameplate data.
 2. Airflow.
 3. Entering- and leaving-air temperatures at full load.
 4. Voltage and amperage input of each phase at full load and at each incremental stage.
 5. Calculated kW at full load.
 6. Fuse or circuit-breaker rating for overload protection.
- 3.9 TEMPERATURE TESTING
- A. During testing, adjusting, and balancing, report need for adjustment in temperature regulation within the automatic temperature-control system.
 - B. Measure outside-air, wet- and dry-bulb temperatures.
- 3.10 TEMPERATURE-CONTROL VERIFICATION
- A. Verify that controllers are calibrated and commissioned.
 - B. Check transmitter and controller locations and note conditions that would adversely affect control functions.
 - C. Record controller settings and note variances between set points and actual measurements.
 - D. Verify operation of limiting controllers (i.e., high- and low-temperature controllers).
 - E. Verify free travel and proper operation of control devices such as damper and valve operators.
 - F. Verify sequence of operation of control devices. Note air pressures and device positions and correlate with airflow and water-flow measurements. Note the speed of response to input changes.
 - G. Confirm interaction of electrically operated switch transducers.
 - H. Confirm interaction of interlock and lockout systems.
 - I. Verify main control supply-air pressure and observe compressor and dryer operations.
 - J. Record voltages of power supply and controller output. Determine if the system operates on a grounded or nongrounded power supply.
 - K. Note operation of electric actuators using spring return for proper fail-safe operations.
- 3.11 TOLERANCES
- A. Set HVAC system airflow and water flow rates within the following tolerances:
 1. Supply and Exhaust Fans: Plus 5 to plus 10 percent.
 2. Air Outlets and Inlets: 0 to minus 10 percent.
 3. Cooling-Water Flow Rate: 0 to minus 5 percent.
- 3.12 FINAL REPORT
- A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in 3-ring binder, tabulated and divided into sections by tested and balanced systems.
 - B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.
 1. Include a list of the instruments used for procedures, along with proof of calibration.
 - C. Final Report Contents: In addition to the certified field report data, include the following:
 1. Fan curves.
 2. Manufacturers' test data.
 3. Field test reports prepared by system and equipment installers.
 4. Other information relative to equipment performance, but do not include approved Shop Drawings and Product Data.

- D. General Report Data: In addition to the form titles and entries, include the following data in the final report, as applicable:
1. Title page.
 2. Name and address of testing, adjusting, and balancing Agent.
 3. Project name.
 4. Project location.
 5. Architect's name and address.
 6. Engineer's name and address.
 7. Contractor's name and address.
 8. Report date.
 9. Signature of testing, adjusting, and balancing Agent who certifies the report.
 10. Summary of contents, including the following:
 - a. Design versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
 11. Nomenclature sheets for each item of equipment.
 12. Data for terminal units, including manufacturer, type size, and fittings.
 13. Notes to explain why certain final data in the body of reports vary from design values.
 14. Test conditions for fans and pump performance forms, including the following:
 - a. Settings for outside-, return-, and exhaust-air dampers.
 - b. Conditions of filters.
 - c. Cooling coil, wet- and dry-bulb conditions.
 - d. Face and bypass damper settings at coils.
 - e. Fan drive settings, including settings and percentage of maximum pitch diameter.
 - f. Settings for supply-air, static-pressure controller.
 - g. Other system operating conditions that affect performance.
- E. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present with single-line diagrams and include the following:
1. Quantities of outside, supply, return, and exhaust airflows.
 2. Water and steam flow rates.
 3. Duct, outlet, and inlet sizes.
 4. Pipe and valve sizes and locations.
 5. Terminal units.
 6. Balancing stations.
- F. Roof Top Unit Test Reports: For air-handling units with coils, include the following:
1. Unit Data: Include the following:
 - a. Unit identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and unit size.
 - e. Manufacturer's serial number.
 - f. Unit arrangement and class.
 - g. Discharge arrangement.
 - h. Sheave make, size in inches (mm), and bore.
 - i. Number of belts, make, and size.
 - j. Number of filters, type, and size.
 2. Motor Data: Include the following:
 - a. Make and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 3. Test Data: Include design and actual values for the following:

- a. Total airflow rate in cfm (L/s).
 - b. Total system static pressure in inches wg (Pa).
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg (Pa).
 - e. Preheat coil static-pressure differential in inches wg (Pa).
 - f. Cooling coil static-pressure differential in inches wg (Pa).
 - g. Heating coil static-pressure differential in inches wg (Pa).
 - h. Outside airflow in cfm (L/s).
 - i. Return airflow in cfm (L/s).
 - j. Outside-air damper position.
 - k. Return-air damper position.
 - l. Discharge air temperature
- G. Electric-Coil Test Reports: For electric duct coils, and electric coils installed in central-station air-handling units, include the following:
1. Unit Data: Include the following:
 - a. System identification.
 - b. Location.
 - c. Coil identification.
 - d. Capacity in Btuh (kW).
 - e. Number of stages.
 - f. Connected volts, phase, and hertz.
 - g. Rated amperage.
 - h. Discharge air temperature
 2. Test Data: Include design and actual values for the following:
 - a. Heat output in Btuh (kW).
 - b. Airflow rate in cfm (L/s).
 - c. Air velocity in fpm (m/s).
 - d. Entering-air temperature in deg F (deg C).
 - e. Leaving-air temperature in deg F (deg C).
 - f. Voltage at each connection.
 - g. Amperage for each phase.
- H. Fan Test Reports: For exhaust fans, include the following:
1. Fan Data: Include the following:
 - a. System identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and size.
 - e. Manufacturer's serial number.
 - f. Arrangement and class.
 2. Motor Data: Include the following:
 - a. Make and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Number of belts, make, and size.
 3. Test Data: Include design and actual values for the following:
 - a. Total airflow rate in cfm (L/s).
 - b. Total system static pressure in inches wg (Pa).
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg (Pa).
 - e. Suction static pressure in inches wg (Pa).

I. Condenser Reports: For refrigerant side of unitary systems, stand-alone refrigerant compressors, air-cooled condensing units, include the following:

1. Unit Data: Include the following:
 - a. Unit identification.
 - b. Location.
 - c. Unit make and model number.
 - d. Manufacturer's compressor serial numbers.
 - e. Compressor make.
 - f. Compressor model and serial numbers.
 - g. Refrigerant weight in lb (kg).
2. Test Data: Include design and actual values for the following:
 - a. Entering-air, dry-bulb temperature in deg F (deg C).
 - b. Leaving-air, dry-bulb temperature in deg F (deg C).
 - c. Control settings.
 - d. Unloader set points.
 - e. Low-pressure-cutout set point in psig (kPa).
 - f. High-pressure-cutout set point in psig (kPa).
 - g. Suction pressure in psig (kPa).
 - h. Suction temperature in deg F (deg C).
 - i. Condenser refrigerant pressure in psig (kPa).
 - j. Condenser refrigerant temperature in deg F (deg C).
 - k. Oil pressure in psig (kPa).
 - l. Oil temperature in deg F (deg C).
 - m. Voltage at each connection.
 - n. Amperage for each phase.
 - o. The kW input.
 - p. Number of fans.

3.13 ADDITIONAL TESTS

- A. Within 90 days of completing testing, adjusting, and balancing, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

END OF SECTION

SECTION 23 07 13 - DUCT INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes semirigid and flexible duct, plenum, and breeching insulation; insulating cements; field-applied jackets; accessories and attachments; and sealing compounds.

1.2 SUBMITTALS

- A. Product Data: Identify thermal conductivity, thickness, and jackets (both factory and field applied, if any), for each type of product indicated.

1.3 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: As determined by testing materials identical to those specified in this Section according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and sealer and cement material containers with appropriate markings of applicable testing and inspecting agency.

- 1. Insulation Installed Indoors: Flame-spread rating of 25 or less, and smoke-developed rating of 50 or less.

- 2. Insulation Installed Outdoors: Flame-spread rating of 75 or less, and smoke-developed rating of 150 or less.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Ship insulation materials in containers marked by manufacturer with appropriate ASTM specification designation, type and grade, and maximum use temperature.
- B. Deliver and store all insulation with protective material until installation. Any material left exposed to moisture and/or particulates shall be removed and replaced.
- C. Any installed insulation left temporarily incomplete shall be covered with protective material until final connections can be installed.

1.5 COORDINATION

- A. Coordinate clearance requirements with duct Installer for insulation application.

1.6 SCHEDULING

- A. Schedule insulation application after testing duct systems. Insulation application may begin on segments of ducts that have satisfactory test results.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Mineral-Fiber Insulation:
 - a. CertainTeed Manson.
 - b. Knauf FiberGlass GmbH.
 - c. Owens-Corning Fiberglas Corp.
 - d. Schuller International, Inc.

2.2 INSULATION MATERIALS

- A. Mineral-Fiber Blanket Thermal Insulation: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II, with all-service jacket manufactured from kraft paper, reinforcing scrim, aluminum foil, and vinyl film

2.3 Field Applied Jacket

- A. Foil and paper Jacket: Laminated, glass-fiber-reinforced, flame-retardant kraft paper and aluminum foil.

2.4 ACCESSORIES AND ATTACHMENTS

- A. Glass Cloth and Tape: Comply with MIL-C-20079H, Type I for cloth and Type II for tape. Woven glass-fiber fabrics, plain weave, presized a minimum of 8 oz./sq. yd. (270 g/sq. m).
 - 1. Tape Width: 4 inches (100 mm).
- B. Adhesive-Attached Anchor Pins and Speed Washers: Galvanized steel plate, pin, and washer manufactured for attachment to duct and plenum with adhesive. Pin length sufficient for insulation thickness indicated.
 - 1. Adhesive: Recommended by the anchor pin manufacturer as appropriate for surface temperatures of ducts, plenums, and breechings; and to achieve a holding capacity of 100 lb (45 kg) for direct pull perpendicular to the adhered surface.

2.5 VAPOR RETARDERS

- A. Mastics: Materials recommended by insulation material manufacturer that are compatible with insulation materials, jackets, and substrates.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 GENERAL APPLICATION REQUIREMENTS

- A. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; and free of voids throughout the length of ducts and fittings.
- B. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each duct system.
- C. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Apply multiple layers of insulation with longitudinal and end seams staggered.
- E. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.
- F. Keep insulation materials dry during application and finishing.
- G. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.
- H. Apply insulation with the least number of joints practical.
- I. Apply insulation over fittings and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
- J. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic. Apply insulation continuously through hangers and around anchor attachments.
- K. Insulation Terminations: For insulation application where vapor retarders are indicated, seal ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
- L. Apply insulation with integral jackets as follows:
 - 1. Pull jacket tight and smooth.
 - 2. Joints and Seams: Cover with tape and vapor retarder as recommended by insulation material manufacturer to maintain vapor seal.
 - 3. Vapor-Retarder Mastics: Where vapor retarders are indicated, apply mastic on seams and joints and at ends adjacent to duct flanges and fittings.
- M. Cut insulation according to manufacturer's written instructions to prevent compressing insulation to less than 75 percent of its nominal thickness.
- N. Install vapor-retarder mastic on ducts and plenums scheduled to receive vapor retarders.
 - 1. Ducts with Vapor Retarders: Overlap insulation facing at seams and seal with vapor-retarder mastic and pressure-sensitive tape having same facing as insulation. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-retarder seal.
 - 2. Ducts without Vapor Retarders: Overlap insulation facing at seams and secure with outward clinching staples and pressure-sensitive tape having same facing as insulation.
- O. Roof Penetrations: Apply insulation for interior applications to a point even with top of roof flashing.
 - 1. Seal penetrations with vapor-retarder mastic.
 - 2. Apply insulation for exterior applications tightly joined to interior insulation ends.
 - 3. Seal insulation to roof flashing with vapor-retarder mastic.
- P. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and partitions, except fire-rated walls and partitions.
- Q. Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire/smoke damper sleeves for fire-rated wall and partition penetrations.
- R. Floor Penetrations: Terminate insulation at underside of floor assembly and at floor support at top of floor.
 - 1. For insulation indicated to have vapor retarders, taper termination and seal insulation ends with vapor-retarder mastic.

3.4 MINERAL-FIBER INSULATION APPLICATION

- A. Blanket Applications for Ducts and Plenums: Secure blanket insulation with adhesive and anchor pins and speed washers.
 - 1. Apply adhesives according to manufacturer's recommended coverage rates per square foot, for 100 percent coverage of duct and plenum surfaces.
 - 2. Install anchor pins and speed washers on sides and bottom of horizontal ducts and all sides of vertical ducts as follows:

- a. On duct sides with dimensions 18 inches (450 mm) and smaller, along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.
 - b. On duct sides with dimensions larger than 18 inches (450 mm). Space 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) maximum from insulation joints. Apply additional pins and clips to hold insulation tightly against surface at cross bracing.
 - c. Anchor pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not overcompress insulation during installation.
3. Impale insulation over anchors and attach speed washers.
 4. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 5. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches (50 mm) from one edge and one end of insulation segment. Secure laps to adjacent insulation segment with 1/2-inch (13-mm) staples, 1 inch (25 mm) o.c., and cover with pressure-sensitive tape having same facing as insulation.
 6. Overlap unfaced blankets a minimum of 2 inches (50 mm) on longitudinal seams and end joints. Secure with steel band at end joints and spaced a maximum of 18 inches (450 mm) o.c.
 7. Apply insulation on rectangular duct elbows and transitions with a full insulation segment for each surface. Apply insulation on round duct elbows with individually mitered gores cut to fit the elbow.
 8. Insulate duct stiffeners, hangers, and flanges that protrude beyond the insulation surface with 6-inch- (150-mm-) wide strips of the same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with anchor pins spaced 6 inches (150 mm) o.c.
 9. Apply vapor-retarder mastic to open joints, breaks, and punctures for insulation indicated to receive vapor retarder.

3.5 DUCT SYSTEM APPLICATIONS

- A. Insulation materials and thicknesses are specified in schedules at the end of this Section.
- B. Materials and thicknesses for systems listed below are specified in schedules at the end of this Section.
- C. Insulate the following plenums and duct systems:
 1. Indoor concealed supply-, return-, and outside-air ductwork.
 2. Indoor exposed supply-, return-, and outside-air ductwork.
 3. Indoor concealed range-hood exhaust ductwork.
 4. Indoor concealed dishwasher ductwork.
- D. Items Not Insulated: Unless otherwise indicated, do not apply insulation to the following systems, materials, and equipment:
 1. Factory-insulated flexible ducts.
 2. Factory-insulated plenums, casings, terminal boxes, and filter boxes and sections.
 3. Flexible connectors.
 4. Vibration-control devices.
 5. Testing agency labels and stamps.
 6. Nameplates and data plates.
 7. Access panels and doors in air-distribution systems.

3.6 INDOOR DUCT AND PLENUM APPLICATION SCHEDULE

- A. Service: Round and rectangular, supply-air ducts, concealed.
 1. Material: Mineral-fiber blanket.
 2. Thickness: 3 inches (R-8 or greater)
 3. Number of Layers: One.
 4. Field-Applied Jacket: Foil and paper.
 5. Vapor Retarder Required: Yes.
- B. Service: Round and rectangular, return-air ducts, outside air duct, concealed or exposed.
 1. Material: Mineral-fiber blanket.
 2. Thickness: 2 inches (50 mm).
 3. Number of Layers: One.
 4. Field-Applied Jacket: Foil and Paper
 5. Vapor Retarder Required: Yes.
- C. Service: Round and rectangular, supply and return-air ducts, exposed and in mechanical rooms.
 1. Material: 2" liner insulation
 2. Thickness: 2 inches (50 mm).
 3. Number of Layers: One.
 4. Field-Applied Jacket: None.
 5. Vapor Retarder Required: No
- D. Service: Round and rectangular, exhaust air ducts, concealed & exposed and in mechanical rooms.

1. Material: 1" Interior liner
2. Thickness: 1 inches
3. Number of Layers: One.
4. Field-Applied Jacket: None.
5. Vapor Retarder Required: No

END OF SECTION

SECTION 23 09 23 - DIRECT DIGITAL CONTROL SYSTEM FOR HVAC

PART 1- GENERAL

1.1 DESCRIPTION

- A. General: The control system shall consist of a high-speed, peer-to-peer network of DDC controllers, a control system server, and a web-based operator interface.
- B. 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.
- C. System shall use the BACnet protocol for communication to the operator workstation or web server and for communication between control modules. I/O points, schedules, setpoints, trends and alarms specified in Sequence of Operations for HVAC Controls" shall be BACnet objects.

1.2 APPROVED CONTROL SYSTEM MANUFACTURERS

- A. The following are approved control system suppliers, manufacturers, and product lines:

Supplier	Manufacturer	Product Line
Trane	Trane	Tracer SC

1.3 QUALITY ASSURANCE

- A. Installer and Manufacturer Qualifications

- 1. Installer shall have an established working relationship with Control System Manufacturer.
- 2. Installer shall have successfully completed Control System Manufacturer's control system training. Upon request, Installer shall present record of completed training including course outlines.

1.4 ARCHITECTURE/COMMUNICATION

- A. Wireless equipment controllers and auxiliary control devices shall conform to:
- B. IEEE 802.15.4 radios to minimize risk of interference and maximize battery life, reliability, and range.
- C. Operating range shall be a minimum of 200 feet; open range shall be 2,500 ft. (762 m) with less than 2% packet error rate.
- D. To maintain robust communication, mesh networking and two-way communications shall be used to optimize the wireless network health.
- E. Certifications shall include FCC CFR47 - RADIO FREQUENCY DEVICES - Section 15.247 & Subpart E
- F. Shall be ZigBee Building Automation Certified to allow wireless integration with products from multiple suppliers.

1.4 GRAPHICS PACKAGE

- A. All floor plan graphics shall be represented in a 3D extruded wall thermograph.
- B. All equipment graphics shall by 3D representations of actual equipment at site.

1.5 CODES AND STANDARDS

- A. Work, materials, and equipment shall comply with the most restrictive of local, state, and federal authorities' codes and ordinances or these plans and specifications. As a minimum, the installation shall comply with the current editions in effect 30 days prior to the receipt of bids of the following codes:
 - 1. ANSI/ASHRAE Standard 135, BACnet - A Data Communication Protocol for Building Automation and Control Systems

- B. Schedules:

- 1. Within one month of contract award, provide a schedule of the work indicating the following:
 - a. Intended sequence of work items
 - b. Start date of each work item
 - c. Duration of each work item
 - d. Planned delivery dates for ordered material and equipment and expected lead times
 - e. Milestones indicating possible restraints on work by other trades or situations.
- 2. Monthly written status reports indicating work completed and revisions to expected delivery dates. Include updated schedule of work.

1.6 WARRANTY

A. Warrant work as follows:

1. Warrant labor and materials for specified control system free from defects for a period of 12 months after final acceptance. Control system failures during warranty period shall be adjusted, repaired, or replaced at no additional cost or reduction in service to Owner. Respond during normal business hours within 24 hours of Owner's warranty service request.
2. Work shall have a single warranty date, even if Owner receives beneficial use due to early system start-up. If specified work is split into multiple contracts or a multi-phase contract, each contract or phase shall have a separate warranty start date and period.
3. If the engineer determines that equipment and systems operate satisfactorily at the end of final start-up, testing, and commissioning phase, the engineer will certify in writing that control system operation has been tested and accepted in accordance with the terms of this specification. Date of acceptance shall begin warranty period.
4. Provide updates to operator workstation or web server software, project-specific software, graphic software, database software, and firmware that resolve the contractor-identified software deficiencies at no charge during warranty period. If available, Owner can purchase in-warranty service agreement to receive upgrades for functional enhancements associated with above-mentioned items. Do not install updates or upgrades without Owner's written authorization.
5. Exception: Contractor shall not be required to warrant reused devices except those that have been rebuilt or repaired. Installation labor and materials shall be warranted. Demonstrate operable condition of reused devices at time of Engineer's acceptance.

1.7 OWNERSHIP OF PROPRIETARY MATERIAL

- A. Project-specific software and documentation shall become Owner's property. This includes, but is not limited to:
1. Graphics
 2. Record drawings
 3. Database
 4. Application programming code
 5. Documentation

1.8 TRAINING

- A. Provide training for a designated staff of Owner's representatives in two four hour sessions. Training shall be provided via web-based or computer-based training, classroom training, or a combination of training methods.
- B. Training shall enable students to accomplish the following objectives.
1. Day-to-day Operators:
 - a. Proficiently operate the system
 - b. Understand control system architecture and configuration
 - c. Understand DDC system components
 - d. Understand system operation, including DDC system control and optimizing routines (algorithms)
 - e. Operate the workstation and peripherals
 - f. Log on and off the system
 - g. Access graphics, point reports, and logs
 - h. Adjust and change system set points, time schedules, and holiday schedules
 - i. Recognize malfunctions of the system by observation of the printed copy and graphical visual signals
 - j. Understand system drawings and Operation and Maintenance manual
 - k. Understand the job layout and location of control components
 - l. Access data from DDC controllers and ASCs
 - m. Operate portable operator's terminals

PART -2 SEQUENCE OF OPERATIONS FOR HVAC CONTROLS

2.1 SECTION INCLUDES:

- A. Rooftop Units
- B. Fan Powered Box
- C. Variable Air Volume
- D. DX Single Zone Unit
- E. Exhaust Fan

2.2 ROOFTOP UNITS (RTU-1 AND 2)

Building Automation System Interface:

The Building Automation System (BAS) shall send the controller Occupied Bypass, Pre-Cool, Occupied / Unoccupied and

Heat / Cool modes. If a BAS is not present, or communication is lost with the BAS the controller shall operate using default modes and setpoints.

Occupied Mode:

During occupied periods, the supply fan shall run continuously and the outside air damper shall open to maintain minimum ventilation requirements. The unit controller shall control the supply fan VFD to maintain the current duct static pressure setpoint (adj.). The DX cooling shall stage to maintain the current discharge air temperature setpoint. If economizing is enabled the outside air damper shall modulate to maintain the current discharge air temperature setpoint.

Unoccupied Mode:

When the space temperature is above the unoccupied cooling setpoint of 85.0 deg. F (adj.) the supply fan variable frequency drive (VFD) shall operate as necessary to maintain duct static pressure setpoint (adj.), the outside air damper shall open if economizing is enabled and remain closed if economizing is disabled and the DX cooling shall be enabled. When the space temperature falls below the unoccupied cooling setpoint of 85.0 deg. F minus the unoccupied differential of 4.0 deg. F (adj.) the supply fan shall stop, the DX cooling shall be disabled and the outside air damper shall close.

Optimal Start:

The BAS shall monitor the scheduled occupied time, occupied space setpoints and space temperature to calculate when the optimal start occurs.

Pre-Cool Mode:

During optimal start, if the average space temperature is above the occupied cooling setpoint, pre-cool mode shall be activated. When pre-cool is initiated the unit shall enable the fan and cooling or economizer. The outside air damper shall remain closed, unless economizing. When the average space temperature reaches occupied cooling setpoint (adj.), the unit shall transition to the occupied mode.

Optimal Stop:

The BAS shall monitor the scheduled unoccupied time, occupied setpoints and space temperature to calculate when the optimal stop occurs. When the optimal stop mode is active the unit controller shall maintain the space temperature to the space temperature offset setpoint.

Occupied Bypass:

The BAS shall monitor the status of the "on" and "cancel" buttons of the space temperature sensors. When an occupied bypass request is received from a space sensor, the unit shall transition from its current occupancy mode to occupied bypass mode and the unit shall maintain the space temperature to the occupied setpoints (adj.).

Cooling Mode:

The unit controller shall use the discharge air temperature sensor and discharge air temperature cooling setpoint to determine when to initiate requests for cooling. Discharge air setpoint shall be maintained by modulating the economizer or staging the DX cooling as required to maintain the discharge air setpoint.

Supply Air Temperature Reset Control:

The discharge air temperature setpoint, 55.0 deg. F - 65.0 deg. F (adj.) shall be reset based on either the outside air temperature or space average temperature (adj.). The minimum discharge air setpoint shall be set at 55.0 deg. F (adj.). The discharge temperature sensor shall prevent the discharge air temperature from falling below the minimum discharge air setpoint (adj.). If the discharge air temperature continues to fall, the discharge temperature sensor shall act as a low discharge temperature limit, a low temperature alarm shall be annunciated, and the unit shall shut down. If the discharge temperature rises above the high limit setpoint the sensor shall act as a high discharge temperature limit and shall keep the unit running, a high temperature alarm shall be annunciated.

Outdoor Air Temperature Reset:

The discharge air temperature setpoint shall be adjusted based on the outside air temperature and the cooling load of the building.

Space Temperature Reset:

The discharge air temperature setpoint shall be adjusted based on the temperature of the critical space(s).

Economizer:

The supply air sensor shall measure the dry bulb temperature of the air leaving the evaporator coil while economizing. When economizing is enabled and the unit is operating in the cooling mode, the economizer damper shall be modulated between its minimum position and 100% to maintain the discharge air temperature setpoint. The economizer damper shall modulate toward minimum position in the event the mixed air temperature falls below the low limit temperature setting. Compressors shall be delayed from operating until the economizer has opened to 100%.

Supply Fan:

The supply fan shall be enabled while in the occupied mode and cycled on during the unoccupied mode. A differential

pressure switch shall monitor the differential pressure across the fan. If the switch does not open within 40 seconds after a request for fan operation a fan failure alarm shall be annunciated at the BAS, the unit shall stop, requiring a manual reset.

Critical Zone Reset (Static Pressure Control):

The duct static pressure setpoint shall be reset to the optimal setpoint communicated by the BAS. The BAS shall reset the duct static pressure setpoint based on the position of the furthest open VAV damper. The supply duct static pressure sensor shall also act as a high duct static pressure safety and shall shut down the unit in the event that the duct static pressure reaches 3.00 inches of W.C. (adj.). A manual reset shall be required to re-start the unit. When the unit is in the unoccupied mode the controller shall modulate the speed of the VFD to 50%. If the duct static pressure sensor fails, the VFD shall modulate its speed to 50% and an alarm shall be annunciated at the BAS.

Filter Status:

A differential pressure switch shall monitor the differential pressure across the filter when the fan is running. If the switch closes for 2 minutes after a request for fan operation a dirty filter alarm shall be annunciated at the BAS.

2.3 FAN POWERED BOX (TYPICAL OF 7)

Building Automation System Interface:

The Building Automation System (BAS) shall send the controller Occupied and Unoccupied commands. The BAS may also send a Heat/Cool mode, priority shutdown commands, space temperature and/or space temperature setpoint. If communication is lost with the BAS, the VAV controller shall operate using its local setpoints.

Occupancy Mode:

The occupancy mode shall be communicated or hardwired to the VAV via a binary input. Valid Occupancy modes for the VAV shall be:

Occupied:

Normal operating mode for occupied spaces or daytime operation. When the unit is in the occupied mode the VAV shall maintain the space temperature at the active occupied heating or cooling setpoint. Applicable ventilation and airflow setpoints shall be enforced. The occupied mode shall be the default mode of the VAV.

Occupied Standby:

The occupancy sensor shall be used to indicate that the space is unoccupied, even though the BAS has scheduled the space as occupied. In the occupied standby mode, the active cooling and heating setpoints shall be relaxed (see below) and both the ventilation airflow and minimum airflow setpoints shall be lowered (see VAV schedule).

Unoccupied:

Normal operating mode for unoccupied spaces or nighttime operation. When the unit is in unoccupied mode the VAV controller shall maintain the space temperature at the stored unoccupied heating or cooling setpoint regardless of the presence of a hardwired or communicated setpoint. When the space temperature exceeds the active unoccupied setpoint the VAV shall modulate fully closed.

Occupied Bypass:

Mode used to temporarily place the unit into the occupied operation. Tenants shall be able to override the unoccupied mode from the space sensor. The override shall last for a maximum of 4 hours (adj.). The tenants shall be able to cancel the override from the space sensor at any time. During the override the unit shall operate in occupied mode.

Heat/Cool Mode:

The Heat/Cool mode shall be set by a communicated value or automatically by the VAV. In standalone or auto mode the VAV shall compare the primary air temperature with the configured auto changeover setpoint to determine if the air is "hot" or "cold". Heating mode shall command the VAV to heat only; it implies the primary air temperature is hot. Cooling mode shall command the VAV to cool only; it implies the primary air temperature is cold

Heat/Cool Setpoint:

The space temperature setpoint shall be determined either by a local (e.g., thumbwheel) setpoint, the VAV default setpoint or a communicated value. The VAV shall use the locally stored default setpoints when neither a local setpoint nor communicated setpoint is present. If both a local setpoint and communicated setpoint exist, the VAV shall use the communicated value.

Cooling Mode:

When the unit is in cooling mode, the VAV controller shall maintain the space temperature at the active cooling setpoint by modulating the airflow between the active cooling minimum airflow setpoint to the maximum cooling airflow setpoint. Based on the VAV controller occupancy mode, the active cooling setpoint shall be one of the following:

Setpoint	Default Value
Occupied Cooling Setpoint	74.0 deg. F
Unoccupied Cooling Setpoint	85.0 deg. F
Occupied Standby Cooling Setpoint	78.0 deg. F

Occupied Min Cooling Airflow Setpoint	See VAV Schedule
Occupied Max Cooling Airflow Setpoint	See VAV Schedule

The VAV shall use the measured space temperature and the active cooling setpoint to determine the requested cooling capacity of the unit. The outputs will be controlled based on the unit configuration and the requested cooling capacity.

Heating Mode:

When the unit is in heating mode, the VAV controller shall maintain the space temperature at the active heating setpoint by modulating the airflow between the active heating minimum airflow setpoint to the maximum heating airflow setpoint. Based on the VAV controller occupancy mode, the active heating setpoint shall be one of the following:

Setpoint	Default Value
Occupied Heating Setpoint	71.0 deg. F
Unoccupied Heating Setpoint	60.0 deg. F
Occupied Standby Heating Setpoint	67.0 deg. F
Occupied Min Heating Airflow Setpoint	See VAV Schedule
Occupied Max Heating Airflow Setpoint	See VAV Schedule

The VAV controller shall use the measured space temperature and the active heating setpoint to determine the requested heating capacity of the unit. The outputs will be controlled based on the unit configuration and the requested heating capacity.

Continuous Fan Control:

The VAV fan shall operate continuously in all occupied modes. During the unoccupied mode, the primary air valve shall modulate fully closed. The terminal fan and heat shall cycle as needed to maintain a reduced space temperature.

Reheat Control:

Reheat will only be allowed when the primary air temperature is 5.0 deg. F below the configured reheat enable setpoint of 70.0 deg. F (adj.). The reheat shall be enabled when the space temperature drops below the active cooling setpoint and the airflow is at the minimum cooling airflow setpoint. During reheat the VAV shall operate at its minimum heating airflow setpoint and energize the heat as follows:

Pulse Width Modulated Reheat (PWM):

If the space temperature is at the heating setpoint, energize first stage of heat. The second stage of heating shall be energized based on time and temperature deviation from setpoint. Duty cycle these stages on a three-minute window. Stage 1 shall modulate from 0-50% deviation and be on continuously above 50%. Stage 2 shall modulate from 50-100% deviation

Space Sensor Failure:

If there is a fault with the operation of the zone sensor an alarm shall be annunciated at the BAS. Space sensor failure shall cause the VAV to drive the damper to minimum air flow if the VAV is in the occupied mode, or drive it closed if the VAV is in the unoccupied mode. The series fan shall be enabled and the reheat will be disabled.

2.4 VARIABLE AIR VOLUME (TYPICAL OF 4)

Building Automation System Interface:

The Building Automation System (BAS) shall send the controller Occupied and Unoccupied commands. The BAS may also send a Heat/Cool mode, priority shutdown commands, space temperature and/or space temperature setpoint. If communication is lost with the BAS, the VAV controller shall operate using its local setpoints.

Occupancy Mode:

The occupancy mode shall be communicated or hardwired to the VAV via a binary input. Valid Occupancy modes for the VAV shall be:

Occupied:

Normal operating mode for occupied spaces or daytime operation. When the unit is in the occupied mode the VAV shall maintain the space temperature at the active occupied heating or cooling setpoint. Applicable ventilation and airflow setpoints shall be enforced. The occupied mode shall be the default mode of the VAV.

Unoccupied:

Normal operating mode for unoccupied spaces or nighttime operation. When the unit is in unoccupied mode the VAV controller shall maintain the space temperature at the stored unoccupied heating or cooling setpoint regardless of the

presence of a hardwired or communicated setpoint. When the space temperature exceeds the active unoccupied setpoint the VAV shall modulate fully closed.

Occupied Bypass:

Mode used to temporarily place the unit into the occupied operation. Tenants shall be able to override the unoccupied mode from the space sensor. The override shall last for a maximum of 4 hours (adj.). The tenants shall be able to cancel the override from the space sensor at any time. During the override the unit shall operate in occupied mode.

Heat/Cool Mode:

The Heat/Cool mode shall be set by a communicated value or automatically by the VAV. In standalone or auto mode the VAV shall compare the primary air temperature with the configured auto changeover setpoint to determine if the air is "hot" or "cold". Heating mode shall command the VAV to heat only; it implies the primary air temperature is hot. Cooling mode shall command the VAV to cool only; it implies the primary air temperature is cold.

Heat/Cool Setpoint:

The space temperature setpoint shall be determined either by a local (e.g., thumbwheel) setpoint, the VAV default setpoint or a communicated value. The VAV shall use the locally stored default setpoints when neither a local setpoint nor communicated setpoint is present. If both a local setpoint and communicated setpoint exist, the VAV shall use the communicated value.

Cooling Mode:

When the unit is in cooling mode, the VAV controller shall maintain the space temperature at the active cooling setpoint by modulating the airflow between the active cooling minimum airflow setpoint to the maximum cooling airflow setpoint. Based on the VAV controller occupancy mode, the active cooling setpoint shall be one of the following:

Setpoint	Default Value
Occupied Cooling Setpoint	74.0 deg. F
Unoccupied Cooling Setpoint	85.0 deg. F
Occupied Standby Cooling Setpoint	78.0 deg. F
Occupied Min Cooling Airflow Setpoint	See VAV Schedule
Occupied Max Cooling Airflow Setpoint	See VAV Schedule

The VAV shall use the measured space temperature and the active cooling setpoint to determine the requested cooling capacity of the unit. The outputs will be controlled based on the unit configuration and the requested cooling capacity.

Space Sensor Failure:

If there is a fault with the operation of the zone sensor an alarm shall be annunciated at the BAS. Space sensor failure shall cause the VAV to drive the damper to minimum air flow if the VAV is in the occupied mode, or drive it closed if the VAV is in the unoccupied mode.

2.5 DX SINGLE ZONE UNIT

Run Conditions – Scheduled through BAS:

The unit shall be controlled using a BACnet communicating thermostat.

Alarms shall be provided as follows:

Zone Setpoint Adjust:

The occupant shall be able to adjust the zone temperature heating and cooling setpoints at the zone sensor.

The supply fan shall run anytime the unit is commanded to run, unless shutdown on internal safeties.

Cooling Stages:

The controller shall measure the zone temperature and stage the cooling to maintain its cooling setpoint.

Electric Heating Stages:

The controller shall measure the zone temperature and stage the heating to maintain its heating setpoint.

2.6 MISCELLANEOUS CONTROL POINTS

Outdoor Air Temperature and Humidity:

A temperature and humidity sensor mounted on the north side of the building will continually broadcast their information on the network as global information

Building Exhaust Fan:

When any RTU is active the BAS will energize the exhaust fan. The exhaust fan will be off when the RTU is inactive.

Temperature monitor of elevator equipment room served by minisplits. Alarms shall be provided as follows:

High Temp: When temp is above user defined setpoint an alarm will be initiated.

END OF SECTION

SECTION 23 23 00 - REFRIGERANT PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:

1. Furnish and install piping and specialties for refrigeration systems as described in Contract Documents.

B. Products Installed But Not Furnished Under This Section:

1.2 REFERENCES

A. Association Publications:

1. Federal Emergency Management Agency (FEMA) / Vibration Isolation and Seismic Control Manufacturers Association (VISCMA) / American Society of Civil Engineers (ASCE):
 - a. FEMA 412, 'Installing Seismic Restraints For Mechanical Equipment' (December 2002).
2. Vibration Isolation and Seismic Control Manufacturers Association (VISCMA):
 - a. VISCMA 101-12, 'Seismic Restraint Specification Guidelines for Mechanical, Electrical, and Plumbing Systems'.
 - b. VISCMA 102-12, 'Vibration Isolation Specification Guidelines for Mechanical, Electrical, and Plumbing Systems'.

B. Definitions:

1. Refrigerant: Absorbs heat by a change of state (evaporation) from liquid to a gas, and releases heat by a change of state (condenses) from gas back to a liquid.
2. Vibration Isolation: Vibration reduction in which an isolation system is placed between the source of unwanted vibration and an item which needs to be shielded from the vibration.

C. Reference Standards:

1. American National Standards Institute (ANSI) / American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):
 - a. ANSI/ASHRAE Standard 15-2010, 'Safety Standard for Refrigeration Systems'.
 - b. ANSI/ASHRAE Standard 34-2010, 'Designation and Classification of Refrigerants'.
2. American National Standards Institute / American Welding Society:
 - a. ANSI/AWS A5.8M/A5.8-2011, 'Specification for Filler Metals for Brazing and Braze Welding'.
3. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):
 - a. '2011 ASHRAE Handbook - HVAC Applications'.
 - 1) Chapter 48, 'Noise and Vibration Control'.
4. ASTM International:
 - a. ASTM A36/A36M-08, 'Standard Specification for Carbon Structural Steel'.
 - b. ASTM B280-08, 'Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service'.
5. National Fire Protection Association / American National Standards Institute:
 - a. NFPA 90A-2012, 'Installation of Air Conditioning and Ventilating Systems'.
6. Underwriters Laboratories:
 - a. UL 2182, 'Refrigerants' (2nd Edition).

1.3 SUBMITTALS

A. Action Submittals:

1. Shop Drawings: Show each individual equipment and piping support.

B. Informational Submittals:

1. Qualification Statements: Technician certificate for use of HFC and HCFC refrigerants.

1.4 QUALITY ASSURANCE

A. Regulatory Agency Sustainability Approvals:

1. Refrigerants:

a. Underwriters Laboratories / Underwriters Laboratories of Canada:

1) Comply with requirements of UL 2182.

B. Qualifications. Section 01 4301 applies, but is not limited to the following:

1. Installer: Refrigerant piping shall be installed by refrigeration contractor licensed by State and by technicians certified in use of HFC and HCFC refrigerants.

PART 2 - PRODUCTS

2.1 COMPONENTS

A. Manufacturers:

1. Manufacturer Contact List:

- a. Airtec,
- b. Cush-A-Clamp by ZSI Manufacturing,
- c. Elkhart Products Corp.,
- d. Emerson Climate Technologies,
- e. Handy & Harman Products
- f. Harris Products Group,
- g. Henry Valve Co,
- h. Hilti Inc,
- i. Hydra-Zorb Co,
- j. JB Industries,
- k. Mueller Steam Specialty,
- l. Nibco Inc,
- m. Packless Industries, Parker Corp,
- n. Sporlan Valve Co.
- o. Sherwood Valves,.
- p. Thomas & Betts,
- q. Unistrut, Div of Atkore International, Inc.
- r. Universal Metal Hose.
- s. Vibration Mountings & Controls,
- t. Virginia KMP Corp,

B. Materials:

1. Refrigerant Piping:

- a. Meet requirements of ASTM B280, hard drawn straight lengths. Soft copper tubing not permitted.
- b. Do not use pre-charged refrigerant lines.

2. Refrigerant Fittings:

- a. Wrought copper with long radius elbows.
- b. Category Four Approved Manufacturers. See Section 01 6200 for definitions of Categories:
 - 1) Mueller Streamline.
 - 2) Nibco Inc.
 - 3) Elkhart.

3. Suction Line Traps:

- a. Manufactured standard one-piece traps.
- b. Category Four Approved Manufacturers. See Section 01 6200 for definitions of Categories:
 - 1) Mueller Streamline.
 - 2) Nibco Inc.
 - 3) Elkhart.

4. Tee Access:

- a. Brass:
 - 1) Category Four Approved Manufacturers. See Section 01 6200 for definitions of Categories:
 - a) JB Industries: Part #A3 Series with Factory Cap and Valve Core.

5. Connection Material:
 - a. Brazing Rods in accordance with ANSI/AWS A5.8M/A5.8:
 - 1) Copper to Copper Connections:
 - a) Classification BCuP-4 Copper Phosphorus (6 percent silver).
 - b) Classification BCuP-5 Copper Phosphorus (15 percent silver).
 - 2) Copper to Brass or Copper to Steel Connections: Classification BAg-5 Silver (45 percent silver).
 - 3) Do not use rods containing Cadmium.
 - b. Flux:
 - 1) Type Two Acceptable Products:
 - a) Stay-Silv White Brazing Flux by Harris Products Group.
 - b) High quality silver solder flux by Handy & Harmon.
 - c) Equal as approved by Architect before use. See Section 01 6200.
6. Valves:
 - a. Expansion Valves:
 - 1) For pressure type distributors, externally equalized with stainless steel diaphragm, and same refrigerant in thermostatic elements as in system.
 - 2) Size valves to provide full rated capacity of cooling coil served. Coordinate selection with evaporator coil and condensing unit.
 - 3) Category Four Approved Manufacturers. See Section 01 6200 for definitions of Categories:
 - a) Emerson Climate Technologies.
 - b) Henry.
 - c) Mueller.
 - d) Parker.
 - e) Sporlan.
 - b. Manual Refrigerant Shut-Off Valves:
 - 1) Ball valves designed for refrigeration service and full line size.
 - 2) Valve shall have cap seals.
 - 3) Valves with hand wheels are not acceptable.
 - 4) Provide service valve on each liquid and suction line at compressor.
 - 5) If service valves come as integral part of condensing unit, additional service valves shall not be required.
 - 6) Category Four Approved Manufacturers. See Section 01 6200 for definitions of Categories:
 - a) Henry.
 - b) Mueller.
 - c) Sherwood.
 - d) Virginia.
7. Filter-Drier:
 - a. On lines **3/4 inch (19 mm)** outside diameter and larger, filter-drier shall be replaceable core type with Schraeder type valve.
 - b. On lines smaller than **3/4 inch (19 mm)** outside diameter, filter-drier shall be sealed type with brazed end connections.
 - c. Size shall be full line size.
 - d. Category Four Approved Manufacturers. See Section 01 6200 for definitions of Categories:
 - 1) Emerson Climate Technologies.
 - 2) Mueller.
 - 3) Parker.
 - 4) Sporlan.
 - 5) Virginia.
8. Sight Glass:
 - a. Combination moisture and liquid indicator with protection cap.
 - b. Sight glass shall be full line size.
 - c. Sight glass connections and sight glass body shall be solid copper or brass, no copper-coated steel sight glasses allowed.

- d. Category Four Approved Product. See Section 01 6200 for definitions of Categories:
 - 1) HMI by Emerson Climate Technologies.
- 9. Flexible Connectors:
 - a. Designed for refrigerant service with bronze seamless corrugated hose and bronze braiding.
 - b. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - 1) Vibration Absorber Model VAF by Packless Industries.
 - 2) Vibration Absorbers by Virginia KMP Corp.
 - 3) Anaconda 'Vibration Eliminators' by Universal Metal Hose.
 - 4) Style 'BF' Spring-flex freon connectors by Vibration Mountings.
- 10. Refrigerant Piping Supports:
 - a. Base, Angles, And Uprights: Steel meeting requirements of ASTM A36.
 - b. Securing Channels:
 - 1) At Free-Standing Pipe Support:
 - a) Class One Quality Standard: P-1000 channels by Unistrut.
 - b) Acceptable Manufacturers: Hilti, Thomas & Betts.
 - c) Equal as approved by Architect before installation. See Section 01 6200.
 - 2) At Wall Support:
 - a) Class One Quality Standard: P-3300 channels by Unistrut.
 - b) Acceptable Manufacturers: Hilti, Thomas & Betts.
 - c) Equal as approved by Architect before installation. See Section 01 6200.
 - 3) At Suspended Support:
 - a) Class One Quality Standard: P-1001 channels by Unistrut.
 - b) Acceptable Manufacturers: Hilti, Thomas & Betts.
 - c) Equal as approved by Architect before installation. See Section 01 6200.
 - 4) Angle Fittings:
 - a) Class One Quality Standard: P-2626 90 degree angle by Unistrut.
 - b) Acceptable Manufacturers: Hilti, Thomas & Betts.
 - c) Equal as approved by Architect before installation. See Section 01 6200.
 - c. Pipe Clamps:
 - 1) Type Two Acceptable Manufacturers:
 - a) Hydra-Zorb.
 - b) ZSI Cush-A-Clamp.
 - c) Hilti Cush-A-Clamp.
 - d) Equal as approved by Architect before installation. See Section 01 6200.
 - d. Protective Cover: 18 ga (1.2 mm) steel, hot-dipped galvanized.
- 11. Locking Refrigerant Cap:
 - a. Provide and install on charging valves:
 - 1) Class One Quality Standard: 'No Vent' locking refrigerant cap.
 - 2) Acceptable Manufacturers: Airtec.
 - 3) Equal as approved by Architect before installation. See Section 01 6200.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refrigerant Lines:
 - 1. Install as high in upper mechanical areas as possible. Do not install underground or in tunnels.
 - 2. Slope suction lines down toward compressor one inch/10 feet (25 mm in 3 meters). Locate traps at vertical rises against flow in suction lines.
- B. Connections:
 - 1. Refrigeration system connections shall be copper-to-copper, copper-to-brass, or copper-to-steel type properly cleaned and brazed with specified rods. Use flux only where necessary. No soft solder (tin, lead, antimony) connections will be allowed in system.
 - 2. Braze manual refrigerant shut-off valve, sight glass, and flexible connections.

3. Circulate dry nitrogen through tubes being brazed to eliminate formation of copper oxide during brazing operation.

C. Specialties:

1. Install valves and specialties in accessible locations. Install refrigeration distributors and suction outlet at same end of coil.
2. Install thermostatic bulb as close to cooling coil as possible. Do not install on vertical lines.
3. Install equalizing line in straight section of suction line, downstream of and reasonably close to thermostatic bulb. Do not install on vertical lines.
4. Provide flexible connectors in each liquid line and suction line at both condensing unit and evaporator on systems larger than five tons. Anchor pipe near each flexible connector.

D. Refrigerant Supports:

1. Support Spacing:
 - a. Piping 1-1/4 inch (32 mm) And Larger: 8 feet (2.450 m) on center maximum.
 - b. Piping 1-1/8 inch (28.5 mm) And Smaller: 6 feet (1.80 m) on center maximum.
 - c. Support each elbow.
2. Isolate pipe from supports and clamps with Hydrozorb or Cush-A-Clamp systems.
3. Run protective cover continuous from condensing units to risers or penetrations at building wall.

3.2 FIELD QUALITY CONTROL

A. Field Tests:

1. Make evacuation and leak tests in presence of Architect's Engineer after completing refrigeration piping systems. Positive pressure test will not suffice for procedure outlined below.
 - a. Draw vacuum on each entire system with two stage vacuum pump. Draw vacuum to 300 microns using micron vacuum gauge capable of reading from atmosphere to 10 microns. Do not use cooling compressor to evacuate system nor operate it while system is under high vacuum.
 - b. Break vacuum with nitrogen and re-establish vacuum test. Vacuum shall hold for 30 minutes at 300 microns without vacuum pump running.
 - c. Conduct tests at 70 deg F (21 deg C) ambient temperature minimum.
 - d. Do not run systems until above tests have been made and systems started up as specified. Inform Owner's Representative of status of systems at time of final inspection and schedule start-up and testing if prevented by outdoor conditions before this time.
 - e. After testing, fully charge system with refrigerant and conduct test with Halide Leak Detector.
 - f. Recover all refrigerant in accordance with applicable codes. Do not allow any refrigerant to escape to atmosphere.

B. Non-Conforming Work:

1. If it is observed that refrigerant lines are being or have been brazed without proper circulation of nitrogen through lines, all refrigerant lines installed up to that point in time shall be removed and replaced at no additional cost to Owner.

END OF SECTION

SECTION 23 31 13 - METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions.

1.2 SUMMARY

- B. This Section includes rectangular, round, and flat-oval metal ducts and plenums for heating, ventilating, and air-conditioning systems in pressure classes from minus 2- to plus 10-inch wg

1.3 DEFINITIONS

- A. Thermal Conductivity and Apparent Thermal Conductivity (k-Value): As defined in ASTM C 168. In this Section, these values are the result of the formula $\text{Btu} \times \text{in./h} \times \text{sq. ft.} \times \text{deg F}$ or $\text{W/m} \times \text{K}$ at the temperature differences specified. Values are expressed as Btu or W.

1.4 SYSTEM DESCRIPTION

- A. Duct system design, as indicated, has been used to select and size air-moving and -distribution equipment and other components of air system. Changes to layout or configuration of duct system must be specifically approved in writing by Architect.

1.5 SUBMITTALS

- A. Product Data: For duct liner and sealing materials.
- B. Shop Drawings: Show details of the following:
 - 1. Duct layout indicating pressure classifications and sizes on plans.
 - 2. Fittings.
 - 3. Penetrations through fire-rated and other partitions.
 - 4. Coordination with other trades and including but not limited to: structural members, electrical lights and conduits, plumbing lines, & fire sprinkler lines.
- C. Coordination Drawings: Reflected ceiling plans drawn to scale and coordinating penetrations and ceiling-mounted items. Show the following:
 - 1. Ceiling- and wall-mounted access doors and panels required to provide access to dampers and other operating devices.
 - 2. Coordination with ceiling-mounted items, including lighting fixtures, diffusers, grilles, speakers, sprinkler heads, access panels, and special moldings.
- D. Duct Construction Standards: Provide a copy of the duct construction standards to be used for each pressure classification in this project. Duct Construction Standards must comply with the latest edition of SMACNA "HVAC Duct Construction Standards – Metal and Flexible."
- E. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
- F. Record Drawings: Indicate actual routing, fitting details, reinforcement, support, and installed accessories and devices.

1.6 QUALITY ASSURANCE

- A. Welding Standards: Qualify welding procedures and welding personnel to perform welding processes for this Project according to AWS D1.1, "Structural Welding Code--Steel," for hangers and supports; AWS D1.2, "Structural Welding Code--Aluminum," for aluminum supporting members; and AWS D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.
- B. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," unless otherwise indicated.
- C. Comply with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems," unless otherwise indicated.
- D. Comply with NFPA 96, "Ventilation Control and Fire Protection of Commercial Cooking Operations," Chapter 3, "Duct System," for range hood ducts, unless otherwise indicated.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver sealant and firestopping materials to site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multicomponent materials.
- B. Store and handle sealant and firestopping materials according to manufacturer's written recommendations.
- C. Deliver and store stainless-steel sheets with mill-applied adhesive protective paper maintained through fabrication and installation
- D. Deliver and store all ductwork with protective material until installation. Any material left exposed to moisture and/or particulates shall be removed and replaced.
- E. Any installed ductwork or piping system left temporarily incomplete shall be covered with protective material until final connections can be installed.
- F. All ductwork and/or liner insulation to be wrapped with protective material until installation. Any ductwork or insulation left exposed to the environment or contaminating particulate matter shall be replaced at the contractor's expense.

PART 2 - PRODUCTS

2.1 SHEET METAL MATERIALS

- A. Galvanized, Sheet Steel: Lock-forming quality; ASTM A 653/A 653M, G90 (Z275) coating designation; mill-phosphatized finish for surfaces of ducts exposed to view.
- B. Carbon-Steel Sheets: ASTM A 366/A 366M, cold-rolled sheets; commercial quality; with oiled, exposed matte finish.
- C. Stainless Steel: ASTM A 480/A 480M, Type 316, sheet form with No. 4 finish for surfaces of ducts exposed to view; and Type 304, sheet form with No. 1 finish for concealed ducts.
- D. Reinforcement Shapes and Plates: Galvanized steel reinforcement where installed on galvanized, sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- E. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for 36-inch (900-mm) length or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

2.2 SEALANT MATERIALS

- A. Joint and Seam Sealants, General: The term "sealant" is not limited to materials of adhesive or mastic nature but includes tapes and combinations of open-weave fabric strips and mastics.
 - 1. Joint and Seam Sealant: One-part, nonsag, solvent-release-curing, polymerized butyl sealant, formulated with a minimum of 75 percent solids.
 - 2. Flanged Joint Mastics: One-part, acid-curing, silicone, elastomeric joint sealants, complying with ASTM C 920, Type S, Grade NS, Class 25, Use O.

2.3 HANGERS AND SUPPORTS

- A. Hanger Materials: Galvanized, sheet steel or round, threaded steel rod.
 - 1. Hangers Installed in Corrosive Atmospheres: Electrogalvanized, all-thread rod or galvanized rods with threads painted after installation.
 - 2. Straps and Rod Sizes: Comply with latest edition of SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for sheet steel width and thickness and for steel rod diameters.
- B. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- C. Trapeze and Riser Supports: Steel shapes complying with ASTM A 36/A 36M.
 - 1. Supports for Galvanized-Steel Ducts: Galvanized steel shapes and plates.
 - 2. Supports for Stainless-Steel Ducts: Stainless-steel support materials.
 - 3. Supports for Aluminum Ducts: Aluminum support materials, unless materials are electrolytically separated from ductwork.

2.4 RECTANGULAR DUCT FABRICATION

- A. General: Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction with galvanized, sheet steel, according to the latest edition of SMACNA's "HVAC Duct Construction Standards--Metal and Flexible." Comply with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals.
 - 1. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure classification.
 - 2. Materials: Free from visual imperfections such as pitting, seam marks, roller marks, stains, and discolorations.

- B. Fabricate range hood exhaust ducts with 0.0598-inch- thick, galvanized sheet for concealed ducts and 0.0500-inch-thick stainless steel for exposed ducts. Weld and flange seams and joints. Comply with NFPA 96.
- C. Fabricate dishwasher hood exhaust ducts with 0.0500-inch- thick stainless steel. Weld and flange seams and joints.
- D. Static-Pressure Classifications: Unless otherwise indicated, construct ducts to the following:
 - 1. Supply Ducts between AHU and Air Terminal Units: 3-inch wg.
 - 2. Supply Ducts after air terminal units and on constant volume supply equipment: 1-inch wg (250 Pa), positive pressure
 - 3. Return Ducts: 1-inch wg ,negative pressure.
 - 4. Exhaust Ducts: 1-inch wg negative pressure.
- E. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19 inches and larger and 0.0359 inch thick or less, with more than 10 sq. ft. of unbraced panel area, unless ducts are lined.

2.5 ROUND FABRICATION

- A. Round Ducts: Fabricate spiral seam supply and return ducts of galvanized steel according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible." Snap Lock Longitudinal seam ductwork will not be allowed. Adjustable elbows will not be allowed.
- B. Spiral seam round or oval duct may be substituted for rectangular duct at the contractors option. Spiral seam ductwork sizing must result in the same or less pressure drop than the rectangular duct indicated on the plans.

2.6 DUCT STORAGE

- A. All duct must have end capped with plastic covers on both ends from end of fabrication to duct installation. If this is not provided at the field, vacuum ducts before final acceptance to remove dust and debris.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION, GENERAL

- A. Duct installation requirements are specified in other Division Sections. Drawings indicate general arrangement of ducts, fittings, and accessories.
- B. Construct and install each duct system for the specific duct pressure classification indicated.
- C. Install round ducts in lengths not less than 10 feet (3 m), unless interrupted by fittings.
- D. Install ducts with fewest possible joints.
- E. Install fabricated fittings for changes in directions, changes in size and shape, and connections.
- F. Install couplings tight to duct wall surface with a minimum of projections into duct.
- G. Install ducts, unless otherwise indicated, vertically and horizontally, parallel and perpendicular to building lines; avoid diagonal runs.
- H. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- I. Install ducts with a clearance of 1 inch (25 mm), plus allowance for insulation thickness.
- J. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions, unless specifically indicated.
- K. Coordinate layout with suspended ceiling, fire- and smoke-control dampers, lighting layouts, and similar finished work.
- L. Electrical Equipment Spaces: Route ductwork to avoid passing through transformer vaults and electrical equipment spaces and enclosures.
- M. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, and are exposed to view, conceal space between construction opening and duct or duct insulation with sheet metal flanges of same metal thickness as duct. Overlap opening on four sides by at least 1-1/2 inches (38 mm).
- N. Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, install appropriately rated fire damper, sleeve, and firestopping sealant. Fire and smoke dampers are specified in Division Section "Duct Accessories." Firestopping materials and installation methods are specified in other Divisions

3.2 SEAM AND JOINT SEALING

- A. General: Seal duct seams and joints according to the duct pressure class indicated and as described in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible." All duct to be sealed to SMACNA seal class A which requires sealing all transverse joints, longitudinal seams and duct wall penetrations regardless of pressure classification.
- B. Seal externally insulated ducts before insulation installation.

- C. All ducts shall be inspected after sealing is complete and prior to insulation installation. Provide the engineer with a minimum 7 days notice prior to beginning duct insulation.

3.3 RANGE HOOD EXHAUST DUCT INSTALLATIONS

- A. Install ducts to allow for thermal expansion of ductwork through 2000 deg F temperature range.
- B. Install ducts without dips or traps that may collect residues, unless traps have continuous or automatic residue removal.
- C. Install access openings at each change in direction and at 15-foot intervals; locate on sides of duct a minimum of 1-1/2 inches from bottom; and fit with grease-tight covers of same material as duct.
- D. Do not penetrate fire-rated assemblies.

3.4 DISHWASHER EXHAUST DUCT INSTALLATIONS

- A. Install dishwasher exhaust ducts according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

3.5 HANGING AND SUPPORTING

- A. Install rigid round and rectangular metal duct with support systems indicated in the latest edition of SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
- B. Support horizontal ducts within 24 inches of each elbow and within 48 inches of each branch intersection.
- C. Support vertical ducts at a maximum interval of 16 feet and at each floor.
- D. Install upper attachments to structures with an allowable load not exceeding one-fourth of failure (proof-test) load.

3.6 CONNECTIONS

- A. Connect equipment with flexible connectors according to Section "Duct Accessories."
- B. For branch, outlet and inlet, and terminal unit connections, comply with the latest edition of SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

3.7 DUCT APPLICATION

- A. Service: Round and rectangular, supply/return/outside -air ducts, concealed.
- B. Sheet-metal with wrap insulation
- C. Service: Round and rectangular, supply/return/outside -air ducts, exposed and in mechanical rooms.
 - 1. Sheet-metal double wall with lined insulation in-between.
 - 2. Inner sheet-metal duct shall be perforated in areas with acoustical requirements, ref. plans.

3.8 FIELD QUALITY CONTROL

- A. Disassemble, reassemble, and seal segments of systems as required to accommodate leakage testing and as required for compliance with test requirements.
- B. 25% of the duct installed after the air handling units and (prior to the air terminal units, when applicable) shall be tested in the presence of the Architect, at static pressures equal to maximum design pressure of system or section being tested. The sections of duct to be tested shall be chosen by the architect or engineer after installation of the duct. If pressure classifications are not indicated, test entire system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure. Give seven days' advance notice for testing.
- C. Leakage Test: Perform tests according to SMACNA's "HVAC Air Duct Leakage Test Manual."
- D. Maximum Allowable Leakage: Comply with requirements for Leakage Classification 3 for round, Leakage Classification 12 for rectangular ducts in pressure classifications less than and equal to 2-inch wg (both positive and negative pressures), and Leakage Classification 6 for pressure classifications from 2- to 10-inch wg.
- E. Remake leaking joints and retest until leakage is less than maximum allowable.

3.9 CLEANING

- A. After completing system installation, including outlet fittings and devices, inspect the system.

END OF SECTION

SECTION 23 33 00 - HVAC DUCT ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Backdraft dampers.
 - 2. Manual-volume dampers.
 - 3. Fire dampers.
 - 4. Turning vanes.
 - 5. Duct-mounted access doors and panels.
 - 6. Flexible ducts.
 - 7. Flexible connectors.
 - 8. Duct accessory hardware.

1.2 SUBMITTALS

- A. Product Data: For the following:
 - 1. Backdraft dampers.
 - 2. Manual-volume dampers.
 - 3. Fire dampers.
 - 4. Duct-mounted access doors and panels.
 - 5. Flexible ducts.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loadings, required clearances, method of field assembly, components, location, and size of each field connection. Detail the following:
 - 1. Special fittings and manual- and automatic-volume-damper installations.
 - 2. Fire-damper installations, including sleeves and duct-mounted access doors and panels.
- C. Product Certificates: Submit certified test data on dynamic insertion loss; self-noise power levels; and airflow performance data, static-pressure loss, dimensions, and weights.

1.3 QUALITY ASSURANCE

- A. NFPA Compliance: Comply with the following NFPA standards:
 - 1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."
 - 2. NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

1.4 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.
 - 1. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

PART 2 - PRODUCTS

2.1 SHEET METAL MATERIALS

- A. Galvanized, Sheet Steel: Lock-forming quality; ASTM A 653/A 653M, G90 (Z275) coating designation; mill-phosphatized finish for surfaces of ducts exposed to view.
- B. Carbon-Steel Sheets: ASTM A 366/A 366M, cold-rolled sheets, commercial quality, with oiled, exposed matte finish.
- C. Reinforcement Shapes and Plates: Galvanized steel reinforcement where installed on galvanized, sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- D. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for 36-inch (900-mm) length or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

2.2 BACKDRAFT DAMPERS

- A. Description: Suitable for horizontal or vertical installations.
- B. Frame: 0.052-inch- (1.3-mm-) thick, galvanized, sheet steel, with welded corners and mounting flange.
- C. Blades: 0.025-inch- (0.6-mm-) thick, roll-formed aluminum.
- D. Blade Seals: Vinyl.

- E. Blade Axles: Galvanized steel.
- F. Tie Bars and Brackets: Galvanized steel.
- G. Return Spring: Adjustable tension.

2.3 MANUAL-VOLUME DAMPERS

- A. General: Factory fabricated with required hardware and accessories. Stiffen damper blades for stability. Include locking device to hold single-blade dampers in a fixed position without vibration. Close duct penetrations for damper components to seal duct consistent with pressure class.
- B. Standard Volume Dampers: Multiple- or single-blade, parallel- or opposed-blade design as indicated, standard leakage rating, with linkage outside airstream, and suitable for horizontal or vertical applications.
 - 1. Steel Frames: Hat-shaped, galvanized, sheet steel channels, minimum of 0.064 inch (1.62 mm) thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls; and flangeless frames where indicated for installing in ducts.
 - 2. Roll-Formed Steel Blades: 0.064-inch- (1.62-mm-) thick, galvanized, sheet steel.
 - 3. Blade Axles: Galvanized steel.
 - 4. Tie Bars and Brackets: Galvanized steel.
- C. Jackshaft: 1-inch- (25-mm-) diameter, galvanized steel pipe rotating within a pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
 - 1. Length and Number of Mountings: Appropriate to connect linkage of each damper of a multiple-damper assembly.
- D. Damper Hardware: Zinc-plated, die-cast core with dial and handle made of 3/32-inch- (2.4-mm-) thick zinc-plated steel, and a 3/4-inch (19-mm) hexagon locking nut. Include center hole to suit damper operating-rod size. Include elevated platform for insulated duct mounting.

2.4 FIRE DAMPERS

- A. General: Labeled to UL 555.
- B. Fire Rating: One and one-half hours.
- C. Fire Rating: One and one-half hours.
- D. Frame: SMACNA Type B with blades out of airstream; fabricated with roll-formed, 0.034-inch- (0.85-mm-) thick galvanized steel; with mitered and interlocking corners.
- E. Mounting Sleeve: Factory- or field-installed galvanized, sheet steel.
 - 1. Minimum Thickness: 0.052 inch (1.3 mm) or 0.138 inch (3.5 mm) thick as indicated, and length to suit application.
 - 2. Exceptions: Omit sleeve where damper frame width permits direct attachment of perimeter mounting angles on each side of wall or floor, and thickness of damper frame complies with sleeve requirements.
- F. Mounting Orientation: Vertical or horizontal as indicated.
- G. Blades: Roll-formed, interlocking, 0.034-inch- (0.85-mm-) thick, galvanized, sheet steel. In place of interlocking blades, use full-length, 0.034-inch- (0.85-mm-) thick, galvanized steel blade connectors.
- H. Horizontal Dampers: Include a blade lock and stainless-steel negator closure spring.
- I. Fusible Link: Replaceable, 165 deg F (74 deg C) rated as indicated.

2.5 TURNING VANES

- A. Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
- B. Acoustic Turning Vanes: Fabricate of airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

2.6 DUCT-MOUNTED ACCESS DOORS AND PANELS

- A. General: Fabricate doors and panels airtight and suitable for duct pressure class.
- B. Frame: Galvanized, sheet steel, with bend-over tabs and foam gaskets.
- C. Door: Double-wall, galvanized, sheet metal construction with insulation fill and thickness, and number of hinges and locks as indicated for duct pressure class. Include vision panel where indicated. Include 1-by-1-inch (25-by-25-mm) butt or piano hinge and cam latches.
- D. Seal around frame attachment to duct and door to frame with neoprene or foam rubber.
- E. Insulation: 1-inch- (25-mm-) thick, fibrous-glass or polystyrene-foam board.

2.7 FLEXIBLE CONNECTORS

- A. General: Flame-retarded or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.
- B. Standard Metal-Edged Connectors: Factory fabricated with a strip of fabric 3-1/2 inches (89 mm) wide attached to two strips of 2-3/4-inch- (70-mm-) wide, 0.028-inch- (0.7-mm-) thick, galvanized, sheet steel or 0.032-inch (0.8-mm) aluminum sheets. Select metal compatible with connected ducts.
- C. Extra-Wide Metal-Edged Connectors: Factory fabricated with a strip of fabric 5-3/4 inches (146 mm) wide attached to two strips of 2-3/4-inch- (70-mm-) wide, 0.028-inch- (0.7-mm-) thick, galvanized, sheet steel or 0.032-inch (0.8-mm) aluminum sheets. Select metal compatible with connected ducts.
- D. Transverse Metal-Edged Connectors: Factory fabricated with a strip of fabric 3-1/2 inches (89 mm) wide attached to two strips of 4-3/8-inch- (111-mm-) wide, 0.028-inch- (0.7-mm-) thick, galvanized, sheet steel or 0.032-inch (0.8-mm) aluminum sheets. Select metal compatible with connected ducts.
- E. Conventional, Indoor System Flexible Connector Fabric: Glass fabric double coated with polychloroprene.
 - 1. Minimum Weight: 26 oz./sq. yd. (880 g/sq. m).
 - 2. Tensile Strength: 480 lbf/inch (84 N/mm) in the warp, and 360 lbf/inch (63 N/mm) in the filling.
- F. Conventional, Outdoor System Flexible Connector Fabric: Glass fabric double coated with a synthetic-rubber, weatherproof coating resistant to the sun's ultraviolet rays and ozone environment.
 - 1. Minimum Weight: 26 oz./sq. yd. (880 g/sq. m).
 - 2. Tensile Strength: 530 lbf/inch (93 N/mm) in the warp, and 440 lbf/inch (77 N/mm) in the filling.

2.8 FLEXIBLE DUCTS

- A. General: Comply with UL 181, Class 1.
- B. Flexible Ducts, Insulated: Factory-fabricated, insulated, round duct, with an outer jacket enclosing 1-1/2-inch- (38-mm-) thick, glass-fiber insulation around a continuous inner liner.
 - 1. Reinforcement: Steel-wire helix encapsulated in inner liner.
 - 2. Outer Jacket: Polyethylene film.
 - 3. Inner Liner: Polyethylene film.
- C. Pressure Rating: 6-inch wg (1500 Pa) positive, 1/2-inch wg (125 Pa) negative.

2.9 ACCESSORY HARDWARE

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments, and length to suit duct insulation thickness.
- B. Splitter Damper Accessories: Zinc-plated damper blade bracket; 1/4-inch (6-mm), zinc-plated operating rod; and a duct-mounted, ball-joint bracket with flat rubber gasket and square-head set screw.
- C. Flexible Duct Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action, in sizes 3 to 18 inches (75 to 450 mm) to suit duct size.
- D. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install duct accessories according to applicable details shown in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for metal ducts and NAIMA's "Fibrous Glass Duct Construction Standards" for fibrous-glass ducts.
- B. Install volume dampers in lined duct; avoid damage to and erosion of duct liner.
- C. Provide test holes at fan inlet and outlet and elsewhere as indicated.
- D. Install fire and smoke dampers according to manufacturer's UL-approved written instructions.
 - 1. Install fusible links in fire dampers.
- E. Install duct access panels for access to both sides of duct coils. Install duct access panels downstream from volume dampers, fire dampers, turning vanes, and equipment.
 - 1. Install duct access panels to allow access to interior of ducts for cleaning, inspecting, adjusting, and maintaining accessories and terminal units.
 - 2. Install access panels on side of duct where adequate clearance is available.
- F. Label access doors according to Division "Mechanical Identification."

3.2 ADJUSTING

- A. Adjust duct accessories for proper settings.
- B. Adjust fire dampers for proper action.
- C. Final positioning of manual-volume dampers is specified in Section "Testing, Adjusting, and Balancing."

END OF SECTION

SECTION 23 33 46 - FLEXIBLE DUCTS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:

1. Furnish and install supply air branch duct runouts to diffusers as described in Contract Documents.

1.2 REFERENCES

A. Reference Standards:

1. National Fire Protection Association / American National Standards Institute:
 - a. NFPA 90A: 'Standard for the Installation of Air-Conditioning and Ventilating Systems' (2012 Edition).
2. Underwriters Laboratories:
 - a. UL 181, 'Factory-Made Ducts and Air Connectors' (10th Edition).
 - b. UL 181B, 'Closure Systems for Use With Flexible Air Ducts and Air Connectors' (3rd Edition).

PART 2 - PRODUCTS

2.1 SYSTEM

A. Manufacturers:

1. Manufacturer Contact List:
 - a. Anco Products Inc,
 - b. Thermaflex by Flexible Technologies
 - c. Flexmaster USA Inc, Houston, TX

B. Materials:

1. Ducts:
 - a. Formable, flexible, circular duct which shall retain its cross-section, shape, rigidity, and shall not restrict airflow after bending.
 - b. Insulation:
 - 1) Nominal 1-1/2 inches (38 mm), 3/4 lb per cu ft (12 kg per cu m) density fiberglass insulation with air-tight, polyethylene or polyester core, sheathed in seamless vapor barrier jacket factory installed over flexible assembly.
 - c. Assembly, including insulation and vapor barrier, shall meet Class I requirement of NFPA 90A and be UL 181 rated, with flame spread of 25 or less and smoke developed rating of 50 or under.
 - d. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - 1) ANCO-FLEX 4625 by Anco Products.
 - 2) M-KC by Thermaflex by Flexible Technologies.
 - 3) Type 4m Insulated by Flexmaster.
2. Cinch Bands: Nylon, 3/8 inch removable and reusable type.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install duct in fully extended condition free of sags and kinks, using 60 inch maximum lengths.
- B. Make duct connections by coating exterior of duct collar for 3 inches with duct sealer and securing duct in place over sheet metal collar with specified cinch bands.

END OF SECTION

SECTION 23 34 16 - CENTRIFUGAL HVAC FANS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes centrifugal fans and vent sets.

1.2 PERFORMANCE REQUIREMENTS

- A. Project Altitude: Base air ratings on actual site elevations.
- B. Operating Limits: Classify according to AMCA standards.

1.3 SUBMITTALS

- A. Product Data: Include rated capacities, furnished specialties, and accessories for each unit scheduled and include the following:
 - 1. Certified fan performance curves with system operating conditions indicated.
 - 2. Certified fan sound-power ratings.
 - 3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
 - 4. Material gages and finishes, including color charts.
 - 5. Dampers, including housings, linkages, and operators.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.
- C. Maintenance Data: For centrifugal fans to include in maintenance manuals specified in specifications.

1.4 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. AMCA Compliance: Products shall comply with performance requirements and shall be licensed to use the AMCA-Certified Ratings Seal.
- C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver fans as factory-assembled units, to the extent allowable by shipping limitations, with protective crating and covering.
- B. Disassemble and reassemble units, as required for moving to the final location, according to manufacturer's written instructions.
- C. Lift and support units with manufacturer's designated lifting or supporting points.

1.6 COORDINATION

- A. Coordinate size and location of structural support members and/or shaft locations.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in these documents.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Belts: One set for each belt-driven unit.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cook, Loren Company.
 - 2. Greenheck.

2.2 HOUSINGS

- A. Roof Mounted Centrifugal Exhaust Fan.
 - 1. The fan shall be of bolted and welded construction utilizing corrosion resistant fasteners. The spun aluminum structural components shall be constructed of minimum 16 gauge marine alloy aluminum, bolted to a rigid

aluminum support structure. The aluminum base shall have continuously welded curb cap corners for maximum leak protection. The discharge baffle shall have a rolled bead for added strength. An integral conduit chase shall be provided through the curb cap and into the motor compartment to facilitate wiring connections. Bearings and drives shall be mounted on a minimum 14 gauge steel power assembly, isolated from the unit structure with rubber vibration isolators. These components shall be enclosed in a weather-tight compartment, separated from the exhaust airstream. Unit shall bear an engraved aluminum nameplate and shall be shipped in ISTA certified transit tested packaging.

2.3 WHEELS

A. Roof Mounted Centrifugal Exhaust Fan

1. Wheel shall be centrifugal backward inclined, constructed of 100% aluminum, including a precision machined cast aluminum hub. Wheel inlet shall overlap an aerodynamic aluminum inlet cone to provide maximum performance and efficiency. Wheel shall be balanced in accordance with AMCA Standard 204-96, Balance Quality and Vibration Levels for Fans.

2.4 SHAFTS

- A. Statically and dynamically balanced and selected for continuous operation at maximum rated fan speed and motor horsepower, with final alignment and belt adjustment made after installation.
- B. Turned, ground, and polished hot-rolled steel with keyway. Ship with a protective coating of lubricating oil.
- C. Designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.

2.5 BEARINGS

A. Prelubricated and Sealed Shaft Bearings: Self-aligning, pillow-block-type ball bearings.

1. Ball-Bearing Rating Life: ABMA 9, L₅₀ of 200,000 hours.
2. Roller-Bearing Rating Life: ABMA 11, L₅₀ of 200,000 hours.

2.6 BELT DRIVES

- A. Description: Factory mounted, with final alignment and belt adjustment made after installation.
 1. Service Factor Based on Fan Motor: 1.5.
- B. Fan Pulleys: Cast iron or cast steel with split, tapered bushing; dynamically balanced at factory.
- C. Motor Pulleys: Adjustable pitch for use with motors through 5 hp; fixed pitch for use with motors larger than 5 hp. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
- D. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.
- E. Motor Mount: Adjustable for belt tensioning.

2.7 ACCESSORIES

- A. Scroll Access Doors: Shaped to conform to scroll, with quick-opening latches and gaskets.
- B. Companion Flanges: Galvanized steel, for duct connections.
- C. Scroll Drain Connection: **NPS 1 (DN 25)** steel pipe coupling welded to low point of fan scroll.
- D. Shaft Cooler: Metal disk between bearings and fan wheel, designed to dissipate heat from shaft.
- E. Spark-Resistant Construction: AMCA 99 (where required).
- F. Shaft Seals: Airtight seals installed around shaft on drive side of single-width fans.
- G. Weather Cover: Enameled-steel sheet with ventilation slots, bolted to housing.

2.8 MOTORS

- A. Refer to Section "Motors" for general requirements for factory-installed motors.
- B. Motor Construction: NEMA MG 1, general purpose, continuous duty, high efficiency, Design B.
- C. Enclosure Type: [Open dripproof] [Totally enclosed, fan cooled].

2.9 SOURCE QUALITY CONTROL

- A. Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.
- B. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install centrifugal fans level and plumb.

- B. Install units with clearances for service and maintenance.
- C. Label fans according to requirements specified in Section "Mechanical Identification."

3.2 CONNECTIONS

- A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section "Duct Accessories."
- B. Install ducts adjacent to fans to allow service and maintenance.
- C. Ground equipment.
- D. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.3 FIELD QUALITY CONTROL

- A. Equipment Startup Checks:
 - 1. Verify that shipping, blocking, and bracing are removed.
 - 2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
 - 3. Verify that cleaning and adjusting are complete.
 - 4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
 - 5. Verify lubrication for bearings and other moving parts.
- B. Starting Procedures:
 - 1. Energize motor and adjust fan to indicated rpm.
 - 2. Measure and record motor voltage and amperage.
- C. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new units, and retest.
- D. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Shut unit down and reconnect automatic temperature-control operators.
- F. Refer to Section "Testing, Adjusting, and Balancing" for testing, adjusting, and balancing procedures.
- G. Replace fan and motor pulleys as required to achieve design airflow.
- H. Repair or replace malfunctioning units. Retest as specified above after repairs or replacements are made.

3.4 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Adjust belt tension.
- C. Lubricate bearings.

3.5 CLEANING

- A. On completion of installation, internally clean fans according to manufacturer's written instructions. Remove foreign material and construction debris. Vacuum fan wheel and cabinet.
- B. After completing system installation, including outlet fitting and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain centrifugal fans.
 - 1. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment and schedules.
 - 2. Review data in maintenance manuals. Refer to specifications Section "Closeout Procedures."
 - 3. Schedule training with Owner, through Architect, with at least seven days' advance notice.

END OF SECTION

SECTION 23 37 13 - DIFFUSERS, REGISTERS AND GRILLES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes ceiling- and wall-mounted diffusers, registers, and grilles.

1.2 DEFINITIONS

- A. Diffuser: Circular, square, or rectangular air distribution outlet, generally located in the ceiling and comprised of deflecting members discharging supply air in various directions and planes and arranged to promote mixing of primary air with secondary room air.
- B. Grille: A louvered or perforated covering for an opening in an air passage, which can be located in a sidewall, ceiling, or floor.
- C. Register: A combination grille and damper assembly over an air opening.

1.3 SUBMITTALS

- A. Product Data: For each model indicated, include the following:
 - 1. Data Sheet: For each type of air outlet and inlet, and accessory furnished; indicate construction, finish, and mounting details.
 - 2. Performance Data: Include throw and drop, static-pressure drop, and noise ratings for each type of air outlet and inlet.
 - 3. Schedule of diffusers, registers, and grilles indicating drawing designation, room location, quantity, model number, size, and accessories furnished.
 - 4. Assembly Drawing: For each type of air outlet and inlet; indicate materials and methods of assembly of components.
- B. Coordination Drawings: Reflected ceiling plans and wall elevations drawn to scale to show locations and coordination of diffusers, registers, and grilles with other items installed in ceilings and walls.

1.4 QUALITY ASSURANCE

- A. NFPA Compliance: Install diffusers, registers, and grilles according to NFPA 90A, "Standard for the Installation of Air-Conditioning and Ventilating Systems."

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

- A. Diffusers, registers, and grilles are scheduled on Drawings.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Titus.
 - 2. Price

2.2 SOURCE QUALITY CONTROL

- A. Testing: Test performance according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb, according to manufacturer's written instructions, Coordination Drawings, original design, and referenced standards.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practicable. Coordinate device locations with ceiling grid, sprinklers, and lights. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

- C. Install diffusers, registers, and grilles with airtight connection to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

3.4 CLEANING

- A. After installation of diffusers, registers, and grilles, inspect exposed finish. Clean exposed surfaces to remove burrs, dirt, and smudges. Replace diffusers, registers, and grilles that have damaged finishes.

END OF SECTION

SECTION 26 00 00 - ELECTRICAL

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 WORK COVERED BY CONTRACT DOCUMENTS

- A. The following Summary of Work is intended as an aid to achieve an understanding of the various elements of work included in the project, as is not intended to be all-inclusive. Detailed descriptions of work and requirements are given in drawings and specifications.
- B. General Scope of Work:
 - 1. Providing new panels, feeders, conduits, disconnect, fire alarm, rough-in for telephone and data system, and new light fixtures.

1.4 COORDINATION

- A. All electrical work shall be done under sub-contract to a General Contractor. Electrical Contractor shall coordinate all work through General Contractor, even in areas where only electrical work is to take place.
- B. Work shall take place with minimal disruption to Owner's operations in areas surrounding the new building.
- C. Cooperate fully with other contractors so that work under those contracts may be carried out smoothly, without interfering with or delaying work under this Contract.
- D. Fully coordinate with mechanical contractor for providing power to mechanical equipment.

1.5 UTILITIES

- 1. Coordinate with power company and provide conduit, and trenching from transformer to power source. Coordinate with water, telephone, cable and gas utilities to locate all utilities prior to digging in any area.
- 2. Obtain any approvals required from utilities to relocate utilities.
- 3. Cost of relocating or bypassing utilities indicated on drawings shall be included in Base Bid.

1.6 CONTRACTOR USE OF PREMISES

- A. Use of the Site: Limit use of the premises to work in areas indicated. Confine operations to areas within contract limits indicated. Do not disturb portions of the site beyond the areas in which the Work is indicated.
 - 1. Driveways and Entrances: Keep driveways and entrances serving the premises, clear and available to the Owner, the Owner's employees, and emergency vehicles at all time. Do not use these areas for parking or storage of materials. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
- B. Site Safety: Take every precaution to ensure the site does not present a threat to the safety of occupants and/or workers. Minimal safety requirements include, but are not limited to the following:
 - 1. Temporary fencing around construction areas.
 - 2. Yellow caution tape and construction barricades along open trenches during the day. Trenches shall be covered at night and warning lights provided on construction barricades.
 - 3. Temporary fencing around equipment while site work is in progress.

1.7 SUBMITTALS

1. To expedite the submittal process more efficiently, do not piece-meal the submittals. Submit entire electrical in a bound enclosure. This will eliminate delays in the submittal process. Unbound submittals shall be returned without review. Submit 10 copies minimum.

END OF SECTION

SECTION 26 01 20 OPERATION AND MAINTENANCE OF LOW-VOLTAGE ELECTRICAL DISTRIBUTION

PART1- GENERAL

1.1 RELATED REQUIREMENTS

- A. The General Provisions, Supplemental General Provisions, Special Provisions, Specification Sections and all relevant documents shall form a part of this Section of the Specifications, and shall be incorporated in this Section and each Section 260000 hereinafter as if repeated verbatim herein. All conditions imposed by these documents shall be applicable to all portions of the work under this Section. Certain specific paragraphs of said references may be referred to hereinafter in this Section. These references are intended to point out specific items to the Contractor, but in no way relieve him of the responsibility of reading and complying with all relevant parts of the entire Specification.
- B. The Contractor shall examine and coordinate with all Contract Drawings and Specifications, and all Addenda issued. Failure to comply shall not relieve him of responsibility. The omission of details of other portions of the work from this Section shall not be used as a basis for a request for additional compensation.
- C. The specific features and details for other portions of the work related to the construction in progress or to the adjacent building shall be determined by examination at the site.

1.2 SCOPE OF WORK

- A. The requirements contained in this Section apply to all work performed under these Specifications.
- B. The work covered by this Section of the Specifications comprises the furnishing of labor, material, equipment, transportation, tools and services, and performing operations required for, and reasonably incidental to, the installation of the work in accordance with the applicable Contract Documents, and subject to the terms and conditions of the Contract.
- C. Refer to other Sections of the Specifications for related work.

1.3 DEFINITION OF "CONTRACTOR"

- A. Where the word "Contractor" is used under any Section of this Section of the Specifications, it shall mean the Contractor engaged to execute the work included under that Section, even though this Contractor may be technically described as a Subcontractor, or an authorized representative.
- B. If the Contractor, engaged to execute a portion of the work, employs a Subcontractor to perform some of that work, he shall be completely responsible for the proper execution of this Subcontractor's work, in full conformity with the Contract Documents.

1.4 RESPONSIBILITY OF THE CONTRACTOR

- A. The Contractor shall be responsible for all work of every description in connection with this Section of the Specifications. The Contractor shall specifically and distinctly assume, and does zeso assume, all risk for damage or injury from whatever cause to property or person used or employed on or in connection with this work and of all damages or injury to any person or property wherever located, resulting from an action or operation under the Contract in connection with the work, and undertake the responsibility to defend the Owner against all claims on account of any such damage or injury.
- B. The Contractor will be held responsible for the satisfactory execution and completion of the work in accordance with the true intent of the Contract Documents. The Contractor shall provide without extra charge all incidental items required as part of the work, even though it may not be specifically indicated. If the Contractor has reason for objecting to the use of any material, equipment, device or method of construction as indicated, the Contractor shall make report of such objections to the Owner's Representative, obtain proper approval and adjustment to the Contract, and shall proceed with the work.

1.5 TERMINOLOGY

- A. Whenever the words "furnish", "provide", "furnish and install", "provide and install", and similar phrases occur, it is the intent that the materials, equipment and devices described be furnished, installed and connected under this Section, complete for operation, unless specifically noted to the contrary.
- B. It is also the intent, unless specifically noted to the contrary, that all materials, equipment and devices described and specified under this Section of the Specifications be similarly furnished, installed and connected under this Section, whether or not a phrase as described in the preceding paragraph has been actually included.
- C. Whenever the words "Owner's Representative" occurs, it is intended to refer to the Architect, Engineer and/or specific Owner's Representative responsible for or capable of providing the necessary direction pertaining to the referenced issue.

1.6 ORDINANCES, PERMITS AND CODES

- A. It shall be the Contractor's duty to perform the work and provide the materials covered by these specifications in conformance with all ordinances and regulations of all authorities having jurisdiction.
- B. All work herein shall conform to all applicable laws, ordinances and regulations of the local utility companies.
- C. The Contractor shall obtain and pay for all permit and connection fees as required for the complete installation of the specified systems, equipment, devices and materials.
- D. The Contractor shall obtain permits, plan checks, inspections and approvals applicable to the work as required by the regulatory authorities. Fees and costs of any nature whatsoever incidental to these permits, inspections and approvals shall be assumed and paid by the Contractor. The pro-rata costs, if any, for utilities serving this property will be paid for by the Owner and shall not be included as part of this Contract.
- E. The work shall be in accordance with, but shall not be limited to, the requirements of:
 - 1 National Fire Protection Association
 - 2 National Electrical Code
 - 3 National Safety Code
 - 4 State of Texas Safety Code
 - 5 Local City Building Codes
 - 6 State of Texas Building Codes
- F. Codes and standards referred to are minimum standards. Where the requirements of the Drawings or Specifications exceed those of the codes and regulations, the Drawings and Specifications govern.

1.7 MATERIALS, EQUIPMENT AND DEVICE DESCRIPTION

- A. Materials, equipment and devices shall be of the best quality customarily applied in quality commercial practice, and shall be the products of reputable manufacturers. Each major component shall bear a nameplate giving the name and address of the manufacturer, and the catalog number or designation of the component.
- B. Materials, equipment and devices furnished under this Section of the Specifications shall be essentially the standard product of the specified manufacturer, or where allowed, an alternate manufacturer. Where two or more units of the same kind or class of a specific item are required, these shall be the products of a single manufacturer; however, the component parts of the item need not be the products of one manufacturer.
- C. In describing the various materials, equipment and devices, in general each item will be described singularly, even though there may be a multiplicity of identical items. Also, where the description is only general in nature, exact sizes, duties, space arrangements, horsepower requirements and other data shall be determined by reference to the Contract Documents.
- D. Space allocations for materials, equipment and devices have been made on the basis of present and known future requirements and the dimensions of items of equipment or devices of a particular manufacturer

whether indicated or not. The Contractor shall verify that all materials, equipment and devices proposed for use on this project are within the constraints of the allocated space.

1.8 QUALITY ASSURANCE

- A. Materials, equipment and devices shall be new and of the quality specified, and shall be free from defects at the time of installation. Materials, equipment and devices damaged in shipment or otherwise damaged or found defective prior to acceptance by the Owner shall not be repaired at the job site, but shall be replaced with new materials, equipment or devices identical with those damaged, unless specifically approved otherwise by the Owner's Representative.
- B. Wherever a UL standard has been established for a particular type of material, equipment or device, each item of such material, equipment or device provided on this project shall meet the requirements of the UL standard in every way, and shall be UL listed and labeled.

1.9 REFERENCE STANDARDS

- A. Materials, equipment, devices and workmanship shall comply with applicable local, county, state and national codes, laws and ordinances, utility company regulations and industry standards.
- B. In case of differences between building codes, state laws, local ordinances, industry standards, utility company regulations and the Contract Documents, the most stringent shall govern. The Contractor shall promptly notify the Owner's Representative in writing of any such difference. Should the Contractor perform any work that does not comply with local codes, laws and ordinances, industry standards or other governing regulations, the work shall be corrected of noncompliance deficiencies with the Contractor bearing all costs.
- C. In addition to the aforementioned ordinances, industry standards published by the following organizations shall apply:

AABM	-	American Association of Battery Manufacturers
ADA	-	American's with Disabilities Act
AIA	-	American Institute of Architects
ANSI	-	American National Standards Institute
ASTM	-	American Society for Testing and Materials
CBM	-	Certified Ballast Manufacturers Association
ETL	-	Electrical Testing Laboratories
FM	-	Factory Mutual
ICEA	-	Insulated Cable Engineers Associated
IEEE	-	Institute of Electrical and Electronic Engineers
IES	-	Illuminating Engineering Society
IRI	-	Industrial Risk Insurance
NBS	-	National Bureau of Standards
NEC	-	National Electrical Code
NECA	-	National Electrical Contractors Association
NEMA	-	National Electrical Manufacturers Association
NESC	-	National Electrical Safety Code
NETA	-	National Electrical Testing Association
NFPA	-	National Fire Protection Association
UL	-	Underwriters Laboratories

1.10 DRAWINGS AND SPECIFICATIONS

- A. The interrelation of the Drawings (including the schedules) and the Specifications are as follows:
 - 1 The Drawings establish quantities, locations, dimensions and details of materials, equipment and devices. The schedules on the Drawings indicate the capacities, characteristics and components.
 - 2 The Specifications provide written requirements for the quality, standard and nature of the materials, equipment, devices and construction systems.
- B. The Drawings and Specifications shall be considered as being compatible; therefore, the work called for by one and not by the other shall be furnished and installed as though called for by both. Resolution of conflicts between Drawings and Specifications shall be as follows:
 - 1 If the Drawings and Specifications disagree in themselves, or with each other, the Contractor's pricing shall be based on furnishing and installing the most expensive combination of quality and quantity of work indicated for a complete operable system. Contractor is responsible to notifying the Architect and Engineer. In the event of this type of disagreement, the resolution shall be determined by the Owner's Representative. The contractor shall assume for an operable system at the most expensive combination as per the latest National Electrical Code. The contractor shall review all drawings and specifications prior to bid date.
 - 2 The Contractor shall be responsible for bringing any conflicts in the Drawings and the Specifications to the attention of the Owner's Representative immediately, prior to bid date.
 - 3 In general, if there is conflict between the Drawings and Specifications, the Drawings shall govern the Specifications.
 - 4 Where the Specifications do not fully agree with schedules on the Drawings, the schedules shall govern. Actual numerical dimensions indicated on the Drawings govern scale measurements and large scale details govern small scale drawings.
 - 5 Materials, equipment and devices called for on the Drawings and not indicated herein, shall be completely provided and installed as though it were fully described herein.
 - 6 Materials, equipment and devices called for herein shall be completely provided and installed, whether or not it is fully detailed, scheduled or indicated on the Drawings.
- C. The Contractor shall examine the Drawings and Specifications of the other portions of the work for fixtures and finishes in connection with this work. The Contractor shall carefully examine the Drawings to determine the general construction conditions, and shall familiarize himself with all limitations caused by such conditions.
- D. When discrepancies exist between scale and dimension, or between the Drawings of the various portions of the work, they shall be called to the attention of the Owner's Representative for further instruction, whose instructions shall be final and binding and work promptly resumed without any additional cost to the Owner.
- E. Review the construction details of the building(s) as illustrated on the Drawings of the other portions of the work, i.e., architectural, structural, civil, landscape, etc., and be guided thereby. Route conduits and set all boxes as required by the pace of the general construction.
- F. The Drawings diagrammatically show the sizes and locations of the various equipment and devices, and the sizes of the major interconnecting wires, without showing exact details as to elevations, offsets, control wiring and other installation requirements. Carefully layout the work at the site to conform to the architectural and structural conditions, to avoid obstructions and to permit proper grading of pipe associated with other portions of the work. In cooperation with other Contractors, determine the exact location of equipment and devices and connections thereto by reference to the submittals and rough-in drawings, and by measurements at the site. Make minor relocations necessitated by the conditions at the site, or directed by the Owner's Representative, without additional cost to the Owner.
- G. The Drawings and Specifications are intended to describe and illustrate systems which will not interfere with the structure of the building(s), fit into the available spaces, and insure complete and satisfactory

operating installations. Prepare installation drawings as required for all critical areas illustrating the installation of the work in this Section as related to the work of all other Sections and correct all interferences with the other portions of the work or with the building structures before the work proceeds.

- H. The Drawings do not indicate the existing electrical installations other than to identify modifications or extensions thereto. Visit the site and ascertain the conditions to be met and the work to be accomplished in removing and modifying the existing work, and in installing the new work. Failure to comply with this shall not constitute grounds for any additional payment in connection with removing or modifying any part of the existing installation or installing any new or temporary work under this Section.

1.11 SUBMITTALS

- A. Submit product data and shop drawings in accordance with the Specifications.
- B. Process product data and shop drawings to insure that the proposed materials, equipment and devices conform to the requirements of the Contract Documents, and that there are no omissions or duplications. Provide layouts, fabrication information and data for systems, materials, equipment and devices proposed for the project.
- C. Submittals shall be provided for review and approval on all systems, equipment, devices and materials proposed for use on this project. Submittals shall include, but not be limited to, the following:
 - 1 Lighting and Appliance Panelboards
 - 2 Disconnect Switches
 - 3 Circuit Breakers and Fuses
 - 4 Materials: conduit, conductors, connectors, supports, etc.
 - 5 Lighting Fixtures, Lamps and Control Systems/Devices
 - 6 Wiring Devices
 - 7 Transformers
 - 8 Distribution Panelboards
 - 9 Motor Control Center
 - 10 As indicated on each submittal section
- D. The product data shall not consist of manufacturer's catalogs or cut sheets that contain no indication of the exact item offered. The submission on individual items shall designate the exact item offered.
- E. Do not submit detailed quantitative listings of materials, equipment and devices. It is the Contractor's responsibility to provide proper sizes and quantities to conform to Contract Documents.
- F. Assemble submittals on related items procured from a single manufacturer in bound brochures or other suitable package form, rather than submitting a multiplicity of loose sheets.
- G. Prepare shop drawings whenever equipment proposed varies in physical size and arrangement from that indicated thus causing rearrangement of equipment space, where tight spaces require extreme coordination between this work and other work, where called for elsewhere in these Specifications and where specifically requested by the Owner's Representative. Shop drawings shall be prepared at a scale of not less than 1/4 inch equals 1 foot.
- H. The Contractor shall sign the submittal as an indication of compliance with the Contract Documents. If there are any deviations from the Contract Documents, he shall so indicate on the submittal. Any deviations not so indicated shall be cause for rejection and removal of the non-complying equipment at the Contractor's expense.

1.12 SUBSTITUTIONS

- A. Where a single manufacturer is mentioned by trade name or manufacturer's name, unless specifically noted otherwise, it is the only manufacturer that will be accepted.
- B. Where multiple manufacturers are listed, none other than those manufacturers will be accepted.
- C. Manufacturers not listed will be considered for substitution prior to bid only. The substitute manufacturer shall submit a complete copy of the appropriate technical specification section minimum seven (7)

business days prior to bid with each sub-paragraph noted with the comment, "compliance", "deviation", "alternate" or "not applicable". In the case of non-primary, vendor-supplied items, the name of the sub-vendor supplying said item, including model number, shall be indicated.

- 1 By noting the term "compliance" or "C", it shall be understood that the manufacturer is in full compliance with the item specified and will provide exactly the same with no deviations.
 - 2 By noting the term "deviation" or "D", it shall be understood that the manufacturer prefers to provide a different component in lieu of that specified. Manufacturer shall indicate all deviations.
 - 3 By noting the term "alternate" or "A", it shall be understood that the manufacturer proposes to provide the same operating function but prefers to do it in a different manner. An alternate shall be fully described as to what the manufacturer proposes to provide.
 - 4 By noting the term "not applicable" or "N/A", it shall be understood that the specified item is not applicable to the project.
- D. It shall be understood that space allocations have been made on the basis of present and known future requirements and the dimensions of items of equipment or devices of a particular manufacturer whether indicated or not. If any item of equipment or device is offered in substitution which differs substantially in dimension or configuration from that indicated on the Drawings or specifications, provide as part of the submittal 1/4 inch equals 1 foot scaled drawings showing that the substitute can be installed in the space available without interfering with other portions of the work or with access for operations and maintenance in the completed project.
- E. Where substitute equipment or devices requiring different arrangement or connections from that indicated is accepted by the Owner's Representative, install the equipment or devices to operate properly and in harmony with the intent of the Contract Documents, making all incidental changes in piping, ductwork or wiring resulting from the equipment or device selection without any additional cost to the Owner. The Contractor shall pay all additional costs incurred by other portions of the work in connection with the substituted equipment or device.
- F. The Owner's Representative reserves the right to call for samples of any item of material, equipment or device offered in substitution, together with a sample of the specific item when, in their opinion, the quality of the item and/or the appearance is involved, and it is deemed that an evaluation of the item may be better made by visual inspection.
- G. When any request for a substitution of material, equipment or device is submitted and rejected, the item named in the Contract Documents shall be furnished. Repetitive submittal of substitutions for the same item will not be considered.

1.13 INSTALLATION DRAWINGS

- A. Prepare installation drawings for coordinating the work of this Section with the work of other Sections, to illustrate its concealment in finished spaces, to avoid obstructions, and to demonstrate the adaptability of any item of material, equipment or device in the space upon which the Contract Documents are based.
- B. Use these drawings in the field for the actual installation of this work. Provide three (3) copies, not for approval, to the Owner's Representative for his information, review and record.

1.14 WORKMANSHIP AND INSTALLATION

- A. In no case shall the Contractor provide a class of material, equipment, device or workmanship less than that required by the Contract Documents or applicable codes, regulations, ordinances or standards. All modifications which may be required by a local authority having legal jurisdiction over all or any part of the work shall be made by the Contractor without any additional charge. In all cases where such authority requires deviations from the requirements of the Drawings or Specifications, the Contractor shall report same to the Owner's Representative and shall secure his approval before the work is started.
- B. The work shall be performed by properly licensed technicians skilled in their respective trades. All materials, equipment and devices shall be installed in accordance with the recommendations of the manufacturer and in the best standard practice to bring about results of a first class condition.

- C. The NECA "Standards of Installation" as published by the National Electrical Contractors Association shall be considered a part of these Specifications, except as specifically modified by other provisions contained in these Specifications.

1.15 INSPECTION OF SITE

- A. The accompanying drawings do not indicate existing installations other than to identify modifications of and extensions thereto. The Contractor shall visit the site, inspect the installations and ascertain the conditions to be met and the work to be performed. Failure to comply with this shall not constitute ground for any additional payments in connection with removing or modifying any part of the existing installations and/or installing any new work under this Section.
- B. Review construction details of the adjacent building presently under construction during the site inspection and include all work required to modify the existing installations and install new materials, comprising a part of the installation. Review all construction details of the new building as illustrated on the drawings and be guided thereby.

1.16 WARRANTY

- A. All materials, equipment, devices and workmanship shall be warranted for a period of one year from the date of acceptance by the Owner's Representative for beneficial use by the Owner, except that where specific equipment is noted to have extended warranties. The warranty shall be in accordance with AIA Document A201. The Contractor shall be responsible for the proper registration of these warranties so that the Owner can make all proper claims should future need develop.
- B. The Contractor shall furnish to the Owner's Representative for transmittal to the Owner, the name, address and telephone number of those persons responsible for service on systems and equipment covered by the warranty.

1.17 OPERATION PRIOR TO ACCEPTANCE

- A. When any equipment is operable, and it is to the advantage of the Contractor to operate the equipment, the Contractor may do so provided that he properly supervises the operation, and retains full responsibility for the equipment operated. Regardless of whether or not the equipment has or has not been operated, the Contractor shall clean the equipment properly, make required adjustments and complete punch list items before final acceptance by the Owner.

1.18 INSTRUCTION OF OWNER'S PERSONNEL

- A. Provide the services of competent engineers and/or technicians acceptable to the Owner's Representative to instruct other representatives of the Owner in the complete and detailed operation of each item of equipment or device of all the various electrical systems. These instructions shall be provided for whatever periods may be necessary to accomplish the desired results. Upon completion of these instructions, the Contractor shall obtain a letter of release, acknowledged by the Owner or his authorized representative, stating the dates on which the various kinds of instruction were given, and the personnel to whom the instructions were given.
- B. The Contractor shall be fully responsible for proper maintenance of equipment and systems until the instructions have been given to the Owner's personnel and the letter of release acknowledged.
- C. In providing the instructions to the Owner's personnel, the written operating and maintenance manuals shall be followed in all instances, and the Owner's personnel shall be familiarized with such manuals. Operating and maintenance manuals used for instructions shall include wiring diagrams, manufacturer's operating and maintenance instructions, parts lists (with sources identified), and other data as appropriate for each system.

1.19 SCHEDULE AND SEQUENCE OF WORK

- A. The Contractor shall meet and cooperate with the Owner and Owner's Representative to schedule and sequence this work so as to insure meeting scheduled completion dates and avoid delaying other portions of the work. Work requiring special sequencing shall be at no additional cost to the Owner and shall have

no impact on the schedule.

1.20 INSTALLATION INSPECTIONS AND CERTIFICATIONS

- A. Obtain timely inspections of the installation by the regulatory authorities. Remedy any deficiencies to the satisfaction of the inspecting official.
- B. Upon final completion of the work, obtain certificates of acceptance from the regulatory authorities. Deliver the certificates to the Owner's Representative for transmission to the Owner.

1.21 EQUIPMENT INSTALLATION

- A. Install equipment and devices in a manner to permit access to all surfaces or components, requiring such access, without the need to disassemble other unrelated parts of the work.
- B. Equipment specified to be factory assembled and tested prior to shipment shall not be disassembled at the job site and reassembled at its final location. Apparatus not so specified may be disassembled and reassembled in the proper location.
- C. Furnish all scaffolding, rigging and hoisting required for the installation of all the work.

1.22 CONCRETE HOUSEKEEPING PADS

- A. Concrete housekeeping pads shall be provided for all floor mounted equipment, unless noted or required otherwise.
- B. All pads shall be not less than 3-1/2" high and extend a maximum 3" beyond the actual equipment size. Coordinate the proper size of the pad with the equipment furnished. Pads shall be poured in forms built of new dressed lumber with corners chamfered using sheet metal or triangular wood strips nailed to the form. Use 6 x 6 No. 3 mesh for reinforcing. Install heavy duty adjustable anchor bolts, set in the form and positioned using templates, prior to pouring concrete. After the equipment is set on the pad, the equipment shall be aligned, leveled and fully grouted to the pad and all void spaces shall be filled with a non-shrinking grout.
- C. Perform all concrete work specified to be provided under this Section in strict accordance with the applicable provisions of Section, CONCRETE.

1.23 SLEEVES

- A. Each conduit, regardless of material, which passes through a concrete slab, masonry wall, or roof or portion of the building structure shall be free from the structure and shall pass through a sleeve.
- B. All sleeves shall be constructed from electrical-metallic tubing or equivalent weight galvanized steel tubing and shall be flush on both sides of the surface penetrated, unless noted otherwise. All sleeves penetrating the roof areas shall extend a minimum 10 inches above the roof with approved weatherproof counterflashing attached to the conduit above the roof. All sleeves penetrating floors shall extend a minimum of 6 inches above the finished floors. The sleeves shall be sized to allow free passage of the conduit to be inserted.
- C. Sleeves passing through walls or floors on or below grade or in moist areas shall be constructed of galvanized rigid steel and shall be designed with a suitable flange in the center to form a waterproof passage. After the conduit has been installed in the sleeves, the void space around the conduit shall be caulked and filled with an asphalt-base compound to insure a waterproof penetration. Jute twine caulking shall not be used due to susceptibility to termite infestation.

1.24 ESCUTCHEONS

- A. In each finished space, provide a chromium plated, sectional escutcheon on each conduit, or hanger rod penetrating a wall, floor or ceiling.
- B. Size escutcheons and collars to fit snugly around conduit and rods.
- C. Where required, provide escutcheons with set screws so that they fit snugly against the finished surface.

1.25 ACCESS PANELS

- A. Provide wall and ceiling access panels for unrestricted access to all concealed electrical equipment items and devices installed behind furrings, chases or non-removable suspended ceilings.

- B. Access panels shall be UL listed and labeled as required to suit the fire rating of the surface in which installed, with mounting straps, concealed hinges, screwdriver locks, 180 degree open door design, 16 gauge steel construction and door and frame finished in prime coat finish. Panels shall be 12-inch by 12-inch minimum size, but shall be larger as the access requirement of the concealed electrical equipment item or device increases.

1.26 SEALING OF PENETRATIONS

- A. All penetrations in horizontal or vertical fire-rated construction shall be sealed using approved fire-rated sealing materials equivalent to the following:
 - 1 Foam: Dow Corning 3-6548 RTV silicone foam, liquid component Part 4 (black) and liquid component Part B (off-white).
 - 2 Sealant: Dow Corning 96-081 RTV silicone adhesive sealant.
 - 3 Damming Materials: Mineral fiberboard, mineral fiber matting, mineral fiber putty, plywood or particle board, as selected by applicator.
- B. Preparation: Remove combustible materials and loose impediments from penetration opening and involved surfaces. Remove free liquid and oil from penetration surfaces.
- C. Installation: In accordance with manufacturer's instructions, install damming materials and sealant to cover and seal penetration openings; inject foam mixtures into openings.
- D. In addition to the Dow Corning products, equal products by Spec Seal Firestop Products, 3M Fire Barrier or CS240 Firestop are acceptable.

1.27 PROTECTION OF APPARATUS

- A. At all times take every precaution to properly protect apparatus from damage due to dust, dirt, water, etc. or from damage due to physical forces. Include the erection of temporary shelters as required, to adequately protect any apparatus stored at the site, the cribbing of any apparatus directly above the construction, and the covering of apparatus in the incomplete building with tarpaulins or other protective covering. Failure on the part of the Contractor to comply with the above to the entire satisfaction of the Owner's Representative will be sufficient cause for the rejection of the pieces of apparatus in question.
- B. Responsibility for the protection of apparatus extend also to existing apparatus involved in this Section of the work, whether such apparatus is designated to be used temporarily and later removed, or is to be reused as a part of the permanent installation. Erect temporary sheltering structures, provide temporary bracing and supports, or cover equipment as required or directed to afford proper protection for that equipment.
- C. The Contractor shall protect this work and the work of all other Contractors from damage by his work or workmen and shall make good any damage thus caused. He shall also be responsible for the proper protection of his equipment, machinery, materials and accessories delivered and installed on the job.

1.28 INSTALLATION OF CONTROL AND OPERATING DEVICES

- A. The highest operable part of controls (light switches, dimmer switches, emergency power off devices, etc.), receptacles (electrical and communications) and other operable devices shall be 48" above finish floor. The lowest operable part shall be no less than 15" above finished floor. For purposes of uniformity, unless noted otherwise, the top of a device shall be maximum 48" AFF and the bottom of a device shall be minimum 15" AFF. Refer to the electrical symbols list on the Drawings for specific requirements.
- B. Visual alarm appliances shall be placed 80" above finished floor (the highest floor level within a space) or 6" below the ceiling, whichever is lower.

1.29 INSTALLATION AND CONNECTION OF OTHER SECTION'S EQUIPMENT

- A. Verify the electrical requirements of all equipment furnished under other Sections, separate contracts, or by the Owner. Install conduit, power wiring, control wiring, devices, etc. as required for complete operation of all equipment.

1.30 OPTION TO RELOCATE OUTLETS AND RELATED DEVICES

- A. The location of power, data and telephone outlets, wall switches and other related devices may be relocated at the Owner's option, at no additional cost to the Owner, to a point within 10 feet of their present location provided the Contractor is notified prior to installation.

1.31 COOPERATION AND CLEAN-UP

- A. It shall be the responsibility of the Contractor to cooperate fully to keep the job site in a clean and safe condition. Upon the Contractor shall immediately remove all of his tools, equipment, surplus materials and debris.
- B. After the installation is complete and before the equipment is energized, clean the interior and exterior of all equipment thoroughly. Clean equipment, removing all debris, rubbish and foreign materials. Each component shall be cleaned and all dust and other foreign material. Components shall be cleaned of oxidation. The inside and outside of all switchgear shall also be wiped clean with lemon-oil rag after all other cleaning is complete. Any portion of the work requiring touch-up finishing shall be so finished to equal the specified finish on the product.

1.32 RECORD DRAWINGS AND DOCUMENTATION FOR OWNER

- A. The Contractor shall obtain at his own expense a complete set of blue-line prints on which to keep an accurate record of the installation of all materials, equipment and devices covered by the Contract. The Contractor shall record up to date information at least once a week and retain the set of prints on site for periodic review by the Architect/Engineer. The record drawings shall indicate the location of all equipment and devices, and the routing of all systems. If the Contractor prepared large scale installation drawings of electrical rooms, conduit routing, busduct, routing, etc., these drawings or reproducible sepia's therefrom shall be revised as required to accurately illustrate the actual installation. All conduit buried in concrete slabs, walls and below grade shall be located by dimension; both horizontally and by vertical elevation, unless a surface mounted device in each space indicates the exact location.
- B. Upon anticipated completion of the job, obtain one complete reproducible set of the original drawings on which to neatly, legibly and accurately transfer all project related notations and deliver these record drawings to the Architect/Engineer at job completion before final payment and delivery to the Owner. This information shall be delivered prior to final acceptance.
- C. The Contractor shall accumulate in duplicate during the job progress, the following data prepared in indexed 3-ring looseleaf, hard-back binders sized for 8-1/2 inch by 11 inch sheets. No binder shall exceed 3-1/2 inches thick. This data shall be turned over to the Owner's Representative for review and subsequent delivery to the Owner prior to final acceptance.
 - 1 Warranties, guarantees and manufacturer's directions on material, equipment and devices covered by the Contract.
 - 2 Approved lighting fixture brochures, wiring diagrams and control diagrams.
 - 3 Copies of approved submittals and shop drawings.
 - 4 Operating instructions and recommended maintenance procedures for major apparatus.
 - 5 Copies of all other data and/or drawings required during construction.
 - 6 Repair parts list of major apparatus, including name, address and telephone number of local supplier or representative.
 - 7 Tag charts and diagrams hereinbefore specified.

1.33 FINAL OBSERVATION

- A. The purpose of the final observation is to determine whether the Contractor has completed the construction in accordance with the Contract Documents and that in the Owner Representative's opinion the installation is satisfactory for final acceptance by the Owner.
- B. It shall be the responsibility of the Contractor to assure that the installation is ready for final acceptance prior to calling upon the Owner's Representative to make a final observation.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 26 05 00 - COMMON WORK RESULTS FOR ELECTRICAL

1.1 GENERAL

1.2 RELATED DOCUMENTS

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

1.3 SUMMARY

This Section includes the following:

1. Raceways.
2. Building wire and connectors.
3. Supporting devices for electrical components.
4. Electrical identification.
5. Electricity-metering components.
6. Concrete equipment bases.
7. Electrical demolition.
8. Cutting and patching for electrical construction.
9. Touchup painting.

1.4 DEFINITIONS

EMT: Electrical metallic tubing.

FMC: Flexible metal conduit.

IMC: Intermediate metal conduit.

LFMC: Liquidtight flexible metal conduit.

RNC: Rigid nonmetallic conduit.

1.5 SUBMITTALS

Product Data: For electricity-metering equipment.

Shop Drawings: Dimensioned plans and sections or elevation layouts of electricity-metering equipment.

Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

1.6 QUALITY ASSURANCE

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.

Comply with NFPA 70.

1.7 COORDINATION

Coordinate chases, slots, inserts, sleeves, and openings with general construction work and arrange in building structure during progress of construction to facilitate the electrical installations that follow.

1. Set inserts and sleeves in poured-in-place concrete, masonry work, and other structural components as they are constructed.

Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the Work. Coordinate installing large equipment requiring positioning before closing in the building.

Coordinate electrical service connections to components furnished by utility companies.

2. Coordinate installation and connection of exterior underground and overhead utilities and services, including provision for electricity-metering components.
3. Comply with requirements of authorities having jurisdiction and of utility company providing electrical power and other services.

Coordinate location of access panels and doors for electrical items that are concealed by finished surfaces. Access doors and panels are specified in Section "Access Doors."

Where electrical identification devices are applied to field-finished surfaces, coordinate installation of identification devices with completion of finished surface.

Where electrical identification markings and devices will be concealed by acoustical ceilings and similar finishes, coordinate installation of these items before ceiling installation.

1.8 PRODUCTS

1.9 EQUIPMENT FOR UTILITY COMPANY'S ELECTRICITY METERING

Current-Transformer Cabinets: Comply with requirements of electrical power utility company.

Meter Sockets: Comply with requirements of electrical power utility company.

Modular Meter Centers: Factory-coordinated assembly of a main meter center circuit-breaker unit with wireways, tenant meter socket modules, and tenant branch circuit breakers arranged in adjacent vertical sections, complete with interconnecting buses.

1. Housing: NEMA 250, Type 3R enclosure.
2. Tenant Branch Circuit Breakers: Series combination rated to protect circuit breakers in downstream panelboards that have 10,000-A interrupting capacity,
3. minimum.

1.10 CONCRETE BASES

Concrete Forms and Reinforcement Materials: As specified in Section "Cast-in-Place Concrete."

Concrete: 3000-psi, 28-day compressive strength as specified in Section "Cast-in-Place Concrete."

1.11 TOUCHUP PAINT

For Equipment: Equipment manufacturer's paint selected to match installed equipment finish.

Galvanized Surfaces: Zinc-rich paint recommended by item manufacturer.

PART 2 - PRODUCTS

PART 3 - EXECUTION

3.1 ELECTRICAL EQUIPMENT INSTALLATION

Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide the maximum possible headroom.

Materials and Components: Install level, plumb, and parallel and perpendicular to other building systems and components, unless otherwise indicated.

Equipment: Install to facilitate service, maintenance, and repair or replacement of components. Connect for ease of disconnecting, with minimum interference with other installations.

Right of Way: Give to raceways and piping systems installed at a required slope.

3.2 RACEWAY AND CABLE INSTALLATION

Conceal raceways and cables, unless otherwise indicated, within finished walls, ceilings, and floors.

Install raceways and cables at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Locate horizontal raceway runs above water and steam piping.

Use temporary raceway caps to prevent foreign matter from entering.

Make conduit bends and offsets so ID is not reduced. Keep legs of bends in the same plane and straight legs of offsets parallel, unless otherwise indicated.

Use raceway and cable fittings compatible with raceways and cables and suitable for use and location.

Install raceways embedded in slabs in middle third of slab thickness where practical, and leave at least 1-inch concrete cover.

1. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.
2. Space raceways laterally to prevent voids in concrete.
3. Install conduit larger than 1-inch trade size parallel to or at right angles to main reinforcement. Where conduit is at right angles to reinforcement, place conduit close to slab support.
4. Transition from nonmetallic tubing to Schedule 80 nonmetallic conduit, rigid steel conduit, or IMC before rising above floor.
5. Make bends in exposed parallel or banked runs from same centerline to make bends parallel. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for exposed parallel raceways.

Install pull wires in empty raceways. Use No. 14 AWG zinc-coated steel or monofilament plastic line with not

less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of the pull wire.

Install telephone and signal system raceways, 2-inch trade size and smaller, in maximum lengths of 150 feet and with a maximum of two 90-degree bends or equivalent. Separate lengths with pull or junction boxes where necessary to comply with these requirements, in addition to requirements above.

Connect motors and equipment subject to vibration, noise transmission, or movement with a maximum of 72-inch flexible conduit. Install LFMC in wet or damp locations. Install separate ground conductor across flexible connections.

Set floor boxes level and trim after installation to fit flush to finished floor surface.

3.3 ELECTRICAL SUPPORTING DEVICE APPLICATION

Damp Locations and Outdoors: Hot-dip galvanized materials or nonmetallic, U-channel system components.

Dry Locations: Steel materials.

Support Clamps for PVC Raceways: Click-type clamp system.

Selection of Supports: Comply with manufacturer's written instructions.

Strength of Supports: Adequate to carry present and future loads, times a safety factor of at least four; minimum of 200-lb design load.

3.4 SUPPORT INSTALLATION

Install support devices to securely and permanently fasten and support electrical components.

Install individual and multiple raceway hangers and riser clamps to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assemblies and for securing hanger rods and conduits.

Support parallel runs of horizontal raceways together on trapeze- or bracket-type hangers.

Size supports for multiple raceway installations so capacity can be increased by a 25 percent minimum in the future.

Support individual horizontal raceways with separate, malleable-iron pipe hangers or clamps.

Install 1/4-inch-diameter or larger threaded steel hanger rods, unless otherwise indicated.

Spring-steel fasteners specifically designed for supporting single conduits or tubing may be used instead of malleable-iron hangers for 1-1/2-inch and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings and for fastening raceways to slotted channel and angle supports.

Arrange supports in vertical runs so the weight of raceways and enclosed conductors is carried entirely by raceway supports, with no weight load on raceway terminals.

Simultaneously install vertical conductor supports with conductors.

Separately support cast boxes that are threaded to raceways and used for fixture support. Support sheet-metal boxes directly from the building structure or by bar hangers. If bar hangers are used, attach bar to raceways on opposite sides of the box and support the raceway with an approved fastener not more than 24

inches from the box.

Install metal channel racks for mounting cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices unless components are mounted directly to structural elements of adequate strength.

Install sleeves for cable and raceway penetrations of concrete slabs and walls unless core-drilled holes are used. Install sleeves for cable and raceway penetrations of masonry and fire-rated gypsum walls and of all other fire-rated floor and wall assemblies. Install sleeves during erection of concrete and masonry walls.

Securely fasten electrical items and their supports to the building structure, unless otherwise indicated. Perform fastening according to the following unless other fastening methods are indicated:

1. Wood: Fasten with wood screws or screw-type nails.
2. Masonry: Toggle bolts on hollow masonry units and expansion bolts on solid masonry units.
3. New Concrete: Concrete inserts with machine screws and bolts.
4. Existing Concrete: Expansion bolts.
5. Instead of expansion bolts, threaded studs driven by a powder charge and provided with lock washers may be used in existing concrete.
6. Steel: Welded threaded studs or spring-tension clamps on steel.
 - a. Field Welding: Comply with AWS D1.1.
7. Welding to steel structure may be used only for threaded studs, not for conduits, pipe straps, or other items.
8. Light Steel: Sheet-metal screws.
9. Fasteners: Select so the load applied to each fastener does not exceed 25 percent of its proof-test load.

3.5 IDENTIFICATION MATERIALS AND DEVICES

Install at locations for most convenient viewing without interference with operation and maintenance of equipment.

Coordinate names, abbreviations, colors, and other designations used for electrical identification with corresponding designations indicated in the Contract Documents or required by codes and standards. Use consistent designations throughout Project.

Self-Adhesive Identification Products: Clean surfaces before applying.

Identify raceways and cables with color banding as follows:

1. Bands: Pretensioned, snap-around, colored plastic sleeves or colored adhesive marking tape. Make each color band 2 inches wide, completely encircling conduit, and place adjacent bands of two-color markings in contact, side by side.
2. Band Locations: At changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
3. Colors: As follows:
 - a. Fire Alarm System: Red.
 - b. Security System: Blue and yellow.
 - c. Telecommunication System: Green and yellow.

Tag and label circuits designated to be extended in the future. Identify source and circuit numbers in each cabinet, pull and junction box, and outlet box. Color-coding may be used for voltage and phase identification.

Install continuous underground plastic markers during trench backfilling, for exterior underground power, control, signal, and communication lines located directly above power and communication lines. Locate 6 to 8 inches below finished grade. If width of multiple lines installed in a common trench or concrete envelope does not exceed 16 inches, overall, use a single line marker.

Color-code 208/120-V system secondary service, feeder, and branch-circuit conductors throughout the secondary electrical system as follows:

4. Phase A: Black.
5. Phase B: Red.
6. Phase C: Blue.
7. Neutral: White.
8. Ground: Green.

Color-code 480/277-V system secondary service, feeder, and branch-circuit conductors throughout the secondary electrical system as follows:

9. Phase A: BROWN.
10. Phase B: ORANGE.
11. Phase C: YELLOW.
12. Neutral: White with a colored stripe or gray.
13. Ground: Green.

Install warning, caution, and instruction signs where required to comply with 29 CFR, Chapter XVII, Part 1910.145, and where needed to ensure safe operation and maintenance of electrical systems and of items to which they connect. Install engraved plastic-laminated instruction signs with approved legend where instructions are needed for system or equipment operation. Install metal-backed butyrate signs for outdoor items.

Install engraved-laminated emergency-operating signs with white letters on red background with minimum 3/8-inch-high lettering for emergency instructions on power transfer, load shedding, and other emergency operations.

3.6 UTILITY COMPANY ELECTRICITY-METERING EQUIPMENT

Install equipment according to utility company's written requirements. Provide grounding and empty conduits as required by utility company.

3.7 FIRESTOPPING

Apply firestopping to cable and raceway penetrations of fire-rated floor and wall assemblies to achieve fire-resistance rating of the assembly. Firestopping materials and installation requirements are specified in Section "Firestopping."

3.8 CONCRETE BASES

Construct concrete bases of dimensions indicated, but not less than 4 inches larger, in both directions, than supported unit. Follow supported equipment manufacturer's anchorage recommendations and setting templates for anchor-bolt and tie locations, unless otherwise indicated. Use 3000-psi, 28-day compressive-

strength concrete and reinforcement as specified in Section "Cast-in-Place Concrete."

3.9 CUTTING AND PATCHING

Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces required to permit electrical installations. Perform cutting by skilled mechanics of trades involved.

Repair and refinish disturbed finish materials and other surfaces to match adjacent undisturbed surfaces. Install new fireproofing where existing firestopping has been disturbed. Repair and refinish materials and other surfaces by skilled mechanics of trades involved.

3.10 FIELD QUALITY CONTROL

Inspect installed components for damage and faulty work, including the following:

1. Raceways.
2. Building wire and connectors.
3. Supporting devices for electrical components.
4. Electrical identification.
5. Electricity-metering components.
6. Concrete bases.
7. Electrical demolition.
8. Cutting and patching for electrical construction.
9. Touchup painting.

Test Owner's electricity-metering installation for proper operation, accuracy, and usability of output data.

10. Connect a load of known kW rating, 1.5 kW minimum, to a circuit supplied by the metered feeder.
11. Turn off circuits supplied by the metered feeder and secure them in the "off" condition.
12. Run the test load continuously for eight hours, minimum, or longer to obtain a measurable meter indication. Use a test load placement and setting that ensure continuous, safe operation.
13. Check and record meter reading at end of test period and compare with actual electricity used based on test load rating, duration of test, and sample measurements of supply voltage at the test load connection. Record test results.
14. Repair or replace malfunctioning metering equipment or correct test setup; then retest. Repeat for each meter in installation until proper operation of entire system is verified.

3.11 REFINISHING AND TOUCHUP PAINTING

Refinish and touch up paint. Paint materials and application requirements are specified in Section "Painting."

Clean damaged and disturbed areas and apply primer, intermediate, and finish coats to suit the degree of damage at each location.

1. Follow paint manufacturer's written instructions for surface preparation and for timing and application of successive coats.
2. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
3. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.12 CLEANING AND PROTECTION

1. On completion of installation, including outlets, fittings, and devices, inspect exposed finish. Remove burrs, dirt, paint spots, and construction debris.
2. Protect equipment and installations and maintain conditions to ensure that coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

END OF SECTION

SECTION 26 05 19 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTOR AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes building wires and cables and associated connectors, splices, and terminations for wiring systems rated 600 V and less.

1.3 SUBMITTALS

- A. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

1.4 QUALITY ASSURANCE

- A. Listing and Labeling: Provide wires and cables specified in this Section that are listed and labeled.
 - 1. The Terms "Listed" and "Labeled": As defined in NFPA 70, Article 100.
- B. Comply with NFPA 70.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver wires and cables according to NEMA WC 26.

1.6 COORDINATION

- A. Coordinate layout and installation of cables with other installations.
- B. Revise locations and elevations from those indicated, as required to suit field conditions and as approved by Architect.

PART 2 - PRODUCTS

2.1 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:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Wires and Cables:
 - a. American Insulated Wire Corp.; Leviton Manufacturing Co.
 - b. BICC Brand-Rex Company.
 - c. Carol Cable Co., Inc.
 - d. Senator Wire & Cable Company.
 - e. Southwire Company.
 - 2. Connectors for Wires and Cables:
 - a. AMP Incorporated.
 - b. General Signal; O-Z/Gedney Unit.
 - c. Monogram Co.; AFC.
 - d. Square D Co.; Anderson.
 - e. 3M Company; Electrical Products Division.

2.2 BUILDING WIRES AND CABLES

- A. UL-listed building wires and cables with conductor material, insulation type, cable construction, and rating as specified in Part 3 "Wire and Insulation Applications" Article.
- B. Rubber Insulation Material: Comply with NEMA WC 3.
- C. Thermoplastic Insulation Material: Comply with NEMA WC 5.
- D. Ethylene Propylene Rubber Insulation Material: Comply with NEMA WC 8.
- E. Conductor Material: Copper.

- F. Stranding: Solid conductor for No. 10 AWG and smaller; stranded conductor for larger than No. 10 AWG.
- G. Plenum rated cable for all cables above the ceiling.

2.3 CONNECTORS AND SPLICES

- A. UL-listed, factory-fabricated wiring connectors of size, ampacity rating, material, type, and class for application and service indicated. Comply with Project's installation requirements and as specified in Part 3 "Wire and Insulation Applications" Article.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine raceways and building finishes to receive wires and cables for compliance with requirements for installation tolerances and other conditions affecting performance of wires and cables. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 WIRE AND INSULATION APPLICATIONS

- A. Service Entrance: Type RHW or THWN, in raceway.
- B. Feeders: Type 75C insulation THHN/THWN, in raceway.
- C. Fire-Pump Feeder: Type MI, 3-conductor.
- D. Branch Circuits: Type THHN/THWN, in raceway.
- E. Fire Alarm Circuits: Type THHN/THWN, in raceway.
- F. Class 1 Control Circuits: Type THHN/THWN, in raceway.
- G. Class 2 Control Circuits: Type THHN/THWN, in raceway.
- H. Equipment or any device rated 100 amperes or less, conductor shall be rated 60C as per National Electrical Code.
- I. Equipment or any device rated over 100 amperes, conductor shall be rated 75C as per National Electrical Code.

3.3 INSTALLATION

- A. Install wires and cables as indicated, according to manufacturer's written instructions and NECA's "Standard of Installation."
- B. Remove existing wires from raceway before pulling in new wires and cables.
- C. Pull Conductors: 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 "Basic Electrical Materials and Methods."
- G. Seal around cables penetrating fire-rated elements according to Section "Firestopping."
- H. Identify wires and cables according to Section "Basic Electrical Materials and Methods."
- I. Identify wires and cables according to Section "Electrical Identification."

3.4 CONNECTIONS

- A. Conductor Splices: Keep to minimum.
- B. Install splices and tapes that possess equivalent or better mechanical strength and insulation ratings than conductors being spliced.
- C. Use splice and tap connectors compatible with conductor material.
- D. Use oxide inhibitor in each splice and tap connector for aluminum conductors.
- E. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches (300 mm) of slack.
- F. Connect outlets and components to wiring and to ground as indicated and instructed by manufacturer.
- G. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening

values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.5 FIELD QUALITY CONTROL

- A. Testing: On installation of wires and cables and before electrical circuitry has been energized, demonstrate product capability and compliance with requirements.
 - 1. Procedures: Perform each visual and mechanical inspection and electrical test stated in NETA ATS, Section 7.3.1. Certify compliance with test parameters.
- B. Correct malfunctioning conductors and cables at Project site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units and retest.

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 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes grounding and bonding of electrical systems and equipment. Grounding requirements specified in this Section may be supplemented by special requirements of systems described in other Sections.
- B. Related Sections include the following:
 - 1. List below only products, construction, and equipment that the reader might expect to find in this Section but are specified elsewhere.
 - 2. Section "Underground Ducts and Utility Structures" for ground test wells.

1.3 SUBMITTALS

- A. Revise this Article to suit Project and office practice. Frequently, no product submittal is required for this Section.
- B. Product Data: For each type of product indicated.
- C. Retain paragraph above if Product Data are required for each product specified. Retain paragraph below if Product Data are required only for selected products.
- D. Product Data: For the following:
 - 1. Ground rods.
 - 2. Chemical rods.
 - 3. Qualification Data: For firms and persons specified in "Quality Assurance" Article.
- E. Field Test Reports: Submit written test reports to include the following:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

1.4 QUALITY ASSURANCE

- A. Retain paragraph and subparagraph below if Contractor or manufacturer selects testing agency. Delete if Contractor is allowed to perform ground-resistance testing.
- B. 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.
 - 1. Comply with UL 467.
- C. Comply with NFPA 70; for overhead-line construction and medium-voltage underground construction, comply with IEEE C2.
- D. Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system.

PART 2 - PRODUCTS

2.1 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:
- B. Retain above for nonproprietary or below for semiproprietary Specification. Refer to Division 1 Section "Materials and Equipment."
- C. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. See Editing Instruction No. 1 in the Evaluations for cautions about naming products and manufacturers.
2. Grounding Conductors, Cables, Connectors, and Rods:
 - a. Apache Grounding/Erco Inc.
 - b. Boggs, Inc.
 - c. Chance/Hubbell.
 - d. Copperweld Corp.
 - e. Dossert Corp.
 - f. Erco Inc.; Electrical Products Group.
 - g. Framatome Connectors/Burndy Electrical.
 - h. Galvan Industries, Inc.
 - i. Hastings Fiber Glass Products, Inc.
 - j. Ideal Industries, Inc.
 - k. ILSCO.
 - l. Kearney/Cooper Power Systems.
 - m. Korns: C. C. Korns Co.; Division of Robroy Industries.
 - n. Lightning Master Corp.
 - o. Lyncole XIT Grounding.
 - p. O-Z/Gedney Co.; a business of the EGS Electrical Group.
 - q. Raco, Inc.; Division of Hubbell.
 - r. Robbins Lightning, Inc.
 - s. Salisbury: W. H. Salisbury & Co.
 - t. Superior Grounding Systems, Inc.
 - u. Thomas & Betts, Electrical.

2.2 GROUNDING CONDUCTORS

- A. For insulated conductors, comply with Section "Conductors and Cables."
- B. If only copper conductors are permitted in Division 16 Section "Conductors and Cables," delete paragraph below.
- C. Material: copper.
- D. Equipment Grounding Conductors: Insulated with green-colored insulation.
- E. Isolated Ground Conductors: Insulated with green-colored insulation with yellow stripe. On feeders with isolated ground, use colored tape, alternating bands of green and yellow tape to provide a minimum of three bands of green and two bands of yellow.
- F. Grounding Electrode Conductors: Stranded cable.
- G. Underground Conductors: stranded, unless otherwise indicated.
- H. Sizes and types below are typical. Adjust to suit Project conditions and requirements.
- I. Copper Bonding Conductors: As follows:
 1. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG copper conductor, 1/4 inch (6.4 mm) in diameter.
 2. Bonding Conductor: No. 4 or No. 6 AWG, stranded copper conductor.
 3. Bonding Jumper: Bare copper tape, braided bare copper conductors, terminated with copper ferrules; 1-5/8 inches (42 mm) wide and 1/16 inch (1.5 mm) thick.
 4. Tinned Bonding Jumper: Tinned-copper tape, braided copper conductors, terminated with copper ferrules; 1-5/8 inches (42 mm) wide and 1/16 inch (1.5 mm) thick.
- J. Delete paragraph and subparagraphs below if use of aluminum conductors is not permitted.
- K. Ground Conductor and Conductor Protector for Wood Poles: As follows:
 1. No. 4 AWG minimum, soft-drawn copper conductor.
 2. Conductor Protector: Half-round PVC or wood molding. If wood, use pressure-treated fir, or cypress or cedar.

- L. Grounding Bus: Bare, annealed copper bars of rectangular cross section, with insulators.

2.3 CONNECTOR PRODUCTS

- A. Comply with IEEE 837 and UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items.
- B. Bolted Connectors: Bolted-pressure-type connectors, or compression type.
- C. Welded Connectors: Exothermic-welded type, in kit form, and selected per manufacturer's written instructions.

2.4 GROUNDING ELECTRODES

- A. Copper-clad steel is most common. See Evaluations for discussion on where other materials might be more appropriate.
- B. Ground Rods: Copper-clad steel.
 - 1. Select paragraph above or paragraph and subparagraph below. Sectional types are used when rods longer than 10 feet (3 m) are installed.
 - 2. Size: 3/4 by 120 inches (19 by 3000 mm) in diameter.
- C. Chemical Electrodes: Copper tube, straight or L-shaped, filled with nonhazardous chemical salts, terminated with a 4/0 bare conductor. Provide backfill material recommended by manufacturer.
- D. Test Wells: Provide handholes as specified in Section "Underground Ducts and Utility Structures."

PART 3 - EXECUTION

3.1 APPLICATION

- A. Delete paragraph below if only copper conductors are specified in Division 16 Section "Conductors and Cables."
- B. Use only copper conductors for both insulated and bare grounding conductors in direct contact with earth, concrete, masonry, crushed stone, and similar materials.
- C. In raceways, use insulated equipment grounding conductors.
- D. Exothermic-Welded Connections: Use for connections to structural steel and for underground connections, except those at test wells.
- E. Equipment Grounding Conductor Terminations: Use bolted pressure clamps.
- F. Ground Rod Clamps at Test Wells: Use bolted pressure clamps with at least two bolts.
- G. Delete paragraph and subparagraphs below if grounding bus is not required, or edit to suit Project.
- H. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
 - 1. Use insulated spacer; space 1 inch (25.4 mm) from wall and support from wall 6 inches (150 mm) above finished floor, unless otherwise indicated.
 - 2. At doors, route the bus up to the top of the door frame, across the top of the doorway, and down to the specified height above the floor.
- I. Edit below to suit Project.
- J. Underground Grounding Conductors: Use tinned copper conductor, No. 2/0 AWG minimum. Bury at least 24 inches (600 mm) below grade or bury 12 inches (300 mm) above duct bank when installed as part of the duct bank.

3.2 EQUIPMENT GROUNDING CONDUCTORS

- A. NEC permits two basic types of equipment grounding conductors: metallic raceway or cable sheath as the conductor, or a separate equipment grounding conductor. The installation of an equipment grounding conductor provides an additional degree of safe operation when compared to relying on raceway as the conductor. Revise paragraphs and subparagraphs in this Article to suit Project.
- B. Comply with NFPA 70, Article 250, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by NFPA 70 are indicated.
- C. Install equipment grounding conductors in all feeders and circuits.
- D. Select paragraph above or paragraph and subparagraphs below.

- E. Install insulated equipment grounding conductor with circuit conductors for the following items, in addition to those required by NEC:
 - 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. Armored and metal-clad cable runs.
- F. Busway Supply Circuits: Install insulated equipment grounding conductor from the grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.
- G. Computer Outlet Circuits: Install insulated equipment grounding conductor in branch-circuit runs from computer-area power panels or power-distribution units.
- H. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate grounding conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.
- I. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate equipment grounding conductor. Isolate equipment grounding conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.
- J. Nonmetallic Raceways: Install an equipment grounding conductor in nonmetallic raceways unless they are designated for telephone or data cables.
- K. Air-Duct Equipment Circuits: Install an equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners and heaters. Bond conductor to each unit and to air duct.
- L. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate equipment grounding conductor to each electric water heater, heat-tracing, and antifrost heating cable. Bond conductor to heater units, piping, connected equipment, and components.
- M. Coordinate paragraph and subparagraphs below with Drawings and Specification Sections for systems referenced. Edit to suit Project.
- N. Signal and Communication Systems: For telephone, alarm, voice and data, and other communication systems, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.
 - 1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-2-by-12-inch (6.4-by-50-by-300-mm) grounding bus.
 - 2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.
- O. Metal Poles Supporting Outdoor Lighting Fixtures: Provide a grounding electrode in addition to installing a separate equipment grounding conductor with supply branch-circuit conductors.

3.3 INSTALLATION

- A. Ground Rods: Install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes.
 - 1. Drive ground rods until tops are 2 inches (50 mm) below finished floor or final grade, unless otherwise indicated.
 - 2. Interconnect ground rods with grounding electrode conductors. Use exothermic welds, except at test wells and as otherwise indicated. Make connections without exposing steel or damaging copper coating.

- B. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- C. Bonding Straps and Jumpers: Install so vibration by equipment mounted on vibration isolation hangers and supports is not transmitted to rigidly mounted equipment. Use exothermic-welded connectors for outdoor locations, unless a disconnect-type connection is required; then, use a bolted clamp. Bond straps directly to the basic structure taking care not to penetrate any adjacent parts. Install straps only in locations accessible for maintenance.
- D. Metal Water Service Pipe: Provide 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 by grounding clamp connectors. Where a dielectric main water fitting is installed, connect grounding conductor to street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
- E. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with grounding clamp connectors.
- F. Bond interior metal piping systems and metal air ducts to equipment grounding conductors of associated pumps, fans, blowers, electric heaters, and air cleaners. Use braided-type bonding straps.
- G. Bond each aboveground portion of gas piping system upstream from equipment shutoff valve.
- H. Install one test well for each service at the ground rod electrically closest to the service entrance. Set top of well flush with finished grade or floor.
- I. Ufer Ground (Concrete-Encased Grounding Electrode): Fabricate according to NFPA 70, Paragraph 250-81(c), using a minimum of 20 feet (6 m) of bare copper conductor not smaller than No. 4 AWG. If concrete foundation is less than 20 feet (6 m) long, coil excess conductor within the base of the foundation. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building grounding grid or to a grounding electrode external to concrete.

3.4 CONNECTIONS

- A. Coordinate paragraph and subparagraphs below with Drawings.
- B. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
 - 1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to 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.
- C. Exothermic-Welded Connections: Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.
- D. Equipment Grounding Conductor Terminations: For No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.
- E. Noncontact Metal Raceway Terminations: If metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically noncontinuous conduits at entrances and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.

- F. Connections at Test Wells: Use compression-type connectors on conductors and make bolted- and clamped-type connections between conductors and ground rods.
- G. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- H. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.
- I. Moisture Protection: If insulated grounding conductors are connected to ground rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

3.5 FIELD QUALITY CONTROL

- A. Retain one of three paragraphs below.
- B. Testing: Perform the following field quality-control testing:
 - 1. After installing grounding system but before permanent electrical circuitry has been energized, test for compliance with requirements.
 - 2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at ground test wells. Measure ground resistance not less than two full days after the last trace of precipitation, and without the soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance. Perform tests, by the fall-of-potential method according to IEEE 81.
 - 3. Provide drawings locating each ground rod and ground rod assembly and other grounding electrodes, identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
 - a. NFPA 70 has minimum value of 25 ohms. See Evaluations for discussion on appropriate grounding resistance values. Values listed below are typical; adjust to suit Project conditions.
 - b. Equipment Rated 500 kVA and Less: 10 ohms.
 - c. Equipment Rated 500 to 1000 kVA: 5 ohms.
 - d. Equipment Rated More Than 1000 kVA: 3 ohms.
 - e. Substations and Pad-Mounted Switching Equipment: 5 ohms.
 - f. Manhole Grounds: 10 ohms.
 - 4. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

3.6 GRADING AND PLANTING

- A. Delete below if inappropriate or if surface restoration work is covered on Drawings or in Division 2 Sections. Coordinate with Drawings.
- B. Restore surface features, including vegetation, at areas disturbed by Work of this Section. Reestablish original grades, unless otherwise indicated. If sod has been removed, replace it as soon as possible after backfilling is completed. Restore areas disturbed by trenching, storing of dirt, cable laying, and other activities to their original condition. Include application of topsoil, fertilizer, lime, seed, sod, sprig, and mulch. Comply with Section "Landscaping." Maintain restored surfaces. Restore disturbed paving as indicated.

END OF SECTION

SECTION 26 05 29 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- A. The General Provisions, Supplemental General Provisions, Special Provisions and Specification sections, apply to work covered by this Section.
- B. Comply with this sections, as applicable. Refer to other sections for coordination of work.

1.2 SCOPE OF WORK

- A. Provide labor, material, equipment, tools and services, and perform operations required for, and reasonably incidental to, the providing of supporting devices, including related systems and accessories.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Unistrut Corp.
- B. B-Line Systems, Inc.
- C. Midland Ross-Kindorf

2.2 MATERIALS

A. Suspension Hangers

- 1. Suspension hangers for individual conduit runs shall be zinc plated formed steel type.

B. Vertical Supports

- 1. Malleable iron one hole pipe straps shall be used for vertical runs

C. Clamps

- 1. Beam clamps shall be used for bar joists and beams.

D. Anti-Vibration Hangers

- 1. Anti-vibration hangers shall be combination type having a double deflection neoprene element in series with a steel coil spring; double deflection of 0.30"; steel coil spring shall be selected from a 1" static deflection series with a minimum additional travel to solid of ½"; spring diameters shall be large enough to permit 15 degree angular misalignment of the rod connecting the hanger to the ceiling support without rubbing the hanger box.

2.3 LIGHT FIXTURE HANGERS

- A. Refer to Section 26 51 00
- B. Corrosive Areas: PVC; at factory apply a minimum of 10-mil-thick PVC coating, bonded to metal, inside and outside.Z

PART 3 - EXECUTION

3.1 INSTALLATION

A. Hangers

- 1. Approved hangers and stiff leg supports shall be installed in quantity and size as required to carry the weight of raceway and contents and shall be arranged to prevent vibration transmission to the building and allow for raceway movement.
- 2. Hangers shall be supported by means of uncoated solid steel rods which are threaded to allow vertical adjustments. Lock nuts shall be provided in sufficient number and location to lock all rod adjustments

permanently at the adjusted height. Two lock nuts shall be used unless the nut tightens against a threaded socket. Minimum rod diameters shall be as follows:

B. NOMINAL CONDUIT SIZE ROD DIAMETER

1/2" through 2 1/4"

2-1/2" through 3 3/8"

4" and 5 1/2"

1. Hanger spacing shall be as required for proper and adequate support raceway, but in no case shall be less than one hanger per 8'-0" of raceway length except that conduit less than 1" diameter shall be supported at least every 6'-0".
2. Where numerous conduits are run parallel to one another, they may be supported from a trapeze type hanger arrangement with strut bottom.
3. Anti-vibration type hangers shall be provided for equipment as required to minimize vibration and/or as directed by the Architect/Engineer.

Supports

4. Support of hangers shall be by means of sufficient quantities of individual after set steel expansion shields, or beam clamps attached to structural steel.
5. Stiff-legs shall be furnished and installed in cases where support from overhead structure is not possible.
6. Ceiling mounted lighting fixtures shall be supported from the building structure at two opposite corners. The Contractor shall provide fixture hangers to properly interface with the ceiling system.
7. Furnish and install complete any additional structural support steel, brackets, fasteners, etc., as required to adequately support all raceway and equipment.
8. Support of hangers from concrete slabs shall be by means of sufficient quantity of "U" brackets attached with after set expansion shields and bolts.
9. Support of hangers from concrete tees shall be by means of sufficient quantity of angle iron brackets attached with after set expansion shields and bolts.

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 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.
 - 1. Edit lists below to suit Project.
 - 2. Raceways include the following:
 - a. RMC.
 - b. IMC.
 - c. PVC externally coated, rigid steel conduits.
 - d. PVC externally coated, IMC.
 - e. EMT.
 - f. FMC.
 - g. LFMC.
 - h. LFNC.
 - i. RNC.
 - j. ENT.
 - k. Wireways.
 - l. Surface raceways.
 - 3. Boxes, enclosures, and cabinets include the following:
 - a. Device boxes.
 - b. Floor boxes.
 - c. Outlet boxes.
 - d. Pull and junction boxes.
 - e. Cabinets and hinged-cover enclosures.
- B. Related Sections include the following:
 - 1. List below only products and equipment for this Project that the reader might expect to find in this Section but are specified elsewhere. Verify that Section titles listed below are correct for this Project's Specifications because Section titles may have changed since this Section was updated.
 - 2. Section "Basic Electrical Materials and Methods" for raceways and box supports.
 - 3. Section "Wiring Devices" for devices installed in boxes and for floor-box service fittings.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. ENT: Electrical nonmetallic tubing.
- C. FMC: Flexible metal conduit.
- D. IMC: Intermediate metal conduit.
- E. LFMC: Liquidtight flexible metal conduit.
- F. LFNC: Liquidtight flexible nonmetallic conduit.
- G. RMC: Rigid metal conduit.
- H. RNC: Rigid nonmetallic conduit.

1.4 SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Delete below except for custom enclosures.
- C. Shop Drawings: Include layout drawings showing components and wiring for nonstandard boxes, enclosures, and cabinets.

1.5 QUALITY ASSURANCE

- A. Listing and Labeling: Provide raceways and boxes specified in this Section that are listed and labeled.
 - 1. The Terms "Listed" and "Labeled": As defined in NFPA 70, Article 100.
 - 2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" as defined in OSHA Regulation 1910.7.
- B. Comply with NECA's "Standard of Installation."
- C. Comply with NFPA 70.

1.6 COORDINATION

- A. Coordinate layout and installation of raceways and boxes with other construction elements to ensure adequate headroom, working clearance, and access.

PART 2 - PRODUCTS

2.1 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:
- B. Retain above for nonproprietary or below for semiproprietary Specification. Refer to Division 1 Section "Materials and Equipment."
- C. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Metal Conduit and Tubing:
 - a. Alflec Corp.
 - b. Anamet, Inc.; Anaconda Metal Hose.
 - c. Anixter Brothers, Inc.
 - d. Carol Cable Co., Inc.
 - e. Cole-Flex Corp.
 - f. Electri-Flex Co.
 - g. Flexcon, Inc.; Coleman Cable Systems, Inc.
 - h. Grinnell Co.; Allied Tube and Conduit Div.
 - i. Monogram Co.; AFC.
 - j. Spiraduct, Inc.
 - k. Triangle PWC, Inc.
 - l. Wheatland Tube Co.
 - 2. Nonmetallic Conduit and Tubing:
 - a. Anamet, Inc.; Anaconda Metal Hose.
 - b. Arnco Corp.
 - c. Breeze-Illinois, Inc.
 - d. Cantex Industries; Harsco Corp.
 - e. Certainteed Corp.; Pipe & Plastics Group.
 - f. Cole-Flex Corp.
 - g. Condux International; Electrical Products.
 - h. Electri-Flex Co.
 - i. George-Ingraham Corp.
 - j. Hubbell, Inc.; Raco, Inc.
 - k. Lamson & Sessions; Carlon Electrical Products.
 - l. R&G Sloan Manufacturing Co., Inc.
 - m. Spiraduct, Inc.
 - n. Thomas & Betts Corp.
 - 3. Conduit Bodies and Fittings:
 - a. American Electric; Construction Materials Group.
 - b. Crouse-Hinds; Div. of Cooper Industries.
 - c. Emerson Electric Co.; Appleton Electric Co.
 - d. Hubbell, Inc.; Killark Electric Manufacturing Co.
 - e. Lamson & Sessions; Carlon Electrical Products.
 - f. O-Z/Gedney; Unit of General Signal.

- g. Scott Fetzer Co.; Adalet-PLM.
- h. Spring City Electrical Manufacturing Co.
- 4. Metal Wireways:
 - a. Hoffman Engineering Co.
 - b. Keystone/Rees, Inc.
 - c. Square D Co.

2.2 METAL CONDUIT AND TUBING

- A. Rigid Steel Conduit: ANSI C80.1.
- B. Rigid Aluminum Conduit: ANSI C80.5.
- C. IMC: ANSI C80.6.
- D. EMT and Fittings: ANSI C80.3.
 - 1. Fittings: Set-screw type.
- E. Fittings: NEMA FB 1; compatible with conduit/tubing materials.

2.3 NONMETALLIC CONDUIT AND TUBING

- A. RNC: NEMA TC 2, Schedule 40 or 80 PVC.
- B. RNC Fittings: NEMA TC 3; match to conduit or conduit/tubing type and material.
- C. LFNC: UL 1660.

2.4 METAL WIREWAYS

- A. Material: Sheet metal sized and shaped as indicated.
- B. Fittings and Accessories: Include 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.
- C. Select features, unless otherwise indicated, as required to complete wiring system and to comply with NFPA 70.
- D. Select 1 of 4 paragraphs below.
- E. Wireway Covers: Screw – cover type flanged-and-gasketed type.
- F. Finish: Manufacturer's standard enamel finish.

2.5 OUTLET AND DEVICE BOXES

- A. Sheet Metal Boxes: NEMA OS 1.
- B. Edit paragraph below. Aluminum is also available and suitable for use with steel raceways.
- C. Cast-Metal Boxes: NEMA FB 1, Type FD, cast box with gasketed cover.

2.6 PULL AND JUNCTION BOXES

- A. Small Sheet Metal Boxes: NEMA OS 1.
- B. Cast-Metal Boxes: NEMA FB 1, cast aluminum with gasketed cover.

2.7 ENCLOSURES AND CABINETS

- A. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous hinge cover and flush latch.
 - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
 - 2. Nonmetallic Enclosures: Plastic, finished inside with radio-frequency-resistant paint.
- B. Cabinets: NEMA 250, Type 1, galvanized steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel. Hinged door in front cover with flush latch and concealed hinge. Key latch to match panelboards. Include metal barriers to separate wiring of different systems and voltage, and include accessory feet where required for freestanding equipment.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces to receive raceways, boxes, enclosures, and cabinets for compliance with installation tolerances and other conditions affecting performance of raceway installation. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 WIRING METHODS

- A. Use a comprehensive wiring method schedule on Drawings or use this Article to specify where various raceway types are to be installed. Edit examples below, adding or deleting materials and methods to suit Project. Coordinate with Division 16 Section "Wires and Cables." Do not duplicate information on Drawings, in NFPA 70, or in other Division 16 Sections. List exceptions to stated requirements. Check code to avoid specifying uses not permitted.
- B. Outdoors: Use the following wiring methods:
 - 1. Exposed: Rigid steel.
 - 2. Concealed: Rigid steel.
 - 3. Underground, Single Run: RNC.
 - 4. Underground, Grouped: RNC.
 - 5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
 - 6. Boxes and Enclosures: NEMA 250, Type 3R .
- C. Indoors: Use the following wiring methods:
 - 1. Exposed: EMT.
 - 2. Concealed: EMT.
 - 3. Underground, Single Run: RNC.
 - 4. Underground, Grouped: RNC
 - 5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC; except in wet or damp locations, use LFMC.
 - 6. Damp or Wet Locations: Rigid steel conduit.
 - 7. Boxes and Enclosures: NEMA 250, Type 1, except as follows:
 - a. Select 1 of 2 subparagraphs below and add other specific box and enclosure requirements to suit Project.
 - b. Damp or Wet Locations: NEMA 250, Type 4, stainless steel.

3.3 INSTALLATION

- A. Install raceways, boxes, enclosures, and cabinets as indicated, according to manufacturer's written instructions.
- B. Select paragraph above or below.
- C. Minimum Raceway Size: 3/4-inch trade size (DN21).
- D. Conceal conduit and EMT, unless otherwise indicated, within finished walls, ceilings, and floors.
- E. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- F. Install raceways level and square and at proper elevations. Provide adequate headroom.
- G. Complete raceway installation before starting conductor installation.
- H. Support raceways as specified in Section "Basic Electrical Materials and Methods."
- I. Use temporary closures to prevent foreign matter from entering raceways.
- J. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portion of bends is not visible above the finished slab.
- K. Make bends and offsets so ID is not reduced. Keep legs of bends in the same plane and straight legs of offsets parallel, unless otherwise indicated.
- L. Use raceway fittings compatible with raceways and suitable for use and location. For intermediate steel conduit, use threaded rigid steel conduit fittings, unless otherwise indicated.
- M. Run concealed raceways, with a minimum of bends, in the shortest practical distance considering the type of building construction and obstructions, unless otherwise indicated.
- N. Raceways Embedded in Slabs (Must be indicated on drawings to be embedded. Please notify Engineer if required but not shown): Install in middle third of slab thickness where practical, and leave at least 1-inch (25-mm) concrete cover.
 - 1. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.

2. Space raceways laterally to prevent voids in concrete.
 3. Run conduit larger than **1-inch trade size (DN27)** parallel to or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
 4. Transition from nonmetallic tubing to Schedule 80 nonmetallic conduit, rigid steel conduit, or IMC before rising above floor.
- O. Install exposed raceways parallel to or at right angles to nearby surfaces or structural members, and follow the surface contours as much as practical.
1. Run parallel or banked raceways together, on common supports where practical.
 2. Make bends in parallel or banked runs from same centerline to make bends parallel. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for parallel raceways.
- P. Join raceways with fittings designed and approved for the purpose and make joints tight.
1. Make raceway terminations tight. Use bonding bushings or wedges at connections subject to vibration. Use bonding jumpers where joints cannot be made tight.
 2. Use insulating bushings to protect conductors.
- Q. Tighten set screws of threadless fittings with suitable tools.
- R. Terminations: Where raceways are terminated with locknuts and bushings, align raceways to enter squarely and install locknuts with dished part against the box. Where terminations are not secure with 1 locknut, use 2 locknuts: 1 inside and 1 outside the box.
- S. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into the hub so the end bears against the wire protection shoulder. Where chase nipples are used, align raceways so the coupling is square to the box and tighten the chase nipple so no threads are exposed.
- T. Install pull wires in empty raceways. Use No. 14 AWG zinc-coated steel or monofilament plastic line with not less than **200-lb (90-kg)** tensile strength. Leave at least **12 inches (300 mm)** of slack at each end of the pull wire.
- U. Telephone and Signal System Raceways, **2-Inch Trade Size (DN53)** and Smaller: In addition to the above requirements, install raceways in maximum lengths of **150 feet (45 m)** and with a maximum of two 90-degree bends or equivalent. Separate lengths with pull or junction boxes where necessary to comply with these requirements.
- V. Delete paragraph below if not applicable.
- W. Install raceway sealing fittings according to manufacturer's written instructions. Locate fittings at suitable, approved, and accessible locations and fill them with UL-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 at the following points:
1. Where conduits pass from warm to cold locations, such as the boundaries of refrigerated spaces.
 2. Where otherwise required by NFPA 70.
- X. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment. Install with an adjustable top or coupling threaded inside for plugs set flush with the finished floor. Extend conductors to equipment with rigid steel conduit; FMC may be used **6 inches (150 mm)** above the floor. Install screwdriver-operated, threaded flush plugs flush with floor for future equipment connections.
- Y. Flexible Connections: Use maximum of **6 feet (1830 mm)** of flexible conduit for recessed and semirecessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for all motors. Use liquidtight flexible conduit in wet or damp locations. Install separate ground conductor across flexible connections.
- Z. Delete paragraph below if no high-frequency installation.
- AA. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in a nonmetallic sleeve.
- BB. Do not install aluminum conduits embedded in or in contact with concrete.
- CC. PVC Externally Coated, Rigid Steel Conduits: Use only fittings approved for use with that material. Patch all nicks and scrapes in PVC coating after installing conduits.

DD. Surface Raceways: Install a separate, green, ground conductor in raceways from junction box supplying the raceways to receptacle or fixture ground terminals.

1. Select each surface raceway outlet box, to which a lighting fixture is attached, of sufficient diameter to provide a seat for the fixture canopy.
2. Where a surface raceway is used to supply a fluorescent lighting fixture having central-stem suspension with a backplate and a canopy (with or without extension ring), no separate outlet box is required.
3. Provide surface metal raceway outlet box, and the backplate and canopy, at the feed-in location of each fluorescent lighting fixture having end-stem suspension.
4. Where a surface metal raceway extension is made from an existing outlet box on which a lighting fixture is installed, no additional surface-mounted outlet box is required. Provide a backplate slightly smaller than the fixture canopy.

EE. Set floor boxes level and adjust to finished floor surface.

FF. Select paragraph above for metal floor boxes and below for nonmetallic floor boxes.

GG. Set floor boxes level and trim after installation to fit flush to finished floor surface.

HH. Install hinged-cover enclosures and cabinets plumb. Support at each corner.

- II. NO PVC CONDUIT ALLOWED ABOVE THE CEILING OR IN THE A/C RETURN PLENUM. PROVIDE RIGID CONDUIT. Verify all MEP documents.

3.4 PROTECTION

A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure coatings, finishes, and cabinets are without damage or deterioration at the time of Substantial Completion.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.5 CLEANING

A. On completion of installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish, including chips, scratches, and abrasions.

END OF SECTION

SECTION 26 05 43 - UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART1 -GENERAL

1.1 RELATED REQUIREMENTS

- A. The General Provisions, Supplemental General Provisions, Special Provisions and Specification sections, apply to work covered by this Section.

1.2 SCOPE OF WORK

- A. Provide labor, materials, equipment, tools and services, and perform operations required for, and reasonably incidental to, the providing of all site electrical work.
- B. The site electrical work shall include, but not be limited to, the furnishing and installation of necessary materials and making arrangements for:
 - 1. The connection of electrical and telephone utilities.
 - 2. Underground conduit.

1.3 SUBMITTALS

- A. Submit product data and shop drawings in accordance with Section for products specified under PARTS 2 PRODUCTS.

1.4 REFERENCE STANDARDS

- A. National Electrical Code (NEC), Article 300
- B. Service installation standards of the serving utility company(s).

PART 2 - PRODUCTS

2.1 ELECTRICAL SERVICE

- A. Coordination: The location of the service entrance shall be coordinated with all other trades. Provide materials and equipment required to connect the electrical service. Contractor shall coordinate with the Power Company for all requirements prior to bid date. Contractor shall include all cost to for Utility Company to extend service to project site bid.
- B. Materials: Provide materials in accordance with other Sections of these Specifications.

2.2 COMMUNICATION SERVICE

- A. Coordination: The location of the telephone, cable, and internet service entrance shall be coordinated with all other trades. Provide materials and equipment required to connect the telephone, cable and internet services. Contractor shall coordinate with the Telephone , cable, and internet company for all requirements prior to bid date. Contractor is responsible to coordinate with utility companies.
- B. Materials: Provide materials in accordance with other sections of this specification.

PART 3 - EXECUTION

3.1 GENERAL

- A. Underground installation of more than one conduit shall be in a duct arrangement as indicated. All conduits shall be laid so joints are staggered. All bends and stub-ups shall be rigid steel.
- B. Pour a red colored concrete envelope 3" thick over utility service, emergency generator and fire pump conduits. Where conduits cross a driveway, road or parking area, reinforcing rods shall be installed.
- C. Perform excavation, shoring, backfilling and concrete work in connection with electrical work in accordance with other sections of the Specifications.
- D. All conduit shall be sloped away from the building to negate water entering the building through the conduit system.

3.2 UTILITIES

- A. The locations, elevations and voltage of electrical lines and the location of the telephone lines included within the area of this work are indicated on the Drawings or in the Specifications in accordance with information received by the Architect/Engineer and Owner.
- B. The Contractor shall examine the site and shall verify, to his own satisfaction, the location and elevation of all utilities, and shall adequately inform himself as to their relation to the work.

- C. Existing utility lines not indicated but encountered during construction shall be protected, relocated or capped as directed by the Architect/Engineer. All precautions shall be exercised to prevent damage to existing lines not shown, but should work become necessary, it must be authorized prior to execution except in an emergency situation.
- D. Before beginning excavations of any nature whatsoever, the Contractor shall make an attempt to locate all underground utilities of every nature occurring within the bounds of the area to be excavated. Contractor is responsible to call 811 prior to any work. The Contractor shall then proceed with caution in his excavation work so that no utility shall be damaged with a resultant loss of service.
- E. Should a damage result to any utility through the Contractor's negligence or failure to comply with the above directive, he shall be liable for such damage and for all expense incurred in the expeditious repair or replacement of such damaged utilities.
- F. Repair of damaged utilities shall be to a condition equal to or better than the adjacent undamaged portion of such utility and to the complete satisfaction of the Architect/Engineer and Owner.

END OF SECTION

SECTION 26 05 53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- A. The General Provisions, Supplemental General Provisions, Special Provisions and Specification sections, apply to work covered by this Section.
- B. Comply with ELECTRICAL Sections, as applicable. Refer to other sections for coordination of work.

1.2 SCOPE OF WORK

- A. Provide labor, material, equipment, tools and services, and perform operations required for, and reasonably incidental to, the providing of electrical identification, including related accessories.
- B. Provide electrical identification for the following:
 - 1. Panelboards, motor starters, contactors, disconnect switches, circuit breakers and other electrical equipment with nameplate identifying the item of equipment and the equipment serving the same.
 - 2. Raceways, junction boxes and pull boxes.
 - 3. Label each panelboard index indicating the room #s to the related circuit. Also add the index sheet in a laminated white core, plastic with beveled edges, minimum 1/16 inch thick. Lettering shall be machine-engraved, not less than 1/4" high, cut through the black or red surface to the white core.
 - 4. Wiring devices.
 - 5. Wiring.
 - 6. Three phase motor rotation.

1.3 SUBMITTALS

- A. Submit product data in accordance with Section for products specified under PART 2 - PRODUCTS.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Brady
- B. Panduit
- C. Thomas & Betts
- D. Seton

2.2 IDENTIFICATION

- E. A. Nameplates
 - 1. Nameplates shall be black engraved surface on white core for normal power circuits and red engraved surface on white core for emergency power circuits.
 - 2. Provide for each distribution panelboard, branch circuit panelboard, transformer and any other similar equipment furnished under this section identification as to its given name, voltage and origination of service. Examples are as follows:

'LR1'
120/240V
FED FROM 'MDP'

'LR2'
120/240V
FED FROM 'MDP'

- 3. Provide for each motor starter enclosure, circuit breaker enclosure, disconnect switch and any other similar equipment furnished under this section, identification as to the specific load that it serves and the origination of service. Examples are as follows:

'AHU-1' 'CU-1'
FED FROM 'MDP' FED FROM 'MDP'

- 4. Provide for each feeder protective device in each distribution panelboard and any other similar equipment furnished under this section, identification as to the specific load that it serves.
- 5. Nameplates shall be laminated, white core, plastic with beveled edges, minimum 1/16 inch thick. Lettering

- shall be machine-engraved, not less than 1/4" high, cut through the black or red surface to the white core.
- F. B. Junction Boxes and Pull Boxes
 - 1. 1. Identification shall be with a black permanent marking pen on the top of 4" x 4" junction box covers or on the back of an outlet box cover plate identifying the branch circuits and systems within the conduit. Pull boxes shall be provided with a nameplate stating voltage and system served.
 - G. C. Wiring Device Wall Plates
 - 1. 1. On the back side of wiring device wall plates identify with a black permanent marking pen the panelboard and branch circuit number the device is served from.
 - H. D. Wire Markers
 - 1. 1. Wire markers for identification of wiring shall be self-adhesive type having letters and numerals indicating serving equipment and feeder or branch circuit number.
 - I. Rotation Tags
 - 1. Rotation tags shall be brass or aluminum securely attached to equipment.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Surfaces to receive labels or nameplates shall be carefully prepared in accordance with the manufacturer's instructions and recommendations.

3.2 NAMEPLATES

- J. A. Nameplates shall be properly attached to identify panelboards, feeder circuit breakers, disconnect switches, pull boxes and other similar equipment furnished under this section.

3.3 WIRE MARKERS

- K. A. Wire markers shall be applied to each conductor or cable within panelboards, motor starter enclosures, circuit breaker enclosures, disconnect switches, cabinets, junction boxes, pull boxes, and other similar equipment identifying the serving equipment and feeder or branch circuit from which the conductors originate.

END OF SECTION

SECTION 26 05 73- POWER SYSTEM STUDIES

PART 1 -GENERAL

1.1 SCOPE

- A. The contractor shall furnish short-circuit and protective device coordination studies which shall be prepared by the equipment manufacturer.
- B. The contractor shall furnish an Arc Flash Hazard Analysis Study per NFPA 70E - Standard for Electrical Safety in the Workplace, reference Article 130.5 and Informative Annex D.

1.2 REFERENCES

- A. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - 1. IEEE 141 – Recommended Practice for Electric Power Distribution and Coordination of Industrial and Commercial Power Systems
 - 2. IEEE 242 – Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
 - 3. IEEE 399 – Recommended Practice for Industrial and Commercial Power System Analysis
 - 4. IEEE 241 – Recommended Practice for Electric Power Systems in Commercial Buildings
 - 5. IEEE 1015 – Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems
 - 6. IEEE 1584 – Guide for Performing Arc-Flash Hazard Calculations
- B. American National Standards Institute (ANSI):
 - 1. ANSI C57.12.00 – Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
 - 2. ANSI C37.13 – Standard for Low Voltage AC Power Circuit Breakers Used in Enclosures
 - 3. ANSI C37.010 – Standard Application Guide for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis
 - 4. ANSI C 37.41 – Standard Design Tests for High Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches and Accessories
 - 5. ANSI C37.5 – Methods for Determining the RMS Value of a Sinusoidal Current Wave and Normal-Frequency Recovery Voltage, and for Simplified Calculation of Fault Currents
- C. The National Fire Protection Association (NFPA)
 - 1. NFPA 70 - National Electrical Code, latest edition
 - 2. NFPA 70E – Standard for Electrical Safety in the Workplace

1.3 SUBMITTALS FOR REVIEW/APPROVAL

- A. The short-circuit and protective device coordination studies shall be submitted to the design engineer prior to receiving final approval of the distribution equipment shop drawings and/or prior to release of equipment drawings for manufacturing. If formal completion of the studies may cause delay in equipment manufacturing, approval from the engineer may be obtained for preliminary submittal of sufficient study data to ensure that the selection of device and characteristics will be satisfactory.

1.4 SUBMITTALS FOR CONSTRUCTION

- A. The results of the short-circuit, protective device coordination and arc flash hazard analysis studies shall be summarized in a final report. No more than five (5) bound copies of the complete final report shall be submitted. For large system studies, submittals requiring more than five (5) copies of the report will be provided without the section containing the computer printout of the short-circuit input and output data. Additional copies, where required, shall be provided on CD in PDF format.
- B. The report shall include the following sections:
 - 1. One-line diagram showing protective device ampere ratings and associated designations, cable size & lengths, transformer kVA & voltage ratings, motor & generator kVA ratings, and switchgear/switchboard/panelboard designations
 - 2. Descriptions, purpose, basis and scope of the study
 - 3. Tabulations of the worst-case calculated short circuit duties as a percentage of the applied device rating (automatic transfer switches, circuit breakers, fuses, etc.); the short circuit duties shall be upward-adjusted for X/R ratios that are above the device design ratings
 - 4. Protective device time versus current coordination curves with associated one line diagram identifying the plotted devices, tabulations of ANSI protective relay functions and adjustable circuit breaker trip unit settings

5. Multi-function relay setting file printouts including all ANSI protective relay functions and associated logic and control. Metering, communication, and control logic settings not associated with ANSI protective functions are not required.
6. Fault study input data, case descriptions, and current calculations including a definition of terms and guide for interpretation of the computer printout
7. Incident energy and flash protection boundary calculations
8. Comments and recommendations for system improvements, where needed
9. Executive Summary including source of information and assumptions made

1.5 QUALIFICATIONS

- A. The short-circuit, protective device coordination and arc flash hazard analysis studies shall be conducted under the supervision and approval of a Registered Professional Electrical Engineer skilled in performing and interpreting the power system studies. The Registered Professional Electrical Engineer shall be a full-time employee of the Engineering Services Organization.

PART 2 PRODUCT

2.1 STUDIES

- A. Contractor to furnish short-circuit and protective device coordination studies as prepared by equipment manufacturer. By using the equipment manufacturer the study allows coordination of proper breakers, fuses, and current transformers. The coordination study shall begin with the utility company's feeder protective device and include all of the electrical protective devices down to and include the largest feeder circuit breaker and motor starter in the 480 Volt motor control centers and power distribution panelboards. The study shall also include variable frequency drives, harmonic filters, power factor correction equipment, transformers and protective devices associated with variable frequency drives, emergency and standby generators associated paralleling equipment and distribution switchgear.
- B. The contractor shall furnish an Arc Flash Hazard Analysis Study per NFPA 70E - Standard for Electrical Safety in the Workplace, reference Article 130.5 and Informative Annex D.

2.2 DATA COLLECTION

- A. Contractor shall furnish all field data as required by the power system studies. The Engineer performing the short-circuit, protective device coordination and arc flash hazard analysis studies shall furnish the Contractor with a listing of required data immediately after award of the contract. The Contractor shall expedite collection of the data to eliminate unnecessary delays and assure completion of the studies as required for final approval of the distribution equipment shop drawings and/or prior to the release of the equipment for manufacturing.
- B. Source combination may include present and future utility supplies, motors, and generators.
- C. Load data utilized may include existing and proposed loads obtained from Contract Documents provided by Owner or Contractor.
- D. Include fault contribution of existing motors in the study, with motors < 50 hp grouped together. The Contractor shall obtain required existing equipment data, if necessary, to satisfy the study requirements.

2.3 SHORT-CIRCUIT AND PROTECTIVE DEVICE EVALUATION STUDY

- A. Use actual conductor impedances if known. If unknown, use typical conductor impedances based on IEEE Standards 141, latest edition.
- B. Transformer design impedances and standard X/R ratios shall be used when test values are not available.
- C. Provide the following:
 1. Calculation methods and assumptions
 2. Selected base per unit quantities
 3. One-line diagram of the system being evaluated with available fault at each bus, and interrupting rating of devices noted
 4. Source impedance data, including electric utility system and motor fault contribution characteristics
 5. Typical calculations
 6. Tabulations of calculated quantities
 7. Results, conclusions, and recommendations
- D. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault at each:
 1. Electric utility's supply termination point
 2. Incoming switchgear
 3. Unit substation primary and secondary terminals
 4. Low voltage switchgear
 5. Motor control centers
 6. Standby generators and automatic transfer switches
 7. Branch circuit panelboards

8. Other significant locations throughout the system
- E. For grounded systems, provide a bolted line-to-ground fault current study for areas as defined for the three-phase bolted fault short-circuit study.
- F. Protective Device Evaluation:
 1. Evaluate equipment and protective devices and compare to short circuit ratings
 2. Adequacy of switchgear, motor control centers, and panelboard bus bracing to withstand short-circuit stresses
 3. Adequacy of transformer windings to withstand short-circuit stresses
 4. Cable and busway sizes for ability to withstand short-circuit heating
 5. Notify Owner in writing, of existing, circuit protective devices improperly rated for the calculated available fault current

2.4 PROTECTIVE DEVICE COORDINATION STUDY

- A. Proposed protective device coordination time-current curves shall be graphically displayed on log-log scale paper.
- B. Include on each curve sheet a complete title and one-line diagram with legend identifying the specific portion of the system covered.
- C. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which device is exposed.
- D. Identify device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.
- E. Plot the following characteristics on the curve sheets, where applicable:
 1. Electric utility's protective device
 2. Medium voltage equipment relays
 3. Medium and low voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands
 4. Low voltage equipment circuit breaker trip devices, including manufacturer's tolerance bands
 5. Transformer full-load current, magnetizing inrush current, and ANSI transformer withstand parameters
 6. Conductor damage curves
 7. Ground fault protective devices, as applicable
 8. Pertinent motor starting characteristics and motor damage points
 9. Pertinent generator short-circuit decrement curve and generator damage point
 10. Other system load protective devices for the largest branch circuit and the largest feeder circuit breaker in each motor control center
- F. Provide adequate time margins between device characteristics such that selective operation is provided, while providing proper protection.
- G. Select each primary protective device required for a delta-wye connected transformer so that the characteristics or operating band is within the transformer parameters which includes a parameter equivalent to 58% of the ANSI withstand point to afford protection for secondary line-to-ground faults.
- H. Separate low voltage power circuit breakers from each other and the associated primary protective device by a 16% current margin for coordination and protection in the event of secondary line-to-line faults.
- I. Engineer shall provide settings file printouts for all multifunction relays supplied under this contract including all ANSI protective relay functions and associated logic and control. Metering, communication, and control logic settings not associated with ANSI protective functions are not required.

2.5 ARC FLASH HAZARD ANALYSIS

- A. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA70E-2012, Informative Annex D.
- B. When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model. Alternative methods shall be presented in the proposal.
- C. The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system (switchboards, switchgear, motor-control centers, panelboards, busway and splitters) where work could be performed on energized parts.
- D. The Arc-Flash Hazard Analysis shall include all MV, 575v, & 480v locations and significant locations in 240 volt and 208 volt systems fed from transformers equal to or greater than 125 kVA.
- E. Safe working distances shall be specified for calculated fault locations based upon the calculated arc flash boundary considering an incident energy of 1.2 cal/cm².
- F. The Arc Flash Hazard analysis shall include calculations for maximum and minimum contributions of fault current magnitude. The minimum calculation shall assume that the utility contribution is at a minimum and shall assume a minimum motor load. Conversely, the maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.

- G. Arc flash computation shall include both line and load side of main breaker calculations, where necessary.
- H. Arc Flash calculations shall be based on actual overcurrent protective device clearing time. Maximum clearing time will be capped at 2 seconds based on IEEE 1584-2002 section B.1.2.

I.

2.6 REPORT SECTIONS

A. Input Data:

- 1. Utility three-phase and line-to-ground available contribution with associated X/R ratios
- 2. Short-circuit reactance of rotating machines with associated X/R ratios
- 3. Cable type, construction, size, # per phase, length, impedance and conduit type
- 4. Bus duct type, size, length, and impedance
- 5. Transformer primary & secondary voltages, winding configurations, kVA rating, impedance, and X/R ratio
- 6. Reactor inductance and continuous ampere rating
- 7. Aerial line type, construction, conductor spacing, size, # per phase, and length

B. Short-Circuit Data:

- 1. Source fault impedance and generator contributions
- 2. X to R ratios
- 3. Asymmetry factors
- 4. Motor contributions
- 5. Short circuit kVA
- 6. Symmetrical and asymmetrical fault currents

C. Recommended Protective Device Settings:

- 1. Phase and Ground Relays:
 - a. Current transformer ratio.
 - b. Current setting.
 - c. Time setting.
 - d. Instantaneous setting.
 - e. Specialty non-overcurrent device settings.
 - f. Recommendations on improved relaying systems, if applicable.
- 2. Circuit Breakers:
 - a. Adjustable pickups and time delays (long time, short time, ground).
 - b. Adjustable time-current characteristic.
 - c. Adjustable instantaneous pickup.
 - d. Recommendations on improved trip systems, if applicable.

D. Incident energy and arc flash boundary calculations.

- 1. Arcing fault magnitude
- 2. Device clearing time
- 3. Duration of arc
- 4. Arc flash boundary
- 5. Working distance
- 6. Incident energy
- 7. Recommendations for arc flash energy reduction

PART 3 - EXECUTION

3.1 FIELD ADJUSTMENT

- A. Adjust relay and protective device settings according to the recommended settings table provided by the coordination study. Field adjustments to be completed by the engineering service division of the equipment manufacturer under the Startup and Acceptance Testing contract portion.
- B. Make minor modifications to equipment as required to accomplish conformance with short circuit and protective device coordination studies.
- C. Notify Owner in writing of any required major equipment modifications.
- D. Following completion of all studies, acceptance testing and startup by the field engineering service division of the equipment manufacturer, a 2-year warranty shall be provided on all components manufactured by the engineering service parent manufacturing company.

3.2 ARC FLASH WARNING LABELS

- A. The vendor shall provide a 4 in. x 4 in. thermal transfer type label of high adhesion polyester for each work location analyzed.

- B. The label shall have an orange header with the wording, “WARNING, SHOCK & ARC FLASH HAZARD”, and shall include the following information:
 - 1. Location designation
 - 2. Nominal voltage
 - 3. Arc flash boundary
 - 4. Incident energy
 - 5. Working distance
 - 6. Shock Boundaries
 - 7. Engineering report number, revision number and issue date
- C. Labels shall be machine printed, with no field markings
- D. Arc flash labels shall be provided in the following manner and all labels shall be based on recommended overcurrent device settings.
 - 1. For each 600, 480 and applicable 208 volt panelboards and disconnects, one arc flash label shall be provided
 - 2. For each motor control center, one arc flash label shall be provided
 - 3. For each low voltage switchboard, one arc flash label shall be provided
 - 4. For each switchgear, one flash label shall be provided
 - 5. For medium voltage switches one arc flash label shall be provided
- E. Labels shall be field installed by the engineering service division of the equipment manufacturer under the Startup and Acceptance Testing contract portion.

3.3 ARC FLASH TRAINING

- A. The equipment vendor shall train personnel of the potential arc flash hazards associated with working on energized equipment (minimum of 4 hours). Maintenance procedures in accordance with the requirements of NFPA 70E, Standard For Electrical Safety Requirements For Employee Workplaces, shall be provided in the equipment manuals. The training shall be certified for continuing education units (CEUs) by the International Association for Continuing Education Training (IACET).

END OF SECTION

SECTION 26 09 23 - LIGHTING CONTROL DEVICES

PART 1 GENERAL

1.1 DESIGN / PERFORMANCE REQUIREMENTS

- A. WattStopper Digital Lighting Management (DLM) shall accommodate the square-footage coverage requirements for each area controlled, utilizing room controllers, digital occupancy sensors, switches, daylighting sensors and accessories that suit the required lighting and electrical system parameters.
- B. Approved Manufacturers for Interior Lighting Controls:
 - 1. Wattstopper
 - 2. Hubbell Building Automation (basis of design)
 - 3. nLight

1.2 SUBMITTALS

- A. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. This specification red mark where the system does not comply. Any areas not red marked, it is assumed the system meets this specification. In the event it is found that the system does not meet this specification and this specification is not red marked, the specified system will be purchased and installed by the electrical contractor at no additional cost to the project.
 - 2. Catalog sheets and specifications.
 - 3. Ratings, configurations, standard wiring diagrams, dimensions, colors, service condition requirements, and installed features.
 - 4. Storage and handling requirements and recommendations.
 - 5. Installation instructions.
- B. Shop Drawings: Wiring diagrams a for the various components of the System specified including:
 - 1. Composite wiring and/or schematic diagram of each control circuit as proposed to be installed.
 - 2. Show location of all devices, including at minimum sensors, load controllers, switches/dimmers for each area on reflected ceiling plans, and in-room bus connections.
 - 3. Provide room/area details including products and sequence of operation for each room or area. Illustrate typical acceptable room/area connection topologies.
 - 4. Network riser diagram including floor and building level details. Include network cable specification. Illustrate points of connection to integrated systems. Coordinate integration with mechanical and/or other trades.
- C. Manufacturer's Certificates: Certify products meet or exceed specified requirements.
- D. Closeout Submittals:
 - 1. Project Record Documents: Record actual installed locations and settings for lighting control devices.
 - 2. Operation and Maintenance Manual:
 - a. Include approved Shop Drawings and Product Data.
 - b. Include Sequence of Operation, identifying operation for each room or space.
 - c. Include manufacturer's maintenance information.
 - d. Operation and Maintenance Data: Include detailed information on device programming and setup.
 - e. Include startup and test reports.

1.3 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing of centralized and distributed lighting control systems with a minimum of 10 years documented experience.
- B. System Components: Demonstrate that individual components have undergone quality control and testing prior to shipping.

1.4 PRE-INSTALLATION MEETINGS

- A. Convene minimum two weeks prior to commencing Work of this section. Meeting to be attended by Contractor, system installer, factory authorized manufacturer's representative, and representative of all trades related to the system installation.
- B. Review installation procedures and coordination required with related Work and the following:
 - 1. Confirm the location and mounting of all devices, with special attention to placement of switches, dimmers, and any sensors.
 - 2. Review the specifications for low voltage control wiring and termination.
 - 3. Discuss the functionality and configuration of all products, including sequences of operation, per design requirements.
 - 4. Discuss requirements for integration with other trades
- C. Inspect and make notes of job conditions prior to installation:
 - 1. Record minutes of the conference and provide copies to all parties present and the specifier.
 - 2. Identify all outstanding issues in writing designating the responsible party for follow-up action and the timetable for completion.
 - 3. Installation shall not begin until all outstanding issues are resolved to the satisfaction of the specifier.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store products in a clean, dry space in original manufacturer's packaging in accordance with manufacturer's written instructions until ready for installation

1.6 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.
- B. Do not install equipment until following conditions can be maintained in spaces to receive equipment:
 - 1. Ambient temperature: 32 to 104 degrees F (0 to 40 degrees C).
 - 2. Relative humidity: Maximum 90 percent, non-condensing.

1.7 WARRANTY

- A. Manufacturer shall provide a 5 year limited warranty on products within this installation, except where otherwise noted, and consisting of a one for one device replacement.

PART 2 PRODUCTS

2.1 INTERIOR DISTRIBUTED DIGITAL LIGHTING CONTROL SYSTEM

- A. Provide a complete system with all necessary enclosures, wiring, and system components to ensure a complete and properly functioning system as indicated on the Drawings and specified herein. If a conflict is identified, between the Drawing and this Specification, contact the specifier for clarification prior to proceeding.
- B. Provide a lighting control system with the following features:
 - 1. Free topology, plug-in wiring system (Cat 5e) for power and data to room devices.
 - 2. Room Controllers: Self-configuring, digitally addressable one, two or three relay plenum-rated controllers for on/off control. Selected models include 0-10 volt or line voltage forward phase MLV, ELV, or LED control dimming outputs and integral current monitoring capabilities. Controllers include a manual override / dimming button for each channel on the controller. Polarity of each load output is reversible, via digital configuration, so that on is off and off is on. The Class 1 and Class 2 0-10 volt output automatically open upon loss of power to the Room Controller to assure full light output from the controlled lighting. When room controllers are daisy chained the available power to operate devices is cumulative, so all in room devices can be daisy be chained and powered from a single room controller port. Single dimming controller can support up to 48 communicating devices; single switching room controller can support up to 24 communicating devices.

3. Occupancy Sensors: Self-configuring, digitally addressable, calibrated occupancy sensors with LCD display, two-way active infrared (IR) communications, local PC interface, or network front end. Ceiling sensors offer two built-in RJ45 ports. Digital calibration and pushbutton configuration for the following variables:
 - a. Sensitivity, 0-100 percent in 10 percent increments
 - b. Time delay, 1-30 minutes in 1 minute increments
 - c. Detection technology, PIR, Ultrasonic or Dual Technology activation and/or re-activation.
4. Switches: Single gang self-configuring pushbutton switches in 1, 2, 3, 4, 5 and 8 button configuration, digitally addressable pushbutton on/off, dimming, and scene switches with two-way active infrared (IR) communications. Removable buttons for field replacement with engraved buttons and/or alternate color buttons. Button replacement may be completed without removing the switch from the wall or reprogramming. Load and Scene button function may be reconfigured in the field for individual buttons from Load to Scene, and vice versa
5. Daylighting Sensors: Single-zone closed loop, multi-zone open loop and single-zone dual-loop daylighting sensors with two-way active infrared (IR) communications for daylight harvesting using switching, bi-level, tri-level or dimming control.
 - a. Single-zone closed loop automatic self-calibration, initiated from the photosensor, a wireless configuration tool or a PC with appropriate software. Automatically establishes application-specific setpoints following self-calibration. For switching operation, an adequate deadband between the ON and OFF setpoints shall prevent the lights from cycling; for dimming operation a sliding setpoint control algorithm with separate Day and Night setpoints shall prevent abrupt ramping of loads
 - b. Multi-zone open loop photocell automatically establishes application-specific setpoints following manual calibration using a wireless configuration tool or a PC with appropriate software. For switching operation, an adequate deadband between the ON and OFF setpoints for each zone shall prevent the lights from cycling; for dimming operation, a proportional control algorithm shall maintain the design lighting level in each zone. Each of the three discrete daylight zones can include any non overlapping group of loads in the room.
6. **(Optional)** Configuration Tools: Able to read and modify parameters for load controllers and relay panels, occupancy sensors, wall switches, daylighting sensors, network bridges, and identify devices by type and serial number. Handheld remote for room configuration and relay panel programming provides two-way infrared (IR) communications to digital devices and allows complete configuration and reconfiguration of the device / room from up to 30 feet away. Save up to eight occupancy sensor setting profiles, and apply profiles to selected sensors.
7. (Required with Line Item 8) Building segment network: Linear topology, BACnet MS/TP network to connect multiple local networks for centralized control.
8. (Optional) Segment Manager: BACnet MS/TP-based controller with web browser-based user interface for system control, scheduling, power monitoring, room device parameter administration and reporting. Automatic discovery of devices and relay panels on the segment networks in a standard navigation tree format. Allow information for all devices to be imported into the Segment Manager via a single XML based site file. Provide capabilities for integration with a BAS via BACnet protocol. At a minimum, the following points shall be available to the BAS via BACnet IP connection to the segment manager: room occupancy state; room schedule mode; room switch lock control; individual occupancy sensor state; room lighting power; room plug-load power; load ON/OFF state; load dimming level; panel channel schedule state; panel relay state; and Segment Manager Group schedule state control. Any of above items shall be capable of being moved into an "Export Table" that will provide any integrator with only the data they need, and by using the Export Table effectively create a firewall between the integrator's request for info and the overall system performance. Any device on the building network can be remotely accessed through a cellular VPN to verify system is ready for start-up, aid in remote trouble troubleshooting, and device programming for the first year. The VPN is isolated from the building network.
9. Programming and Configuration Software: Free PC-native application capable of accessing and saving control parameters within a room, for the local network, via a USB adapter, or globally, for many

segment networks simultaneously, via BACnet/IP communication.

10. (Optional) Digital Zone Controller: Connect up to 64 room controllers. Zone Controller accepts program changes from Two-way infrared (IR) handheld remote or USB programming adapter tool for date and time, location, holidays, event scheduling, button binding and group programming. Provides BACnet MS/TP-compliant digital networked communication between other lighting controls and/or building automation system (BAS).
11. (Optional) Network Bridge: Provides communication between local room networks, relay panels, segment manager, or BAS via BACnet MS/TP.

2.2 BACnet INFORMATION BY DEVICE

A. Digital Room Controllers:

1. BACnet object information shall be available for the following objects:
 - a. Load status
 - b. Schedule state, normal or after-hours
 - c. Demand Response enable and disable
 - d. Room occupancy status
 - e. Total room lighting and plug loads watts
 - f. Electrical current
 - g. Total watts per controller
 - h. Total room watts/sq ft.
 - i. Force on/off all loads

B. Digital Sensors:

1. BACnet object information shall be available for the following objects:
 - a. Detection state
 - b. Occupancy sensor time delay
 - c. Occupancy sensor sensitivity, PIR and Ultrasonic

C. Digital Wall Switches:

1. BACnet object information shall be available for the following objects:
 - a. Button state
 - b. Switch lock control
Switch lock status

D. Digital Photocells:

1. BACnet object information shall be available for the following objects:
 - a. Light level
 - b. Day and night setpoints
 - c. Off time delay
 - d. On and off setpoints
 - e. Up to three zone setpoints
 - f. Operating mode - on/off, bi-level, tri-level or dimming

E. Network Bridge:

1. BACnet object information shall be available for the following objects:
 - a. Read/write the normal or after hours schedule state for the room
 - b. Read the detection state of each occupancy sensor
 - c. Read the aggregate occupancy state of the room
 - d. Read/write the On/Off state of loads
 - e. Read/write the dimmed light level of loads
 - f. Read the button states of switches
 - g. Read total current in amps, and total power in watts through the load controller
 - h. Read/write occupancy sensor time delay, PIR sensitivity and ultrasonic sensitivity settings
 - i. Activate a preset scene for the room
 - j. Read/write daylight sensor fade time and day and night setpoints
 - k. Read the current light level, in foot-candles, from interior and exterior photosensors and photocells

- l. Set daylight sensor operating mode
- m. Read/write wall switch lock status
- n. Read watts per square foot for the entire controlled room
- o. Write maximum light level per load for demand response mode
- p. Read/write activation of demand response mode for the room
- q. Activate/restore demand response mode for the room

2.3 PREPARATION

- A. Do not begin installation until measurements have been verified and work areas have been properly prepared.
- B. If preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- C. Verify that required pre-installation meeting specified in Part 1 of this specification has been completed, recorded meeting minutes have been distributed and all outstanding issues noted have been resolved prior to the start of installation.

2.4 INSTALLATION

- A. Install system in accordance with the approved system shop drawings and manufacturer's instructions.
- B. Install all room/area devices using manufacturer's factory-tested Cat 5e cable with pre-terminated RJ-45 connectors. In room wire substitution is not permitted
 - 1. Install all room to room network devices using manufacturer-supplied LM-MSTP network wire. Network wire substitution is not permitted and may result in loss of product warranty.
 - 2. Low voltage wiring topology must comply with manufacturer's specifications.
 - 3. Route network wiring as indicated on the Drawings as closely as possible. Document final wiring location, routing and topology on as built drawings.
- C. All line voltage connections shall be tagged to indicate circuit and switched legs.
- D. Test all devices to ensure proper communication.
- E. Calibrate all sensor time delays and sensitivity to guarantee proper detection of occupants and energy savings. Adjust time delay so that controlled area remains lighted while occupied.
- F. Provide written or computer-generated documentation on the configuration of the system including room by room description including:
 - 1. Sensor parameters, time delays, sensitivities, and daylighting setpoints.
 - 2. Sequence of operation, (e.g. manual ON, Auto OFF. etc.)
 - 3. Load Parameters (e.g. blink warning, etc.)
- G. Post start-up tuning – Areas connected to a segment manager, adjust lighting control devices for the owner at no additional charge for the first year.
- H. All Class II cabling shall enter enclosures from within low-voltage wiring areas and shall remain within those areas. No Class I conductors shall enter a low-voltage area.
- I. Run separate neutrals for any phase dimmed branch load circuit. Different types of dimming loads shall have separate neutral.
- J. Verify all non-panel-based lighting loads to be free from short circuits prior to connection to room controllers.

2.5 START-UP:

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to have a preconstruction meeting, midway construction meeting and final meeting inspection.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to have components, assemblies, and equipment installations, including connections, and to assist in testing. Notify Architect and

Manufacturer in writing a minimum of 3 weeks prior to system start-up and testing.

- C. Tests and Inspections: Manufacturer's service representative shall perform the following inspections and prepare reports.
1. Verify Class I and II wiring connections are terminated properly by validating system performance.
 2. Set IP addresses and other network settings of system front end hardware per facilities IT instructions.
 3. Verify / complete task programming for all switches, dimmers, time clocks, and sensors.
 4. Verify that the control of each space complies with the Sequence of Operation.
 5. Correct any system issues and retest..

2.6 DEMONSTRATION AND TRAINING

- A. Before Substantial Completion, arrange and provide a one-day Owner instruction period to designated Owner personnel. Set-up, starting of the lighting control system and Owner instruction includes:
1. Provide training to cover installation, programming, operation, and troubleshooting of the lighting control system.

2.7 PRODUCT SUPPORT AND SERVICE

- A. Factory telephone support shall be available at no cost to the Owner following acceptance. Factory assistance shall consist of assistance in solving application issues pertaining to the control equipment.

END OF SECTION

SECTION 26 09 43 - DISTRIBUTED DIGITAL LIGHTING CONTROL SYSTEM

PART 1 GENERAL

1.1 DESIGN / PERFORMANCE REQUIREMENTS

- A. WattStopper Digital Lighting Management (DLM) shall accommodate the square-footage coverage requirements for each area controlled, utilizing room controllers, digital occupancy sensors, switches, daylighting sensors and accessories that suit the required lighting and electrical system parameters.
- B. Approved Manufacturers for Interior Lighting Controls:
 - 1. Wattstopper
 - 2. Hubbell Building Automation (basis of design)
 - 3. Osram Encelium
- C. Approved Manufacturers for Exterior Wireless Lighting Controls:
 - 1. Synapse Wireless (basis of design)
 - 2. Hubbell Building Automation
 - 3. Wattstopper

1.2 SUBMITTALS

- A. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. This specification red mark where the system does not comply. Any areas not red marked, it is assumed the system meets this specification. In the event it is found that the system does not meet this specification and this specification is not red marked, the specified system will be purchased and installed by the electrical contractor at no additional cost to the project.
 - 2. Catalog sheets and specifications.
 - 3. Ratings, configurations, standard wiring diagrams, dimensions, colors, service condition requirements, and installed features.
 - 4. Storage and handling requirements and recommendations.
 - 5. Installation instructions.
- B. Shop Drawings: Wiring diagrams a for the various components of the System specified including:
 - 1. Composite wiring and/or schematic diagram of each control circuit as proposed to be installed.
 - 2. Show location of all devices, including at minimum sensors, load controllers, switches/dimmers for each area on reflected ceiling plans, and in-room bus connections.
 - 3. Provide room/area details including products and sequence of operation for each room or area. Illustrate typical acceptable room/area connection topologies.
 - 4. Network riser diagram including floor and building level details. Include network cable specification. Illustrate points of connection to integrated systems. Coordinate integration with mechanical and/or other trades.
- C. Manufacturer's Certificates: Certify products meet or exceed specified requirements.
- D. Closeout Submittals:
 - 1. Project Record Documents: Record actual installed locations and settings for lighting control devices.
 - 2. Operation and Maintenance Manual:
 - a. Include approved Shop Drawings and Product Data.
 - b. Include Sequence of Operation, identifying operation for each room or space.
 - c. Include manufacturer's maintenance information.
 - d. Operation and Maintenance Data: Include detailed information on device programming and setup.

- e. Include startup and test reports.

1.3 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing of centralized and distributed lighting control systems with a minimum of 10 years documented experience.
- B. System Components: Demonstrate that individual components have undergone quality control and testing prior to shipping.

1.4 PRE-INSTALLATION MEETINGS

- A. Convene minimum two weeks prior to commencing Work of this section. Meeting to be attended by Contractor, system installer, factory authorized manufacturer's representative, and representative of all trades related to the system installation.
- B. Review installation procedures and coordination required with related Work and the following:
 - 1. Confirm the location and mounting of all devices, with special attention to placement of switches, dimmers, and any sensors.
 - 2. Review the specifications for low voltage control wiring and termination.
 - 3. Discuss the functionality and configuration of all products, including sequences of operation, per design requirements.
 - 4. Discuss requirements for integration with other trades
- C. Inspect and make notes of job conditions prior to installation:
 - 1. Record minutes of the conference and provide copies to all parties present and the specifier.
 - 2. Identify all outstanding issues in writing designating the responsible party for follow-up action and the timetable for completion.
 - 3. Installation shall not begin until all outstanding issues are resolved to the satisfaction of the specifier.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store products in a clean, dry space in original manufacturer's packaging in accordance with manufacturer's written instructions until ready for installation

1.6 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.
- B. Do not install equipment until following conditions can be maintained in spaces to receive equipment:
 - 1. Ambient temperature: 32 to 104 degrees F (0 to 40 degrees C).
 - 2. Relative humidity: Maximum 90 percent, non-condensing.

1.7 WARRANTY

- A. Manufacturer shall provide a 5 year limited warranty on products within this installation, except where otherwise noted, and consisting of a one for one device replacement.

1.8 EXTRA MATERIALS

- A. If any of the following products are part of the design, provide 5% attic stock for each type:
 - Ceiling Sensor
 - Indoor Digital Daylighting Photocell
 - Digital Wall Switches
 - Digital Switching Room Controller

Digital Dimming Room Controller
Digital Dimming Room Controller with Current Monitoring
Network Bridge

PART 2 PRODUCTS

2.1 INTERIOR DISTRIBUTED DIGITAL LIGHTING CONTROL SYSTEM

- A. Provide a complete system with all necessary enclosures, wiring, and system components to ensure a complete and properly functioning system as indicated on the Drawings and specified herein. If a conflict is identified, between the Drawing and this Specification, contact the specifier for clarification prior to proceeding.
- B. Provide a lighting control system with the following features:
 - 1. Free topology, plug-in wiring system (Cat 5e) for power and data to room devices.
 - 2. Room Controllers: Self-configuring, digitally addressable one, two or three relay plenum-rated controllers for on/off control. Selected models include 0-10 volt or line voltage forward phase MLV, ELV, or LED control dimming outputs and integral current monitoring capabilities. Controllers include a manual override / dimming button for each channel on the controller. Polarity of each load output is reversible, via digital configuration, so that on is off and off is on. The Class 1 and Class 2 0-10 volt output automatically open upon loss of power to the Room Controller to assure full light output from the controlled lighting. When room controllers are daisy chained the available power to operate devices is cumulative, so all in room devices can be daisy be chained and powered from a single room controller port. Single dimming controller can support up to 48 communicating devices; single switching room controller can support up to 24 communicating devices.
 - 3. Occupancy Sensors: Self-configuring, digitally addressable, calibrated occupancy sensors with LCD display, two-way active infrared (IR) communications, local PC interface, or network front end. Ceiling sensors offer two built-in RJ45 ports. Digital calibration and pushbutton configuration for the following variables:
 - a. Sensitivity, 0-100 percent in 10 percent increments
 - b. Time delay, 1-30 minutes in 1 minute increments
 - c. Detection technology, PIR, Ultrasonic or Dual Technology activation and/or re-activation.
 - 4. Switches: Single gang self-configuring pushbutton switches in 1, 2, 3, 4, 5 and 8 button configuration, digitally addressable pushbutton on/off, dimming, and scene switches with two-way active infrared (IR) communications. Removable buttons for field replacement with engraved buttons and/or alternate color buttons. Button replacement may be completed without removing the switch from the wall or reprogramming. Load and Scene button function may be reconfigured in the field for individual buttons from Load to Scene, and vice versa
 - 5. Daylighting Sensors: Single-zone closed loop, multi-zone open loop and single-zone dual-loop daylighting sensors with two-way active infrared (IR) communications for daylight harvesting using switching, bi-level, tri-level or dimming control.
 - a. Single-zone closed loop automatic self-calibration, initiated from the photosensor, a wireless configuration tool or a PC with appropriate software. Automatically establishes application-specific setpoints following self-calibration. For switching operation, an adequate deadband between the ON and OFF setpoints shall prevent the lights from cycling; for dimming operation a sliding setpoint control algorithm with separate Day and Night setpoints shall prevent abrupt ramping of loads
 - b. Multi-zone open loop photocell automatically establishes application-specific setpoints following manual calibration using a wireless configuration tool or a PC with appropriate software. For switching operation, an adequate deadband between the ON

and OFF setpoints for each zone shall prevent the lights from cycling; for dimming operation, a proportional control algorithm shall maintain the design lighting level in each zone. Each of the three discrete daylight zones can include any non overlapping group of loads in the room.

6. **(Optional)** Configuration Tools: Able to read and modify parameters for load controllers and relay panels, occupancy sensors, wall switches, daylighting sensors, network bridges, and identify devices by type and serial number. Handheld remote for room configuration and relay panel programming provides two-way infrared (IR) communications to digital devices and allows complete configuration and reconfiguration of the device / room from up to 30 feet away. Save up to eight occupancy sensor setting profiles, and apply profiles to selected sensors.
7. **(Required with Line Item 8)** Building segment network: Linear topology, BACnet MS/TP network to connect multiple local networks for centralized control.
8. **(Optional)** Segment Manager: BACnet MS/TP-based controller with web browser-based user interface for system control, scheduling, power monitoring, room device parameter administration and reporting. Automatic discovery of devices and relay panels on the segment networks in a standard navigation tree format. Allow information for all devices to be imported into the Segment Manager via a single XML based site file. Provide capabilities for integration with a BAS via BACnet protocol. At a minimum, the following points shall be available to the BAS via BACnet IP connection to the segment manager: room occupancy state; room schedule mode; room switch lock control; individual occupancy sensor state; room lighting power; room plug-load power; load ON/OFF state; load dimming level; panel channel schedule state; panel relay state; and Segment Manager Group schedule state control. Any of above items shall be capable of being moved into an "Export Table" that will provide any integrator with only the data they need, and by using the Export Table effectively create a firewall between the integrator's request for info and the overall system performance. Any device on the building network can be remotely accessed through a cellular VPN to verify system is ready for start-up, aid in remote trouble troubleshooting, and device programming for the first year. The VPN is isolated from the building network.
9. Programming and Configuration Software: Free PC-native application capable of accessing and saving control parameters within a room, for the local network, via a USB adapter, or globally, for many segment networks simultaneously, via BACnet/IP communication.
10. **(Optional)** Digital Zone Controller: Connect up to 64 room controllers. Zone Controller accepts program changes from Two-way infrared (IR) handheld remote or USB programming adapter tool for date and time, location, holidays, event scheduling, button binding and group programming. Provides BACnet MS/TP-compliant digital networked communication between other lighting controls and/or building automation system (BAS).
11. **(Optional)** Network Bridge: Provides communication between local room networks, relay panels, segment manager, or BAS via BACnet MS/TP.

2.2 BACnet INFORMATION BY DEVICE

A. Digital Room Controllers:

1. BACnet object information shall be available for the following objects:
 - a. Load status
 - b. Schedule state, normal or after-hours
 - c. Demand Response enable and disable
 - d. Room occupancy status
 - e. Total room lighting and plug loads watts

- f. Electrical current
 - g. Total watts per controller
 - h. Total room watts/sq ft.
 - i. Force on/off all loads
- B. Digital Sensors:
 - 1. BACnet object information shall be available for the following objects:
 - a. Detection state
 - b. Occupancy sensor time delay
 - c. Occupancy sensor sensitivity, PIR and Ultrasonic
- C. Digital Wall Switches:
 - 1. BACnet object information shall be available for the following objects:
 - a. Button state
 - b. Switch lock control
 - Switch lock status
- D. Digital Photocells:
 - 1. BACnet object information shall be available for the following objects:
 - a. Light level
 - b. Day and night setpoints
 - c. Off time delay
 - d. On and off setpoints
 - e. Up to three zone setpoints
 - f. Operating mode - on/off, bi-level, tri-level or dimming
- E. Network Bridge:
 - 1. BACnet object information shall be available for the following objects:
 - a. Read/write the normal or after hours schedule state for the room
 - b. Read the detection state of each occupancy sensor
 - c. Read the aggregate occupancy state of the room
 - d. Read/write the On/Off state of loads
 - e. Read/write the dimmed light level of loads
 - f. Read the button states of switches
 - g. Read total current in amps, and total power in watts through the load controller
 - h. Read/write occupancy sensor time delay, PIR sensitivity and ultrasonic sensitivity settings
 - i. Activate a preset scene for the room
 - j. Read/write daylight sensor fade time and day and night setpoints
 - k. Read the current light level, in foot-candles, from interior and exterior photosensors and photocells
 - l. Set daylight sensor operating mode
 - m. Read/write wall switch lock status
 - n. Read watts per square foot for the entire controlled room
 - o. Write maximum light level per load for demand response mode
 - p. Read/write activation of demand response mode for the room
 - q. Activate/restore demand response mode for the room

2.3 PREPARATION

- A. Do not begin installation until measurements have been verified and work areas have been properly prepared.
- B. If preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- C. Verify that required pre-installation meeting specified in Part 1 of this specification has been

completed, recorded meeting minutes have been distributed and all outstanding issues noted have been resolved prior to the start of installation.

2.4 INSTALLATION

- A. Install system in accordance with the approved system shop drawings and manufacturer's instructions.
- B. Install all room/area devices using manufacturer's factory-tested Cat 5e cable with pre-terminated RJ-45 connectors. In room wire substitution is not permitted
 - 1. Install all room to room network devices using manufacturer-supplied LM-MSTP network wire. Network wire substitution is not permitted and may result in loss of product warranty.
 - 2. Low voltage wiring topology must comply with manufacturer's specifications.
 - 3. Route network wiring as indicated on the Drawings as closely as possible. Document final wiring location, routing and topology on as built drawings.
- C. All line voltage connections shall be tagged to indicate circuit and switched legs.
- D. Test all devices to ensure proper communication.
- E. Calibrate all sensor time delays and sensitivity to guarantee proper detection of occupants and energy savings. Adjust time delay so that controlled area remains lighted while occupied.
- F. Provide written or computer-generated documentation on the configuration of the system including room by room description including:
 - 1. Sensor parameters, time delays, sensitivities, and daylighting setpoints.
 - 2. Sequence of operation, (e.g. manual ON, Auto OFF. etc.)
 - 3. Load Parameters (e.g. blink warning, etc.)
- G. Post start-up tuning – Areas connected to a segment manager, adjust lighting control devices for the owner at no additional charge for the first year.
- H. All Class II cabling shall enter enclosures from within low-voltage wiring areas and shall remain within those areas. No Class I conductors shall enter a low-voltage area.
- I. Run separate neutrals for any phase dimmed branch load circuit. Different types of dimming loads shall have separate neutral.
- J. Verify all non-panel-based lighting loads to be free from short circuits prior to connection to room controllers.

2.5 START-UP:

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing. Notify Architect and Manufacturer in writing a minimum of 3 weeks prior to system start-up and testing.
- B. Tests and Inspections: Manufacturer's service representative shall perform the following inspections and prepare reports.
 - 1. Verify Class I and II wiring connections are terminated properly by validating system performance.
 - 2. Set IP addresses and other network settings of system front end hardware per facilities IT instructions.
 - 3. Verify / complete task programming for all switches, dimmers, time clocks, and sensors.
 - 4. Verify that the control of each space complies with the Sequence of Operation.
 - 5. Correct any system issues and retest..

2.6 DEMONSTRATION AND TRAINING

- A. Before Substantial Completion, arrange and provide a one-day Owner instruction period to designated Owner personnel. Set-up, starting of the lighting control system and Owner instruction includes:
 - 1. Provide training to cover installation, programming, operation, and troubleshooting of the lighting control system.

2.7 PRODUCT SUPPORT AND SERVICE

- A. Factory telephone support shall be available at no cost to the Owner following acceptance. Factory assistance shall consist of assistance in solving application issues pertaining to the control equipment.

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 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes load centers and panelboards, overcurrent protective devices, and associated auxiliary equipment rated 600 V and less for the following types:
 - 1. Edit panelboards below to suit Project.
 - 2. Lighting and appliance branch-circuit panelboards.
 - 3. Distribution panelboards.
- B. Related Sections include the following:
 - 1. List below only products, construction, and equipment that the reader might expect to find in this Section but are specified elsewhere.
 - 2. Retain subparagraph below if Project includes fusible panelboards.
 - 3. Section "Fuses."

1.3 DEFINITIONS

- A. Retain abbreviations that remain after this Section has been edited.
- B. EMI: Electromagnetic interference.
- C. GFCI: Ground-fault circuit interrupter.
- D. RFI: Radio-frequency interference.
- E. RMS: Root mean square.
- F. SPDT: Single pole, double throw.
- G. TVSS: Transient voltage surge suppressor.

1.4 SUBMITTALS

- A. Product Data: For each type of panelboard, overcurrent protective device, TVSS device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
 - 1. Dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings. Include the following:
 - a. Enclosure types and details for types other than NEMA 250, Type 1.
 - b. Bus configuration, current, and voltage ratings.
 - c. Short-circuit current rating of panelboards and overcurrent protective devices.
 - d. Delete subparagraph below if series rating of overcurrent protective devices is not used.
 - e. UL listing for series rating of installed devices.
 - f. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 2. Wiring Diagrams: Diagram power, signal, and control wiring and differentiate between manufacturer-installed and field-installed wiring.
- C. Delete paragraph below if independent testing agency is not used.
- D. Qualification Data: Submit data for testing agencies indicating that they comply with qualifications specified in "Quality Assurance" Article.
- E. Field Test Reports: Submit written test reports and include the following:
 - 1. Test procedures used.

2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- F. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.
- G. Maintenance Data: For panelboards and components to include in maintenance manuals specified in other sections. In addition to requirements specified in Section "Contract Closeout," include the following:
 1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 2. Time-current curves, including selectable ranges for each type of overcurrent protective device.

1.5 QUALITY ASSURANCE

- A. Retain paragraph and subparagraph below if Contractor or manufacturer selects testing agency.
- B. 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.
- C. Comply with NEMA PB 1.
- D. Comply with NFPA 70.

1.6 COORDINATION

- A. Edit below to delete or add types of equipment that affect panelboard installation.
- B. 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, and encumbrances to work-space clearance requirements.

1.7 EXTRA MATERIALS

- A. Extra materials may not be allowed for publicly funded projects. Revise quantity below to suit Project.
- B. Keys: [SIX] 6 spares of each type of panelboard cabinet lock.

PART 2 - PRODUCTS

2.1 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:
- B. Retain above for nonproprietary or below for semiproprietary Specification. Refer to Division 1 Section "Materials and Equipment."
- C. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Lists below are examples only. Retain or insert only those manufacturers whose products correspond with other requirements and whose availability and suitability for the application have been verified.
 2. Panelboards, Overcurrent Protective Devices, Controllers, Contactors, and Accessories:
 - a. Eaton
 - b. Square D Co.
 - c. General Electric

2.2 FABRICATION AND FEATURES

- A. Enclosures: Flush- and surface-mounted cabinets. NEMA PB 1, Type 1, to meet environmental conditions at installed location.
 1. Delete items below if not applicable. Add other Project-specific requirements.
 2. Outdoor Locations: NEMA 250, Type 3R.
 3. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
 4. Enclosures in hazardous locations must be carefully selected to meet the division and group listing of the environment.
 5. Hazardous Areas Indicated on Drawings: NEMA 250, Type 7C.
- B. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
- C. Retain paragraph above or below.
- D. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
- E. Finish: Manufacturer's standard enamel finish over corrosion-resistant treatment or primer coat.
- F. Directory Card: With transparent protective cover, mounted inside metal frame, inside panelboard door.
- G. Bus: Hard-drawn copper, 98 percent conductivity.
- H. Main and Neutral Lugs: Copper mechanical type suitable for use with conductor material.

- I. Ten paragraphs below are special features. Add other required features and coordinate with Drawings.
- J. Equipment Ground Bus: Copper and adequate for feeder and branch-circuit equipment ground conductors; bonded to box.
- K. Delete paragraph below except for panelboards incorporating one or more main service disconnect switches. Edit to suit Project.
- L. Service Equipment Label: UL labeled for use as service equipment for panelboards with main service disconnect switches.
- M. Delete paragraph below if future provisions are not required.
- N. Isolated Equipment Ground Bus: Copper and adequate for branch-circuit equipment ground conductors; insulated from box.
- O. Extra-Capacity Neutral Bus: Copper neutral bus rated 200 percent of phase bus and UL listed as suitable for nonlinear loads.
- P. Split Bus: Vertical buses divided into individual vertical sections.
- Q. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
- R. Gutter Barrier: Arrange to isolate individual panel sections.
- S. Column-Type Panelboards: Narrow gutter extension, with cover, to overhead junction box equipped with ground and neutral terminal buses.
- T. Feed-through Lugs: Copper mechanical type suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.

2.3 PANELBOARD SHORT-CIRCUIT RATING

- A. Select one of two paragraphs below for series-rated system or system that has panelboards and circuit breakers rated for full value of short-circuit current available at location of equipment. Edit to suit Project and coordinate with Drawings.
- B. Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Branch Overcurrent Protective Devices: Plug-in or bolt on circuit breakers, replaceable without disturbing adjacent units.
- B. Coordinate below with Drawings.
- C. Doors: Front mounted with concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.5 DISTRIBUTION PANELBOARDS

- A. Edit three paragraphs and associated subparagraphs below to suit Project. Coordinate with Drawings.
- B. Doors: Front mounted, except omit in fused-switch panelboards; secured with vault-type latch with tumbler lock; keyed alike.
- C. Main Overcurrent Protective Devices: Circuit breaker.
- D. Branch overcurrent protective devices shall be one of the following:
 - 1. For Circuit-Breaker Frame Sizes 125 A and Smaller: Plug-in or Bolt-on circuit breakers.
 - 2. For Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

2.6 OVERCURRENT PROTECTIVE DEVICES

- A. Edit three paragraphs and associated subparagraphs below to suit Project. Coordinate with schedules and Drawings.
- B. Molded-Case Circuit Breaker: NEMA AB 1, with interrupting capacity to meet available fault currents.
 - 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 - 2. Electronic Trip Unit Circuit Breakers: RMS sensing; field-replaceable rating plug; with the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Long- and short-time pickup levels.
 - c. Long- and short-time time adjustments.
 - d. Ground-fault pickup level, time delay, and I^2t response.

3. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
 4. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker; trip activation on fuse opening or on opening of fuse compartment door.
 5. GFCI Circuit Breakers: Single- and two-pole configurations with [5] [30]-mA trip sensitivity.
- C. Molded-Case Circuit-Breaker Features and Accessories. Standard frame sizes, trip ratings, and number of poles.
1. Lugs: Mechanical style, suitable for number, size, trip ratings, and material of conductors.
 2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
 3. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
- D. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install panelboards and accessories according to NEMA PB 1.1.
- B. Mounting Heights: Top of trim 74 inches (1880 mm) above finished floor, unless otherwise indicated.
- C. Mounting: Plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish.
- D. Revise paragraph below if "Balancing Loads" Paragraph is deleted from "Field Quality Control" Article below.
- E. Circuit Directory: Create a directory to indicate installed circuit loads after balancing panelboard loads. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- F. Install filler plates in unused spaces.
- G. Revise below if "Balancing Loads" Paragraph is deleted from "Field Quality Control" Article below.
- H. Wiring in Panelboard Gutters: Arrange conductors into groups and bundle and wrap with wire ties after completing load balancing.

3.2 IDENTIFICATION

- A. Select Division 16 Section "Basic Electrical Materials and Methods" for projects with simple requirements and Division 16 Section "Electrical Identification" for projects with complex requirements.
- B. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Section "Basic Electrical Materials and Methods" [Electrical Identification.]
- C. Panelboard Nameplates: Label each panelboard with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.

3.3 CONNECTIONS

- A. Coordinate paragraphs below with Drawings.
- B. Install equipment grounding connections for panelboards with ground continuity to main electrical ground bus.
- 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 and UL 486B.

3.4 FIELD QUALITY CONTROL

- A. Prepare for acceptance tests as follows:
 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 2. Test continuity of each circuit.
- B. Testing: After installing panelboards and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.
 1. Procedures: Perform each visual and mechanical inspection and electrical test indicated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.
 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- C. Balancing Loads: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes as follows:
 1. Measure as directed during period of normal system loading.

2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data-processing, computing, transmitting, and receiving equipment.
3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

3.5 ADJUSTING

- A. Set field-adjustable switches and circuit-breaker trip ranges.

3.6 CLEANING

- A. On completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

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 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes receptacles, connectors, switches, and finish plates.

1.3 DEFINITIONS

- A. Retain abbreviations that remain after this Section has been edited for Project.
- B. GFI: Ground-fault circuit interrupter.
- C. TVSS: Transient voltage surge suppressor.

1.4 SUBMITTALS

- A. Product Data: For each product specified.
- B. Shop Drawings: Legends for receptacles and switch plates.
- C. Include sample review below if products may have critical features needing hands-on appraisal.
- D. Samples: For devices and device plates for color selection and evaluation of technical features.
- E. Maintenance Data: For materials and products to include in maintenance manuals specified in other sections.

1.5 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.
- B. Comply with NEMA WD 1.
- C. Comply with NFPA 70.

1.6 COORDINATION

- A. Delete paragraph below unless receptacles for Owner-Furnished equipment with plugs have unknown configurations.
- B. Receptacles for Owner-Furnished Equipment: Match plug configurations.
- C. Coordinate with pool contractor for special receptacles.

PART 2 - PRODUCTS

2.1 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:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Wiring Devices:
 - a. Bryant Electric, Inc.
 - b. Eagle Electric Manufacturing Co., Inc.
 - c. GE Company; GE Wiring Devices.
 - d. Hubbell, Inc.; Wiring Devices Div.
 - e. Killark Electric Manufacturing Co.
 - f. Leviton Manufacturing Co., Inc.
 - g. Pass & Seymour/Legrand; Wiring Devices Div.
 - h. Pyle-National, Inc.; an Amphenol Co.

2.2 RECEPTACLES

- A. Select one of three paragraphs below to specify grade of receptacles. See Editing Instruction No. 3 in the Evaluations for wiring device grades.
- B. Straight-Blade and Locking Receptacles: Heavy-Duty grade. The device shall be 20-ampere, 125-volts, Nema configuration 5-20R, back and side wired.
- C. Special Receptacles for NEMA configuration refer to Manufacturer specs.
- D. Termination-type GFCI unit may be substituted for feed-through type where no protection of downstream receptacles is required.
- E. GFI Receptacles: Feed-through type, with integral NEMA WD 6, Configuration 5-20R duplex receptacle arranged to protect connected downstream receptacles on same circuit. Design units for installation in a 2-3/4-inch- (70-mm-) deep outlet box without an adapter. Device shall have an indicator light.
- F. Isolated-Ground Receptacles: Equipment grounding contacts connected only to the green grounding screw terminal of the device with inherent electrical isolation from mounting strap. Device shall be white finish with the orange symbol.

2. Devices: Listed and labeled as solated-ground receptacles.
3. Isolation Method: Integral to receptacle construction and not dependent on removable parts.

2.3 SWITCHES

A. General

1. Switches shall be toggle rocker type as indicated herein.. The body of the switch shall be made of an arc-resistant thermoset material. All toggle switch handles shall be constructed of a thermoplastic material. All rocker switch handles shall be constructed of a thermoset material. All wall switches shall be of the quiet AC type.
2. Switches shall be SPST, DPST, 3-way or 4-way as indicated on the Drawings.
3. Switch color shall be white unless noted otherwise. Coordinate with Architect.

B. Specification Grade

1. Specification Grade switches shall be toggle type. The contact arms shall be made of one-piece copper alloy material. The switch shall include a green ground screw attached to the mounting strap. The switch shall be 20-ampere, 120/277-volts AC, horsepower rated, back and side-wired.

C. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on/off switches and audible and electromagnetic noise filters.

1. Modify subparagraph below to suit preference.
2. Control: Continuously adjustable slide, toggle, or rotary knob. Single-pole or three-way switch to suit connections.
3. Incandescent Lamp Dimmers: Modular, 120 V, 60 Hz with continuously adjustable slide with "on/off" switch; single pole with soft tap or other quiet switch; electromagnetic filter to eliminate noise, RF, and TV interference; and 5-inch (130-mm) wire connecting leads. Dimmer to be sized per circuit load.

2.4 WALL PLATES(All wall plates)

A. For all single and combination types match corresponding wiring devices.

4. Plate-Securing Screws: Metal with head color to match plate finish.
5. Select one of five subparagraphs below. Coordinate with Division 9 Section "Painting."
6. Material for Finished Spaces: 0.04-inch- (1-mm-) thick, Type 302, satin-finished stainless steel.
7. Select one of three subparagraphs below or delete all.
8. Material for Unfinished Spaces: stainless steel.

2.5 FLOOR SERVICE FITTINGS

- A. Items in this Article are available for telephone and data cable service as well as power. Edit to suit Project.
- B. Select one of three paragraphs below.
- C. Power Receptacle: NEMA WD 6, Configuration 5-20R, gray finish, unless otherwise indicated.
- D. Signal Outlet: Blank cover with bushed cable opening, unless otherwise indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install devices and assemblies plumb and secure.
- B. Install wall plates when painting is complete.
- C. Install wall dimmers to achieve indicated rating after derating for ganging as instructed by manufacturer.
- D. Do not share neutral conductor on load side of dimmers.
- E. Coordinate two paragraphs below with Drawings.
- F. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical, and grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.
- G. Protect devices and assemblies during painting.
- H. Adjust locations at which floor service outlets and telephone/power service poles are installed to suit arrangement of partitions and furnishings.
- I.

3.2 IDENTIFICATION

- A. Comply with Section "Electrical Identification."
- B. Select paragraph above or below.
- C. Comply with Section "Basic Electrical Materials and Methods."
1. Switches: Where three or more switches are ganged, and elsewhere as indicated, identify each switch with approved legend engraved on wall plate.
2. Receptacles: Identify panelboard and circuit number from which served. Use machine-printed, pressure-sensitive, abrasion-resistant label tape on face of plate and durable wire markers or tags within outlet boxes.

3.3 CONNECTIONS

- A. Select paragraph above or below. Coordinate with Division 16 Section "Grounding."
- B. Connect wiring device grounding terminal to branch-circuit equipment grounding conductor.
- C. Isolated-Ground Receptacles: Connect to isolated-ground conductor routed to designated isolated equipment ground terminal of electrical system.
- D. Tighten electrical connectors and terminals according to manufacturers published torque-tightening values. If manufacturers torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 FIELD QUALITY CONTROL

- A. Test wiring devices for proper polarity and ground continuity. Operate each device at least six times.
- B. Dparagraph below if GFCIs are not in Part 2.
- C. Test GFCI operation with both local and remote fault simulations according to manufacturer's written instructions.
- D. Replace damaged or defective components.

3.5 CLEANING

- A. Internally clean devices, device outlet boxes, and enclosures. Replace stained or improperly painted wall plates or devices.

END OF SECTION

SECTION 26 28 13 - FUSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Fuses.

1.3 SUBMITTALS

- A. Use this Article to convey basic design intent. Delete if Drawings show sufficient detail to clarify intent.
- B. General: Submit each item in this Article according to the Conditions of the Contract and Specification Sections.
- C. Product Data for each fuse type specified.
- D. Select above or below. Data listed in paragraph below are appropriate where selective coordination is necessary.
- E. Field test reports indicating and interpreting test results.
- F. Maintenance data for tripping devices to include in the operation and maintenance manual specified in other sections.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain fuses from one source and by a single manufacturer.
- B. Comply with NFPA 70 for components and installation.
- C. Listing and Labeling: Provide fuses specified in this Section that are listed and labeled.
 - 1. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.
 - 2. Subparagraph below is required by some Federal agencies.
 - 3. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

1.5 EXTRA MATERIALS

- A. Extra materials may not be allowed for publicly funded projects.
- B. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.
 - 1. Spare Fuses: Furnish quantity equal to 20 percent of each fuse type and size installed, but not less than 1 set of 3 of each type and size.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering fuses that may be incorporated into the Work include, but are not limited to, the following:
- B. Retain above for nonproprietary or below for semiproprietary Specification. Refer to Division 1 Section "Materials and Equipment."
- C. Manufacturers: Subject to compliance with requirements, provide fuses by one of the following:
 - 1. See Editing Instruction No. 1 in the Evaluations for cautions about naming products and manufacturers.
 - 2. Cooper Industries, Inc.; Bussmann Div.
 - 3. Eagle Electric Mfg. Co., Inc.
 - 4. Ferraz Corp.
 - 5. General Electric Co.; Wiring Devices Div.
 - 6. Gould Shawmut.

7. Tracor, Inc.; Littelfuse, Inc. Subsidiary.

2.2 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, nonrenewable cartridge fuse; class as specified or indicated; current rating as indicated; voltage rating consistent with circuit voltage.

2.3 SPARE FUSE CABINET

A. Cabinet: Wall-mounted, 0.05-inch- (1.27-mm-) thick steel unit with full-length, recessed piano-hinged door with key-coded cam lock and pull.

1. Size: Adequate for orderly storage of spare fuses specified with 15 percent spare capacity minimum.

2. Finish: Gray, baked enamel.

3. Identification: Stencil legend "SPARE FUSES" in 1-1/2-inch (40-mm) letters on door.

4. Fuse Pullers: For each size fuse.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine utilization equipment nameplates and installation instructions to verify proper fuse locations, sizes, and characteristics.

B. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

A. Select and edit paragraphs below. Add paragraphs as Project requires to specify fuse applications rather than show them on Drawings.

B. Motor Branch Circuits: Class RK1, time delay.

C. Other Branch Circuits: Class RK5, non-time delay.

3.3 INSTALLATION

A. Install fuses in fusible devices as indicated. Arrange fuses so fuse ratings are readable without removing fuse.

B. Install spare fuse cabinet where indicated.

3.4 IDENTIFICATION

A. Install typewritten labels on inside door of each fused switch to indicate fuse replacement information.

END OF SECTION

SECTION 26 28 16.16 - ENCLOSED SWITCHES

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- A. The General Provisions, Supplemental General Provisions, Special Provisions and Specification sections, apply to work covered by this Section.

1.2 SCOPE OF WORK

- A. Provide labor, materials, equipment, tools and services, and perform operations required for, and reasonably incidental to, the providing of disconnect switches, including all related systems and accessories.

1.3 SUBMITTALS

- A. Submit product data and shop drawings in accordance with other Sections for products specified under PART 2 - PRODUCTS.
- B. Provide outline drawings with dimensions, and equipment ratings for voltage, amperage, horsepower and short circuit.
- C. Provide designations for each disconnect. RE: to section 16075.

1.4 REFERENCE STANDARDS

- A. Switches shall be manufactured in accordance with the following standards:
 - 1. UL 98 - Enclosed and Dead Front Switches
 - 2. NEMA KS1 - Enclosed Switches
 - 3. NEMA 250 - Enclosures for Electrical Equipment

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Eaton
- B. Square D Co.
- C. General Electric

2.2 GENERAL

- A. Switches shall be heavy duty type.

2.3 SWITCH INTERIOR

- A. Switches shall have switch blades which are visible when the switch is OFF and the cover is open.
- D. Lugs shall be copper and front removable and UL listed for 60°C or 75°C conductors 30-100 ampere, 75°C conductors 200 ampere and up.
- E. Current carrying parts shall be plated to resist corrosion.
- F. Switches shall have removable arc suppressor to facilitate easy access to line side lugs.
- G. Switches shall have provisions for a field installable electrical interlock.

2.4 SWITCH MECHANISM

- A. Switch operating mechanism shall be quick-make, quick-break such that, during normal operation of the switch, the operation of the contacts shall not be capable of being restrained by the operating handle after the closing or opening action of the contacts has started.
- B. The operating handle shall be an integral part of the box, not the cover.
- C. Provisions for padlocking the switch in the OFF position with at least three padlocks shall be provided.
- D. The handle position shall travel at least 90° between OFF and ON positions to clearly distinguish and indicate handle position.
- E. Switches shall have a dual cover interlock mechanism to prevent unintentional opening of the switch cover when the switch is ON and prevent turning the switch ON when the cover is open. The cover interlock mechanism shall have an externally operated override but the override shall not permanently disable the interlock mechanism. The tool used to override the cover interlock mechanism shall not be required to enter the enclosure in order to override the interlock.

2.5 SWITCH ENCLOSURES

- A. Switch covers shall be attached with welded pin-type hinges (Type 1) or top-hinged, attached with removable screws and securable in the open position (Type 3R).
- B. The enclosure shall be finished with gray baked enamel paint which is electrodeposited on cleaned, phosphate pre-treated steel (Type 1) or gray baked enamel paint which is electrodeposited on cleaned, phosphate pre-treated galvanized steel (Type 3R).
- C. The enclosure shall have ON and OFF markings stamped into the cover.
- D. The operating handle shall be provided with a dual colored, red/black position indication.
- E. Switches shall have provisions to accept up to three 3/8" hasp padlocks to lock the operating handle in the OFF position.
- H. Tangential knockouts shall be provided to facilitate ease of conduit entry (Type 1).
- I. Type 3R enclosure shall contain no knockouts. Supply watertight hubs.
- J. Type 4x shall be stainless steel enclosure with no knockouts. Supply watertight hubs.

2.6 SWITCH RATINGS

- A. Switches shall be horsepower rated.
- B. The UL listed short circuit current rating of the switches shall be: 200,000 rms symmetrical amperes when used with or protected by Class R or Class J fuses 30-600 ampere employing appropriate fuse rejection schemes.

PART 3- EXECUTION

3.1 INSTALLATION

- D. Install disconnect switches where indicated shown or not shown.
- E. Install fuses in fusible disconnect switches.

END OF SECTION

SECTION 26 32 13 - DIESEL ENGINE DRIVEN GENERATOR SET

PART 1 – GENERAL

1.1 RELATED REQUIREMENTS

The General Provisions, Supplemental General Provisions, Special Provisions and Division 1 Specification Sections apply to Work covered by this Section.

Comply with other Division 16 Sections, as applicable. Refer to other Divisions for coordination of the Work.

1.2 SCOPE OF WORK

Provide labor, materials, equipment, tools and services, and perform operations required for, and reasonably incidental to, the providing of the standby engine-generator set, including all related systems and accessories.

1.3 SUBMITTALS

- A. Product Data: Include data on features, components, ratings, and performance. Include the following:
 - B. Dimensioned outline plan and elevation drawings of engine generator set and other components specified.
 - C. Thermal damage curve for generator.
 - D. Time-current characteristic curves for generator protective device.
 - E. Shop Drawings: Indicate fabrication details, dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - F. Design Calculations: Signed and sealed by a qualified professional engineer. Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
 - G. Vibration Isolation Base Details: Signed and sealed by a qualified professional engineer. Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include base weights.
 - H. Wiring Diagrams: Detail wiring for power and control connections and differentiate between factory-installed and field-installed wiring.
 - I. Qualification Data: For firms and persons specified in "Quality Assurance" Article.
 - J. Field Test and Observation Reports: Indicate and interpret test results and inspection records relative to compliance with performance requirements.
 - L. Certified summary of prototype-unit test report.
 - M. Certified Test Reports: For components and accessories that are equivalent, but not identical, to those tested on prototype unit.
 - O. Certified Summary of Performance Tests: Demonstrate compliance with specified requirement to meet performance criteria for sensitive loads.
 - P. Factory Test Reports: For units to be shipped for this Project, showing evidence of compliance with specified requirements.
 - R. Exhaust Emissions Test Report: To show compliance with applicable regulations.
 - S. Sound or noise measurement test report.
 - T. Certification of Torsional Vibration Compatibility: Comply with NFPA 110.
 - U. Field test report of tests specified in Part 3.
 - V. Maintenance Data: For each packaged engine generator and accessories to include in maintenance manuals specified in Division 1. Include the following:
 - X. List of tools and replacement items recommended to be stored at the Project for ready access. Include part and drawing numbers, current unit prices, and source of supply.
 - Y. Detail operating instructions for both normal and abnormal conditions.
- Manufacturer's installation instructions.

1.4 WARRANTY

A no deductible warranty shall be provided for all products against defects in materials and workmanship for a two year or 1500 hour period from the start-up date, per the manufacturer's Extended Coverage Limited Warranty.

PART 2 - PRODUCTS

MANUFACTURER

1. Cummins
2. Generac
3. Kohler
4. Caterpillar

2.1 GENERAL

The installation of a Standby Electric Power System shall include one electric generating set rated as shown on the plans. Refer to Electrical Engineering plans.

The system shall be packaged by manufacturer

1. A diesel engine driven electric generating set to provide standby power.
2. An engine start-stop control system mounted on the generating set.
3. An automatic load transfer control to provide automatic starting and stopping of the engine and switching of the load.
4. Mounted accessories as specified.

This system shall be built, tested and shipped by same Manufacturer so there is one source of supply and responsibility. The performance of this generating set series shall be tested at full power rating, stability and voltage and frequency regulation.

This standby electric power system, furnished completely by the manufacturer, shall be warranted for a period of one year from the date of start-up.

B. Engine

The Engine shall be diesel-fueled, turbo charged, four-cycle, water cooled with mounted radiator, fan and water pump. It shall be sized to deliver the required KW rating. Intake and exhaust valves shall be heat resisting alloy steel, free rotating. Exhaust valve seat inserts shall be provided. Full pressure lubrication shall be supplied by a positive displacement lube oil pump. The engine shall have air cleaner, coolant, fuel and oil filters with replaceable elements; lube oil cooler and a fuel transfer pump. Engine speed shall be governed by a Woodward Electronic governor to maintain alternator frequency within .25 percent from no-load to full-load alternator output. The engine shall have a 12-volt battery charging DC, alternator with a transistorized voltage regulator. Starting shall be a 12-volt, solenoid shaft, electric starter.

C. Engine Instruments

The engine instrument panel shall contain an oil pressure gauge, coolant temperature gauge and battery charge rate voltmeter.

a. Engine Controls

The generating set shall contain a complete engine start-stop control which starts engine on closing contact and stops engine on opening contact. A cranking limiter shall be provided to open the starting circuit after three cycle cranking attempts. The engine controls shall also include a 3-position selector switch with the following positions: RUN-STOP-REMOTE. High engine temperature, low oil pressure, and overspeed shutdown with signal light and alarm terminal shall also be provided.

b. Brushless Alternator

The alternator shall be a 4-pole, revolving field design with temperature compensated solid state voltage regulator and brushless rotating rectifier exciter system. No brushes shall be allowed. The stator shall be directly connected to the engine flywheel housing, and the rotor shall be driven through a semiflexible driving flange to insure permanent alignment. The insulation system shall be Class H as defined by NEMA MG1-165. The three phase, broad range alternator shall be 12-lead, reconnectable. Excitation system shall be capable of sustained short circuit current of 3 X FLC at 60 Hz.

c. Unit Performance

Frequency regulation shall not exceed .25-hertz from no load to rated load. Voltage regulation shall be within plus or minus 1 percent of rated voltage, from no load to full rated load. The instantaneous voltage dip shall be less than 15 percent of rated voltage when full, 3-phase, load and rated power factor is applied to the alternator. Recover to stable operation shall occur within 2 seconds. Stable or steady state operation is defined as operation with terminal voltage remaining constant within plus or minus 1 percent of rated voltage. A rheostat shall provide a minimum of plus or minus 5 percent voltage adjustment from rated value. Temperature rise shall be within NEMA MG1-22.40 definition.

d. Alternator Instrument Panel

The alternator instrument panel shall be wired, tested and shock mounted on the generating set by the Manufacturer of the Genset. It shall contain panel; frequency meter; running time meter; voltage potentiometer, AC voltmeter; AC ammeter; meter switch; voltmeter-ammeter phase selector with OFF position. Panel shall provide annunciation of: low oil pressure, low water temp., high water temp., overspeed, over crank, low battery, high battery, low fuel level, fuel tank leak detection, control panel not in auto position. Supply 16 light remote annunciation.

e. Generating Set Mounting

The electric generating set shall be equipped with vibration isolators between genset & genset base which shall provide suitable mounting to any level surface.

f. Housing

The complete generating set shall be enclosed in a weatherproof highly corrosion resistant galvanized sheet metal housing with removable side panels and hinged meter panel door. Enclosure shall incorporate internally mounted residential grade muffler.

g. Accessories

All accessories needed for the proper operation of the generating set shall be furnished. These shall include a residential muffler internally mounted inside weatherproof enclosure, flexible exhaust connection, starting batteries, battery cables, battery rack, 5amp battery charger , 110 volt 1500 watt jacket water heater, 120 volt thermostat controlled alternator heater, double wall UL-142 Listed base mounted fuel tank for 24-hours, with flexible fuel lines, Unit mounted UL - Listed circuit breaker rated at maximum genset output and detailed operation and maintenance manuals.

h. Automatic Load Transfer Control

1. Refer to Electrical riser diagram rated automatic transfer switch model number.
Upon power line return, transfer the load back to the line and stop the standby set

i. Startup & Delivery

Genset shall be delivered to job site. (off loading by installing contractor) Startup up shall be performed by factory trained person using available site loads.

2.3 ENGINE-GENERATOR SET BASE

The engine-generator set shall be mounted on a heavy duty steel base to maintain alignment between components. The base shall incorporate a battery tray with hold-down clamps within the rails.

2.4 AUXILIARY EQUIPMENT AND ACCESSORIES

Engine mounted, thermostatically controlled, water jacket heater. The heater shall be sized as recommended by the generator set manufacturer. Vibration isolators, spring/pad type, quantity as recommended by the generator set manufacturer. Isolators shall include seismic restraints if required by site location. Starting and Control Batteries: Starting battery bank, calcium/lead antimony type, 24 volt DC, sized as recommended by the generator set manufacturer, shall be supplied for each generator set with battery cables and connectors. Battery Charger: A UL listed/CSA certified 10 amp voltage regulated battery charger shall be provided for each engine-generator set. The charger may be located in an automatic transfer switch, or may be wall mounted, at the discretion of the installer. Input AC voltage and DC output voltage shall be as required. Chargers shall be equipped with float, taper and equalize charge settings. Operational monitors shall provide visual output along with individual form C contacts rated at 4 amps, 120 VAC, 30VDC for remote indication of

- Loss of AC power - red light
- Low battery voltage - red light
- High battery voltage - red light
- Power ON - green light (no relay contact)
- Analog DC voltmeter and ammeter, 12 hour equalize charge timer, AC and DC fuses shall also be provided on the charger.

2.5 REMOTE ANNUNCIATOR

Provide and install a 20-light LED remote alarm annunciator with horn, to be located by owner. The remote annunciator shall provide the following audible and visual alarms:

Lamp Legend	Generator Set Condition Indicated	Light	Alarm
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High Battery Voltage	Battery charger too high	Red	No		
Low Battery Voltage	Battery voltage too low	Red	No		
Normal Battery Voltage	Battery voltage ok			Green	No
Generator Running	Generator has output voltage	Green	No		
Normal Utility Power	Utility power supplying the load		Green	No	
EPS Supplying Load	Genset supplying the load	Green	No		
Pre-Low Oil Pressure	Oil pressure approaching low limit		Yellow	Yes	
Low Oil Pressure	Engine has shut down due to low oil pressure		Red	Yes	
Pre-High Coolant Temp	Temperature of coolant approaching high limit		Yellow	Yes	
High Coolant Temp	Genset has shut down due to high coolant temp	Red	Yes		
Low Engine Temp	Engine heater has malfunctioned	Red	Yes		
Overspeed	Engine has shut down due to overspeed	Red	Yes		
Overcrank	Engine failed to start			Red	Yes
Not in Auto	Engine control switch not in AUTO position	Flashing	Red	Yes	
Battery Charger					
Malfunction	Charger is signaling a failure		Red	Yes	
Low Fuel	Fuel level below preset minimum		Red	Yes	
Fuel Leak	Fuel leak detected within dual wall containment of fuel tank		Red	Yes	

Spare lamps shall be provided to allow future addition of other alarm and status functions to the annunciator. Provisions for labeling of the annunciator in a fashion consistent with the specified functions shall be provided. Alarm silence and lamp test switch(es) shall be provided. LED lamps shall be replaceable, and indicating lamp color shall be capable of changes needed for specific application requirements. Alarm horn shall be switchable for all annunciation points. Alarm horn (where switched on) shall sound for first fault, and all subsequent faults, regardless of whether first fault has been cleared. The remote annunciator shall comply with NFPA 110 for Level 1 emergency power supply systems. The remote annunciator shall be located in the main administration office. Provide (1)- 3" C underground to the mentioned location. Coordinate exact location. Provide all accessories as required for an operational system.

2.6 EXHAUST MUFFLER

Exhaust muffler(s) shall be provided for the engine, size and type as recommended by the generator set manufacturer. The mufflers shall be critical grade. Exhaust system shall be installed according to the generator set manufacturers recommendations and applicable codes and standards.

2.7 FUEL SYSTEM

Sub-Base Fuel Storage Tank: Provide a skid mounted fuel storage tank with minimum 24 hours operation at full load. The tank shall be constructed of corrosion resistant steel and shall be UL listed double wall. The equipment, as installed, shall meet all local and regional requirements. Fuel leak detection shall be provided within the containment.

PART 3 - EXECUTION

3.1 INSTALLATION

The standby engine-generator set shall be installed as recommended by the manufacturer(s) and as required by the local authorities having jurisdiction.

The Contractor shall coordinate the installation of the standby engine-generator and the automatic transfer switch to insure a completely functional and operational system.

3.2 FACTORY TESTING

The manufacturer's standard factory test shall be provided. A certified test report shall be provided upon delivery.

3.3 START UP AND ON-SITE TESTING

The manufacturer's authorized representative/technician shall provide startup and on-site testing.

On-Site Testing

Perform on-site testing in the presence of the Owner's Representative.

Prestart Checks

Oil level
Water level
Day tank fuel level
Main tank fuel level
Battery connection and charge condition
Engine to control interconnects
Engine generator intake/exhaust obstructions
Enclosure ventilation obstructions
Removal of all packing materials

Operation

Load: 30-minutes operation at 50% of full load rating. 30-minutes operation at 75% of full load rating. Four (4) hours operation at 100% of full load rating. After the first half-hour stabilization period at full load, the following shall be recorded at fifteen minute intervals:

Voltage and amperage (3 phase), frequency

Fuel pressure, oil pressure and water temperature

Proper operation of controls, engine shutdown, and safety devices shall be demonstrated.

The manufacturer's representative shall provide resistive load banks and fuel for all testing, including fuel for retests due to test failures. Building load shall not be used.

Should these tests indicate that the equipment does not meet the specified performance requirements, National Electric Code and Local codes, the cost of all corrective measures shall be borne by the manufacturer's and/or local authorized dealer.

Orientation

The manufacturer's local authorized dealer shall provide a complete orientation for the Owner's engineering and maintenance personnel. Orientation shall include both classroom and hands-on instruction. Topics covered shall include control operation, schematics, wiring diagrams, meters, indicators, warning lights, shutdown system and routine maintenance.

Service Manuals and Parts Books

The manufacturer's local authorized dealer shall furnish one copy of each of the following manuals and books listed:

Operating Instructions: With description and illustration of all engine and generator controls and indicators.

Parts Books: That illustrate and list all assemblies, subassemblies and components, except standard fastening hardware (nuts, bolts, washers, etc.).

Preventative Maintenance Instructions: On the complete unit that cover daily, weekly, monthly, biannual, and annual maintenance requirements and include a complete lubrication chart.

Routine Test Procedures: For all electronic and electrical circuits and for the main AC generator.

Troubleshooting Chart: Covering the complete unit showing description of trouble, probable cause, and suggested remedy.

Recommended Spare Parts List: Showing all consumables anticipated to be required during routine maintenance and test.

Wiring Diagrams and Schematics: Showing function of all electrical components.

All manuals and books described above shall be contained in rigid plastic pouches.

Contract Maintenance

The system manufacturer's local authorized dealer shall furnish the Owner with a copy of any contract maintenance agreement negotiated relative to the equipment specified in this section. The contract information shall detail agreed maintenance intervals, work to be performed at each interval, reimbursement schedule for maintenance work, and owner's responsibilities versus dealer's responsibilities

END OF SECTION

SECTION 26 36 23 - AUTOMATIC TRANSFER SWITCH

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. This Section includes transfer switches rated 600 V and less, including the following:

- 1. Automatic transfer switches
- 2. Remote annunciation systems

- B. Related Sections include the following:

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, weights, operating characteristics, furnished specialties, and accessories.

- 1. Technical data on all major components of all transfer switches and other products described in this section. Data is required for the transfer switch mechanism, control system, cabinet, and protective devices specifically listed for use with each transfer switch. Include steady state and fault current ratings, weights, operating characteristics, and furnished specialties and accessories.
- 2. Single-Line Diagram: Show connections between transfer switch, bypass/isolation switch, power sources, and load; and show interlocking provisions for each combined transfer switch and bypass/isolation switch.

- B. Shop Drawings: Dimensioned plans, elevations, sections, and details showing minimum clearances, conductor entry provisions, gutter space, installed features and devices, and material lists for each switch specified.

- 1. Dimensioned outline drawings of assembly, including elevations, sections, and details including minimal clearances, conductor entry provisions, gutter space, installed features and devices and material lists for each switch specified.
- 2. Internal electrical wiring and control drawings.
- 3. Interconnection wiring diagrams, showing recommended conduit runs and point-to-point terminal connections to generator set.
- 4. Installation and mounting instructions, including information for proper installation of equipment to meet seismic requirements.

- C. Manufacturer and Supplier Qualification Data

- 1. The transfer switch manufacturer shall be certified to ISO 9001 International Quality Standard and shall have third party certification verifying quality assurance in design/development, production, installation, and service, in accordance with ISO 9001.
- 2. The manufacturer of this equipment shall have produced similar equipment for a minimum period of 10 years. When requested, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

- D. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

- 1. Features and operating sequences, both automatic and manual.

2. List of all factory settings of relays, timers and protective devices; provide setting and calibration instructions where applicable.

E. Warranty documents demonstrating compliance with the project's contract requirements.

1.4 QUALITY ASSURANCE

A. Only approved bidders shall supply equipment provided under this contract.

B. Manufacturer Qualifications: The equipment supplier shall maintain a service center capable of providing training, parts, maintenance and emergency repairs to equipment, including transfer switch generator sets and remote monitoring equipment (if applicable) at the site within a response period of less than (eight hours) from time of notification.

1. The transfer switch shall be serviced by technicians employed by, and specially trained and certified by, the generator set supplier and the supplier shall have a service organization that is factory-certified in both generator set and transfer switch service. The supplier shall maintain an inventory of critical replacement parts at the local service organization, and in service vehicles. The service organization shall be on call 24 hours per day, 365 days per year.

2. Submit names, experience level, training certifications, and locations for technicians that will be responsible for servicing equipment at this site.

3. The manufacturer shall maintain model and serial number records of each transfer switch provided for at least 20 years.

C. Source Limitations: All transfer switches are to be obtained through one source from a single manufacturer. The generator set manufacturer shall warrant transfer switches to provide a single source of responsibility for products provided.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked as suitable for use in emergency, legally required or optional standby use as appropriate for the connected load.

E. The automatic transfer switch installation and application shall conform to the requirements of the following codes and standards:

1. Transfer switches and enclosures shall be UL 1008 listed and labeled as suitable for use in emergency, legally required, and optional standby applications.
2. CSA 282, Emergency Electrical Power Supply for Buildings, and CSA C22.2, No. 14-M91 Industrial Control Equipment
3. NFPA 70, National Electrical Code. Equipment shall be suitable for use in systems in compliance with Articles 700, 701 and 702.
4. Comply with NEMA ICS 10-1993 AC Automatic Transfer Switches
5. IBC 2006 – The transfer switch(es) shall be prototype-tested and third-party certified to comply with the requirements of IBC group III or IV, Category D/F. The equipment shall be shipped with the installation instructions necessary to attain installation compliance
6. IEEE 446 – Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications
7. EN55011, Class B Radiated Emissions and Class B Conducted Emissions
8. IEC 1000-4-5 (EN 61000-4-5); AC Surge Immunity
9. IEC 1000-4-4 (EN 61000-4-4) Fast Transients Immunity
10. IEC 1000-4-2 (EN 61000-4-2) Electrostatic Discharge Immunity
11. IEC 1000-4-3 (EN 61000-4-3) Radiated Field Immunity

12. IEC 1000-4-6 Conducted Field Immunity
 13. IEC 1000-4-11 Voltage Dip Immunity
 14. IEEE 62.41, AC Voltage Surge Immunity
 15. IEEE 62.45, AC Voltage Surge Testing
- F. Comply with NFPA 110 – Emergency and Standby Power Systems. The transfer switch shall meet all requirements for Level 1 systems, regardless of the actual circuit level.
- G. The manufacturer shall warrant the material and workmanship of the transfer switch equipment for a minimum of one (1) year from registered commissioning and start-up, or eighteen (18) months from date of shipment.
- H. The warranty shall be comprehensive. No deductibles shall be allowed for travel time, service hours, repair parts cost, and etc. during the minimum noted warranty period described above.

1.5 PROJECT CONDITIONS

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service:
1. Notify (Architect/Construction Manager/Owner) no fewer than (insert appropriate number) days in advance of proposed interruption of electrical service.
 2. Do not proceed with interruption of electrical service without (Architect/Construction Manager/Owner's) written permission.
 3. Do not energize any new service or distribution equipment without notification and permission of the (Architect/Construction Manager/Owner).

1.6 COORDINATION

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Cummins Power Generation
 2. ASCO
 3. Generac
- B. Equipment specifications for this Project are based on automatic transfer switches manufactured by Cummins Power Generation. Switches manufactured by Russelectric or ASCO that meet the requirement of this specification are acceptable, if approved not less than two weeks before scheduled bid date. Proposals must include a line-by-line compliance statement based on this specification.
- C. Transfer switches utilizing molded case circuit breakers do not meet the requirements of this specification and will not be accepted.

2.2 GENERAL TRANSFER-SWITCH PRODUCT REQUIREMENTS

- A. Provide transfer switches in the number and ratings that are shown on the drawings. 600 OTPC, level 1 controls, Nema 1 enclosure. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer.
- B. Fault-Current Closing and Withstand Ratings: UL 1008 WCR ratings must be specifically listed as meeting the requirements for use with protective devices at installation locations, under specified fault conditions. Withstand and closing ratings shall be based on use of the same set of contacts for the withstand test and the closing test.

- C. Solid-State Controls: All settings should be accurate to +/- 2% or better over an operating temperature range of - 40 to + 60 degrees C (- 40 to + 140 degrees F).
- D. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.41. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.
- E. Electrical Operation: Accomplished by a non-fused, momentarily energized solenoid or electric motor operator mechanism, mechanically and electrically interlocked in both directions (except that mechanical interlock is not required for closed transition switches).
- F. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.
 - 1. Switches using molded-case switches or circuit breakers, or insulated case circuit breaker components are not acceptable.
 - 2. Transfer switches shall be double-throw, electrically and mechanically interlocked, and mechanically held in the Source 1 and Source 2 positions.
 - 3. Main switch contacts shall be high-pressure silver alloy. Contact assemblies shall have arc chutes for positive arc extinguishing. Arc chutes shall have insulating covers to prevent inter-phase flashover.
 - 4. Contacts shall be operated by a high-speed electrical mechanism that causes contacts to open or close within three electrical cycles from signal.
 - 5. The transfer switch operation shall include the ability to switch to an open position (both sources disconnected) for the purpose of load shedding from the generator set.
 - 6. The power transfer mechanism shall include provisions for manual operation under load with the enclosure door closed. Manual operation may be electromechanical or mechanical, but must be coordinated with control function.
 - 7. Transfer switch shall be provided with flame retardant transparent covers to allow viewing of switch contact operation but prevent direct contact with components that could be operating at line voltage levels.
 - 8. The transfer switch shall include the mechanical and control provisions necessary to allow the device to be field-configured for operating speed. Transfer switch operation with motor loads shall be as is recommended in NEMA MG1.
 - a. Phase angle monitoring/timing equipment is not an acceptable substitute for this functionality
 - 9. Transfer switches designated on the drawings as "4-pole" shall be provided with a switched neutral pole switched which is switched simultaneously with phase poles..
- G. Control: Transfer switch control shall be capable of communicating with the genset control, other switches and remote programming devices over a high-speed network interface.
- H. Factory wiring: Transfer switch internal wiring shall be composed of pre-manufactured harnesses that are permanently marked for source and destination. Harnesses shall be connected to the control system by means of locking disconnect plug(s), to allow the control system to be easily disconnected and serviced without disconnecting power from the transfer switch mechanism
- I. Terminals: Terminals shall be pressure type and appropriate for all field wiring. Terminal arrangement and cabinet space must be such that feeder conductors can enter from the top, side or bottom of the switch, at the installer's discretion. Control wiring shall be equipped with suitable lugs, for connection to terminal strips.
- J. Enclosures: All enclosures shall be third-party certified for compliance to NEMA ICS 6 and UL 508, unless otherwise indicated:
 - 1. The enclosure shall provide wire bend space in compliance to the latest version of NFPA70, regardless of the direction from which the conduit enters the enclosure.

2. Exterior cabinet doors shall provide complete protection for the system's internal components. Doors must have permanently mounted key-type latches. Bolted covers or doors are not acceptable.
3. Transfer switches shall be provided in enclosures that are third party certified for their intended environment per NEMA requirements.
 - a. Transfer switches mounted in a controlled indoor environment shall be provided in NEMA Type 1 enclosures (IEC type IP30).

2.3 AUTOMATIC TRANSFER SWITCHES

- A. Comply with requirements for Level 1 equipment according to NFPA 110.
- B. Indicated current ratings:
 1. Refer to the Project drawings for specifications on the sizes and types of transfer switch equipment, withstand and closing ratings, number of poles, voltage and ampere ratings, enclosure type, and accessories.
 2. Main contacts shall be rated for 600 VAC minimum.
 3. Transfer switches shall be rated to carry 100% of rated current continuously in the enclosure supplied, in ambient temperatures of -40 to +60 degrees C (-40 to +140 degrees F), relative humidity up to 95% (non-condensing), and altitudes up to 10,000 feet (3000 meters).
- C. Relay Signal: Control shall include provisions for addition of a pre-transfer relay signal, adjustable from 0 to 60 seconds, to be provided if necessary for elevator operation, based on equipment provided for the project..
- D. Control: Transfer switch control shall be provided with necessary equipment and software to communicate with the genset control, other transfer switches, remote annunciation equipment, and other devices over a high speed control network.
- E. Neutral Switching: Transfer switches designated on the drawings as 4-pole shall be provided with a switched neutral pole. The neutral pole shall be of the same construction and have the same ratings as the phase poles. All poles shall be switched simultaneously using a common crossbar. Substitute equipment using overlapping neutral contacts is not acceptable.
- F. The transfer switch physically located closest to the generator and not more than 50 ft (15 meters) away, except those served by generator paralleling equipment, shall be provided with a battery charger suitable for the requirements of the application and in compliance with NFPA 110 requirements for Level 1 systems. If no transfer switch is located within this distance, a battery charger shall be installed on the generator set.
- G. Automatic Transfer Switch Control Features
 1. The transfer switch control system shall be configurable in the field for any operating voltage level up to 600 VAC. Voltage sensing shall be monitored based on the normal voltage at the site. Systems that utilize voltage monitoring based on standard voltage conditions that are not field configurable are not acceptable.
 2. All transfer switch sensing shall be configurable from an operator panel or from a Windows XP or later PC-based service tool. Designs utilizing DIP switches or other electromechanical devices are not acceptable.
 3. The transfer switch shall be configurable to accept a relay contact signal and a network signal from an external device for load shedding purposes. On receipt of this signal, the transfer switch shall switch to a neutral position when connected to Source 2. If Source 1 is available when the load-shed signal is received, the transfer switch shall connect to Source 1.
 4. The transfer switch shall be configurable to accept a relay contact signal and a network signal from an external device to prevent transfer to the generator service.
 5. The transfer switch shall provide a relay contact signal prior to transfer or re-transfer. The time period before and after transfer shall be adjustable in a range of 0 to 50 seconds.

6. The control system shall be designed and prototype tested for operation in ambient temperatures from - 40 degrees C to + 60 degrees C (- 40 to +140 degrees F). It shall be designed and tested to comply with the requirements of the noted voltage and RFI/EMI standards.
 7. The control shall have optically isolated logic inputs, high isolation transformers for AC inputs and relays on all outputs, to provide optimum protection from line voltage surges, RFI and EMI.
 8. The transfer switch network monitoring equipment, when supplied, shall be provided with a battery-based auxiliary power supply to allow monitoring of the transfer switch when both AC power sources are non-operational. The battery power supply shall be monitored for proper condition, and the transfer switch shall include an alarm condition to indicate low battery condition.
- H. Transfer Switch Control Panel: The transfer switch shall have a microprocessor-based control with a sealed membrane panel incorporating pushbuttons for operator-controlled functions, and LED lamps for system status indicators. The panel shall also include an alphanumeric display for detailed system information. Panel display and indicating lamps shall include permanent labels.
1. The indicator panel LEDs shall display:
 - a. Which source the load is connected to (Source 1 or Source 2)
 - b. Which source or sources are available
 - c. When switch is not set for automatic operation, because the control is disabled or the bypass switch is in use
 - d. When the switch is in test/exercise mode
 2. The indicator shall have pushbuttons that allow the operator to activate the following functions:
 - a. Activate pre-programmed test sequence
 - b. Override programmed delays, and immediately go to the next operation
 - c. Reset the control by clearing any faults
 - d. Test all of the LEDs by lighting them simultaneously
 3. The alphanumeric digital display shall be vacuum fluorescent-type, clearly visible in both bright sunlight and no-light conditions over an angle of 120 degrees, and shall display the following:
 - a. AC voltage for all phases, normal and emergency
 - b. Source status: connected or not connected.
 - c. Load data, including voltage, AC current, frequency, KW, KVA, and power factor.
 4. The display panel shall be password-protected, and allow the operator to view and make adjustments:
 - a. Set nominal voltage and frequency for the transfer switch
 - b. Adjust voltage and frequency sensor operation set points
 - c. Set up time clock functions
 - d. Set up load sequence functions
 - e. Enable or disable control functions including program transition
 - f. View real-time clock data, operation log (hours connected, times transferred, failures) and service history
- I. Control Functions: Functions managed by the control shall include:
1. Software adjustable time delays:

- a. Engine start (prevents nuisance genset starts in the event of momentary power fluctuation): 0 to 120 seconds (default 3 sec)
 - b. Transfer normal to emergency (allows genset to stabilize before load is transferred): 0 to 120 seconds (default 3 sec)
 - c. Re-transfer emergency to normal (allows utility to stabilize before load is transferred from genset): 0 to 30 minutes (default 3 sec)
 - d. Engine cooldown: 0 to 30 minutes (default 10 min)
 - e. Programmed transition: 0 to 60 seconds (default 3 sec)
2. Undervoltage sensing: three-phase normal, three-phase emergency source.
 - a. Pickup: 85 to 98% of nominal voltage (default 90%)
 - b. Dropout: 75 to 98% of nominal voltage (default 90%)
 - c. Dropout time delay: 0.1 to 1.0 seconds (default 0.5 sec)
 - d. Accurate to within +/- 1% of nominal voltage
3. Over-voltage sensing: three-phase normal, three-phase emergency source.
 - a. Pickup: 95 to 99% of dropout setting (default 95%)
 - b. Dropout: 105 to 135% of nominal voltage (default 110%)
 - c. Dropout time delay: 0.5 to 120 seconds (default 3 sec)
 - d. Accurate to within +/- 1% of nominal voltage
4. Over/under frequency sensing:
 - a. Pickup: +/- 5 to +/-20% of nominal frequency (default 10%)
 - b. Dropout: +/-1% beyond pickup (default 1%)
 - c. Dropout time delay: 0.1 to 15.0 seconds (default 5 sec)
 - d. Accurate to within +/- 0.2%
5. Voltage imbalance sensing:
 - a. Dropout: 2 to 10% (default 4%)
 - b. Pickup: 90% of dropout
 - c. Time delay: 2.0 to 20 seconds (default 5 sec)
6. Phase rotation sensing:
 - a. Time delay: 100 msec
7. Loss of single-phase detection:
 - a. Time delay: 100 msec
- J. Control features shall include:
 1. Programmable genset exerciser: A field-programmable control shall periodically start the generator, transfer the load to generator for a preset time, then re-transfer and shut down the generator after a preset cool-down period.
 - a. Push-button programming control shall have a selection of eight different schedules for exercising generator, with or without load.

2. In event of a loss of power to the control, all control settings, real-time clock setting and the engine start-time delay setting will be retained.
3. The system continuously logs information including the number of hours each source has been connected to the load, the number of times transferred, and the total number of times each source has failed. An event recorder stores information, including time and date-stamp, for up to 50 events.
4. Transfer Override Switch: Overrides automatic re-transfer control so automatic transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light to indicate override status.

K. Control Interface

1. Provide one set Form C auxiliary contacts on both sides, operated by transfer switch position, rated 10 amps 250 VAC.
2. The transfer switch shall be provided with a network communication card, and configured to allow network-based communication with the transfer switch and other network system components, including the generator set(s) provided for the Project.
3. Unassigned Auxiliary Contacts: Two normally open, 1-pole, double-throw contacts for each switch position, rated 10A at 240 VAC.

L. Engine Starting Contacts

1. One isolated and normally closed, and one isolated and normally open; rated 10A at 32 VDC minimum.

2.4 REMOTE ANNUNCIATOR SYSTEM

- A. Functional Description: Remote annunciator panel shall annunciate conditions for indicated transfer switches. Annunciation shall include the following:
1. Sources available, as defined by actual pickup and dropout settings of transfer-switch controls.
 2. Switch position.
 3. Switch in test mode.
 4. Failure of communication link.
- B. Annunciator Panel: LED-lamp type with audible signal and silencing switch.
1. Indicating Lights: Grouped for each transfer switch monitored.
 2. Label each group, indicating transfer switch it monitors, location of switch, and identity of load it serves.
 3. Mounting: Flush, modular, steel cabinet, unless otherwise indicated.
 4. Lamp Test: Push-to-test or lamp-test switch on front panel.
- C. Malfunction of annunciator, annunciation and control panel, or communication link shall not affect functions of automatic transfer switch. In the event of failure of communication link, automatic transfer switch automatically reverts to stand-alone, self-contained operation.
- D. Automatic transfer-switch sensing, controlling, or operating function shall not depend on remote panel for proper operation. The remote annunciation system shall not prevent transfer to the alternate source when the primary power source fails, nor prevent return to the primary source if the alternate source fails

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Design each fastener and support to carry load indicated by seismic requirements and according to seismic-restraint details. See Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- B. Floor-Mounting Switch: Anchor to floor by bolting.
 - 1. Floor-mounted transfer switches (except drawout switches supported by wheeled carriages, which must be rolled out at floor level) shall be mounted on concrete bases complying with the following requirements:
 - a. Concrete Bases: 4 inches (100 mm) high, reinforced, with chamfered edges. Extend base no more than 4 inches (100 mm) in all directions beyond the maximum dimensions of switch, unless otherwise indicated or unless required for seismic support. Construct concrete bases according to Division 26 Section "Hangers and Supports for Electrical Systems."
- C. Annunciator and Control Panel Mounting: Flush in wall, unless otherwise indicated.
- D. Identify components according to Division 26 Section "Identification for Electrical Systems."
- E. Set field-adjustable intervals and delays, relays, and engine exerciser clock.

3.2 CONNECTIONS

- A. Wiring to Remote Components: Match type and number of cables and conductors to control and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.
- B. Field control connections shall be made on a common terminal block that is clearly and permanently labeled.
- C. Transfer switch shall be provided with AL/CU mechanical lugs sized to accept the full output rating of the switch. Lugs shall be suitable for the number and size of conductors shown on the drawings.
- D. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- E. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 SOURCE QUALITY CONTROL

- A. Prior to shipping, factory shall test and inspect components, assembled switches, and associated equipment to ensure proper operation.
- B. Factory shall check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements.
- C. Factory shall perform dielectric strength test complying with NEMA ICS 1.

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: The supplier of the transfer switch(es) and associated equipment shall inspect, test, and adjust components, assemblies, and equipment installations, including connections, and report results in writing.
- B. Manufacturer's representative shall perform tests and inspections and prepare test reports.
- C. After installing equipment and after electrical circuitry has been energized, installer shall test for compliance with requirements.
 - 1. Perform recommended installation tests as recommended in manufacturer's installation and service manuals.
 - 2. After energizing circuits, demonstrate interlocking sequence and operational function for each switch.

- a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.
 - b. Verify time-delay settings.
 - c. Verify that the transfer switch is accurately metering AC voltage and current (when provided).
 - d. Test bypass/isolation unit functional modes and related automatic transfer-switch operations.
 - e. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.
3. Ground-Fault Tests (if integral to transfer switch): Coordinate with testing of ground-fault protective devices for power delivery from both sources.
 - a. Verify grounding connections and locations and ratings of sensors.

3.5 DEMONSTRATION

- A. After generator set installation, the generator and transfer switch supplier shall conduct a complete operation, basic maintenance, and emergency service seminar covering generator set and transfer switch equipment, for up to 10 people employed by the Owner.
 1. The seminar shall include instruction on operation of the transfer equipment, normal testing and exercise, adjustments to the control system, use of the PC based service and maintenance tools provided under this contract, and emergency operation procedures.
 2. The class duration shall be at least 8 hours in length, and include practical operation with the installed equipment.

3.6 SERVICE AND SUPPORT

- A. The manufacturer shall supply the Owner with a complete set of the service and maintenance software required to support the product. The software shall be provided at a training class attended by the user, to qualify the user in proper use of the software. The software shall have the following features and capabilities:
 1. The software shall be 32 bit and shall be XP and Vista compatible.
 2. The software shall use the Windows Explorer format, for ease of use and commonality with other software in use at the facility.
 3. The software shall allow adjustment of all functions described herein, adjustment of operating levels of all protective functions, and programming of all optional functions in the controller. Adjustments shall be possible over modem from a facility that is remote from the generator set.
 4. The software shall be capable of storing and displaying data for any function monitored by the generator set control. This data shall be available in common file formats, and on graphical "strip chart" displays.
 5. The software shall automatically record all control operations and adjustments performed by any operator or software user, for tracking of changes to the control.
 6. The software shall display all warning, shutdown, and status changes programmed into transfer switch controller. For each event, the control shall provide information on the nature of the event, when it last occurred, and how many times it has occurred.

END OF SECTION

SECTION 26 43 13 - SURGE PROTECTIVE DEVICES FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- A. The General Provisions, Supplemental General Provisions, Special Provisions, apply to work covered by this Section.
- B. Comply with Electrical Sections, as applicable. Refer to other Sections for coordination of work.

1.2 SCOPE OF WORK

- A. Provide labor, material, equipment, tools and services, and perform operations required for, and reasonably incidental to, the providing of a high-energy power conditioning surge protection device(s) at branch circuit panelboards where indicated on the Drawings. The device shall incorporate transient voltage surge suppression (TVSS) and high-frequency electrical line noise filtering. The device shall provide effective high energy transient voltage suppression, surge current diversion, high-frequency attenuation, and line stabilization in ANSI/IEEE C62.41-2002 environments connected downstream from the facility's main overcurrent protective device. The device shall be connected in parallel with the facility's wiring system.
- B. The device shall be installed as an integral part or external of the panelboard, switchboard.

1.3 SUBMITTALS

- A. Submit product data and shop drawings for products specified under PART 2 - PRODUCTS.
- B. Manufacturers' Product Data: Submit material specifications and installation data for products specified under PART 2 - PRODUCTS.
- C.
- D. Shop Drawings: Submit shop drawings to indicate information not fully described by the product data to indicate compliance with the contract documents.
 - 1 Include electrical characteristics and ratings for the specified equipment.
 - 2 Include wiring diagrams indicating the internal connections of the specified equipment within its enclosure.
 - 3 Drawings shall be provided indicating device dimensions, weights, mounting provisions, connection details and wiring diagrams.
 - 4 Documentation of the specified device UL 1449 3rd Edition voltage protection rating (VPR) and per mode surge current rating shall be included. All submittals without this documentation will be rejected.
 - 5 The manufacturer shall make available upon request certified documentation of applicable Location Category Testing in full compliance with ANSI/IEEE C62.41-1991 and ANSI/IEEE C62.45-1987 Guidelines.
- E. Record Drawings
 - 1 A complete set of manufacturers' product data and shop drawings indicating all post bid revisions and field changes.

1.4 QUALITY ASSURANCE

- A. Industry Reference Standards and Publications: The device shall be designed, manufactured, tested and installed in compliance with the latest editions of:
 - 1 American National Standards Institute (ANSI) and Institute of Electrical and Electronic Engineers (ANSI/IEEE C62.41-2002 and C62.45-2002)
 - 2 Federal Information Processing Standards Publication 94 (FIPS PUB 94)
 - 3 National Electrical Manufacturers Association (NEMA LS-1)
 - 4 National Fire Protection Association (NFPA 70, National Electrical Code (NEC), 75 and 78)
 - 5 Underwriters Laboratories UL 1449 Standard for Transient Voltage Surge Suppressors Surge Protection Devices and UL 1283 Standard for Electromagnetic Interference Filters.
- B. The device shall be UL listed under UL 1449 and UL 1283 complimentary listed.
- C. The device shall be warranted against defects in material and/or workmanship and any failure or end-of-life event including lighting for a minimum of TEN (10) years from the date of shipment.
- D.
- E. The device shall be thoroughly factory-tested before shipment. Testing of the device shall include but not be limited to quality control checks, maximum continuous operating voltage (MCOV) check, and clamping voltage verification tests. The MCOV check shall consist of a minimum of one (1) hour burn-in at the applicable MCOV.
- F.

1.5 SYSTEM DESCRIPTION

A. Environmental Requirements

- 1 Storage Temperature: Storage temperature range shall be -40° to +85° C (-40° to +185° F).
- 2 Operating Temperature: Operating temperature range shall be -40° to +60° C (-40° to 140° F).
- 3 Relative Humidity: Operation shall be reliable in an environment with 5% to 95% non-condensing relative humidity.
- 4 Operating Altitude: The device shall be capable of operation in an altitude of 0 - 12,000 feet above sea level.
- 5 Audible Noise: The device shall not generate any audible noise.
- 6 Magnetic Fields: No appreciable magnetic fields shall be generated. The device shall be capable of use directly in computer rooms in any location without danger to data storage systems or devices.
- 7 Electrical Requirements
- 8 Device Operating Voltage: The nominal operating voltage and configuration shall be that of the switchgear, distribution panel, sub or branch panelboard. Maximum Continuous Operating Voltage (MCOV): The allowable maximum continuous operating voltage of all suppression components utilized in the unit shall not be less than 115% of the nominal operating voltage.
- 9 Operating Frequency: The operating frequency range of the device shall be 47 to 63 Hertz.
- 10 Protection Modes: The devices primary mode of protection shall be line-to-neutral. The secondary modes of protection shall be line-to-ground and neutral-to-ground.
- 11 Surge Current Capacity and Voltage Protection Rating: Unless specifically noted on the drawings and/or the schedules, the surge current capacity, and the voltage protection rating of the SPD shall be not less than listed on the following table.

The above text gives you the option to request a specific surge current rating on the riser or panel schedules

5. Construction: SPD's with a surge current rating of greater than 155,000 amps per mode shall be field serviceable modular devices. SPD's with a surge current rating of less than 155,000 amps may be non-modular.

Location	Per Mode Surge Current Rating	120/208vac 3 phase VPR	277/480vac 3 phase VPR
Switchgear	200,000 amps	900v	1200v
Distribution Panel	150,000 amps	900v	1200v
Sub or Branch Panel	100,000 amps	900v	1200v

1.6 DOCUMENTATION

- A. Equipment Manual. The manufacturer shall furnish an equipment manual with installation, operation, and maintenance instructions for the system.

PART 2 - PRODUCTS

3.1 MANUFACTURER

- 1 Square D
- 2 Cutler-Hammer
- 3 Current Technology
- 4 THOR SYSTEMS

3.2 TRANSIENT VOLTAGE SURGE SUPPRESSION COMPONENTS

- A. The device shall include a solid-state suppression system which includes arrays of fused non-linear voltage dependent metal oxide varistors (MOV's) with similar operating characteristics. The suppression system shall not utilize gas tubes, spark gaps, silicon avalanche diodes or other components which might short or crowbar the line, thus leading to interruption of normal power flow to or system upset of connected loads. The suppression system shall not incorporate any other components which may degrade performance or reliability of the

3.3 HIGH-FREQUENCY FILTER

- A. The device shall include a UL 1283 high frequency extended range tracking filter. The filter shall reduce fast rise-time, high-frequency, error-producing transients and electrical line noise eliminating disturbances which may lead to system upset. The filter shall provide minimum insertion loss of 45 dB at 100 kHz attenuation frequency utilizing the MIL-STD-E220A 50 ohm insertion loss methodology.

3.4 INTERNAL CONNECTIONS

- a. All internal wiring associated with the suppression/filter device and subject to surge currents shall utilize low-impedance copper bus bar and/or #4 AWG copper conductor or larger. All internal connections associated with the suppression/filter device and subject to surge currents shall be made with compression solderless-type lugs and shall be bolted to the bus bars in order to reduce overall system impedance.

SURGE PROTECTIVE DEVICES FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

3.5 FIELD CONNECTIONS

- A. The device shall include mechanical lugs for each phase, neutral and ground, or permanently connected conductors as applicable. The lugs shall accommodate up to #4 AWG copper conductor.

3.6 ENCLOSURE

- A. The device shall be provided in a surface mounted NEMA 1 type hinged enclosure, with a NEMA rating that matches or exceeds that of the switchgear, distribution panel, sub or branch panelboard that is being protected. of minimum 14 gauge steel, painted inside and out. Enclosure width shall not be greater than 24 inches.

3.7 MONITORING

- a. The device shall include solid-state, long-life externally mounted LED visual status indicators that indicate the on-line status of each phase of the unit.
- b. Dry Contacts
- c. Audible alarm with silence switch
- d. For Service Entrance or Switchgear SPD's: LED visual status indicators, Audible alarm with silence switch, Dry Contacts plus Surge Event Counter.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. The installation and testing of the system shall be in full accordance with the manufacturer's installation, operation and maintenance instructions, and all national and local codes.
- B. The device shall be installed as close as practical to the facility's wiring system in accordance with NEC Article 285, IEEE 1100-2005 section 8.4.2.5, plus applicable national/local electrical codes and the manufacturer's recommended installation instructions. Connection shall be from a minimum 40A branch circuit breaker in the switchgear, distribution panel or panelboard with #4 AWG copper conductors not any longer than necessary, avoiding unnecessary bends. Advise the engineer if the installed In no case shall conductors will be longer than 3 feet in length. Verify circuit breaker size with manufacturer.

3.2 TESTING

- A. The system shall be field tested in the presence of the Owner. At the same time operational procedures shall be reviewed with the Owner.
- B. If external test equipment is required, two (2) testers shall be furnished to the owner and two (2) training sessions shall be furnished. The first training session shall be with 90 days of occupancy and the second training session shall be not less eight months, but not more than 12 months after the first training session. Training and test equipment shall be furnished at no additional cost to the owner.

END OF SECTION

SECTION 26 51 00 - INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.

1.2 SUMMARY

- A. This Section includes interior lighting fixtures, lighting fixtures mounted on exterior building surfaces, emergency lighting units, and accessories.
- B. Related Sections include the following:

1.3 SUBMITTALS

- A. Product Data: For each type of lighting fixture indicated, arranged in order of fixture designation. Include data on features, accessories, and the following:
 - 1. Dimensions of fixtures.
 - 2. Select one of two subparagraphs below. With second subparagraph, photometric tests by manufacturer's laboratory are acceptable.
 - 3. Certified results of laboratory tests for fixtures and lamps for photometric performance.
 - 4. Emergency lighting unit battery and charger.
 - 5. LED lights
 - 6. Retain two subparagraphs below for projects with air-handling fixtures.
 - 7. Types of lamps.
- B. Delete paragraph and subparagraph below unless custom fixtures are indicated.
- C. Shop Drawings: Show details of nonstandard or custom fixtures. Indicate dimensions, weights, method of field assembly, components, features, and accessories.
 - 1. Wiring Diagrams: Detail wiring for fixtures and differentiate between manufacturer-installed and field-installed wiring.
- D. Consider retaining paragraph below for projects with congested ceiling space and where Drawings do not include comprehensive reflected ceiling plans.
- E. Coordination Drawings: Reflected ceiling plans and sections drawn to scale and coordinating fixture installation with ceiling grid, ceiling-mounted items, and other components in the vicinity. Include work of all trades that is to be installed near lighting equipment.
- F. Retain paragraph and subparagraphs below if fixture Samples are required for verification purposes. Edit if sample requirements are indicated in other than interior lighting fixture schedule. As an alternative, list of fixture types for sample submission can be added below.
- G. Delete paragraph below if not required.
- H. Product Certificates: Signed by manufacturers of lighting fixtures certifying that products comply with requirements.
- I. Delete paragraph below except for projects with extensive tests of emergency lighting equipment.
- J. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
- K. Maintenance Data: For lighting fixtures to include in maintenance manuals in the close out documents.

1.4 QUALITY ASSURANCE

- A. Fixtures, Emergency Lighting Units, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an acceptable to authorities having jurisdiction.
- B. Comply with NFPA 70.
- C. Delete paragraph below if FM compliance is not required. Coordinate with Drawings.
- D. NFPA 101 Compliance: Comply with visibility and luminance requirements for exit signs.

1.5 COORDINATION

- A. Retain this Article if Coordination Drawings are not required.

- B. Fixtures, Mounting Hardware, and Trim: Coordinate layout and installation of lighting fixtures with ceiling system and other construction.

1.6 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the products indicated in the Interior Lighting Fixture Schedule at the end of Part 3.
- B. Products: Subject to compliance with requirements, provide one of the products indicated for each designation in the Interior Lighting Fixture Schedule in the plans. Submit Manufacturers as is in the Lighting Fixture Schedule or Equal. Submit Equal Manufacturers 10 days prior to bidding day for approval. For Equal Manufacturers submit lighting calculation for each equal fixture submitted for approval.

2.2 FIXTURES AND FIXTURE COMPONENTS, GENERAL

- A. Metal Parts: Free from burrs, sharp corners, and edges.
- B. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.
- C. Doors, Frames, and Other Internal Access: Smooth operating, free from light leakage under operating conditions, and arranged to permit relamping without use of tools. Arrange doors, frames, lenses, diffusers, and other pieces to prevent accidental falling during relamping and when secured in operating position.
- D. Reflecting Surfaces: Minimum reflectance as follows, unless otherwise indicated:
 - 1. White Surfaces: 85 percent.
 - 2. Specular Surfaces: 83 percent.
 - 3. Diffusing Specular Surfaces: 75 percent.
 - 4. Laminated Silver Metallized Film: 90 percent.
- E. Lenses, Diffusers, Covers, and Globes: 100 percent virgin acrylic plastic or annealed crystal glass, unless otherwise indicated.
 - 1. Plastic: High resistance to yellowing and other changes due to aging, exposure to heat, and ultraviolet radiation.
 - 2. Lens Thickness: 0.125 inch (3 mm) minimum, unless greater thickness is indicated.

2.3 LED FIXTURES

- A. Except as otherwise indicated, provide LED luminaires, of types and sizes indicated on fixture schedules.
- B. Include the following features unless otherwise indicated:
 - 1. Each Luminaire shall consist of an assembly that utilizes LEDs as the light source. In addition, a complete luminaire shall consist of a housing, LED array, and electronic driver (power supply).
 - 2. Each luminaire shall be rated for a minimum operational life of 50,000 hours utilizing a minimum ambient temperature of (25°C).
 - 3. Light Emitting Diodes tested under LM-80 Standards for a minimum of 12,000 hours.
 - 4. Color Rendering Index (CRI) of 82 at a minimum.
 - 5. Color temperature [3500] <Insert value> K, unless otherwise indicated.
 - 6. Rated lumen maintenance at 70% lumen output for 50,000 hours, unless otherwise indicated.
 - 7. Fixture efficacy of 60 Lumens/Watt, minimum.
 - 8. 5 year luminaire warranty, minimum.
 - 9. Photometry must comply with IESNA LM-79.
 - 10. The individual LEDs shall be constructed such that a catastrophic loss of the failure of one LED will not result in the loss of the entire luminaire.
 - 11. Luminaire shall be constructed such that LED modules may be replaced or repaired without the replacement of the whole fixture.
- C. Technical Requirements

1. Luminaire shall have a minimum efficacy of 60 lumens per watt. The luminaire shall not consume power in the off state.
2. Operation Voltage: The luminaire shall operate from a 50 HZ to 60 HZ AC line over a voltage ranging from 120 VAC to 277 VAC. The fluctuations of line voltage shall have no visible effect on the luminous output.
3. Power Factor: The luminaire shall have a power factor of 0.9 or greater.
4. THD: Total harmonic distortion (current and voltage) induced into an AC power line by a luminaire shall not exceed 15 percent.
5. Operational Performance: The LED circuitry shall prevent visible flicker to the unaided eye over the voltage range specified above.

D. Thermal Management

1. The thermal management (of the heat generated by the LEDs) shall be of sufficient capacity to assure proper operation of the luminaire over the expected useful life.
2. The LED manufacturer's maximum thermal pad temperature for the expected life shall not be exceeded.
3. Thermal management shall be passive by design. The use of fans or other mechanical devices shall not be allowed.
4. The luminaire shall have a minimum heat sink surface such that LED manufacturer's maximum junction temperature is not exceeded at maximum rated ambient temperature.

2.4 LED EXIT SIGNS

- A. Exit light fixtures shall meet applicable requirements of NFPA and UL.
- B. Housing and door shall be die-cast aluminum.
- C. For general purpose exit light fixtures, door frame shall be hinged, with latch. For vandal-resistant exit light fixtures, door frame shall be secured with tamper-resistant screws.
- D. Finish shall be satin or fine-grain brushed aluminum.
- E. There shall be no radioactive material used in the fixtures.
- F. Fixtures:
 1. Inscription panels shall be cast or stamped aluminum a minimum of 2.25 mm (0.090 inch) thick, stenciled with 150 mm (6 inch) high letters, baked with red color stable plastic or fiberglass. Lamps shall be luminous Light Emitting Diodes (LED) mounted in center of letters on red color stable plastic or fiberglass.
 2. Double-Faced Fixtures: Provide double-faced fixtures where required or as shown on drawings.
 3. Directional Arrows: Provide directional arrows as part of the inscription panel where required or as shown on drawings. Directional arrows shall be the "chevron-type" of similar size and width as the letters and meet the requirements of NFPA 101.
- G. Voltage: Multi-voltage (120 – 277V).

2.5 EMERGENCY LIGHTING UNITS

- A. General Requirements: Self-contained units. Comply with UL 924. Units include the following features:
 1. Battery: Sealed, maintenance-free, lead-acid type with minimum 5-year nominal life and special warranty.
 2. Charger: Fully automatic, solid-state type with sealed transfer relay.
 3. Operation: Relay automatically turns lamp on when supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps, and battery is automatically recharged and floated on charger.

2.6 LAMPS

- A. ALL LED – NO LAMPS

2.7 FINISHES

- A. Fixtures: Manufacturer's standard, unless otherwise indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Fixtures: Set level, plumb, and square with ceiling and walls, and secure according to manufacturer's written instructions and approved submittal materials. Install lamps in each fixture.
 - B. NFPA 70 requires minimum support for fixtures. Retain paragraphs below for more specific support requirements and for requirements exceeding code minimums. Units in seismic zones must have additional supports and restraining devices beyond those specified here. See Editing Instruction No. 3 in the Evaluations.
 - C. Support for Fixtures in or on Grid-Type Suspended Ceilings: Do not use grid for support.
 - 1. Install a minimum of two ceiling support system wires for each fixture. Locate not more than 6 inches (150 mm) from fixture corners.
 - 2. Support Clips: Fasten to fixtures and to ceiling grid members at or near each fixture corner.
 - 3. Fixtures of Sizes Less Than Ceiling Grid: Arrange as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch (20-mm) metal channels spanning and secured to ceiling tees.
 - D. Suspended Fixture Support: As follows:
 - 1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
 - 2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
- 3.2 CONNECTIONS
- A. Ground equipment.
 - 1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- 3.3 FIELD QUALITY CONTROL
- A. Inspect each installed fixture for damage. Replace damaged fixtures and components.
 - B. Advance Notice: Give dates and times for field tests.
 - C. Provide instruments to make and record test results.
 - D. Tests: As follows:
 - 1. Verify normal operation of each fixture after installation.
 - 2. Emergency Lighting: Interrupt electrical supply to demonstrate proper operation.
 - 3. Verify normal transfer to battery source and retransfer to normal.
 - 4. Report results in writing.
 - E. Malfunctioning Fixtures and Components: Replace or repair, then retest. Repeat procedure until units operate properly.
 - F. Corrosive Fixtures: Replace during warranty period.
- 3.4 CLEANING AND ADJUSTING
- A. Clean fixtures internally and externally after installation. Use methods and materials recommended by manufacturer.
 - B. Adjust aimable fixtures to provide required light intensities.

END OF SECTION

SECTION 26 01 00 - SUMMARY OF ELECTRICAL WORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes exterior lighting units with luminaires and lamps.
- B. Related Sections include the following:
 - 1. Section "Interior Lighting" for interior fixtures, lamps, ballasts, emergency lighting units, and accessories; and for exterior luminaires normally mounted on buildings.

1.3 DEFINITIONS

- A. Lighting Unit: A luminaire or an assembly of luminaires complete with a common support, including pole, post, or other structure, and mounting and support accessories.
- B. Luminaire (Light Fixture): A complete lighting device consisting of lamp(s) and ballast(s), when applicable, together with parts designed to distribute light, to position and protect lamps, and to connect lamps to power supply.

1.4 SUBMITTALS

- A. Product Data: For each type of lighting unit indicated, arranged in order of lighting unit designation. Include data on features, accessories, finishes, and the following:
 - 1. Materials and dimensions of luminaires.
 - 2. Delete "independent" in subparagraph below if certified tests by manufacturer are adequate.
 - 3. Select one of two subparagraphs below. With second subparagraph, photometric tests by manufacturer's laboratory are acceptable.
 - 4. Certified results of independent laboratory tests for fixtures and lamps for electrical ratings and photometric data.
 - 5. Certified results of laboratory tests for fixtures and lamps for photometric performance.
 - 6. High-intensity-discharge luminaire ballasts.
- B. Product Certificates: Signed by manufacturers of lighting units certifying that products comply with requirements.
- C. Delete paragraph below except for projects with extensive tests of installations.
- D. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
- E. Maintenance Data: For lighting units to include in maintenance manuals specified in other sections.

1.5 QUALITY ASSURANCE

- A. Luminaires and Accessories: Listed and labeled as defined in NFPA 70, Article 100, for their indicated use, location, and installation conditions by acceptable to authorities having jurisdiction
- B. Comply with ANSI C2.
- C. Comply with NFPA 70.

1.6 WARRANTY

- A. General Warranty: LED fixture warranty is a five year limited warranty. Pole standard warranty is one year.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the products indicated in the Exterior Lighting Unit Schedule at the end of Part 3.
- B. Retain above for nonproprietary or below for semiproprietary Specification, and name products in schedules or details.
- C. Products: Subject to compliance with requirements, provide one of the products indicated for each designation in the Interior Lighting Fixture Schedule in the plans. Submit Manufacturers as is in the Lighting Fixture Schedule or Equal. Submit Equal Manufacturers 10 days prior to bidding day for approval. For Equal Manufacturers submit lighting calculation for each equal fixture submitted for approval.

2.2 LUMINAIRES

- A. Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.
- B. Metal Parts: Free from burrs, sharp corners, and edges.
- C. Sheet Metal Components: Corrosion-resistant aluminum, unless otherwise indicated. Form and support to prevent warping and sagging.
- D. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.
- E. Doors, Frames, and Other Internal Access: Smooth operating, free from light leakage under operating conditions, and arranged to permit relamping without use of tools. Arrange doors, frames, lenses, diffusers, and other pieces to prevent accidental falling during relamping and when secured in operating position. Provide for door removal for cleaning or replacing lens. Arrange to disconnect ballast when door opens.
- F. Exposed Hardware Material: Stainless steel.
- G. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and ultraviolet radiation.
- H. Reflecting Surfaces: Minimum reflectance as follows, unless otherwise indicated:
 - 1. White Surfaces: 85 percent.
 - 2. Specular Surfaces: 83 percent.
 - 3. Diffusing Specular Surfaces: 75 percent.
- I. Lenses and Refractors: Materials as indicated. Use heat- and aging-resistant, resilient gaskets to seal and cushion lens and refractor in luminaire doors.
- J. Photoelectric Relays: As follows:
 - 1. Contact Relays: Single throw, arranged to fail in the on position and factory set to turn light unit on at 1.5 to 3 fc (16 to 32 lx) and off at 4.5 to 10 fc (48 to 108 lx) with 15-second minimum time delay.
 - 2. Relay Mounting: In luminaire housing.
- K. High-Intensity-Discharge Ballasts: Comply with ANSI C82.4. Constant wattage autotransformer or regulating high-power-factor type, unless otherwise indicated.
 - 1. Single-Lamp Ballasts: Minimum starting temperature of minus 40 deg C.
 - 2. Open-circuit operation will not reduce average life.
 - 3. High-Pressure Sodium Ballasts: Equip with a solid-state igniter/starter having an average life in pulsing mode of 10,000 hours at an igniter/starter case temperature of 90 deg C.
 - 4. Noise: Uniformly quiet operation, with a noise rating of B or better.
- L. Lamps: Comply with the standard of the ANSI C78 series that is applicable to each type of lamp. Provide luminaires with indicated lamps of designated type, characteristics, and wattage. Where a lamp is not indicated for a luminaire, provide medium wattage lamp recommended by manufacturer for luminaire.
- M. LED sources shall meet the following requirements:
 - 1. Operating temperature rating shall be between -40 degrees C (-40 degrees F) and 50 degrees C (120 degrees F).
 - 2. Correlated Color Temperature (CCT): 4000K
 - 3. Color Rendering Index (CRI): ≥ 85 .
 - 4. The manufacturer shall have performed reliability tests on the LEDs luminaires complying with Illuminating

LED DRIVERS

- A. LED drivers shall meet the following requirements:
 - 1. Drivers shall have a minimum efficiency of 85%.
 - 2. Starting Temperature: -40 degrees C (-40 degrees F).
 - 3. Input Voltage: 120 to 480 ($\pm 10\%$) volt.
 - 4. Power Supplies: Class I or II output.

5. Surge Protection: The system must survive 250 repetitive strikes of "C Low" (C Low: 6kV/1.2 x 50 μ s, 10kA/8 x 20 μ s) waveforms at 1-minute intervals with less than 10% degradation in clamping voltage. "C Low" waveforms are as defined in IEEE/ASNI C62.41.2-2002, Scenario 1 Location Category C.
6. Power Factor (PF): ≥ 0.90 .
7. Total Harmonic Distortion (THD): $\leq 20\%$.
8. Comply with FCC Title 47 CFR Part 18 Non-consumer RFI/EMI Standards.
9. Drivers shall be reduction of hazardous substances (ROHS)-compliant.//

PART 3 - EXECUTION

3.1 CONNECTIONS

- A. Ground equipment.
 1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- B. Ground metal poles/support structures according to Section "Grounding and Bonding."
 1. Nonmetallic Poles: Ground metallic components of lighting units and foundations. Connect luminaires to grounding system with No. 6 AWG conductor.

3.2 FIELD QUALITY CONTROL

- A. Inspect each installed unit for damage. Replace damaged units.
- B. Advance Notice: Give dates and times for field tests.
- C. Provide instruments to make and record test results.
- D. Tests and Observations: Verify normal operation of lighting units after installing luminaires and energizing circuits with normal power source, and as follows:

3.3 CLEANING AND ADJUSTING

- A. Clean units after installation. Use methods and materials recommended by manufacturer.

END OF SECTION

SECTION 27 05 33 - CONDUITS AND BACKBOXES FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- A. The General Provisions, Supplemental General Provisions, Special Provisions apply to work covered by this Section.
- B. Comply with Sections 26 00 00, as applicable. Refer to other Sections for coordination of work.

1.2 SCOPE OF WORK

- A. Provide labor, materials, equipment, tools and services, and perform operations required for, and reasonably incidental to, the providing of a telephone and data communications empty conduit system, including all related systems and accessories.

1.3 SUBMITTALS

- A. Submit product data and shop drawings in accordance with the Architectural sections.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Conduit, conduit sleeves, outlet boxes, cover plates and pullwire as indicated.
- B. Fireproofing material for telephone and data communication conduit and conduit sleeves through fire rated walls and floors.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install telephone and data communication raceways as indicated.
- B. Install individual raceways from telephone and data communications outlets to above accessible ceiling. In areas without a ceiling, raceways shall be routed to the nearest ceiling space. In building without a ceiling, raceways shall be extended back to the main telephone/ data communication board or to a location indicated on the Drawings.
 - 1 Minimum size conduit: one inch, REFER TO PLANS FOR SIZES.
 - 2 Raceway installation shall be in accordance with Section 26 05 33.
 - 3 Coordinate raceway installations in millwork and other fabricated architectural items with the other portions of the Work.
 - 4 Provide pullwire in each raceway tagged on each end.
 - 5 Raceways shall be terminated with an insulating bushing or a suitable connector with an insulated throat.
- C. Provide telephone and data communications outlet boxes.
 - 6 Provide a one-gang outlet unless noted otherwise.
 - 7 Install outlet box and device ring at each location.
 - 8 Install telephone and data communications outlets at same height specified for convenience outlets unless noted otherwise. Group telephone and data communications outlets with related receptacle outlets unless noted otherwise.
 - 9 Install a blank cover plate on all unused communications outlet boxes.

END OF SECTION

SECTION 28 31 00 - INTRUSION DETECTION

PART 1 - GENERAL

1.1 Manufacturer

- A. The manufacturer shall have at least twenty-five (25) years of experience in the role of fire and security control manufacturing, and a proven track record of forward and backward compatibility for a minimum of twenty (20) years for its product's auxiliary devices, including system keypads, annunciation devices, zone expansion modules, and addressable detection devices.
- B. The manufacturer must also manufacture receiving equipment that is compatible with standard dial-up telephone lines and network monitoring equipment that is compatible with a LAN, WAN, and the Internet. The receiving equipment shall be capable of receiving all status and alarm messages generated by the system. The receiving equipment shall be capable of updating the panel operating program and the system date and time.
- C. Intrusion detection/Access control pane(SEC) equipment manufacturer shall be: Digital Monitoring Products, Incorporated (DMP) #XR500N

1.2 Installer

- A. The installing company shall show proof of having regular experience with design, installation, service, and maintenance of manufactured systems for a minimum of the last twelve (12) calendar months from the project start date. Each system installer and service person must provide manufacturer certification of technical training for installation, service, and system maintenance. Certification shall be proven with an official document issued by the manufacturer.
- B. The installing company shall provide a minimum of 8 (eight) verifiable references from its clients where the manufacturer's system has been installed within the last twelve (12) calendar months from the project start date.
- C. The installing company shall furnish and install a complete electrically supervised Command Processor™ Panel, as detailed in this specification. The system shall be inclusive of all necessary function, monitoring, and control capability as detailed herein and on accompanying shop drawings.
- D. The installing company shall become familiar with all details of the work, verify all dimensions in the field, and shall advise the Architect of any discrepancy before performing the work. Materials shall be installed in strict compliance with local building codes. All work shall be performed in accordance with Digital Monitoring Products, Inc. instructions.

1.3 Central Reporting Station

- A. The central reporting station contractor must possess an Underwriter's Laboratory (UL) listing as a "Mercantile Police Station" or "Mercantile Burglar Alarm Systems" company. A copy of the listing shall be attached as a part of this bid package.
- B. The actual alarm signal receipt and processing is a significant portion of the scope of work. Third party and/ or contract stations are permitted. UL must list the monitoring station for Protective Signaling Services or Central Reporting Station Signaling Services. A copy of the station UL listing shall be attached as part of this bid package.
- C. The monitoring station must provide openings/ closing activity reports, activity day and time, authorized individual, office name and account number and the system type being monitored. These reports are to be mailed to the user's office at the end of each month. The Office Manager or Contract Administrator may request an additional report if an incident occurs.
- D. The contractor must have a valid Alarm Operator License. A copy of licenses shall be attached as part of this bid package.
- E. The contractor may be required to monitor a portion of the alarm systems by way of the end user data network.
- F. The Contractor shall become familiar with all work details, verify all dimensions in the field, and shall advise the Architect of any discrepancy before performing the work.

- G. The end user shall not incur any central station setup charges by the contractor to receive alarm signals by way of the end user data network.

PART2 - SCOPE

2.1 Requirements

- A. Furnish and install a complete Intrusion Detection/ Access Control system (SEC) with the performance criteria detailed in this specification. The system shall be inclusive of all necessary functions, monitoring, and control capability as detailed herein and on accompanying Shop drawings.
- On-site or remote video monitoring
 - Heating, air conditioning, and lighting management
 - Temperature threshold detection and monitoring
 - Humidity threshold detection and monitoring
 - Pressure threshold detection and monitoring
 - Power loss detection and monitoring, generator switching
 - Leak detection and monitoring
 - Carbon Monoxide detection and monitoring
 - Tank level threshold detection and monitoring
- B. This specification document provides the requirements for the installation, programming, and configuration of a complete Command Processor Panel. This system shall include, but not be limited to:
- Control panel
 - System cabinet
 - Power supply
 - Digital Signaling Line Circuits (SLC)
 - Notification Appliance Circuits (NAC)
 - Annunciator/keypad bus
 - Batteries
 - Wiring
 - Conduit
 - Associated peripheral devices
 - Other relevant components and accessories required to furnish and install a complete and operational addressable reporting Life Safety System.

2.2 Standards

- A. The system shall be listed as a Power Limited Device and be listed under the standards in the table. Each system shall be supplied with complete details on all installation criteria necessary to meet all of the listings.

Burglary Listings

- UL 365 Police Connect Burglar
- UL 609 Local Burglar
- UL 1023 Household Burglar Alarm System Units
- UL 1076 Proprietary Burglar
- UL 1610 Central Station Burglar Alarm Units
- UL 1635 Digital Burglar Alarm Communicator System Units

Fire Listings

- UL 864 Control Units for Fire Protective Signaling Systems
- UL 985 Household Fire Warning

Access Control Listings

- UL 294 Access Control System Units

Related Listings

- NFPA 70 National Electric Code (NEC)

- NFPA 72 Local Protective Signaling
- NFPA 72 Remote Station Protective Signaling
- NFPA 72 Proprietary Protective Signaling
- NFPA 72 Household Fire Warning

U.S. Government Standards/Listings

- Meets DCID 6/9
- Meets DoD/NIST SCIF Standards

2.3 Americans with Disabilities

All indicating and notification appliances shall comply with the Americans with Disabilities Act (ADA) requirements.

PART 3 - SUBMITTALS

3.1 General Requirements

The contractor shall submit three (10) complete sets of documentation within thirty (30) calendar days after contract award date. Indicated in the document shall be the manufacturers' names, catalog number, type, size, style, rating, and catalog data sheets for all items proposed to meet these specifications.

3.2 Shop Drawings

Shop drawings shall be submitted in accordance with Section 3.0 Submittals and shall consist of a complete list of equipment and materials, including manufacturer's descriptive and technical literature, performance charts and curves, catalog cuts, and installation instructions.

3.3 As-Built Drawings

The contractor shall provide a complete set of as-built drawings for the entire system upon installation completion. These drawings shall include, but not be limited to, the exact locations of all equipment, connections between all equipment, and wiring for all equipment as the system is installed.

3.4 Spare Parts Data

After shop drawings are approved, and not later than thirty (30) calendar days prior to the date of beneficial occupancy, a list of spare parts data for each item of specified materials and equipment shall be submitted. The data shall include a complete list of parts and supplies with current unit prices and source of supply. Spare parts shall consist of, but not be limited to, five (5) percent of all initiating and notification appliances with a minimum of one (1) each. All spare parts shall be on site prior to commencement of acceptance testing. Depleted spare parts shall be replaced prior to beneficial occupancy.

3.5 Operating Documents

The contractor shall furnish to the architect operating instructions outlining the step-by-step procedures required for system start-up, operation, and shutdown at least thirty (30) calendar days prior to acceptance test. The instructions shall include the manufacturer's name, system model number, service manual, parts list, and a description of all equipment and their basic operating features.

3.6 Maintenance Documents

The contractor shall furnish maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guides at least 30 calendar days prior to acceptance test.

3.7 Performance Test Reports

Upon the installed system completion and testing, test reports shall be submitted in booklet form showing all field tests performed to prove compliance with specified performance criteria.

3.8 Warranty

A copy of the manufacturer's warranty for all equipment and materials shall be provided. Warranty shall be for all equipment, materials, installation, and workmanship for a minimum of three (3) years, unless otherwise specified.

PART 4 - GENERAL COMPONENT REQUIREMENTS

4.1 Component Enclosure

Housings; power supply enclosures, terminal cabinets, control units, and other component housings, collectively referred to as enclosures shall be so formed and assembled as to be sturdy and rigid. If sheet steel is used in the fabrication of enclosures, it shall be not less than an 18 gauge door with a 20 gauge box frame. Where exposed pins,

the hinges shall be of the tight pin type or the ends of hinge pins shall be tack welded to prevent ready removal. Doors having a latch edge length of less than 24 inches shall be provided with a single lock. Where the hinged door latch edge is 24 inches or more in length, doors shall be provided with three-point latching device with lock; or alternatively with two locks, one located near each end. For SCIF and High Security applications an attack proof enclosure with proper tamper UL listed for use with the XR500/XR500N/XR500E shall be used.

4.2 Electronic Components

- A. All system electronic components shall be solid-state type, mounted on printed circuit boards. Light duty relays and similar switching devices shall be solid-state type or electromechanical.
- B. The panel shall have an over current notification LED that lights when devices connected to the Keypad Bus and LX-Bus(es) draw more current than the panel is rated for. When the over current LED lights, the LX-Bus (es) and Keypad bus are shut down.

4.3 Control Unit

- A. A battery test shall be automatically performed to test the integrity of the standby battery. The test shall disconnect the standby battery from the charging circuit and place a load on the battery. This test shall be performed no more than every 180 seconds.
- B. The control unit shall be capable of operating and supervising notification appliance devices as well as addressable initiating detection devices and an integrated supervised dual line digital communicator.

4.4 Remote Annunciators

- A. The system shall support a maximum of sixteen (16) supervised remote annunciators with the identical capabilities, functions and display layout. Operation of the remote annunciators shall be limited to authorized users by the use of a code or key.
- B. The remote annunciators shall be capable of operating at a maximum wiring distance of 15,000 feet from the control unit on unshielded, non-twisted cable.

4.5 Control Designations

Controls shall be provided to ensure ease of operation of all specified characteristics. Where applicable, clockwise rotation of controls shall result in an increasing function. Controls, switches, visual signals and indicating devices, input and output connectors, terminals and test points shall be clearly marked or labeled on the hardware to permit quick identification of intended use and location.

4.6 Test Modes

- A. The system shall include a provision that permits testing from any alphanumeric keypad. The test shall include standby battery, alarm bell or siren, and communication to the central station.
- B. The system shall include a provision for an automatic, daily, weekly, thirty (30) day, or up to sixty (60) day communication link test from the control panel installation site to the central station.
- C. The system shall include a provision for displaying the internal system power and wiring conditions. Internal monitors shall include the bell circuit, AC power, battery voltage level, charging voltage, panel box tamper, phone trouble line 1, phone trouble line 2, transmit trouble, and network trouble.

4.7 Serial Interface

The control panel shall be capable of a serial interface to output information to a standard serial printer or serial interface to a communication port on a standard computer. Through control panel programming the system shall include a provision to allow the selection of which reports are to be output.

4.8 Power Supplies

- A. Power supplies for the control unit shall operate from 120 VAC, supplied at the respective protected areas. Standby batteries shall be supplied to power the system in the event of a utility power failure. Batteries shall be sized to provide 105% capacity for eight hours. Standby batteries shall be sealed lead-acid. Power supplies shall be all Solid State.
- B. Controls shall be designed to maintain full battery charge when alternating current is available. Batteries shall be recharged to 85% capacity within 24 hours from battery use. The system shall be automatically transferred to battery power upon loss of alternating current power and return to alternating current power upon restoration. Intrusion

alarms shall not be initiated during switch over; a signal shall be initiated upon failure of battery or alternating current power.

C. Approved power supplies shall meet or exceed the following power supply model specifications:

- UL Listed DMP 505-12: 12VDC 5 amp with transformer and enclosure.
- UL Listed DMP 504-24: 24 VDC 4 amps with transformer and enclosure.

4.9 Software

A. The system shall interface with computer software with the capability to fully program the panel by connecting to the panel through:

- Direct cable connection interface card
- Receiver phone line connection
- Standard phone line connection
- Ethernet network connection
- Network connection across the Internet

B. The system shall interface with computer software capable of locking down all controlled doors.

C. The system shall interface with computer software capable of monitoring and logging all events.

D. The system shall interface with computer software capable of exporting reports in the following file formats:

- | | |
|--------------------------------|-------------------------------|
| • Excel spreadsheet
(*.xls) | • Text (*.txt) |
| • Rich Text (*.rtf) | • Comma-
separated (*.csv) |
| • Windows Metafile
(*.wmf) | • HTML document
(*.htm) |
| • QuickReport (*.qrp) | |

E. The system shall interface with computer software capable of printing custom, filtered reports including:

- | | |
|----------------------|-----------------------|
| • All Events | • Door Access Granted |
| • Zone Action | • Door Access Denied |
| • Arming/Disarming | • Opening/Closing |
| • Area Late to Close | • Schedule Changes |
| • User Code Changes | • System Monitors |
| | • System Events |

4.10 Control Panel Capability

The basic control panel shall provide:

- Expansion to a total of at least 10,000 user codes with 99 user profile definitions.
- Sixteen (16) independent door/keypad addresses, each with four zones.
- Twenty (20) Holiday Dates for custom holiday scheduling by area.
- A total door access granted event buffer of at least 10,000 events.
- Anti-passback access control selectable by area and user.
- Four (4) shift schedules per area.
- A total of at least 100 programmable output relay schedules.
- Thirty-two (32) individual reporting areas.
- Built-in bell and telephone line supervision.

The networked control panel shall provide:

- All of the above features.
- Require two-man access code or credentials.
- Support programming to require the same or different access code entered within a programmed delay time of 1 to 15 minutes after disarming before activating a silent ambush alarm.
- Support area programming that disables schedule and time-of-day changes while system is armed so that area can only be disarmed during scheduled times.

The encrypted control panel shall provide:

- All of the basic and network features listed above.
- Built-in Encrypted Alarm Router.
- Certified operation that meets 128 Bit AES Rijndael Encryption communications.
- Certified operation that meets SCIF (Sensitive Compartmented Information Facility) application needs.
- Certified operation that meets NIST (National Institute of Standards and Technology) standards.
- Certification that encrypted panel is capable of meeting DCID 6/9 standards.
- Certification that encrypted panel is capable of meeting UL 2050 standards.

PART 5 - FUNCTIONAL DESCRIPTIONS

5.1 System Description

- A. The system areas and zones shall be programmable, and the system shall store, log, display, and transmit specific custom designations for system areas, zones, and user names.
- B. To ensure continued, one-call support, the system shall be constructed of sensing components provided directly by the system manufacturer, such as power supplies, motion detectors, door and window position switches, glass break detectors, or other sensing devices that the manufacturer offers.
- C. The system controller, user interfaces, zone input devices, relay output devices, and the system signal receiving equipment shall be engineered, manufactured, assembled, and must be distributed from a location within the United States of America.
- D. The system shall support user interaction by way of a keypad, web browser, system software, key switch, or radio frequency wireless control, using integrated or auxiliary devices provided by the system manufacturer.
- E. The system shall support controller zone input connections, system keypads, system zone expansion modules, and wireless zone input modules, and must support zone input connections by way of at least two competitive products. The system shall offer a seamless integrated compatibility with hard-wire and/ or wireless zone expansion equipment for at least 200 wireless zones and/ or a maximum of 574 hardwired zones.
- F. The system shall be capable of offering at least five zone expansion buses, each of which can support the connection of up to 15,000 feet of four-wire cable. Zone expansion and keypad data buses that exceed 2,500 feet of cable must include splitter/repeater modules to boost data voltage and maintain data integrity.
- G. The system shall provide a seamless capability to provide a minimum of 500 addressable relays, which can be located at any connection location upon a zone expansion bus.
- H. System relay outputs shall have the capability of being triggered as a result of a command from the user interface, changes in system status, changes in zone status, or by a programmable schedule.
- I. System relay output states shall be programmable for momentary, maintained, pulsed, or must follow the state of an associated system zone input.
- J. The system shall be completely programmable either locally from a keypad or remotely through a standard dial-up, and network connections by way of a LAN, WAN, and/or by way of the Internet.
- K. The control unit shall be completely programmable remotely using remote annunciators, and/ or using upload/download software that communicates using SDLC 300 baud, 2400 baud, or IP Addressed data network. On-site programming from a personal computer shall also be permitted.
- L. The control unit shall be equipped with an anti-reversing circuit breaker to prevent damage due to accidental reversal of battery leads.

5.2 Input/Output Capacity

- A. This system shall be capable of monitoring a maximum of 574 individual zones and controlling a maximum of 502 output relays.
- B. The control panel shall have, as an integral part of the assembly, 2 SPDT Form C relays rated at 1 Amp at 30 VDC and four open collector 12 VDC outputs rated at 50mA each. It shall also have the capacity of a maximum of 125 output expander modules with 500 switched ground, open collector outputs, 50mA maximum and 502 auxiliary relays (Form C rated at 1.0 Amp at 30 VDC).

- C. The panel shall also provide 100 programmable output schedules, and include an integral bell alarm circuit providing at least 1.5 Amps of steady, pulsed, or temporal bell output. Output type shall be programmable by zone type. Relays and voltage outputs shall be capable of being independently programmed to turn on and/or off at selected times each day.

5.3 User/Authorization Level Capacity

- D. The system shall be capable of operation by 10,000 unique Personal Identification Number (PIN) codes with each code having one (1) of ninety-nine (99) custom user profiles. This allows for limitation of certain functions to authorized users. The operation of all keypads shall be limited to authorized users.

5.4 Keypads

- A. The keypads shall be DMP # 7063. The system shall support a maximum of sixteen (16) keypads with alphanumeric display. Each keypad shall be capable of arming and disarming any system area based on a pass code and Proximity key authorization. The keypad alphanumeric display shall provide complete prompt messages during all stages of operation and system programming and display all relevant operating and test data.
- B. Communication between the control panel and all keypads and zone expanders shall be multiplexed over a non-shielded multi-conductor cable, as recommended by the manufacturer. This cable shall also provide the power to all keypads, zone expanders, output expanders, and other power consuming detection devices.
- C. If at any time a keypad does not detect polling, the alphanumeric display shall indicate "SYSTEM TROUBLE". If at any time two devices are programmed for the same address, the alphanumeric keypad shall display "4 WIRE BUS TROUBLE". If at any time a keypad detects polling but not for its particular address, the alphanumeric display shall indicate "NON POLLED ADDR". The system shall display all system troubles at selected keypads with distinct alphanumeric messages.
- D. The keypad shall include self-test diagnostics enabling the installer to test all keypad functions: display test, key test, zone test, LED test, relay test, tone test, and address test.
- E. The keypad shall provide an easy-to-read English text display. The text shall exactly match the text seen in all software reports, keypad displays, and central station reports.
- F. The keypad user interface shall be a simple-to-use, menu-driven help system that is completely user friendly.
- G. The control panel shall support a keypad interface accessible on the World Wide Web in a browser window. The web-accessible keypad interface shall provide at least five (5) programmable hyperlinks for camera access or other use.
- H. The system shall support sub-control keypads with four (4) built-in zones and capable of functioning in the following modes:
 - Panel monitors all four (4) keypad zones independently with a maximum of 125 keypads attached to the control panel
 - Panel assigns one (1) zone to each keypad and monitors all keypad zones as a single zone with a maximum of 500 keypads attached to the control panel
 - Stand-alone mode allowing keypad to operate as a self-contained security system independent of the control panel

5.5 Zone Configuration

- A. A minimum of 4 Class B ungrounded zones shall be available at each keypad or zone expander on the system. The system shall have the capacity for a maximum of sixteen (16) keypads and a maximum of 125 four (4) zone expanders or 500 single zone expanders. It shall also have the capacity of a maximum of 125 supervised relay output expanders. All Class B zones shall be 2-wire, 22 AWG minimum, supervised by an end-of-line (EOL) device and shall be able to detect open and short conditions in excess of 500ms duration.
- B. Each zone shall function in any of the following configurations: Night, Day, Exit, Fire, Supervisory, Emergency, Panic, Auxiliary 1, Auxiliary 2, Fire Verification, Cross Zone, Priority, and Key Switch Arming.
- C. The digital SLCs and the annunciator/keypad bus shall be able to operate at a maximum wiring distance of 2500 feet from the control panel on unshielded, non-twisted cable. This distance may be extended to a total of 15,000 feet when bus repeater modules are installed.
- D. The system shall have the capability to incorporate up to 200 zone expander POPIT™ points.
- E. Each zone shall function in any of the following configurations:

5.6 Communication

- Night • Supervisory • Auxiliary 1 • Cross-
• Day • Emergency • Auxiliary 2 Zone
• Exit • Panic • Fire • Priority
• Fire Verification Arming
- A. The system shall be capable of signaling to two remote monitoring station receivers, four telephone numbers of 32 digits each using two separate switched telephone network lines such that if two unsuccessful attempts are made on the first line to the first number, the system shall make two attempts on first line to the second number. If these two attempts are unsuccessful, the system shall make two further attempts on the first line of the first number. After the tenth unsuccessful attempt, dialing shall stop and the alphanumeric keypad shall display trouble. Should another event occur that requires a report to be transmitted, the dialing process shall be repeated. The system shall have a programmable option to dial a second set of telephone numbers after the first ten attempts using the same sequence.
- B. The system shall be capable of communication using the IBM Synchronous Data Link Control format, and at least two other standard industry formats.
- C. The system shall be capable of supporting Network communication with digital dialer backup, existing Ethernet or token ring data networks, satellite communication, fiber optic networks, local area networks, wide area networks, cellular communication, and retail data networks.

5.7 Network Communication

- A. The control panel shall be capable of asynchronous network communication with a retry time between 3 and 15 seconds for a total of one (1) minute. If communication is unsuccessful the control panel shall be capable of attempting backup communication through any of the available communication methods to the same receiver or a backup receiver.
- B. Network communication between the control panel and the receiver shall be in a proprietary communication format.
- C. The control panel shall be capable of supporting Dynamic Host Communication Protocol (DHCP) Internet Protocol (IP) addressing.
- D. Underwriters Laboratories (UL) shall list network communication by the control panel for Grade AA High-Line Security.
- E. The control panel shall be capable of two-way network communication using standard Ethernet 10BaseT in a LAN, WAN, or Internet configuration.
- F. The control panel shall be capable of communication by means of a 128 Bit AES Rijndael Encryption process certified by NIST (National Institute of Standards and Technology) to an SCS-1R receiver with a built-in Encryption Alarm Router.
- G. The control panel shall be capable of meeting DCID 6/9 and UL 2050 standards.

5.8 TCP/IP Network Trapping

- A. The control panel shall be capable of having communication set to Network operation. When a trap is set in Remote Link, the software shall be capable of sending a panel trap message with the panel account number to the iCOM or iCOM-E installed in an SCS-1R receiver.
- B. The receiver iCOM or iCOM-E shall store the trap and monitor the panel for the next message. When the panel sends its next message, the receiver iCOM or iCOM-E shall then send a message to the panel to contact Remote Link at the IP address contained in the original trap message.
- C. The trap message shall be stored in the receiver iCOM or iCOM-E for up to four hours. If the trap message is not sent to the panel within the four-hour window, the panel trap message shall be discarded and a new trap message must be sent from Remote Link.
- D. The user shall be able to view the trap status in the receiver iCOM or iCOM-E in Remote Link using the Trap Query function.

5.9 NAC Circuit Configuration

- A. The system shall be capable of additional Class B NAC circuits utilizing the Model 867 Notification Module. Each module shall be controlled and supervised via the SLC loop and monitor for short circuits, open circuits, and ground faults. The NAC circuits shall monitor for external NAC trouble conditions.

- B. The system shall be capable of providing Class A NAC circuits utilizing the Model 865 Notification Module. Each module shall monitor for short circuits, open circuits, and ground faults. The NAC circuits shall monitor for external NAC trouble conditions and have a manual bell silence switch.

PART6- INTEGRATED INTRUSION ALARM AND ACCESS CONTROL OPERATION

6.1 Access Authority Levels

The system shall be capable of programming access credentials authority levels to check whether the user has access to a specific area and also has the authority to disarm or arm the area. If the user access credential has access and disarm/arm authority the system shall provide the user the option to disarm the area simultaneously upon opening the door, or to open the door and begin an entry delay timer. With the timer option the user then disarms the area using an intrusion control keypad inside the area. If the user only has access authority to the area and the area is in an armed condition, the user is denied access to the area.

6.2 Door Open Schedule Override

The system shall be capable of programming certain area doors to be scheduled to unlock and lock at specific times of the day or night. The lock/unlock function shall be capable of an override option depending upon the area armed/disarmed status. If the area remains in an armed status at the scheduled unlock time the armed status overrides the unlock schedule ensuring the doors remain locked and armed in situations where the business might open late, close early, is affected by inclement weather, or another emergency.

6.3 Common Area

The system shall be capable of programming a common area to be armed when the last area in the system is armed and disarmed when the first area in the system is disarmed. To ensure the common area works properly it shall not have any user codes assigned to the common area. The system shall also be capable of programming multiple common areas.

6.4 Early Morning Ambush (XR500N and XR500E only)

- A. The system shall be capable of programming an area to require two user codes be entered within a programmed number of minutes to prevent an ambush message from being sent to the Central Station Receiver. If both user codes are not entered within the time an ambush message is sent to the central station receiver.
- B. Both user codes shall have the authority to disarm the specific area and must be entered at the same keypad or reader. The keypad shall not display any indication that the ambush timer is running.
- C. The system shall be capable of programming an output to provide an external indicator that an ambush situation is taking place.

6.5 Two-Man Rule (XR500N and XR500E only)

The system shall be capable of programming an area to require two separate user codes be entered in order to disarm and/or allow access to a specific area. Both required codes shall have at least the same or greater authority level. Both required codes shall be entered within 30 seconds or an alarm shall activate.

6.6 UL Bank Safe & Vault Operation (XR500N and XR500E only)

The system shall be capable of being programmed to only be disarmed during scheduled times regardless of the authority level of any user code or user profile in the system. The schedule and time and date set for this area shall not be capable of being changed while the area is armed. Zones assigned to Bank Safe & Vault areas shall not be able to be bypassed or force armed.

6.7 Panic Button Summary Test (XR500N and XR500E only)

- A. The system shall have the ability to test panic buttons without sending a panic alarm to the Central Station Receiver.
- B. The system shall also have the ability to send panic zone test verification and failure results to the Central Station Receiver.
- C. During the test, each time a panic zone trips, the display number shall increment and the keypad buzzer sound for two seconds.
- D. The number of panic zones tripped shall constantly display until the test ends or no panic zone activity has occurred for 20 minutes.

- E. When the Panic Zone Test ends and a zone failed (did not trip) during the test, the keypad shall be able to display the zone name and number and have the buzzer sounds for one second. Additional zone failed zones shall display when a button is pressed.

PART7- FALSE ALARM REDUCTION FEATURES

The system shall be capable of providing false alarm reduction features, functions, capabilities, or processes that either require alarms be verified or potential alarms be corrected before a system or zone can be placed into an armed state.

7.1 Exit Error Alert and Reporting

The panel shall be able to provide an automatic function to prevent a false alarm from occurring if an exit door does not properly close after the system is armed.

7.2 Entry and Exit Delay Annunciation

- A. When arming, the system shall provide clear annunciation indicators to the user about the need to exit the premises prior to the exit delay time expiring.
- B. When disarming, the system shall notify the user the need to disarm the system prior to the entry delay time expiring.

7.3 Remote Annunciation

The system shall be able to provide entry and exit delay time period notification. This notification can be from DMP keypads, remote annunciators, or bell tests.

7.4 Abort Reporting

The system shall be capable of sending an Abort report to the central station if the system is disarmed while the alarm is still sounding. The Abort report shall be sent *after* the alarm report to notify the central station that an authorized user has cancelled the alarm.

7.5 System Testing

The system shall offer testing features that are simple, quick, and complete and provide the highest measure of safety by ensuring that alarm conditions are detected and communicated to the proper authorities in a timely manner and on a regularly scheduled basis.

7.6 Ambush Code

The system shall offer ambush codes for those dangerous encounters where the user is instructed to either arm or disarm the system under threat of harm. The duress code shall disarm the system without giving local indication of an alarm that might put the user well-being in jeopardy.

7.7 Two-Button Panic Feature

The system shall support DMP keypads that provide the option to use only two-button panic codes. The user shall be required to press and hold two designated keys for approximately two seconds before the system generates a panic alarm.

7.8 Fire Verify Zones

The system shall support Fire Verify zones to help the panel verify the existence of an actual fire condition before it sends an alarm report to the central station. The Fire Verify zone shall require the panel to perform a Sensor Reset whenever a device connected to a Fire Verify zone initiates an alarm. This shall begin a verification period during which the panel waits for a second alarm initiation. If the original zone or any other Fire Verify zone on the panel initiates an alarm within the next 120 seconds, the panel shall recognize this as an actual alarm and send an alarm report to the central station.

7.9 Cross-Zoning Protection

The system shall support cross-zoning as a means of requiring two device trips to occur within a short period of time before sounding an alarm and sending an alarm report to the central station. Supported device trips shall be from one device that trips two times, or from two devices that each trip once.

7.10 Swinger Zone Bypassing

The system shall be capable of automatically bypassing a zone if it goes into an alarm or trouble condition a specified number of times within a one-hour period. The panel shall be able to track the number of times the zone trips while armed and compare that against a programmed number. When that number is reached, the panel shall be able to automatically bypass the zone. The panel shall be capable of resetting the zone when the area to which it is assigned disarms, is manually reset from the keypad or remotely, or remains normal for one hour.

7.11 Recently Armed Report

The system shall be capable sending a System Recently Armed report, along with a zone alarm report, to the central station any time an alarm occurs within five minutes of the system arming. The System Recently Armed report allows the central station operator to follow a "call the subscriber first" procedure instead of immediately dispatching the police to what could be a false alarm.

7.12 Transmit Delay

The system shall be capable of programming the panel to wait up to 60 seconds before sending burglary alarm reports to the central station. If an alarm is accidental, the user shall be able to disarm the system within the programmed Transmit Delay time. An Abort report shall be sent in place of an alarm report after the system disarms. During the alarm, sirens and panel relay outputs shall not be delayed and shall still provide local condition annunciation.

7.13 Call Waiting Cancel

The system shall be capable of being programmed to cancel call waiting any time the panel dials the receiver number to send a report.

PART8- PRODUCTS (NOT USED)

PART9- BURGLARY CONTROL SPECIFICATIONS

9.1 Burglary Standards

The Burglary system shall be listed as a Power Limited Device and be listed under the standards in the table below.

Each system shall be supplied with complete details on all installation criteria necessary to meet all of the listings.

9.2 Area System

Burglary Listings

- UL 365 Police Connect Burglar
- UL 609 Local Burglar
- UL 1023 Household Burglar Alarm System Units
- UL 1076 Proprietary Burglar
- UL 1610 Central Station Burglar Alarm Units
- UL 1635 Digital Burglar Alarm Communicator System Units

F. Additional Listings

- NFPA 72 Local Protective Signaling
- NFPA 72 Remote Station Protective Signaling
- NFPA 72 Proprietary Protective Signaling
- A. U.S. Government Standards
- Meets DCID 6/9
- Meets DoD/NIST SCIF Standards

to an area. The system shall have the ability to operate a Common Area application.

- A. The system user shall be capable of selectively arming and disarming any one or more of 32 areas within the intrusion detection system based on the user PIN code and/or keypad used. Each of the 574 zones shall be able to be assigned to any of the 32 available areas. The system shall be capable of having up to a sixteen (16) character length name programmed for each area.
- B. The system user shall be capable of assigning an opening and closing schedule to all areas or to each of the 32 areas separately. Each area shall be able to arm or disarm automatically by a schedule. The system shall have the capacity for common areas that automatically disarm when any other area disarms and that automatically arm when all others areas arm.
- C. The networked system shall have the ability to comply with Bank Safe & Vault application. The networked system shall also have the ability to use a two-man rule for disarming or allowing door access

9.3 Zones

The system shall have a minimum of eight (8) grounded burglary zones available from the control panel.

9.4 Burglary Equipment

Burglary detection equipment shall communicate to the system by way of the control panel loop expansion bus or 900MHz receiver. The detection equipment shall have a three (3) year warranty and meet or exceed features offered in the products listed in Section 9.0 of this document.

PART10- ACCESS CONTROL SPECIFICATIONS – N/A

PART11- COMPILED DETECTION EQUIPMENT LISTING

11.1 Hard-wired

Hard-wired detection equipment shall communicate to the system by way of the control panel loop expansion bus. The equipment shall have a three (3) year warranty as stated in the current DMP Product Catalog and meet or exceed features offered in the following products:

- Motion Detector – equal to #C&K 907(hallways) and #C&K 706(classrooms)
- Door Contact – DMP Model SD70 (concealed applications – requires DMP zone expander)
- Bus Splitter/Repeater Module – DMP Model 710
- Door Contact – DMP Model SM20WG (surface applications – requires DMP zone expander)
- Output Expansion Module - DMP Models 710, 716
- Graphic Annunciator Module - DMP Model 717

11.3 Power Supplies and Transformers

Power supply, transformer, and battery devices shall maintain system operation. The batteries shall be checked and replaced every three to five years. The equipment shall have a three (3) year warranty as stated in the current DMP Product Catalog and meet or exceed features offered in the following products:

- Power Supply – DMP Model 504-24LX, 115 VAC, 24 VDC
- Power Supply – DMP Model 505-12, 115 VAC, 12 VDC
- Power Supply – DMP Model 505-12LX, 115 VAC, 12 VDC
- Power Supply – DMP Model 508, 115 VAC, 12 or 24 VDC
- Transformer - DMP Model 326, 16 VAC 50 VA, Wire-in
- Transformer - DMP Model 327, 16.5 VAC 50 VA, Plug-in
- Transformer - DMP Model 322, 16.5 VAC 56 VA, Wire-in

PART12-INSTALLATION

12.1 System Component Installation

- A. When used in NFPA 72 compliant installations, the Intrusion Detection/ Access Control shall be on an electrical circuit dedicated branch in accordance with the National Electrical Code (NEC) and the local authority having jurisdiction (AHJ). This circuit shall be available only to authorized personnel and shall be clearly labeled “Security Alarm CIRCUIT CONTROL”.
- B. Materials shall be installed in strict compliance with all local, state, county, province, district, federal and other applicable building, safety, and fire standards, laws, codes, regulations, and guidelines including, but not limited to, all appendices and amendments and the requirements of the local authority having jurisdiction (AHJ).
- C. All wiring from all devices shall be non-spliced home runs.
- D. All cables shall be plenum rated.
- E. All conductors from expanders shall be home runs to control panel separately and shall be non spliced.
- F. All conductors terminating at zone splice box shall be identified as per detail device labeling.
- G. All zone splice boxes shall be located per owner’s preference.
- H. All 120vac shall be provided by contractor to all power supply and panel locations shown or not shown on plans.
- I. Install siren in each inside hallway and one outdoor (weather proof).
- J. Zone expanders and power supplies shall be installed in each electrical room.

END OF SECTION

SECTION 28 46 21.11- ADDRESSABLE FIRE ALARM SYSTEMS

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- A. The General Provisions, Supplemental General Provisions, Special Provisions and Specification Sections apply to Work covered by this Section.
- B. Comply with applicable sections in division 26. Refer to other Sections for coordination of the Work.

1.2 SCOPE OF WORK

- A. Provide labor, materials, equipment, tools and services, and perform operations required for, and reasonably incidental to, the providing additional and new devices for new building.
 - 1. Fire alarm control panel
 - 2. Remote Annunciator
 - 3. Addressable or conventional manual fire alarm stations.
 - 4. Addressable analog and conventional area smoke detectors.
 - 5. Conventional beam detectors.
 - 6. Addressable analog and conventional duct smoke detectors.
 - 7. Addressable analog and conventional heat detectors.
 - 8. Sprinkler water flow alarm switches.
 - 9. Audible notification appliances; bells, horns, chimes.
 - 10. Visual notification appliances; strobes.
 - 11. Central station alarm connection control.
 - 12. Air handling systems shutdown control.
 - 13. Magnetic door holder release.
 - 14. Dry pipe sprinkler release valve/deluge valve control.
 - 15. Sprinkler supervisory switches and tamper switch supervision.
 - 16. Dry pipe sprinkler release valve/deluge valve supervision.
 - 17. Battery standby.
 - 18. System shall activate the overhead gates. Provide all accessories for an active system.

1.3 SUBMITTALS

- A. Submit product data and shop drawings in accordance with other Sections for products specified under PART 2 - PRODUCTS. Shop drawings shall be generated by the Fire Alarm Contractor without the Engineers plans.
- B. The submittal data shall include, but not necessarily be limited to, the following:
 - 1. Complete bill of material indicating quantity, part numbers and brief description.
 - 2. Data sheets for all products. If multiple models are shown on the same data sheet, highlight the specific model used.
 - 3. Provide drawing with all devices.

1.4 REFERENCE STANDARDS

- A. The fire alarm system devices specified herein shall be designed, manufactured, installed and tested according to the latest version of the following standards:

1 National Fire Protection Association Standards

- 1. NFPA 70 - National Electric Code (NEC), Articles 725 & 760.
- 2. NFPA 71 - Central Station Signaling Systems
- 3. NFPA 72 - National Fire Alarm Code (NFAC)
- 4. NFPA 92A - Smoke Control Systems
- 5. NFPA 101 - Life Safety Code
- 6. Underwriters Laboratories, Inc.
- 7. UL 38 - Manually Activated Signaling Boxes
- 8. UL 228 - Door Holders for Fire Protective Signaling Systems
- 9. UL 268 - Smoke Detectors for Fire Protective Signaling Systems
- 10. UL268A - Smoke Detectors for Duct Applications
- 11. UL 346 - Waterflow Indicators for Fire Protective Signaling Systems
- 12. UL 464 - Audible Signaling Appliances
- 13. UL 864/UOJZ/APOU - Control Units for Fire Protective Signaling Systems
- 14. UL 1481 - Power Supplies for Fire Protective Signaling Systems
- 15. UL 1638 - Visual Signaling Appliances

- 16. UL 1711 - Amplifiers for Fire Protective Signaling Systems
- 17. UL 1971 - Standard for Fire Protective Signaling Systems
- 18. Americans with Disabilities Act (ADA)
- 19. Local and State Building Codes
- 20. Local Authorities Having Jurisdiction (LAHJ)

1.5 QUALITY ASSURANCE

- A. The fire alarm system devices shall be listed and labeled by Underwriters Laboratories, Inc. for use in fire protective signaling system.
- B. The Installing Contractor shall be factory authorized and trained and shall be NICET certified in the sub-field of Fire Alarm Systems, for the engineering and technical installation and supervision of the system. This certification shall be Level III for engineering and Level II for technical installation and supervision. Proof of certification shall be provided. All work shall be performed by skilled technicians, under the supervision and direction of the designated NICET engineering technician, all of whom shall be properly trained and qualified for the work.
- C. The fire alarm contractor shall not sub out portion of the work. The fire alarm shall be responsible to complete the job.
- D. Submission to Authority Having Jurisdiction: Submit copies of State Certificate as required by State Fire Marshall. Provide copy with operating and maintenance manual.

1.6 QUALIFICATIONS

- 1. The fire alarm contractor, as a business entity, shall be an authorized and designated representative of the equipment manufacturer and shall have been actively engaged in the business of selling, installation and servicing fire alarm systems for a period of at least (5) years prior to the bid date.
- 2. The fire alarm contractor shall have an office within the Rio Grande Valley with trained technicians who are qualified to manage the installation, to be responsible that the system is installed as submitted, to conduct system start-up, to instruct the project coordinators representatives and local authorities in the proper operation of the system, and to provide service throughout the warranty period. 3. The fire alarm contractor SHALL NOT HAVE any grievances or complaints on record regarding workmanship, code compliance, or service response with either the project coordinator, Architect, Engineer, Owner or the State Fire Marshals office. A contractor that has any prior finding(s) of a Fire Alarm license violation or has any litigation in process with the State Fire Marshal is unacceptable.
- 3. The fire alarm contractor shall be an active installer on the approved manufacturer for a minimum of 5 years.

1.7 WARRANTY

- 1. Warranty of all control equipment, sensors, I/O modules and all other peripherals and of materials, installation and workmanship shall be for one (1) year from date of acceptance.
- 2. The Contractor shall guarantee all wiring and raceways to be free from inherent mechanical or electrical defects for one (1) year from date of final acceptance.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Silent Knight

2.2 CIRCUITING GUIDELINES

- B. Each addressable analog loop shall be circuited as shown on the drawings but device loading in not to exceed 80% of loop capacity in order to leave for space for future devices. The loop shall have Class A operation. When it is necessary to interface conventional initiating devices provide intelligent input modules to supervise Class A zone wiring. The audio system components shall be an integral part of the fire alarm system control panel.
- C. Audio Amplifiers
 - 1. Each audio power amplifier shall have integral audio signal de-multiplexers, allowing the amplifier to select any digitized audio channels. The channel selection shall be directed by the system software. Multiple and different audio signals shall be able to be broadcast simultaneously from the same system network node.
 - 2. Each amplifier output shall include a dedicated, supervised speaker circuit which is suitable for connection of emergency speaker appliances. Each amplifier shall also include a notification appliance circuit for connection of visual (strobe) appliances. This circuit shall be fully programmable and it shall be possible to define the circuit for the support of audible, visible, or ancillary devices.
 - 3. Standby audio amplifiers shall be provided that automatically sense the failure of a primary amplifier, and automatically program themselves to select and de-multiplex the same audio information channel of the failed primary amplifier, and fully replace the function of the failed amplifier.
 - 4. In the event of a total loss of audio data communications, all amplifiers will default to the local "EVAC" tone generator channel. If the local panel has an alarm condition, then all amplifiers will sound the EVAC signal on their connected speaker circuits.

5. In the event of a loss of the fully digitized, multiplexed audio riser, the audio amplifiers shall automatically default to an internally generated alarm tone.
6. Audio amplifiers shall automatically detect a short circuit condition on the connected speaker circuit wiring, and shall inhibit itself from driving into that short circuit condition.

2.3 DETECTORS

D. General

1. Detectors shall be capable of full digital communications using both broadcast and polling protocol. Each detector shall be capable of performing independent fire detection algorithms. The fire detection algorithm shall measure sensor signal dimensions, time patterns and combine different fire parameters to increase reliability and distinguish real fire conditions from unwanted deceptive nuisance alarms. Signal patterns that are not typical of fires shall be eliminated by digital filters.
2. Detectors shall have an integral microprocessor capable of making alarm decisions based on fire parameter information stored in the detector head. Distributed intelligence shall improve response time by decreasing the data flow between detector and loop controller. Detectors not capable of making independent alarm decisions shall not be acceptable. Maximum total loop response time for detectors shall be 0.5 seconds.
3. Detectors shall have a separate means of displaying communication and alarm status. A green LED shall flash to confirm communication with the loop controller. A red LED shall flash to display alarm status. Both LEDs on steady shall indicate alarm-standalone mode status. Both LEDs shall be visible through a full 360 degree viewing angle.
4. Detectors shall be capable of identifying diagnostic codes to be used for system maintenance. The diagnostic codes shall be stored at the detector.
5. Detectors shall be capable of transmitting pre-alarm and alarm signals in addition to the normal, trouble and need cleaning information. It shall be possible to program control panel activity to each level. Each detector shall be individually programmable to operate at various sensibility settings.
6. The detector microprocessor shall contain an environmental compensation algorithm which identifies and sets ambient "environmental thresholds." The microprocessor shall continually monitor the environmental impact of temperature, humidity, other contaminates as well as detector aging. The process shall employ digital compensation to adapt the detector to both long term and short term environmental changes. The microprocessor shall monitor the environmental compensation value and alert the system operator when the detector approaches the allowable environmental compensation value. Differential sensing algorithms shall maintain a constant differential between selected detector sensitivity and the "learned" base line sensitivity. The base line sensitivity information shall be permanently stored at the detector.
7. The detector and loop controller shall provide increased reliability and inherent survivability through intelligent conventional operation. The device shall automatically change to stand alone, conventional device operation in the event of a loop controller polling communications failure. In the standalone detector mode, the detector shall continue to operate using sensitivity and environmental compensation information, stored in its microprocessor at the time of communications failure. The loop controller shall monitor the loop and activate a loop alarm if a detector reaches its alarm sensitivity threshold.
8. Detectors shall be capable of automatic electronic addressing and/or custom addressing. Devices using DIP or rotary switches for addressing, either in the base or on the detector shall not be acceptable.
9. Detectors shall be suitable for operation in the following environment:
 1. Temperature: 32°F to 120°F
 2. Humidity: 0-93% RH, non-condensing
 3. Elevation: Up to 6,000 ft.
10. Photoelectric Smoke Detectors
 - ii. Addressable intelligent photoelectric smoke detectors shall be provided as indicated on the Drawings. The detector shall use a light scattering type photo electric smoke sensor to sense changes in air samples from its surroundings. An integral microprocessor shall dynamically examine values from the sensor and initiate an alarm based on the analysis of data. The detector shall utilize digital filters to remove signal patterns that are not typical of fires. Each detector shall have twin red/green status LEDs. The red LED shall indicate alarm condition and green LED shall indicate normal.
 - iii. The detector shall continually monitor any changes in sensitivity due to the environmental affects of dirt, smoke, temperature and humidity. The information shall be stored in the integral processor and transferred to the loop controller.
 - iv. Detector shall be programmable for different sensitivity during day and night periods.
 - v. The detector shall be suitable for direct insertion into air ducts up to 3 ft. high and 3 ft. wide with air velocities up to 5,000 ft/min.
 - vi. The detector shall be rated for ceiling installation at a minimum of 30 foot centers.

- vii. The percent smoke obscuration per foot alarm setpoint for the detector shall be field selectable to various sensitive settings ranging from 1.0% to 3.5%.
- b. Detector Mounting Bases
 - i. Detector mounting bases shall be suitable for mounting on a standard 4" square electrical outlet box. The base shall contain no electronics, support all detector types and have the following minimum requirements:
 - 1. Removal of the respective detector shall not affect communications with other detectors.
 - 2. Terminal connections shall be made on the room side of the base. Bases which must be removed to gain access to the terminals shall not be acceptable.
 - 3. Capable of supporting a remote LED indicator and test station. Provide remote LED indicators and test stations as indicated on the Drawings.
 - c. Detector Mounting Plates
 - i. Provide detector mounting plate assemblies to facilitate mounting detectors for direct insertion into low velocity ductwork. The mounting plate shall be code gauge steel with corrosion resistant red enamel finish.
 - d. Duct Smoke Detectors
 - i. Air duct mounted smoke detectors shall be provided in the air supply stream of all central air handling equipment above 2000 cfm, i.e. Provide all necessary interface wiring for proper system operation.
 - ii. The duct smoke detector shall be UL listed per UL 268A specifically for use in air handling systems. The detector shall operate at velocities of 300-4000 ft./min. The detector housing shall be equipped with an integral mounting base. It shall be capable of local testing via magnetic switch or remote testing using a remote test station. The duct detector housing shall incorporate an airtight smoke chamber in compliance with UL 268A. The housing shall be capable of mounting to either rectangular or round ducts without adaptor brackets. An integral filter system shall be included to reduce dust and residue effects on detector housing, thereby reducing maintenance and servicing. Sampling tubes shall be easily installed after the housing is mounted to the duct by passing through the duct housing. The housing shall have a red enamel finish.
 - iii. For each duct smoke detector provide a remote LED indicator and test station to be mounted in a location indicated on the Drawings and approved by the local authority having jurisdiction.
 - iv. F. Beam Type Smoke Detectors
 - 1. Provide projected beam type smoke detectors. Then beam detectors shall be four wire 24 Vdc and powered from the control panel 4 wire smoke power source. This unit shall consist of a separate transmitter and receiver capable of being powered separately or together. This unit shall operate in either a short range of 30 to 100 ft. (9.14 to 30.4m) or a long range of 100 to 300 ft. (30.4 to 91.4m). The detector shall feature a bank of four alignment LEDs on both the receiver and transmitter that are used to ensure proper alignment without the use of special tools. The beam detector shall feature automatic gain control which will compensate for gradual signal deterioration from dirt accumulation on lenses. Ceiling or mount as shown on the plans. Testing shall be carried out using calibrated test filters. Provide an activated remote test station>.
- b) SYSTEM MODULES
 - a. Addressable intelligent modules shall support supervised Class A circuits. The modules shall be multi-function capable of field programming. The modules shall have a minimum of 2 diagnostic LEDs mounted behind a finished cover plate. A green LED shall flash to confirm communication with the loop controller. A red LED shall flash to display alarm status. The module shall be capable of storing diagnostic codes which can be retrieved for troubleshooting assistance. Input and output circuit wiring shall be supervised for open and ground faults. The module shall be suitable for operation in the following environment:
 - i. Temperature: 32°F to 120°F (0°C to 49°C)
 - ii. Humidity: 0-93% RH, non-condensing
 - b. Single Input Module
 - i. Addressable intelligent single input modules shall be provided as required for the system configuration. The single input module shall provide one (1) supervised Class A input circuit. The module shall be suitable for mounting on 4" square electrical box. The single input module shall support the following input circuit types:
 - 1. Normally-Open Alarm Latching (Manual Stations, Smoke Detectors, etc.)
 - 2. Normally-Open Alarm Delayed Latching (Waterflow Switches)
 - 3. Normally-Open Active Non-Latching (Monitors, Fans, Dampers, Doors, etc.)
 - 4. Normally-Open Active Latching (Supervisory, Tamper Switches)
 - c. Dual Input Module
 - 1. Addressable intelligent dual input modules shall be provided as required for the system configuration. The dual input module shall provide two (2) supervised CLASS A input circuits. The module shall be suitable for mounting on a standard 4" square electrical box. The dual input module shall support the following input circuit types:
 - 2. Normally-Open Alarm Latching (Manual Stations, Smoke Detectors, etc.)

3. Normally-Open Alarm Delayed Latching (Waterflow Switches)
4. Normally-Open Active Non-Latching (Monitors, Fans, Dampers, Doors, etc.)
5. Normally-Open Active Latching (Supervisory, Tamper Switches)
- d. Monitor Module
 1. Addressable intelligent monitor modules shall be provided as required for the system configuration. The monitor module shall support one (1) supervised Class A normally-open active non-latching monitor circuit. The monitor module shall be suitable for mounting on a standard 4" square electrical box.
- e. Waterflow/Tamper Module
 1. Addressable intelligent waterflow/tamper modules shall be provided as required for the system configuration. The waterflow/tamper module shall support two (2) supervised Class A input circuits. Channel A shall support a normally-open alarm delayed latching waterflow switch circuit. Channel B shall support a normally-open active latching tamper switch. The waterflow/tamper module shall be suitable for mounting on a standard 4" square electrical box.
- f. Single Input Signal Module
 1. Addressable intelligent single input signal modules shall be provided as required for the system configuration. The single input signal module shall provide one (1) supervised Class A output circuit capable of supporting the operation of an audible/ visual signal power selector and a telephone power selector with ring tone for fire fighter's telephone. The module shall be suitable for mounting on a standard 4" square electrical box.
- g. Dual Input Signal Module
 1. Addressable intelligent dual input signal modules shall be provided as required for the system configuration. The dual input signal module shall provide a means to selectively connect one of two (2) signaling circuits to one (1) supervised output circuit. The dual input signal modules shall be capable of supporting the operation of an audible/visual signal power selector. The module shall be suitable for mounting on a standard 4" square electrical box.
- h. Control Relay Module
 1. Addressable intelligent control relay modules shall be provided as required for the system configuration. The control relay module shall provide one form "C" dry relay contact rated at 2 amps @ 24 Vdc to control external appliances or equipment shutdown. The control relay shall be rated for pilot duty and releasing systems. The position of the relay contact shall be confirmed by the system firmware. The control relay module shall be suitable for mounting on a standard 4" square electrical box.
- i. Universal Class A Module
 1. Addressable intelligent class A modules shall be provided as required for the system configuration. The universal class A module shall be capable of numerous operations. The module shall be suitable for mounting on a standard 4" square electrical box. The universal class A module shall support the following circuit types:
 1. Two (2) supervised Class A Normally-Open Alarm Latching.
 2. Two (2) supervised Class A Normally-Open Alarm Delayed Latching.
 3. Two (2) supervised Class A Normally-Open Active Non-Latching.
 4. Two (2) supervised Class A Normally-Open Active Latching.
 5. One (1) form "C" dry relay contact rated at 2 amps @ 24 Vdc.
 6. One (1) supervised Class A Normally-Open Alarm Latching.
 7. One (1) supervised Class A Normally-Open Alarm Delayed Latching.
 8. One (1) supervised Class A Normally-Open Active Non-Latching.
 9. One (1) supervised Class A Normally-Open Active Latching.
 10. One (1) supervised Class A 2-wire Smoke Alarm Non-Verified.
 11. One (1) supervised Class A 2-wire Smoke Alarm Non-Verified.
 12. One (1) supervised Class A 2-wire Smoke Alarm Verified
 13. One (1) supervised Class A 2-wire Smoke Alarm Verified
 14. One (1) supervised Class A Signal Circuit, 24Vdc @ 2A.
 15. One (1) supervised Class A Signal Circuit, 24Vdc @ 2A.
- c) MANUAL PULL STATIONS
 - a. Addressable intelligent dual action, non-break glass type, key reset, semi-flush mounted manual pull stations shall be provided as indicated on the Drawings. The stations shall be of Lexan construction, finished in red with white molded raised letters "PULL IN CASE OF FIRE". The station shall be suitable for mounting on a standard 4" square electrical box. The station shall have a minimum of 2 diagnostic LEDs mounted on their integral, factory assembled single or two stage input module. A green LED shall flash to confirm

communication with the loop controller. A red LED shall flash to display alarm status. The station shall be capable of storing diagnostic codes which can be retrieved for troubleshooting assistance. Input circuit wiring shall be supervised for open and ground faults. The fire alarm pull station shall be suitable for operation in the following environment:

- i. Temperature: 32°F to 120°F (0°C to 49°C)
- ii. Humidity: 0-93% RH, non-condensing

d) NOTIFICATION APPLIANCES

a. General

- i. All appliances shall be UL listed for Fire Protective Service. All audible appliances, visual appliances and combination audible/visual appliances shall be capable of providing the equivalent facilitation which is allowed under the Americans with Disabilities Act Accesabilities Guidelines (ADA/AG), and shall be UL 1971, and ULC S526 listed.
- b. Audible Only Notification Appliances
 - i. Audible appliances shall be a mylar cone type speaker. Paper type cones are not acceptable. The rear of the speaker shall be completely sealed protecting the cone during and after installation. Speakers shall provide power taps at 1/4w, 1/2w, 1w, and 2w. Speakers shall provide UL confirmed 90 dBA sound output at 2w.
 - ii. Audible appliances shall be provided with in/out wiring terminals.
 - iii. Audible appliances shall be flush for ceiling mounted and flush/semi-flush for wall mounted as indicated on the Drawings. They shall have a white faceplate for ceiling mounting and red faceplate for wall mounting. They shall mount to a standard 4" square electrical box.
- c. Visual Only Notification Appliances
 - i. Visual appliances shall be a self-synchronized strobe. The strobe flashtube shall be enclosed in a rugged lexan lens with solid state circuitry. The strobe shall provide 15, 15/75, 30, 60 and 110 candela synchronized flash outputs. The strobe intensity selection shall be based on the installed location within the building.
 - ii. Visual appliances shall be provided with in/out field wiring terminals.
 - iii. Visual appliances shall have lens markings oriented for wall mounting where indicated on the Drawings. They shall have a red faceplate for flush/semi-flush wall mounting. They shall mount to a standard 4" square electrical outlet box.
- d. Combination Audible/Visual Notification Appliances
 - i. Combination appliances shall be a combination of the audible and visual appliances specified previously. They shall have a red faceplate for flush/semi-flush wall mounting.
 - ii. The majority, if not all, of the notification appliances shall be combination devices such that the visual and audible requirements of ADA shall be complied with. Visual notification appliances shall be located in all areas of common use, i.e. lobbies, hallways, restrooms, meeting/conference/assembly areas, break rooms, copy/fax/mail rooms, etc. Audible notification appliances shall produce a sound that exceeds the prevailing equivalent sound level in the room or space by at least 15dba or exceeds any maximum sound level with a duration of 60 seconds by 5dba, whichever is louder. Sound levels for alarm signals shall not exceed 120 dbA. It is the intent of the Drawings to show all devices that are required. The fire alarm system vendor/bidder shall provide all appliances shown and/or required by these specifications but it others are anticipated to be required the vendor/bidder shall qualify the provisions for the system making note of the additional cost for the anticipated additional requirements.

e) ANCILLARY DEVICES

a. Remote Relays

i. Multi-Voltage Control Relays

- 1. Remote control relays shall be provided as required for the system configuration for connection to supervised ancillary circuits for control of fans, dampers, door releases, etc. Relay contact ratings shall be SPDT or DPDT, as required, and rated for 10 amperes at 115 Vac. A single relay may be energized from a voltage source of 12 Vdc, 12 Vac, 24 Vdc, 24 Vac, 115 Vac, or 230 Vac, as required. A red LED shall indicate the relay is energized. A metal enclosure shall be provided.

ii. Manual Override Control Relays

- 1. Remote control relays with a manual override shall be provided as required for the system configuration for connection to supervised ancillary circuits for control of fans, dampers, door releases, etc. Relay contact ratings shall be SPDT and rated for 10 amperes at 115 Vac or 24 Vdc. A single relay may be energized from a voltage source of 24 Vdc or 24 Vac. A red LED shall indicate the relay is energized.

iii. Heavy Duty Power Relays

- 1. Remote control relays shall be provided as required for the system configuration for connection to supervised ancillary circuits for control of fans, dampers, door releases, etc. Relay contact ratings shall be DPDT and rated for 30 amperes at 300 Vac or 2 HP motor load. A single relay may be energized

from a voltage source of 24 Vac, 115 Vac, as required. A metal enclosure shall be provided.

- f) **ELECTROMAGNETIC DOOR HOLDERS**
 - a. Provide single or double door, floor or wall mounted electromagnetic door holder/release devices as indicated on the Drawings. The devices shall be rated for 24V ac/dc input. The devices shall be brushed zinc finished.
- g) **FIRE ALARM CABLE**
 - a. The fire alarm cable shall plenum rated and be UL listed and suitable for use as power limited fire protective signaling circuit cable in accordance with National Electric Code Article 760 (Fire Alarm Systems) and Article 725 (Class 1, Class 2 and Class 3 - Remote Control, Signaling and Power-Limited Circuits).
 - b. Cable Construction
 - i. Conductors shall be solid, soft annealed, uncoated copper.
 - ii. Insulation shall be 300 volt, 105°C polyvinylchloride.
 - iii. Two conductor, non-shielded cables shall be parallel; shielded and three or more conductors shall be cabled round.
 - iv. Shielding shall be mylar backed aluminum foil, helically wrapped to provide 100% coverage. A suitable copper drain wire shall be provided with shielded cables.
 - v. Jacket shall be red, 105°C polyvinylchloride, rated 300 volt.
 - vi. Cable shall be plenum rated when installed in air handling plenums.
 - c. In general, non-shielded cable is acceptable for use throughout except on voice circuits. All voice circuits shall utilize shielded, twisted pair cable.

PART 3 - EXECUTION

3.1 APPROVALS

- A. Complete fire alarm system drawings shall be issued to the Local Authority Having Jurisdiction for approval prior to the installation of the fire alarm system.

3.2 INSTALLATION

- A. Installation of the Fire Alarm System shall be in strict compliance with manufacturers recommendations. The entire system shall be installed in accordance with approved manufacturers manuals and wiring diagrams and as approved by the Local Authority Having Jurisdiction.
- B. Fire alarm cable shall be installed in conduit in areas of exposed structure and within inaccessible ceilings. Conduit shall also be provided from outlet boxes within walls stubbed up to accessible ceilings. Provide end bushings on conduit stub-ups. Cable only is acceptable in accessible ceilings.
- C. All conduit, wiring, outlet boxes, junction boxes, cabinets and similar devices necessary for the complete installation shall be included as part of the system. All junction box blank coverplates shall be labeled with a red "F.A." for identification purposes.
- D. All wiring shall be color coded throughout.
- E. The system shall be installed and fully tested under the supervision of trained manufacturer's representatives. The system shall be demonstrated to perform all the functions as specified.

END OF SECTION