Additional Supplemental General Conditions Required for Aviation Department Projects

1) The use of explosives is strictly prohibited on airports.

2) The Contractor will be responsible for construction staking except for verifying and making benchmarks for horizontal and vertical control.

3) Survey Layout:

The Contractor shall employ an experienced and competent surveyor, registered in the State of Texas, to lay out the detail lines and grades of the work from the horizontal and vertical control established in those contract documents. A closed traverse and level loop within a close proximity of the construction will be provided by the surveyor to the Contractor. A copy of such work will be presented to the Architect/Engineer for review prior to any field layout by the Contractor.

4) This contract shall be a calendar day contract.

5) Extension of Time for Adverse Weather:

Extension of time for adverse weather conditions not reasonably anticipated as provided in Subparagraph 8.3.1 will be granted for those days where precipitation is 0.10 inch or greater and where the number of such days exceed the normal number of rain days in that particular month. This provision shall cease at the time of Substantial Completion. The determination of the normal number of rain days per month shall be according to Local Climatological Data prepared by the National Oceanic and Atmospheric Administration.

For the San Antonio area, the climatological data is recorded at the airport weather station. The Contractor may expect adverse weather for the number of calendar days in accordance with the following local climatological data prepared by NOAA.

	0.10 In. or More Precipitation at San Antonio Airport
January	2
February	4
March	2
April	4
May	4
June	3
July	3
August	3
September	5
October	6
November	3
December	3
Total Days Lost	42

The contractor agrees that the measure of adverse weather during the period covered by the Specification shall be the number of days in excess of those shown for each month.

6) Aviation Department may close the construction site due to security reasons. The contractor will not be compensated for any loss due to shut down for the first three closures. Each day shall be counted as one shut down regardless of the total hours involved for each day.

7) Contractor shall provide, prepare and distribute agendas and minutes for all construction progress meetings and/or coordination meetings.

8) Staging Area and Storage Area:

A) The contractor needs to maintain areas in a clean and neat condition.

B) If the contractor and/or their subcontractors store equipment, fuel, paint, or other hazardous material at the staging areas, and/or storage areas, the contractor will perform and pay the costs for soil and water testing before use of the site, upon exit from the site and any site remediation that may be necessary, as directed by the owner.

C) Prior to occupying and upon vacating any staging areas and/or storage areas, the contractor shall submit to the owner a minimum of 10 photographs documenting the initial and final conditions of the staging areas and/or storage areas. Each photograph must have a date. During the construction, the contractor needs to provide 5 progress photographs for each area with each payment request.

D) The contractor shall provide two weeks written notice to the owner prior to vacating the staging areas and/or storage areas.

E) The policies stated here will be applied to the areas owned by the private citizens and leased by the contractor for the project involved.

SPECIAL CONDITIONS FOR CONSTRUCTION WITHIN THE AIR OPERATIONS AREA AT SAN ANTONIO INTERNATIONAL AIRPORT

San Antonio International Airport maintains operations 24 hours a day, 365 days per year for General Aviation and Air Carrier Service. Safety, Security and Operations will take precedence over all construction activities within the Airport Property. As such, all construction activity shall be conducted in accordance with the stipulations outlined below:

SECURITY

FINES

Any fines assessed to the Aviation Department due to the contractor's violations of any security requirements will be passed on to the contractor.

BADGING

Personnel working within the AOA must display current Airport issued identification at all times. The contractor shall be responsible for providing the necessary background checks for these personnel as well as maintaining personnel files for the project duration. These files are subject to FAA, TSA and Airport Security review. Subsequent to the pre-construction meeting, the contractor must arrange for all badged personnel to attend the SIDA class. Not all personnel must be badged.

It is permissible to have one (1) red-badge (with "E") personnel to escort and be responsible for up to two (2) unbadged persons. All unescorted equipment operators and drivers must be badged. SIDA classes are coordinated through Airport Security and take approximately two (2) hours. All badges remain the property of the Aviation Department and must be returned at the completion of the contract.

CONSTRUCTION ACCESS

The contractor will be issued ingress/egress into the AOA at a point designated by the Aviation Department, Airport Security. This point will be as close and practicable to the marshalling area as possible. The contractor will be required to enter into a security amendment, which shall be issued and kept, on file with Airport Security. It will be the contractor's responsibility to maintain security at all times during the duration of the contract. The access will be locked at all times while unattended and shall be manned by approved badged personnel only. It includes the access to the borrow site, the batch plant site, the storage site and/or the fill area.

OPERATIONS

Aviation Department, Planning and Development Section (P&D) is charged with the responsibility of overseeing construction projects within the airport property, including the proper execution of all facets of the construction activities and compliance with applicable Federal

Regulations. The Aviation Operations Section is responsible for the safety and efficiency of the airport operation through daily operation management. The contractor shall comply with all directives issued by Aviation P&D and Operations Section in a timely manner.

VEHICULAR OPERATIONS

Not all badged personnel need to have an airfield driver license. If the badge personnel need to drive in the airport operations area (AOA), he/she must attend the required driving course sponsored by Airport Operations and takes approximately four (4) hours to complete. No vehicles may be operated within the Air Operations Area (AOA) until the drivers successfully pass the driving course and satisfactory Insurance Certificates are on file with the office of Planning & Development. Upon course completion, the individual will be required to demonstrate knowledge of rules, regulations, and procedures governing their behavior while in movement area via written and practical examinations.

All vehicular movement areas used by the contractor will be subject to the approval of the Aviation Department. All airfield drivers who are found in violation of the Airfield Driver's Training guidelines or the Airport Rules and Regulations will be issued a written citation and will be subject to possible revocation and termination of AOA driving privileges.

All construction vehicles/mechanized equipment operating on Airport property needs to have a 12" company logos or 6" letters identifying the company, displayed on both doors. All construction vehicles and mechanized equipment authorized within the airfield Movement area, ramps or related safety areas shall also need to have one FAA approved flag located on the uppermost portion of the vehicle/ mechanized equipment or is escorted by a vehicle so equipped. The FAA approved flag is a 3'*3' orange and white checkered flag with each box being 1' square.

During the periods of low visibility or evening, the contractor shall follow Advisory Circular 150/5210-5c, Painting, Marking, and Lighting of Vehicles Used on an Airport to provide identification lighting devices on vehicles and construction equipment while working in the airport operations area (AOA).

During the night time hours, all equipment operating on the airport exceeding 15 feet in height shall be lit with a red obstruction light in accordance with Advisory Circular 70/7460-1, Obstruction Marking and Lighting. The light is to be located on the uppermost portion of the equipment.

ESCORT

Any vehicle operated by personnel authorized to drive and to escort (red-badge with "E") within the AOA can only escort two vehicles and equipment being operated by personnel without having successfully completed the driving course. The escorted vehicles must be behind and proximate to the vehicle at all times while within the AOA including departing through the construction access. All escorted vehicles must have a 12" company logo each on the driver door and passenger door. Should the need arise to enter or cross an active runway, the escort must be done by personnel from Airport Operations and coordinated through Airport Operations.

BARRICADES

All construction areas shall be properly barricaded, signed and marked as directed by the Aviation Department in accordance with the barricade markings shown on the drawings. Barricades shall be properly secured as necessary to prevent overturning or displacement from wind or jet blast and shall be illuminated. Refer to FAA Advisory Circular 150/5340-1K "Standards for Airport Markings" for FAA lighting and marking standards on airport runways, taxiways and aprons and FAA AC 150/5370-2E "Operational Safety on Airports during Construction" for aviation safety during construction. Excavated areas shall not be left unattended unless appropriate barricades are provided. The contractor shall have a designated contact person with a telephone number on file with the Airport Operations who shall be on call 24 hours a day in order to maintain the barricades. Location and placement shall be adjusted as necessitated by changes in construction progress.

Safety netting shall be installed in locations as shown on the drawings or as directed by the Resident Engineer on the field. Netting shall be installed prior to the start of construction and shall be maintained for the duration of the project. Adjustments in location shall be made as directed by the Aviation Department.

Should the contractor fail to maintain barricades, barriers, signage and/or erosion control devices and Aviation Department Personnel are required to perform corrective action, the contractor will be charged for this service.

COMMUNICATION:

In order to maintain constant communication with the air traffic control tower, the contractor shall furnish and maintain in good operating condition, at least one two-way portable VHF radio having a frequency of 121.9 MHZ to aid in the control of vehicles on the airfield.

Operators of any radio equipped vehicles on Movement areas must be trained and familiar with airport radio procedures prior to operating on movement and safety areas.

Vehicle operators must obtain ATCT clearance before entering/operating on Movement area. If working in the Movement area and runways/taxiways safety areas, the contractor must continuously monitor radio. Vehicles, equipment and pedestrians will not be allowed into any taxiway/runway safety area while aircraft operations are being conducted.

ACCIDENT REPORT:

Contractor must immediately report in writing to the Airport Communication Center (207-3433) for all accidents in connection with the performance of work, whether on or adjacent to the site. He also needs to send a copy of the report to SAIA Planning and Development Division.

STORAGE & MARSHALLING AREAS

EXCESS MATERIAL

All material removed from the construction site, which is not to be used in the final construction shall be removed from the Airport Property and disposed of in a legal manner. No excess material shall be disposed of on Airport Property unless prior written approval from the Aviation Department is issued.

CONSTRUCTION MATERIALS

Construction materials not for immediate use shall be stockpiled at the Designated Marshalling Area. Other materials may be stored at approved locations proximate to the work area provided however that the piles are no greater than 18" in height. Higher piles may be permitted only during working hours and in such quantity that they may be reduced in height to 18" maximum within thirty (30) minutes of notification.

EQUIPMENT

All equipment shall be stored at the designated storage areas during non-working times. The Aviation Department may grant special provisions for equipment, which is not readily movable to store elsewhere upon approval.

NAVIGATIONAL EQUIPMENT

TESTING

The FAA maintains various forms of navigational equipment and appurtenances throughout the airport. There may be times during construction where tests and/or equipment checks must be run to maintain serviceability. The contractor shall comply with all requests and directives during the prosecution of the tests. Timely notification of such tests cannot be guaranteed.

CABLES

The Aviation Department and the FAA communication cables, navigational cables, monitor cables and power cables traverse the construction area. Every effort has been made to identify and properly depict the locations of all cables on the drawings. It is the contractor's responsibility to contact the Aviation Department at 207-3519, one week in advance of any construction in order for the cables within the construction area to be properly located and identified by Aviation Dept. and FAA San Antonio office.

The contractor shall identify the location and alignment of these cables along and throughout the entire project area using orange safety netting. Gaps to facilitate vehicular crossings will be permitted as required. These crossings shall be protected using 1½" thick by 8' long steel plates placed along the full width of each crossing. No construction shall commence prior to identifying the cables and placing the required steel plates.

Should the contractor encounter cables not identified on the drawings or field located or cut or otherwise damage any cable, he shall immediately cease operation in the area and notify the Aviation Department at 207-3519, in order for the FAA to identify the cable.

Unless directed otherwise, cut or damaged cables shall be replaced between the existing pull boxes (typically 2,000' (ft. apart). An FAA certified splicer shall perform all splicing. After all splices are completed, the cables shall be tested for continuity and meggered by the contractor.

Installation of FAA underground cables to be done in accordance with FAA-C-1391b, Installation and Splicing of Underground Cables.

LIGHTING SYSTEMS

The Aviation Department and the FAA maintain the various forms of lighting systems throughout the airport. All portions of these systems shall be properly located and identified prior to the start of construction. The contractor is to contact the Aviation Department at 207-3519, one week in advance of any construction in order that these systems may be properly identified. All electrical work shall be coordinated through the Aviation Department to insure circuit outages are avoided and that the appropriate circuits are properly tagged out. Where directed, the contractor shall provide the necessary safety netting and vehicular crossings as outlined in the section entitled **Cables**.

Any circuit damaged by the contractor shall be repaired at the sole expense of the contractor. Splices will not be allowed. All repairs shall be made from existing splice to existing splice complete with new conduit. Should the contractor have no electricians available to complete the repair, the Aviation Department electricians will complete the repairs and the contractor will be charged for this service.

All labor, materials, tools, cables and connectors necessary to provide temporary circuits as required shall be provided by the contractor.

December 7, 2011

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ATTACHMENT A

PROCEDURES FOR OBTAINING AIRPORT PERSONNEL IDENTIFICATION BADGE AND AIRFIELD DRIVER'S LICENSE AT SAN ANTONIO INTERNATIONAL AIRPORT (SAT)

As per FAA/TSA guidelines, a person performing work in the Security Identification Display Area (SIDA), Secured Area, Sterile Area or Airport Operations Area must have a valid Personnel Identification Badge (known as a SAT badge) or be under an airport approved escort by a person having a SAT badge with the white "E" (escort endorsement) on the badge. Furthermore, each badge holder with the white "E" may escort up to two (2) unbadged individuals while keeping same under positive control at all times while in the SIDA, Secured Area, Sterile Area and/or the project site. **Note:** If the person is disqualified from receiving a SAT badge during the badge application process, or becomes disqualified after receiving a SAT badge, the individual can no longer be present anywhere within the SIDA, Secured Area, Sterile area and/or the project areas.

If driving is involved, the person must have a valid SAT badge and the appropriate airfield driver's license to operate a vehicle in the SIDA and/or the project site. If a vehicle escort is required, each SAT badge holder with the white "E" on his badge (and the appropriate airfield driver's license) may escort up to two (2) vehicles if there is only one unbadged person in each vehicle being escorted.

All vehicles operating in the SIDA or the project area must have the appropriate airport approved company signage on the vehicle. The signage must meet the following requirements: Company name must be in at least six inch (6") tall lettering and/or the company logo must be at least twelve inches (12") tall. The signage must be placed on both vertical sides of any self propelled, motorized vehicle at all times while within the SIDA or the project site. If signage is not available, an Airport issued "Top Hat" may be used for vehicles under an airport approved vehicle escort or while parked in the SIDA.

The procedures to obtain an Airport Personnel Identification Badge and/or an airport driver's license are as follows:

A) Airport Personnel Identification Badge (SAT ID Badge):

1) The Airport Security Personnel Identification Office (AS PIO) is located at 9623 West Terminal Drive, Bldg. #1322.

2) Once an Aviation Department division has notified the AS PIO of an approved City contract which will require the badging of personnel, the Contactor's designated representative for badging must call (210) 207-3526 to schedule an appointment with the AS PIO to make arrangements to become an Authorizing

Signatory for all SAT badges to be issued to the Contractor's employees working on the contract. Once the Authorizing Signatory has completed the required procedures (i.e., fingerprint-based Criminal History Records Check (CHRC)), Security Threat Assessment (STA) background check, SIDA training, Authorizing Signatory training, etc.) to receive his SAT badge, he will then be authorized to approve applications for other Contractor employees under his responsibility. **Note:** If an employee of Contractor has been convicted of any of the offenses listed in Exhibit 1 hereto, that employee will be immediately disqualified from obtaining a SAT badge and will be ineligible to perform work at SAT

3) All SAT ID badge applications are processed electronically via an online application process. Once the Contractor's Authorizing Signatory has been trained successfully on his responsibilities and completed all phases of the badging process, the website address for Contractor's employees to use to complete the application will be provided. Furthermore, the Authorizing Signatory will be provided instructions on how to setup, use and approve badge applications via the online badging system.

4) As of October 1, 2011 badge processing fees are:

Airport Security Badge & ID Office Service	Amount
Fingerprint-based Criminal History Records Check (CHRC)/STA	65.00
Identification Badge (new/renewal/replacement/exchange)	35.00
Non-Returned Identification Badge	75.00
Reactivation of Identification Badge (Security Violation)	
1st Offense	25.00
2nd Offense	50.00
3rd Offense	75.00
Progressive Security Fee Program	Sliding Scale
AOA Parking Decal (for General Aviation leasehold only)	5.00

There is no refund for badge processing fees.

5) As part of the badging process, all Contractor employees are required to complete a computer-based SIDA training class. All documents necessary to complete the application process (including obtaining the applicants fingerprints to conduct a CHRC must be completed before the Contractor's employees may attend the computer-based SIDA training class. The class is held on a first come, first served basis and is generally available during the following days/times: Monday – Thursday, 8:00 a.m. – 3:00 p.m., and Friday, 8:00 a.m. – 10:30 a.m. and 1:00 p.m. – 3:00 p.m. The SIDA class takes approximately 45 minutes to 1 hour to complete and the applicant must make a 100% on the final test to successfully complete this stage of the badging process. The SAT badge can only be issued after the applicant successfully completes the SIDA class; the Airport Security Compliance

completes the CHRC; and the Airport Security Compliance receives an approved STA check from the TSA. It can take anywhere from three (3) business days to 2 weeks before the applicant may be issued his SAT badge.

6) At the end of the contract, the Contractor's Authorizing Signatory shall return all issued airport identification badges to the AS PIO directly and inform the Aviation Department division that managed the contract that all badges have been returned before final payment for the work can be processed.

7) Any lost or stolen SAT ID badge shall be reported to Airport Security immediately by contacting (210) 207-3526 or 207-3433 so the badge can be deactivated. The Contractor's employee must contact Contractor's Authorizing Signatory to make arrangements to complete the necessary paperwork to receive a replacement SAT badge. The Contractor shall be responsible for any fees/fines resulting from the lost, stolen, or otherwise unaccounted for SAT badge.

B) Airfield Driver License:

1) Contact the Airport Operations Office (AOO) at 207-3475 for hours of operations and procedures. The Airport Operations Office is located at 457 Sandau Rd., San Antonio, TX 78216. The individual has to show a current valid Texas Driver License, a current valid Airport Personnel Identification Badge and a copy of certificate of insurance document of the individual's employer with the proper coverage must be submitted to the AOO to be kept on file.

2) The non-movement classes are held on every Monday at 1:00 P.M., Tuesday and Friday at 9:00 A.M. The movement classes are held every Tuesday at 1:00 P.M. and Thursday at 9:00 A.M. There will be a test at the end of each class. The airfield driver license can only be issued to a person passing the test.

3) A copy of the Airfield Driver's Training Program Fees dated Sept. 30, 2008 is attached for the information. Contact with AOO for the current fees. A $5.00 refund will be issued if the lost license is found within 30 days of the receipt date. For the construction contracts, there is no separate line item on the bid proposal for the costs involved and the costs shall be considered incidental to mobilization expenses.

4) The licensed driver can only travel on the areas authorized and use the gate approved by the Airport Police. A driver who loses his or her Airfield Driver License is responsible for reporting the loss immediately to Airport Operations Office. The employee will be responsible to pay the replacement fee for his/her airfield license.

5) The company shall have coverage for the vehicles used inside Air Operations Area for the project involved at all times. An Automobile Liability Policy with no less than a Combined, Single Limit for Bodily Injury and Property Damage of

$5,000,000 per occurrence, or its equivalent in Umbrella or Excess Liability Coverage. In addition, the City of San Antonio must be listed as an "additional insured" in the endorsement section.

The Insurance can be under the Company name if a company vehicle will be used and the vehicle must be listed in the insurance policy either specifically by VIN number or generally by covering all autos owned, leased or operated while conducting business on behalf of the company. If this is a private vehicle covered only by personal insurance, the insurance must be under the drivers name and VIN number must be listed. It is the company's responsibility to notify the Aviation Department for any insurance changes.

6) At the end of the project, the authorized Project Manager shall return all airfield driver licenses to Planning and Development and at the end of the return process the final payment for the work can be processed.

EXHIBIT I TO ATTACHMENT A

LIST OF DISQUALIFYING CRIMES

AUTHORIZATION FOR FINGERPRINT-BASED
CRIMINAL HISTORY RECORDS CHECK

Please read and review the following list of disqualifying criminal offenses as listed in Transportation Security Regulation (TSR) 1542.209 (d).

1. Forgery of certificates, false marking of aircraft, and other aircraft registration violations: 49 USC 46302
2. Interference with air navigation: 49 USC 46308
3. Improper transportation of a hazardous material: 49 USC 46312
4. Aircraft Piracy: 49 USC 46502
5. Interference with flight crew members or flight attendants: 49 USC 46504
6. Commission of certain crimes aboard aircraft in flight: 49 USC 46506
7. Carrying a weapon or explosive aboard aircraft: 49 USC 46505
8. Conveying false information and threats: 49 USC 46507
9. Aircraft piracy outside the special aircraft jurisdiction of the United States: 49 USC 46502(b)
10. Lighting violations involving transporting controlled substances: 49 USC 46315
11. Unlawful entry into an aircraft or airport area that serves air carriers or foreign air carriers contrary to established security requirements: 49 USC 46314
12. Destruction of an aircraft or aircraft facility: 18 USC 32
13. Murder
14. Assault with intent to murder
15. Espionage
16. Sedition
17. Kidnapping or hostage taking
18. Treason
19. Rape or aggravated sexual abuse
20. Unlawful possession, use, sale, distribution, or manufacture of an explosive or weapon
21. Extortion
22. Armed or felony unarmed robbery
23. Distribution of, or intent to distribute, a controlled substance
24. Felony arson
25. Felony Involving a threat
26. Felony involving
    1. Willful destruction of property
    2. Importation or manufacture of a controlled substance
    3. Burglary
    4. Theft
    5. Dishonesty, fraud, or misrepresentation
    6. Possession or distribution of stolen property
    7. Aggravated assault
    8. Bribery
    9. Illegal possession of a controlled substance punishable by a maximum term of imprisonment of more than one year
27. Violence at international airports: 18 USC 37
28. Conspiracy or attempt to commit any of the criminal acts listed in this paragraph

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MEMORANDUM

TO: San Antonio International Airport Stakeholders

FROM: Ryan E. Rocha, Airport Operations Manager

CC: Tim O'Krongley, Assistant Aviation Director, File

RE: **Airfield Driver's Training Program Fees**

DATE: April 22, 2009

In an effort to improve our Airfield Driver's Training program and to offset costs, the Airport Operations Division has been charging fees for the Airfield Driver's Training classes (Non-Movement & Movement) as well as for replacement licenses as of October 1, 2008.

Fees can be paid at the Airport Operations Office beginning May 1, 2009. Tenants and companies who prefer to maintain an account for automatic deductions can do so with the Personnel Identification Office – Airport Police.

It is the sole responsibility of the tenant and/or company to select the correct training course needed for each employee. Airport Operations will schedule the employee to the course selected for the tenant and/or companies.

Payment for services is required **BEFORE** services are rendered. Acceptable forms of payment will include cash (**exact change only**), company check (for **exact amount of participants**), money order or credit card. The Personnel Identification Office – Airport Police will process all credit card payments until further notice. There will only be a partial refund of $5.00 for replacement licenses if the license is found within 30 days of the date on the receipt.

The employee will be required to present their receipt of payment for the course to the instructor prior to the start of class. ***No one will be permitted to attend the course without proof of payment.***

Non Movement – Aprons and parking areas in the Airport Operations Area (AOA). No ATCT clearance is required in these areas.

Movement w/ Restrictions - Taxiways as well as other areas of an airport that are used for taxiing aircraft & parking areas. ATCT clearance is required.

Course		Amount
Non-Movement		
Monday	**1:00 p.m.**	**$15.00**
Tuesday	**9:00 a.m.**	**$15.00**
Friday	**9:00 a.m.**	**$15.00**
Movement w/Restrictions		
Thursdays	**9:00 a.m.**	**$20.00**
Replacement License		**$10.00**

All the courses start exactly at their designated times. No classes will be disrupted after it has started. **NO EXCEPTIONS**. All employees attending the driving course will be required to have their current state driver's license & security (SIDA) badge. Employees with an expired drivers license or security (SIDA) badge will not be permitted to attend the course. Please note that access by vehicles outside their leasehold area to the Airfield Operations Area (AOA) is granted on an as needed basis and adequate insurance is required before the issuance of a license. For more information on insurance coverage please contact us at 210-207-3475.

Your cooperation and support of the Airfield Driver's Training Program and the Airport Operations Division is greatly appreciated.

CITY OF SAN ANTONIO

SAN ANTONIO
DEPARTMENT OF AVIATION

CRANE AND/OR TEMPORARY CONSTRUCTION EQUIPMENT PROCEDURES IN AND AROUND AIRPORTS BUILDING PERMIT FORM

Permit No. _____

Crane Co.: _____

Max Tip Height: _____

Duration of Crane: _____

Hours of Operation: _____

Address: _____

Crane Co. Signature (Print and Sign):

_____

The purpose of the Airport Zoning ordinance is to prevent hazards to air navigation and airspace so as to protect the lives and property within the limits of San Antonio and the vicinity of airports (San Antonio International and Stinson Municipal Airports, Randolph and Lackland Air Force Bases, and Martindale and Camp Bullis Airfields). The ordinance is to prevent cranes and construction equipment from penetrating; however briefly, the City's airspace unless a special temporary authorization is obtained from the Aviation Department or the FAA. The primary considerations, before approving a crane or temporary construction equipment are the height and location/site of the equipment. The Aviation Department will decide to either approve the request or to involve the FAA based on the height and location of the equipment. The FAA's processing time is at least 60 workdays.

When using a crane or temporary construction equipment, please comply with the following:

1. Notify the Aviation Department as soon as it is decided obstruction equipment is needed for the project, but minimally 48 hours before the actual work starts. Phone numbers are 210-207-3514 and/or cell phone 210-355-2214.
2. Provide a detailed description of where the crane will be used. Use crossing or intersecting streets not an address.
3. Provide the date the equipment will be used, the hours of operation and the maximum height of the equipment.

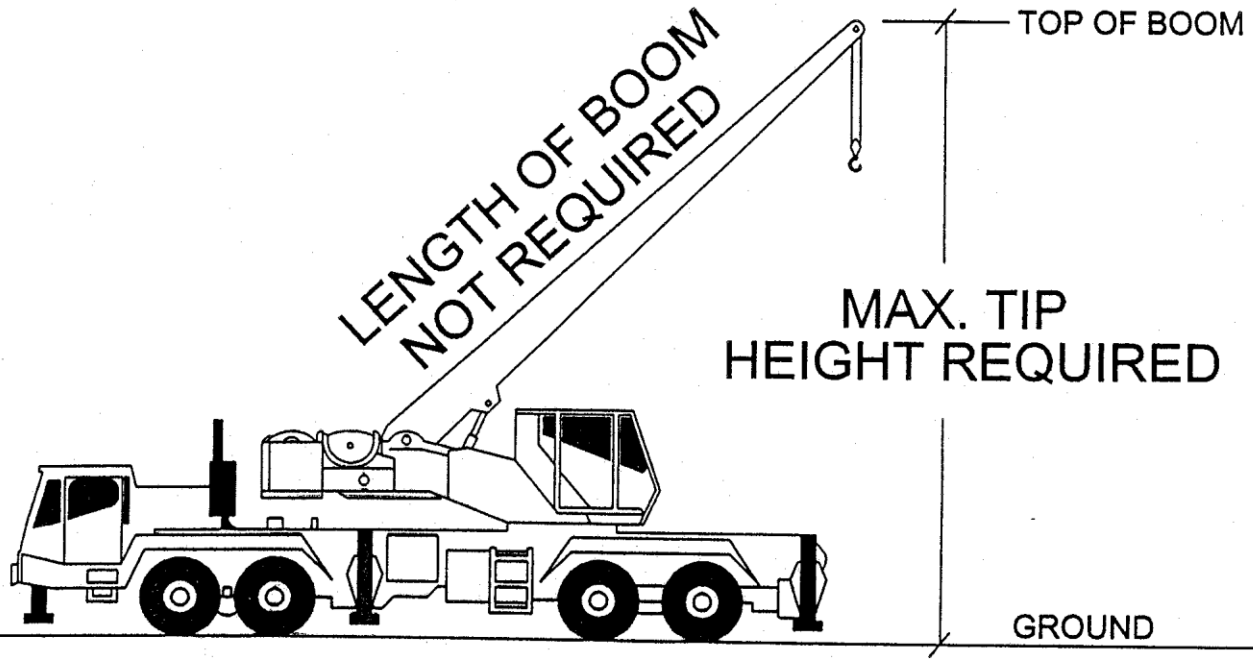
Once approval is given, it is imperative to comply with the following:

1. The equipment will only operate during daylight hours.
2. The equipment will only operate during Visual Flight Rules (VFR) conditions, which is 3 mile visibility or greater.
3. The equipment will be lowered to the surrounding height when not in use.
4. The equipment will be obstruction flagged.

Thank you for maintaining a safe environment for the traveling public. If you have any questions please call Jim Wingate at 210-207-3514 or Alan Lopez at 210-207-3897.

E-Mail Address and phone numbers

Federal Aviation Administration – www.faa.gov
Bruce Beard - 817-838-1996, bruce.beard@faa.gov fax: 817-838-1991
Jim Wingate -210-207-3514, james.wingate@sanantonio.gov fax: 210-207-3544
~~Alan Lopez – 210-207-3897, alan.lopez@sanantonio.gov fax: 210-207-3544~~



DEFINITION OF CRANE HEIGHT

FAA Underground Cable Notes:

Location of existing FAA control and communications cables are shown in approximate general locations. The contractor shall coordinate with appropriate representative at least 48 hours in advance prior to commencing excavation in all areas.

If contractor cuts an FAA communications cable, the following will apply:

A. Contractor will be required to replace the cut cable between the existing pull boxes. The average distance between two pull boxes is over 2,000 L.F.

B. All communications cable-splicing must be performed by the contractor utilizing FAA approved and certified splicers. Prior to commencing any splicing activities, an FAA representative shall be contacted to have him/her identify cable strands.

C. After splicing, cables will be tested by the contractor for continuity and for insulation leakage (Hi-Pot test to ground), as directed by the FAA representative.

D. The contractor shall coordinate all matters relating to FAA cables with the project manager and FAA representatives before commencing excavation or repair work.

E. The contractor shall be required to have splice kits located on site. Kits & FAA certified splicer personnel shall be readily available in the event that any communications cables are cut or damaged. All repairs shall be initiated immediately & completed the same day.

F. The driving of heavy equipment or machinery across existing underground cable shall be restricted to designated crossings only. All underground cable crossings shall be protected with ½" x 10' x 4' steel plates. No costs will be charged to the City. All steel plates must be removed by the contractor after the work is completed and return the field to the previous condition or better.

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Safety Notes:

1) The contractor shall remain clear of all taxiways, runways, taxilanes, non-movement areas and the tenant areas at all times.

2) All contaminated soil must be transported to the designated soil staging facility temporarily. If the contractor contaminates the site, the contractor must notify the City of San Antonio Aviation Department at 207-3506. The contractor must also clean the affected area at their own expense.

3) Any additional costs, and/or fines, charged to the City of San Antonio Aviation Department due to contractor error, or violations will be passed on to the contractor for payment.

4) The contractor shall provide a uniformed and licensed security guard with adequate airport badge, acceptable to the owner and a functioning telephone at the AOA gate at all times while the gate is unlocked. All personnel and vehicles requiring access to the airfield (AOA) shall comply with all requirements of the airport police.

5) If the project is in or next to any taxiway, taxilane or runway, the contractor must have a mobile VHF radio with ATC ground control frequency 121.9 to aid in the control of vehicles on the airfield.

6) All vehicles and/or equipment operating inside Airport Operations Area must be provided with an FAA approved flag on a staff and attached to the vehicle so that the flag will be readily visible. The flag shall not be less than three feet square consisting of Aviation Orange and white squares of not less than a foot of each side.

5/27/2009

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SECTION 01 10 00
SUMMARY

1.00 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 WORK COVERED BY CONTRACT DOCUMENTS

A. Project Identification: General construction of Airport Infrastructure Modernization located at the San Antonio International Airport, San Antonio, Texas.

B. Architect Identification: Documents dated November 11, 2011, were prepared for the Project by The Arizpe Group, Inc., 6330 Hwy. 290 East, Suite 375, Austin, Texas 78723-1156 (512) 339-3707 FAX (512) 339-3709.

C. The work consists of the installation of a new communications infrastructure throughout Terminal A and two exterior locations on the San Antonio International Airport campus as shown on the contract drawings. This work includes the construction and build-out of new communications rooms, installation of communications pathways (conduit and cable trays), installation of a telecommunications grounding system, installation of fiber optic and copper cabling between the new communications rooms, and new fiber optic cabling connecting to existing communications rooms. The work related to communications backbone cabling includes all equipment and appurtenances to facilitate the termination of all cabling as well as complete testing to support the commissioning process. Work in the exterior areas includes the construction and build-out of new communications buildings, disconnection, rerouting, re-termination and testing of existing fiber optic cabling, and the installation of new fiber optic cabling.

D. The work also includes the removal, relocation, and reinstallation of electronic equipment that is currently located in existing communications rooms, cabinets, and racks. This equipment will be relocated to new cabinets in the new communications rooms that will be constructed as part of this project and re-connected to the COSA LAN. This work will require close coordination with the COSA IT department staff to schedule the relocation activities and to minimize any disruption to the Airport's operational activities

1.3 USE OF PREMISES

A. General: Contractor shall have use of premises in areas of construction operations, including use of each Project's site, during construction

period. Contractor's use of premises is limited as noted in Part A and Part B of Division 0 Specifications and by Owner's right to perform work or to retain other contractors on portions of Project.

1. The Project Site is a non-smoking and tobacco-free site inside and outside the building. Personnel must be off site and off the clock in order to smoke or use any type of tobacco products.

2. This project is adjacent to an active airfield. As such, highly stringent cleanup procedures must be followed AT ALL TIMES throughout construction. Loose debris of any kind, weight or size will not be permitted. Landings, take-offs and exercises will NOT be coordinated with the Contractor. Any observation of debris that could endanger life and/or equipment will create an immediate work stoppage until the danger is abated. The Contractor is required to develop a safety program in conjunction with air field management and document that all subcontractors have completed this course prior to commencing work on the site. Should the client document multiple instances of lack of compliance, it will, at the option of the client, constitute a breach of contract. All bidders must account for the training, cleanup and enhanced observation required to meet this provision as a part of their base bid.

1.4 CONTRACT

A. This Project will be constructed under a lump sum contract.

1.5 WORK SEQUENCE

A. The Work will be performed in one phase.

1.6 SPECIFICATION FORMATS AND CONVENTIONS

A. Specification Format: The Specifications are organized into Divisions and Sections using the 2004 Edition, 41-division CSI/CSC's "MasterFormat" numbering system.

1. Section Identification: The Specifications use section numbers and titles to help cross-referencing in the Contract Documents. Sections in the Project Manual are in numeric sequence; however, the sequence is incomplete. Consult the table of contents at the beginning of the Project Manual to determine numbers and names of sections in the Contract Documents.

B. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:

1. Abbreviated Language: Language used in the Specifications and other Contract Documents is abbreviated. Words and meanings shall be interpreted as appropriate. Words implied, but not stated, shall be inferred as the sense requires. Singular words shall be interpreted as plural, and plural words shall be interpreted as

singular where applicable as the context of the Contract Documents indicates.

2. Imperative mood and streamlined language are generally used in the Specifications. Requirements expressed in the imperative mood are to be performed by Contractor. The indicative or subjunctive mood may be used in the Section Text for clarity to describe responsibilities that must be fulfilled indirectly by Contractor or by others when so noted.

   a. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.

2.00 PRODUCTS (Not Applicable)

3.00 EXECUTION (Not Applicable)

END OF SECTION 01 10 00

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SECTION 01 23 00

ALTERNATES

1.00 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for alternates.

1.3 DEFINITIONS

A. Alternate: An amount proposed by bidders, approved in writing by the Construction Administration Manager, and stated on the Bid Form for certain work defined in the Bidding Requirements that may be added to or deducted from the Base Bid amount if Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.

1. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternate into the Work. No other adjustments are made to the Contract Sum.

1.4 PROCEDURES

A. Coordination: Modify or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.

1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.

B. Notification: Immediately following award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicate if alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated modifications to alternates.

C. Execute accepted alternates under the same conditions as other work of the Contract.

2.00 PRODUCTS (Not Applicable)

3.00 EXECUTION (Not Applicable)

END OF SECTION 01 23 00

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SECTION 01 26 00
CONTRACT MODIFICATION PROCEDURES

1.00 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section specifies administrative and procedural requirements for handling and processing Contract modifications.

B. Related Sections include the following:

1. Division 1 Section "Product Requirements" for administrative procedures for handling requests for substitutions made after contract award.

1.3 MINOR CHANGES IN THE WORK

A. Construciton Administration Manager will issue supplemental instructions authorizing Minor Changes in the Work, not involving adjustment to the Contract Sum or the Contract Time.

1.4 PROPOSAL REQUESTS

A. Owner-Initiated Proposal Requests: Construciton Administration Manager will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.

1. Proposal Requests issued by Construciton Administration Manager are for information only. Do not consider them instructions either to stop work in progress or to execute the proposed change.

2. Within 21 days after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.

a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.

b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.

c. Include an updated Contractor's Construction Schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.

B. Contractor-Initiated Proposals: If latent or unforeseen conditions require modifications to the Contract, Contractor may propose changes by submitting a request for a change.

1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.

2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.

3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.

4. Include an updated Contractor's Construction Schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.

5. Comply with requirements in Division 1 Section "Materials and Equipment" if the proposed change requires substitution of one product or system for product or system specified.

C. Proposal Request Form: For Change Order proposals, use forms determined during the Preconstruction Conference.

1.5 ALLOWANCES

C. Allowance Adjustment: To adjust allowance amounts, base each Change Order proposal on the difference between purchase amount and the allowance, multiplied by final measurement of work-in-place. If applicable, include reasonable allowances for cutting losses, tolerances, mixing wastes, normal product imperfections, and similar margins.

1. Include installation costs in purchase amount only where indicated as part of the allowance.

2. If requested, prepare explanation and documentation to substantiate distribution of overhead costs and other margins claimed.

3. Owner reserves the right to establish the quantity of work-in-place by independent quantity survey, measure, or count.

B. Submit claims for increased costs because of a change in scope or nature of the allowance described in the Contract Documents, whether for the Purchase Order amount or Contractor's handling, labor, installation, overhead, and profit. Submit claims within 21 days of receipt of the Change Order or Construction Change Directive authorizing work to proceed. Owner will reject claims submitted after such authorization.

1. Do not include Contractor's or subcontractor's indirect expense in the Change Order cost amount unless it is clearly shown that the nature or extent of work has changed from what could have been foreseen from information in the Contract Documents.

1.4 No change to Contractor's indirect expense is permitted for selection of higher- or lower-priced materials or systems of the same scope and nature as originally indicated.

1.5 CHANGE ORDER PROCEDURES

A. On Owner's approval of a Proposal Request, Construciton Administration Manager will issue a Change Order for signatures of Owner and Contractor on AIA Document G701 form.

1.6 CONSTRUCTION CHANGE DIRECTIVE

A. Construction Change Directive: Construciton Administration Manager may issue a Construction Change Directive on AIA Document G714. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.

1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.

B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.

1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

2.00 PRODUCTS (Not Applicable)

3.00 EXECUTION (Not Applicable)

END OF SECTION 01 26 00

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SECTION 01 29 00
PAYMENT PROCEDURES

1.00 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section specifies administrative and procedural requirements necessary to prepare and process Applications for Payment.

B. Related Sections include the following:

1. Division 1 Section "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.

1.3 SCHEDULE OF VALUES

A. Coordination: Coordinate preparation of the Schedule of Values with preparation of Contractor's Construction Schedule.

1. Correlate line items in the Schedule of Values with other required administrative forms and schedules, including the following:

a. Application for Payment forms with Continuation Sheets.
b. Submittals Schedule.

2. Submit the Schedule of Values to Construction Administration Manager at earliest possible date but no later than fourteen days before the date scheduled for submittal of initial Applications for Payment.

B. Format and Content: Use the Project Manual table of contents as a guide to establish line items for the Schedule of Values. Provide at least one line item for each Specification Section.

1. Identification: Include the following Project identification on the Schedule of Values:

a. Project name and location.
b. Name of Construction Administration Manager.
c. Construction Administration Manager's project number.
d. Contractor's name and address.
e. Date of submittal.

2. Arrange the Schedule of Values in tabular form with separate columns to indicate the following for each item listed:

a. Related Specification Section or Division.
b. Description of the Work.
c. Name of subcontractor.
d. Name of manufacturer or fabricator.
e. Name of supplier.
f. Change Orders (numbers) that affect value.
g. Dollar value.

1) Percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.

3. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with the Project Manual table of contents. Provide several line items for principal subcontract amounts, where appropriate.
4. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
5. Provide a separate line item in the Schedule of Values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.

   a. Differentiate between items stored on-site and items stored off-site. Include evidence of insurance or bonded warehousing if required.

6. Provide separate line items in the Schedule of Values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
7. Each item in the Schedule of Values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.

   a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the Schedule of Values or distributed as general overhead expense, at Contractor's option.

8. Schedule Updating: Update and resubmit the Schedule of Values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

1.4 APPLICATIONS FOR PAYMENT

A. Each Application for Payment shall be consistent with previous applications and payments as certified by Construction Administration Manager and paid for by Owner.

   1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.

B. Mobilization not to exceed 8% of Bid Amount.

C. Payment Application Times: The date for each progress payment is the first of each month. The period covered by each Application for Payment starts on the day following the end of the preceding period and ends 15 days before the date for each progress payment.

D. Payment Application Forms: Use AIA Document G702 and AIA Document G703 Continuation Sheets as form for Applications for Payment.

E. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Construction Administration Manager will return incomplete applications without action.

1. Entries shall match data on the Schedule of Values and Contractor's Construction Schedule. Use updated schedules if revisions were made.
2. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.

F. Transmittal: Submit 3 signed and notarized original copies of each Application for Payment to Construction Administration Manager by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.

1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.

G. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's liens from subcontractors, sub-subcontractors, and suppliers for construction period covered by the previous application.

1. Submit partial waivers on each item for amount requested, before deduction for retainage, on each item.
2. When an application shows completion of an item, submit final or full waivers.
3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
4. Waiver Delays: Submit each Application for Payment with Contractor's waiver of mechanic's lien for construction period covered by the application.

   a. Submit final Application for Payment with or preceded by final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.

5. Waiver Forms: Submit waivers of lien on forms, executed in a manner acceptable to Owner.

H. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:

1. List of subcontractors.
2. Schedule of Values.
3. Contractor's Construction Schedule (preliminary if not final).
4. Products list.
5. Schedule of unit prices.
6. Submittals Schedule (preliminary if not final).
7. List of Contractor's staff assignments.
8. List of Contractor's principal consultants.
9. Copies of building permits.
10. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.

11. Initial progress report.
12. Report of preconstruction conference.
13. Certificates of insurance and insurance policies.
14. Performance and payment bonds.
15. Data needed to acquire Owner's insurance.
16. Initial settlement survey and damage report if required.

I. Application for Payment at Substantial Completion: After issuing the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.

1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
2. This application shall reflect Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of the Work.

J. Final Payment Application: Submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:

1. Evidence of completion of Project closeout requirements.
2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
3. Updated final statement, accounting for final changes to the Contract Sum.
4. AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims."
5. AIA Document G706A, "Contractor's Affidavit of Release of Liens."
6. AIA Document G707, "Consent of Surety to Final Payment."
7. Evidence that claims have been settled.
8. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
9. Final, liquidated damages settlement statement.

2.00 PRODUCTS (Not Applicable)

3.00 EXECUTION (Not Applicable)

END OF SECTION 01 29 00

SECTION 01 31 00
PROJECT MANAGEMENT AND COORDINATION

1.00 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:

1. General project coordination procedures.
2. Conservation.
3. Administrative and supervisory personnel.
4. Project meetings.

B. Contractor shall participate in coordination requirements. Certain areas of responsibility will be assigned to a specific subcontractor.

C. Related Sections: The following Section contains requirements that relate to this Section:

1. Division 1 Section "Closeout Procedures" for coordinating Contract closeout.

1.3 COORDINATION

A. Coordination: Coordinate construction operations included in various Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections, that depend on each other for proper installation, connection, and operation. All construction scheduling shall use MS Project software.

1. Schedule construction operations in sequence required to obtain the best results where execution of one part of the Work depends on execution of other components, before or after its own execution.
2. Make adequate provisions to accommodate items scheduled for later construction.

B. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:

1. Preparation of Contractor's Construction Schedule using MS Project as the construction scheduling tool..
2. Installation and removal of temporary facilities and controls.
3. Progress meetings.
4. Preconstruction conferences.
5. Project closeout activities.

C. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials.

1.4 SUBMITTALS

A. Staff Names: Within 15 days of starting construction operations, submit a list of principal staff assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home, office, and cell telephone numbers. Provide names, addresses, and cell telephone numbers of individuals assigned as standbys in the absence of individuals assigned to Project.

1.5 PROJECT MEETINGS

A. General: Schedule and conduct weekly team meetings and conferences at Project site, unless otherwise indicated.

1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Construction Administration Manager of scheduled meeting dates and times a minimum of 72 hours prior to meeting time.
2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees 24 hours prior to meeting.
3. Primary objectives: Review construction progress, challenges, changes, updated construction schedule and notable coordination items.
4. Status Report and Project Schedule: Reviewed as part of the meeting
5. Minutes: Record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Construction Administration Manager, within 3 days of the meeting.

B. Preconstruction Conference: Schedule a preconstruction conference before starting construction, at a time convenient to Owner and Construction Administration Manager, but no later than 5 days after execution of the Agreement. Hold the conference at Project site or another convenient location. Conduct the meeting to review responsibilities and personnel assignments.

1. Attendees: Authorized representatives of Owner and Construction Administration Manager, and their consultants; Contractor and its superintendent; major subcontractors; manufacturers; suppliers; and other concerned parties shall attend the conference. All participants at the conference shall be familiar with this Project and authorized to conclude matters relating to the Work.
2. Agenda: Discuss items of significance that could affect progress, including the following:

a. Tentative construction schedule using MS Project.
b. Critical work sequencing.
c. Designation of responsible personnel.
d. Distribution of the Contract Documents.
e. Submittal procedures.
f. Use of the premises.

g. Responsibility for temporary facilities and controls.
h. Parking availability.
i. Office, work, and storage areas.
j. Deliveries, removals and priorities.
k. First aid.
l. Security.
m. Working hours.

2.00 PRODUCTS (Not Applicable)

3.00 EXECUTION (Not Applicable)

END OF SECTION 01 31 00

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SECTION 01 32 00
PROGRESS DOCUMENTATION

1.00 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for documenting the existing conditions prior to performance of the Work, including the following:

1. Preliminary Construction Schedule.
2. Contractor's Construction Schedule.
3. Submittals Schedule.
4. Construction reports.
5. Field condition reports.

B. Related Sections include the following:

1. Division 1 Section "Project Management and Coordination" for submitting and distributing meeting and conference minutes.
2. Division 1 Section "Submittal Procedures" for submitting schedules and reports.

1.3 SUBMITTALS

A. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

B. Submittals Schedule: Submit three copies of schedule. Arrange the following information in a tabular format:

1. Scheduled date for first submittal.
2. Specification Section number and title.
3. Submittal category (action or informational).
4. Name of subcontractor.
5. Description of the Work covered.
6. Scheduled date for Construction Administration Manager's final release or approval.

C. Preliminary Construction Schedule: Submit one printed copy and one electronic digital file in pdf format and Microsoft project format.

D. Contractor's Construction Schedule: Submit one printed copy of initial schedule, and one electronic digital file in pdf format and Microsoft project format, showing entire schedule for entire construction period.

E. Daily Construction Reports: Submit by e-mail at weekly intervals.

F. Field Condition Reports: Submit by e-mail at time of discovery of differing conditions.

1.4 QUALITY ASSURANCE

A. Scheduling Consultant Qualifications: An experienced specialist in construction scheduling and reporting.

1.5 COORDINATION

A. Coordinate preparation and processing of schedules and reports with performance of construction activities and with scheduling and reporting of separate contractors.

B. Coordinate Contractor's Construction Schedule with the Submittals Schedule, progress reports, and other required schedules and reports.

C. Auxiliary Services: Provide auxiliary services requested, including access to Project site and use of temporary facilities including temporary lighting.

2.00 PRODUCTS

2.1 SUBMITTALS SCHEDULE

A. Preparation: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, resubmittal, ordering, manufacturing, fabrication, and delivery when establishing dates.

2.2 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

A. Procedures: Comply with procedures contained in AGC's "Construction Planning & Scheduling."

B. Time Frame: Extend schedule from date established for the Notice to Proceed to date of Substantial Completion.

C. Activities: Treat each separate area as a separate numbered activity for each principal element of the Work. Comply with the following:

1. Activity Duration: Define activities so no activity is longer than 7 days, unless specifically allowed by Construction Administration Manager.
2. Submittal Review Time: Include review and resubmittal times indicated in Division 1 Section "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with Submittals Schedule.
3. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Construction Administration Manager's administrative procedures necessary for certification of Substantial Completion.

D. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.

1. Work Restrictions: Show the effect of the following items on the schedule:

a. Coordination with adjacent existing construction.
b. Limitations of continued adjacent occupancies.
c. Uninterruptible services.
d. Use of adjacent premises restrictions.
e. Provisions for Construction Phase construction.
f. Seasonal variations.
g. Environmental control.

2. Area Separations: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other activities to provide for the following:

a. Structural construction.
b. Material removal.
c. Completion of mechanical removal, including refrigeant recovery.
d. Completion of electrical removal.
e. Substantial Completion.

E. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and Final Completion.

F. Computer Software: Prepare schedules using a program that has been developed specifically to manage construction schedules.

2.3 PRELIMINARY CONSTRUCTION SCHEDULE

A. Bar-Chart Schedule: Submit preliminary horizontal bar-chart-type construction schedule a minimum of seven days before the start date established in the Notice to Proceed.

B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line. Outline significant construction activities for first 10 days of construction.

2.4 CONTRACTOR'S CONSTRUCTION SCHEDULE (GANTT CHART)

A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal Gantt-chart-type, Contractor's Construction Schedule maximum of 3 days after the start date established in the Notice to Proceed. Base schedule on the Preliminary Construction Schedule and whatever updating and feedback was received since the start of Project.

B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.

2.5 REPORTS

A. Construction Reports: Prepare construction reports recording the following information concerning events at Project site:

1. List of subcontractors at Project site.
2. List of separate contractors at Project site.
3. Approximate count of personnel at Project site.

4. High and low temperatures and general weather conditions.
5. Accidents.
6. Meetings and significant decisions.
7. Unusual events (refer to special reports).
8. Stoppages, delays, shortages, and losses.
9. Meter readings and similar recordings.
10. Emergency procedures.
11. Orders and requests of authorities having jurisdiction.
12. Change Orders received and implemented.
13. Change Directives received.
14. Services connected and disconnected.
15. Equipment or system tests and startups.
16. Partial Completions and occupancies.
17. Substantial Completions authorized.

3.00 EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Contractor's Construction Schedule Updating: At weekly intervals, update schedule to reflect actual construction progress and activities. Issue schedule two days before each regularly scheduled progress meeting.

1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
3. As the Work progresses, indicate Actual Completion percentage for each activity.

B. Distribution: Distribute copies of approved schedule to Construction Administration Manager and Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.

END OF SECTION 01 32 00

SECTION 01 33 00
SUBMITTAL PROCEDURES

1.00 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.2 DESCRIPTION OF REQUIREMENTS

A. The types of submittal requirements specified in this section include shop drawings, product data, samples and miscellaneous work-related submittals. Individual submittal requirements are specified in applicable sections for each unit of work. Refer to other Division-1 sections and other contract documents for requirements of administrative submittals.

B. Submittals specified in this Section are also required for systems, materials and items which are being substituted for specified items.

C. Definitions: Work-related submittals of this section categorized for convenience as follows:

1. Shop drawings include specially-prepared technical data for this project, including drawings, diagrams, performance curves, data sheets, schedules, templates, patterns, reports, calculations, instructions, measurements and similar information not in standard printed form for general application to a range of similar projects.
2. Product data include standard printed information on materials, products and systems; not specially-prepared for this project, other than the designation of selections from among available choices printed therein.
3. Samples include both fabricated and unfabricated physical examples of materials, products and units of work; both as complete units and as smaller portions of units of work either for limited visual inspection or (where indicated) for more detailed testing and analysis.
4. Mock-ups are a special form of samples, which are too large or otherwise inconvenient for handling in specified manner for transmittal of sample submittals.
5. Miscellaneous submittals related directly to work (non-administrative) include warranties, maintenance agreements, workmanship bonds, project photographs, survey data and reports, physical work records, quality testing and certifying reports, copies of industry standards, record drawings, field measurement data, operating and maintenance materials, overrun stock, and similar information, devices and materials applicable to the work and not processed as shop drawings, product data or samples.

D. Shop Drawings: Provide newly-prepared information, with graphic information at accurate scale (except as otherwise indicated), with name of preparer indicated (firm name). Shop dimensions and note which are based on field measurements. Identify materials and products in the work shown. Indicate compliance with standards, and special coordination requirements. Do not allow shop drawing copies without appropriate final "Action" markings by Construction Administration Manager/Engineer to be used in connection with the work.

1. Physical Format: Minimally, one print and electronic digital file(s) in pdf format; one print will be returned. Multi-copy distribution of approved submittals shall be required for use by the Owner, Construction Administration Manager, Architect, Engineer and Contractor. Transmit two color copies of the final corrected submittal for Owner and Contractor; and an electronic digital file in pdf format for the Construction Administration Manager, the Architect, and the Engineer. The multi-copy reproduction and distribution of submittals shall be provided by the Contractor.

E. Product Data: Collect required data into one submittal of each unit of work or system; and mark each copy to show which choices and options are applicable to project. Include manufacturer's standard printed recommendations for application and use, compliance with standards, application of labels and seals, notation of field measurements which have been checked, and special coordination requirements.

1. Submittals for Review: Submit two sets of copies greater than the Contractor wants returned (the Construction Administration Manager and the Architect or Engineer will each retain one copy and return the remainder).
2. Restrictions: Do not submit product data, or allow its use on the project, until compliance with requirements of contract document has been confirmed by the General Contractor. Submittal is for information and record, unless otherwise indicated.
3. Installer's Copy: Do not proceed with installation of materials, products or systems until final copy of applicable product data is in possession of Installer.

F. Samples: Provide units identical with final condition of proposed materials or products for the work. Include "range" samples (not less than 3 units) where unavoidable variations must be expected, and describe or identify variations between units of each set. Provide two Full sets of optional samples where Construction Administration Manager’s or Architect's/Engineer's selection is required.

1. Quality Control Set: Maintain returned final set of samples at project site, in suitable condition and available for quality control comparisons by Construction Administration Manager, and by others.
2. Reusable Samples: Return samples which are permitted to be incorporated in the work are so indicated in the individual work sections, and must be in undamaged condition at time of use.

G. Mock-Ups: Mock-ups and similar samples specified in work sections are recognized as a special type of sample. Comply with requirements for "samples" to greatest extent possible, and process transmittal forms to provide a record of activity.

1.3 GENERAL SUBMITTAL REQUIREMENTS

A. Submittal Scheduling: Where appropriate in administrative (listing of products, manufacturers, suppliers and subcontractors, and in job progress schedule), show principal work-related submittals and time requirements for coordination of submittal activity with related work in each instance.

1. Listing: Prepare a separate listing, organized by related specification section number sequence, showing principal work related submittals and their initial submittal dates as required for coordination of the work. Submit listing within 45 days of date of commencement of the work.

B. Coordination and Sequencing: Coordinate and process submittals with performance of the work so that work will not be delayed by submittals. Coordinate and sequence different categories of submittals for same work, and for interfacing units of work, so that one will not be delayed for coordination of Construction Administration Manager's, Architect's/engineer's review with another.

C. No Extension of Time will be Authorized when the Contractor fails to transmit submittals to the Construction Administration Manager sufficiently in advance of the work.

1.4 SPECIFIC-CATEGORY SUBMITTAL

A. General: Except as otherwise indicated in individual work sections, comply with requirements specified herein for each indicated category of submittal.

B. Preparation of Submittals: Before submission of Shop Drawings and Brochures, the Contractor shall certify that each Shop Drawing or each item of equipment complies with the Contract Documents for this project. Such certification shall be made by the Owner of, a Partner of, or a Corporate Officer of the Contractor, or by a person duly authorized to sign for the Contractor. Unless so certified, Shop Drawings and/or Brochures shall be returned for resubmittal. Certifications shall be in form of stamp impressions which state:

I hereby certify that this Shop Drawing and/or Brochure has been checked prior to submittal to the Construction Administration Manager and that it complies in all respects, except as specifically noted, with the requirements of the Contract Documents for this Project.

(Name of Contractor)
Signed
Name of Project:
Date
Submittal No.

C. Show Contractor's executed review and approval marking and provide space for Construction Administration Manager's and Architect's/Engineer's "Action" marking. Package Each submittal appropriately for transmittal and handling. Submittals which are received from sources other than through Contractor's office will be returned by Construction Administration Manager "without action".

D. Inspection and Test Reports: Classify each either "shop drawing" or "product data", depending upon whether report is uniquely prepared for project or a standard publication of workmanship control testing at point of production; process accordingly.

E. Warranties: Refer to "Products" section for specific requirements on warranties, product/workmanship bonds, and maintenance agreements. In addition to copies desired for Contractor's use, furnish 2 executed copies, except furnish 2 additional (conformed) copies where required for maintenance manuals.

F. Closeout Submittals: Refer to individual work and to "closeout" sections for specific requirements on submittal of closeout information, materials, tools and similar items.

G. General Distribution: Provide additional submittals (not included in foregoing copy submittal requirements) to subcontractors, suppliers, fabricators, installers, governing authorities and others as necessary for proper performance of the work. Include such additional copies in transmittal to Construction Administration Manager where required to receive "Action" marking before final distribution. Record distributions on transmittal forms.

1.5 ACTION ON SUBMITTALS

A. Review Time:

1. Construction Administration Manager's Action: Where action and return is required or requested, Construction Administration Manager will review each submittal, mark with "Action", forward to the Architect/Engineer for review and marking with "Action", and it is the intent, where possible to return submittals within 10 days of receipt.

2.00 PRODUCTS (Not applicable).

3.00 EXECUTION (Not applicable).

END OF SECTION 01 33 00

SECTION 01 40 00
QUALITY CONTROL SERVICES

1.00 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section specifies administrative and procedural requirements for quality control services.

Quality control services include inspections and tests and related actions including reports, performed by independent agencies, governing authorities, and the Contractor. They do not include Contract enforcement observations performed by the Construction Administration Manager or the Architect/Engineer.

B. Inspection and testing services are required to verify compliance with requirements specified or indicated. These services do not relieve the Contractor of responsibility for compliance with Contract Document requirements.

C. Requirements of this Section relate to customized fabrication and installation procedures, not production of standard products.

1. Specific quality control requirements for individual construction activities are specified in the Sections that specify those activities. Those requirements, including inspections and tests, cover production of standard products as well as customized fabrication and installation procedures.
2. Inspections, test and related actions specified are not intended to limit the Contractor's quality control procedures that facilitate compliance with Contract Document requirements.
3. Requirements for the Contractor to provide quality control services required by the Construction Administration Manager, Owner, Architect/Engineer, or authorities having jurisdiction are not limited by provisions of this Section.

1.3 RESPONSIBILITIES

A. Contractor Responsibilities: The Contractor shall provide inspections, tests and similar quality control services, specified in individual Specification Sections and required by governing authorities and the Owner.

1. The Contractor shall employ and pay an independent agency approved by the Owner, to perform specified quality control services (materials testing).
2. Retesting: The Contractor is responsible for retesting where results of required inspections, tests or similar services prove unsatisfactory and do not indicate compliance with Contract Document requirements, regardless of whether the original test was the Contractor's responsibility.

a. Cost of retesting construction revised or replaced by the Contractor is the Contractor's responsibility, where required tests were performed on original construction.

3. Associated Services: The Contractor shall cooperate with agencies performing required inspections, tests and similar services and provide reasonable auxiliary services as requested. Notify the agency sufficiently in advance of operations to permit assignment of personnel. Auxiliary services required include but are not limited to:

a. Providing access to the Work and furnishing incidental labor and facilities necessary to facilitate inspections and tests.
b. Taking adequate quantities of representative samples of materials that require testing or assisting the agency in taking samples.
c. Providing facilities for storage and curing of test samples, and delivery of samples to testing laboratories.
d. Providing the agency with a preliminary design mix proposed for use for materials mixes that require control by the testing agency.
e. Security and protection of samples and test equipment at the Project site.

B. Coordination: The Contractor and each agency engaged to perform inspections, tests and similar services shall coordinate the sequence of activities to accommodate required services with a minimum of delay. In addition the Contractor and each agency shall coordinate activities to avoid the necessity of removing and replacing construction to accommodate inspections and tests.

1. The Contractor is responsible for scheduling times for inspections, tests, taking samples and similar activities.

1.4 SUBMITTALS

A. The independent testing agency shall submit a certified written report of each inspection, test or similar service, to the Construction Administration Manager, in duplicate, unless the Contractor is responsible for the service. If the Contractor is responsible for the service, submit a certified written report of each inspection, test or similar service through the Contractor, in duplicate.

1. Submit additional copies of each written report directly to the governing authority, when the authority so directs.
2. Submit one copy to the Owner’s PM and the Construction Administration Manager via e-mail.
3. Report Data: Written reports of each inspection, test or similar service shall include, but not be limited to:

a. Date of issue.
b. Project title and number.
c. Name, address and telephone number of testing agency.
d. Dates and locations of samples and tests or inspections.
e. Names of individuals making the inspection or test.
f. Designation of the Work and test method.
g. Identification of product and Specification Section.
h. Complete inspection or test data.

i. Test results and interpretations of test results.
j. Ambient conditions at the time of sample-taking and testing.
k. Comments or professional opinion as to whether inspected or tested Work complies with Contract Document requirements.
l. Name and signature of laboratory inspector.
m. Recommendations on retesting.

1.5 QUALITY ASSURANCE

A. Qualification for Service Agencies: Engage inspection and testing service agencies, including independent testing laboratories, which are prequalified as complying with "Recommended Requirements for Independent Laboratory Qualification" by the American Council of Independent Laboratories, and which specialize in the types of inspections and tests to be performed.

1. Each independent inspection and testing agency engaged on the Project shall be authorized by authorities having jurisdiction to operate in the State in which the Project is located.

2.00 PRODUCTS (Not Applicable).

3.00 EXECUTION

3.1 REPAIR AND PROTECTION

A. General: Upon completion of inspection, testing, sample-taking and similar services, repair damaged construction and restore substrates and finishes to eliminate deficiencies, including deficiencies in visual qualities of exposed finishes. Comply with Contract Document requirements for "Cutting and Patching."

B. Protect construction exposed by or for quality control service activities, and protect repaired construction.

C. Repair and protection is the Contractor's responsibility, regardless of the assignment of responsibility for inspection, testing or similar services.

END OF SECTION 01 40 00

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SECTION 01 42 00
REFERENCES

1.00 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DEFINITIONS

A. General: Basic Contract definitions are included in the Conditions of the Contract.

B. "Approved": The term "approved," when used in conjunction with Construction Administration Manager's action on Contractor's submittals, applications, and requests, is limited to Construction Administration Manager's duties and responsibilities as stated in the Conditions of the Contract.

C. "Directed": Terms such as "directed," "requested," "authorized," "selected," "approved," "required," and "permitted" mean directed by Construction Administration Manager, requested by Construction Administration Manager, and similar phrases.

D. "Indicated": The term "indicated" refers to graphic representations, notes, or schedules on Drawings; or to other paragraphs or schedules in Specifications and similar requirements in the Contract Documents. Terms such as "shown," "noted," "scheduled," and "specified" are used to help the user locate the reference.

E. "Regulations": The term "regulations" includes laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, as well as rules, conventions, and agreements within the construction industry that control performance of the Work.

F. "Furnish": The term "furnish" means to supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.

G. "Install": The term "install" describes operations at Project site including unloading, temporary storage, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.

H. "Provide": The term "provide" means to furnish and install, complete and ready for the intended use.

I. "Installer": An installer is Contractor or another entity engaged by Contractor, as an employee, subcontractor, or contractor of lower tier, to perform a particular construction operation, including installation, erection, application, and similar operations.

J. The term "experienced," when used with the term "installer," means having successfully completed a minimum of five previous projects similar in size and scope to this Project; being familiar with the special requirements indicated; and having complied with requirements of authorities having jurisdiction.

K. Using a term such as "carpentry" does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter." It also does not imply that requirements specified apply exclusively to tradespeople of the corresponding generic name.

L. "Project site" is the space available for performing construction activities, either exclusively or in conjunction with others performing other work as part of Project. The extent of Project site is shown on the Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.3 INDUSTRY STANDARDS

A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

B. Publication Dates: Comply with standards in effect as of the date of the Contract Documents, unless otherwise indicated.

C. Conflicting Requirements: Where compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer uncertainties and requirements that are different, but apparently equal, to Construction Administration Manager for a decision before proceeding.

1. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of the requirements. Refer uncertainties to Construction Administration Manager for a decision before proceeding.

D. Abbreviations and Names: Abbreviations and acronyms are frequently used in the Specifications and other Contract Documents to represent the name of a trade association, standards-developing organization, authorities having jurisdiction, or other entity in the context of referencing a standard or publication. Where abbreviations and acronyms are used in the Specifications or other Contract Documents, they mean the recognized name of these entities. Refer to Gale Research's "Encyclopedia of Associations" or Columbia Books' "National Trade & Professional Associations of the U.S.," which are available in most libraries.

2.00 PRODUCTS (Not Applicable)

3.00 EXECUTION (Not Applicable)

END OF SECTION 01 42 00

SECTION 01 50 00

TEMPORARY FACILITIES AND CONTROLS

1.00 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes requirements for temporary facilities and controls, including temporary utilities, support facilities, and security and protection facilities.

B. Temporary utilities include, but are not limited to, the following:

1. Sewers and drainage.
2. Water service and distribution.
3. Sanitary facilities, including toilets, wash facilities, and drinking-water facilities.
4. Electric power service.
5. Lighting.
6. Telephone service.

B. Support facilities include, but are not limited to, the following:

1. Project identification and temporary signs.
2. Waste disposal facilities.
3. Field office space to be provided by Owner – see IT Mod Area on the attached plan at the end of this specification section.
4. Staging area (approximately 1650 square feet) to be provided by Owner – see Proposed Staging Area on the attached plan at the end of this specification section.
5. Storage sheds on site require Owner's approval.
6. Construction aids and miscellaneous services and facilities.

C. Security and protection facilities include, but are not limited to, the following:

1. Pest control.
2. Security enclosure and lockup.
3. Barricades, warning signs, and lights.
4. Temporary enclosures.
5. Fire protection.

6. Interim Life Safety measures.

D. Related Sections include the following:

1. Division 1 Section "Submittal Procedures" for procedures for submitting copies of implementation and termination schedule and utility reports.

2. Division 1 Section "Execution Requirements" for progress cleaning requirements.

1.3 DEFINITIONS

A. Permanent Enclosure: As determined by Construction Administration Manager and Architect, permanent or temporary roofing is complete, insulated, and weathertight; exterior walls are insulated and weathertight; and all openings are closed with permanent construction or substantial temporary closures.

1.4 USE CHARGES

A. General: Cost or use charges for temporary facilities are not chargeable to Owner or Construction Administration Manager and shall be included in the Contract Sum. Allow other entities to use temporary services and facilities without cost, including, but not limited to, the following:

1. Owner's construction forces.

2. Occupants of Project.

3. Construction Administration Manager.

4. Architect/Engineer.

5. Testing agencies.

6. Personnel of authorities having jurisdiction.

B. Sewer Service: Provide portable toilets for use by all parties engaged in construction, at Project site.

C. Materials Disposal Service: Pay charges for disposal of materials taken from the site that are not salvaged or recycled.

D. Materials Recycling Service: Pay all expenses and charges for recycling materials taken from the site that are to be recycled.

1.5 SUBMITTALS

A. Temporary Utility Reports: Submit reports of tests, inspections, meter readings, and similar procedures performed on temporary utilities.

B. Implementation and Termination Schedule: Within 15 days of date established for submittal of Contractor's Construction Schedule, submit a schedule indicating implementation and termination of each temporary utility.

C. Temporaty Signs: Submit drawings for all temporary signage, including materials and type of base. Coordinate signage locations with Owner’s Representative.

1.6 QUALITY ASSURANCE

A. Standards: Comply with ANSI A10.6, NECA's "Temporary Electrical Facilities," and NFPA 241.

1. Trade Jurisdictions: Assigned responsibilities for installation and operation of temporary utilities are not intended to interfere with trade regulations and union jurisdictions.

2. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.

B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

1.7 PROJECT CONDITIONS

A. Conditions of Use: The following conditions apply to use of temporary services and facilities by all parties engaged in the Work:

1. Keep temporary services and facilities clean and neat.

2. Relocate temporary services and facilities as required by progress of the Work.

3. All temporary facilities must comply with Section 01 10 00, Paragraph 1.3 A.2.

2.00 PRODUCTS

2.1 MATERIALS

A. General: Provide new materials. Undamaged, previously used materials in serviceable condition may be used if approved by Construction Administration Manager. Provide materials suitable for use intended or as specified below.

B. Water: Potable.

2.2 PROJECT SIGNS

A. Description: Within thirty (30) days from issuance of Notide to Prodeed (Work Project Authorization), Contractor shall construct, erect and maintain at his own expense two (2) 4’-0” high x 8’-0” wide signs, neatly constructed of new lumber and completely painted a minimum of two (2) coats of exterior flat enamel with all letters painted with semi-gloss enamel. Signs shall be placed where directed by the Owner’s/City Project Manager who will furnish a detailed drawing of the sign showing letter and colors. Signs shall bear the name of the project, name of funding source(s), the names of the Construction Administration Manager, Architect/Engineers, Contractor and public city officials. See attachment for general layout. Names of current Council members will be provided by the Owner’s/City AProject Manager at the pre-construction meeting. Installation of the approved project signs must be completed prior to acceptance of the contractor’s first payment application.

B. Material: The signs shall be made of ¾" plywood, grade A-C or better and each shall be mounted on (2) 4" x 4" x 12'-0" posts.

2.3 FIELD OFFICE AND PARKING

A. The Contractor may use a portion of an existing construction field office available at the airport for purpose of serving as the contractor's field office. See attached drawings labeled Airport Infrastructure Modernization Site Locations and Field Office. Contractor may furnish and occupy field office after receipt of notice to proceed work order and before beginning of physical work on the project. Contractor may occupy and maintain the field office until the owner accepts the project. The office will remain the property of the owner upon completion of the project. The Contractor is to immediately repair or restore the field office if it is damaged by the contractor at the contractor's expense unless otherwise damaged through negligence by owner or their representative.

B. Field Office:

1. At the expense of the Contractor, a non-load bearing interior partition wall and door will need to be installed to secure assigned office spaces. See note on Airport Infrastructure Modernization Field Office drawing for wall and door location. Request meeting with Aviation Department project representative at construction trailer prior to installation of wall and door.
2. There will be no cost associated with leasing the field office or providing electrical power.
3. Provide drinking water for personnel; provide potable water in proper dispensing containers.
4. Provide and furnish communication devices and telephone service as required by contractor for the limited purpose of contractor's internal communications.

C. Parking: The Contractor will be provided with parking near the field office for purpose of construction operation:

1. An all-weather parking area situated near the field office at a location to be designated by the Owner. The contractor must NOT have construction material stored in the parking area.

D. Storage: The contractor will be provided with a storage (staging) area inside Building 1316, Hangar 4. See attached drawing labeled Airport Infrastructure Modernization Storage Area.

1. Contractor will need to provide and install fence and gate within building to secure staging area.
2. Store products neatly and orderly onsite, arranged to allow inspection.
3. The storage of materials at this location is limited to items that do not require temperature control. Provide off-site facilities for envi-

ronmental control to maintain products within manufacturers' required limits.

4. No material storage will be allowed outside of the construction area or designated storage without Owner's approval.

2.4 EQUIPMENT

A. General: Provide equipment suitable for use intended.

B. Field Offices: Use of space within the building is prohibited (see paragraph 2.3 above).

C. Fire Extinguishers: Hand carried, portable, UL rated. Provide class and extinguishing agent as indicated or a combination of extinguishers of NFPA-recommended classes for exposures.

1. Comply with NFPA 10 and NFPA 241 for classification, extinguishing agent, and size required by location and class of fire exposure.

D. Self-Contained Toilet Units: Single-occupant units of chemical, aerated recirculation, or combustion type; vented; fully enclosed with a glass-fiber-reinforced polyester shell or similar nonabsorbent material.

E. Drinking-Water Fixtures: Containerized, tap-dispenser, bottled-water drinking-water units, including paper cup supply.

F. Electrical Outlets: Properly configured, NEMA-polarized outlets to prevent insertion of 110- to 120-V plugs into higher-voltage outlets; equipped with ground-fault circuit interrupters, reset button, and pilot light.

G. Power Distribution System Circuits: Where permitted and overhead and exposed for surveillance, wiring circuits, not exceeding 125-V ac, 20-A rating, and lighting circuits may be nonmetallic sheathed cable.

3.00 EXECUTION

3.1 INSTALLATION, GENERAL

A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required.

B. Provide each facility ready for use when needed to avoid delay. Maintain and modify as required. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

A. General: Engage appropriate local utility company to install temporary service or connect to existing service. Where utility company provides only part of the service, provide the remainder with matching, compatible materials and equipment. Comply with utility company recommendations.

1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
2. Provide adequate capacity at each stage of construction. Before temporary utility is available, provide trucked-in services.
3. Obtain easements to bring temporary utilities to Project site where Owner's easements cannot be used for that purpose.

B. Sewers and Drainage: Provide temporary connections to remove effluent that can be discharged lawfully.

1. Filter out excessive soil, construction debris, chemicals, oils, and similar contaminants that might clog sewers or pollute waterways before discharge.
2. Connect temporary sewers to municipal system as directed by sewer department officials.
3. Maintain temporary sewers and drainage facilities in a clean, sanitary condition. After heavy use, restore normal conditions promptly.
4. Provide temporary filter beds, settlement tanks, separators, and similar devices to purify effluent to levels acceptable to authorities having jurisdiction.

C. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking-water fixtures. Comply with regulations and health codes for type, number, location, operation, and maintenance of fixtures and facilities.

1. Disposable Supplies: Provide toilet tissue, paper towels, paper cups, and similar disposable materials for each facility. Maintain adequate supply. Provide covered waste containers for disposal of used material.
2. Toilets: Install self-contained toilet units. Shield toilets to ensure privacy. Provide separate facilities for male and female personnel.
3. Drinking-Water Facilities: Provide bottled-water, drinking-water units.
4. Locate toilets and drinking-water fixtures so personnel need not walk more than 200 feet horizontally to facilities.

D. Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment from that specified that will not have a harmful effect on completed installations or elements being installed.

E. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment from that specified that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.

F. Electric Power Service: Provide weatherproof, grounded electric power service and distribution system of sufficient size, capacity, and power characteristics during construction period. Include meters, transformers, overload-protected disconnecting means, automatic ground-fault interrupters, and main distribution switchgear.

1. Install electric power service underground, unless overhead service must be used.

2. Install power distribution wiring overhead and rise vertically where least exposed to damage.

G. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction until permanent water service is in use. Sterilize temporary water piping before use.

H. Electric Distribution: Provide receptacle outlets adequate for connection of power tools and equipment.

1. Provide waterproof connectors to connect separate lengths of electrical power cords if single lengths will not reach areas where construction activities are in progress. Do not exceed safe length-voltage ratio.

I. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations and traffic conditions.

1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.

2. Install exterior-yard site lighting that will provide adequate illumination for construction operations, traffic conditions, and safety signage visibility when the Work is being performed.

J. Telephone Service: Provide temporary telephone service throughout construction period for common-use facilities used by all personnel engaged in construction activities.

3.3 SUPPORT FACILITIES INSTALLATION

A. Temporary Signs: Signs relating to safety are allowed when coordinated and approved through the Owner's Representative. Project identification signs shall be provided, installed, maintained and (at the completion of the project) removed by the Contractor. Do not permit installation of unauthorized signs.

1. Project identification signs shall have posts embedded a minimum of 3'-0" below ground. Construct these signs per 2.2 above.

2. Prepare temporary signs to provide directional information to construction personnel only where approved by Owner's Representative.

3. Construct temporary signs of exterior-type Grade B-B high-density concrete form overlay plywood in sizes and thicknesses approved. Support on posts or framing of preservative-treated wood or steel. Signs are not to penetrate asphalt or concrete surfaces. Provide removable bases for these locations as approved through Owner's Representative.

4. Paint sign panel and applied graphics with exterior-grade alkyd gloss enamel over exterior primer.

B. Project identification signs shall be provided, installed, maintained and (at the completion of the project) removed by the Contractor.

1. Project identification signs shall have posts embedded a minimum of 3'-0" below ground. Construct these and locate these signs per 2.2 above.

C. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Containerize and clearly label hazardous, dangerous, or unsanitary waste materials separately from other waste. Comply with Division 1 Section "Execution Requirements" for progress cleaning requirements.

1. If required by authorities having jurisdiction, provide separate containers, clearly labeled, for each type of waste material to be deposited.

2. Develop a waste management plan for Work performed on Project. Indicate types of waste materials Project will produce and estimate quantities of each type. Provide detailed information for on-site waste storage and separation of recyclable materials. Provide information on destination of each type of waste material and means to be used to dispose of all waste materials.

3. Comply with Section 01 10 00, paragraph 1.3 A.2.

D. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment involved, including temporary utility services. Sheds may be open shelters or fully enclosed spaces within building when approved by Owner, or elsewhere on-site in areas approved by the Owner.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Security Enclosure and Lockup: Install substantial temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security.

B. Temporary Fire Protection: Until fire-protection needs are supplied by permanent facilities, install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241.

1. Provide fire extinguishers, installed on walls on mounting brackets, visible and accessible from space being served, with sign mounted above.

2. Field Offices: Class A stored-pressure water-type extinguishers.

3. Other Locations: Class ABC dry-chemical extinguishers or a combination of extinguishers of NFPA-recommended classes for exposures.

4. Locate fire extinguishers where convenient and effective for their intended purpose.

5. Store combustible materials in containers in fire-safe locations.

6. Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire-protection facilities, and other access routes for firefighting. Prohibit smoking as required in Section 01 10 00, paragraph 1.3 A.1.

7. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition.

8. Permanent Fire Protection: At earliest feasible date in each area of Project, complete installation of permanent fire-protection facility, including connected services, and place into operation and use. Instruct key personnel on use of facilities.

9. Develop and supervise an overall fire-prevention and first-aid fire-protection program for personnel at Project site. Establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.

3.5 OPERATION, TERMINATION, AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.

B. Maintenance: Maintain facilities in good operating condition until removal. Protect from damage caused by freezing temperatures and similar elements.

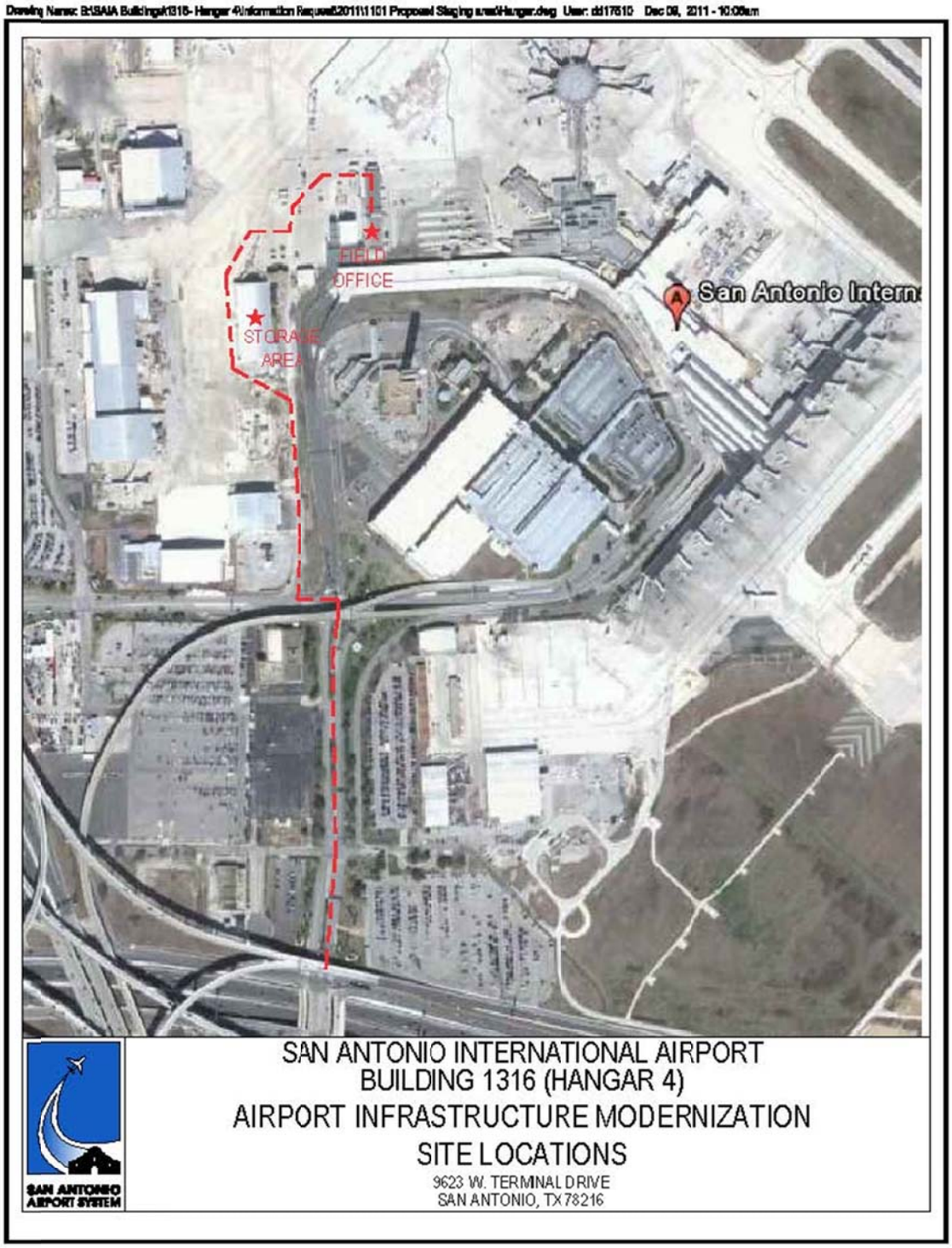
1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.

2. Prevent water-filled piping from freezing. Maintain markers for underground lines. Protect from damage during excavation operations.

C. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

1. Materials and facilities that constitute temporary facilities are the property of Contractor.

2. At Substantial Completion, clean and renovate permanent facilities used during construction period. Comply with final cleaning requirements in Division 1 Section "Closeout Procedures."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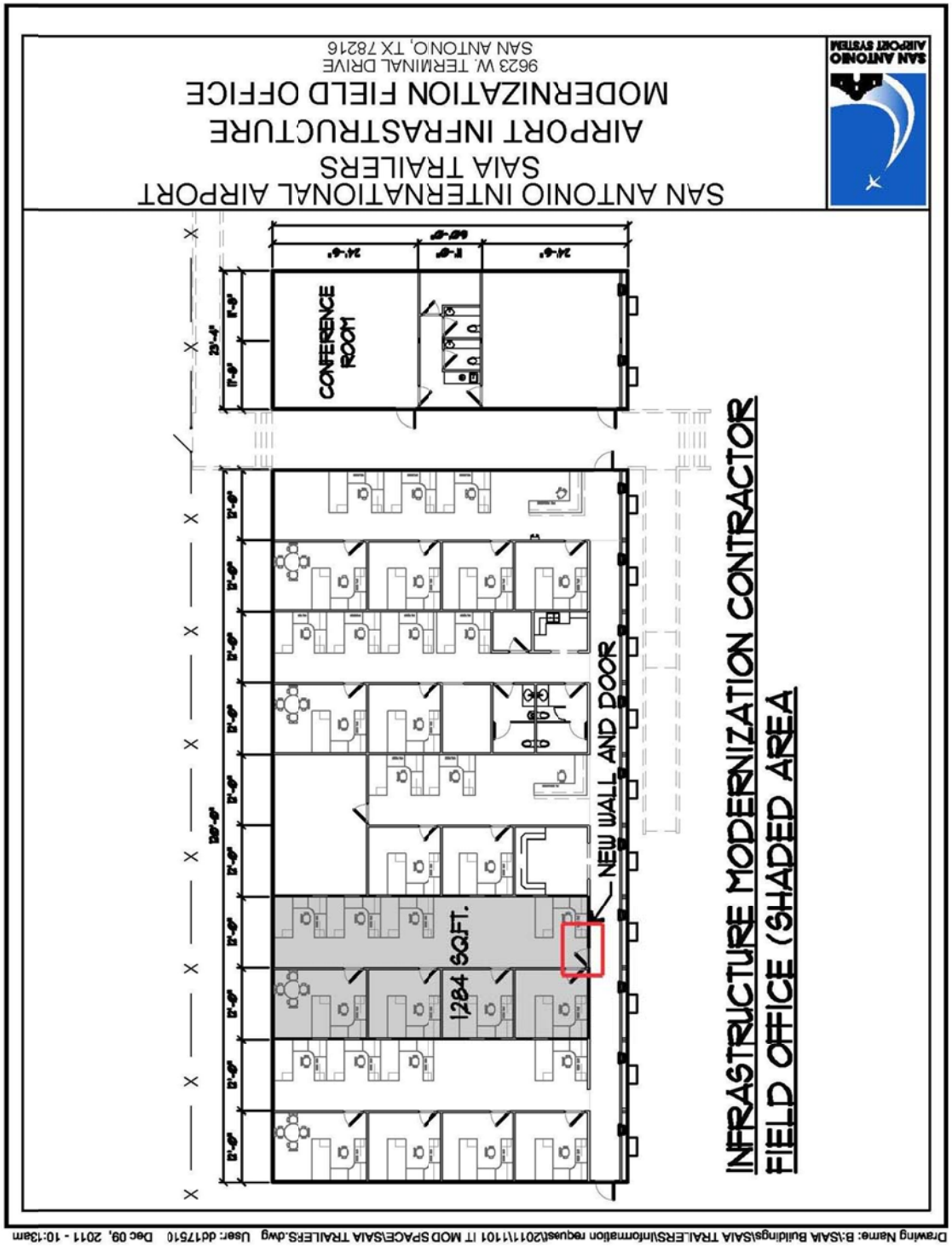
STORAGE AREA
San Antonio Intern
SAN ANTONIO INTERNATIONAL AIRPORT
BUILDING 1316 (HANGAR 4)
AIRPORT INFRASTRUCTURE MODERNIZATION
SITE LOCATIONS
9623 W. TERMINAL DRIVE
SAN ANTONIO, TX 78216
SAN ANTONIO AIRPORT SYSTEM


SAN ANTONIO INTERNATIONAL AIRPORT
SAIA TRAILERS
AIRPORT INFRASTRUCTURE
MODERNIZATION FIELD OFFICE
9623 W. TERMINAL DRIVE
SAN ANTONIO, TX 78216
SAN ANTONIO AIRPORT SYSTEM
INFRASTRUCTURE MODERNIZATION CONTRACTOR
FIELD OFFICE (SHADED AREA
1284 SQFT.
NEW WALL AND DOOR
CONFERENCE ROOM
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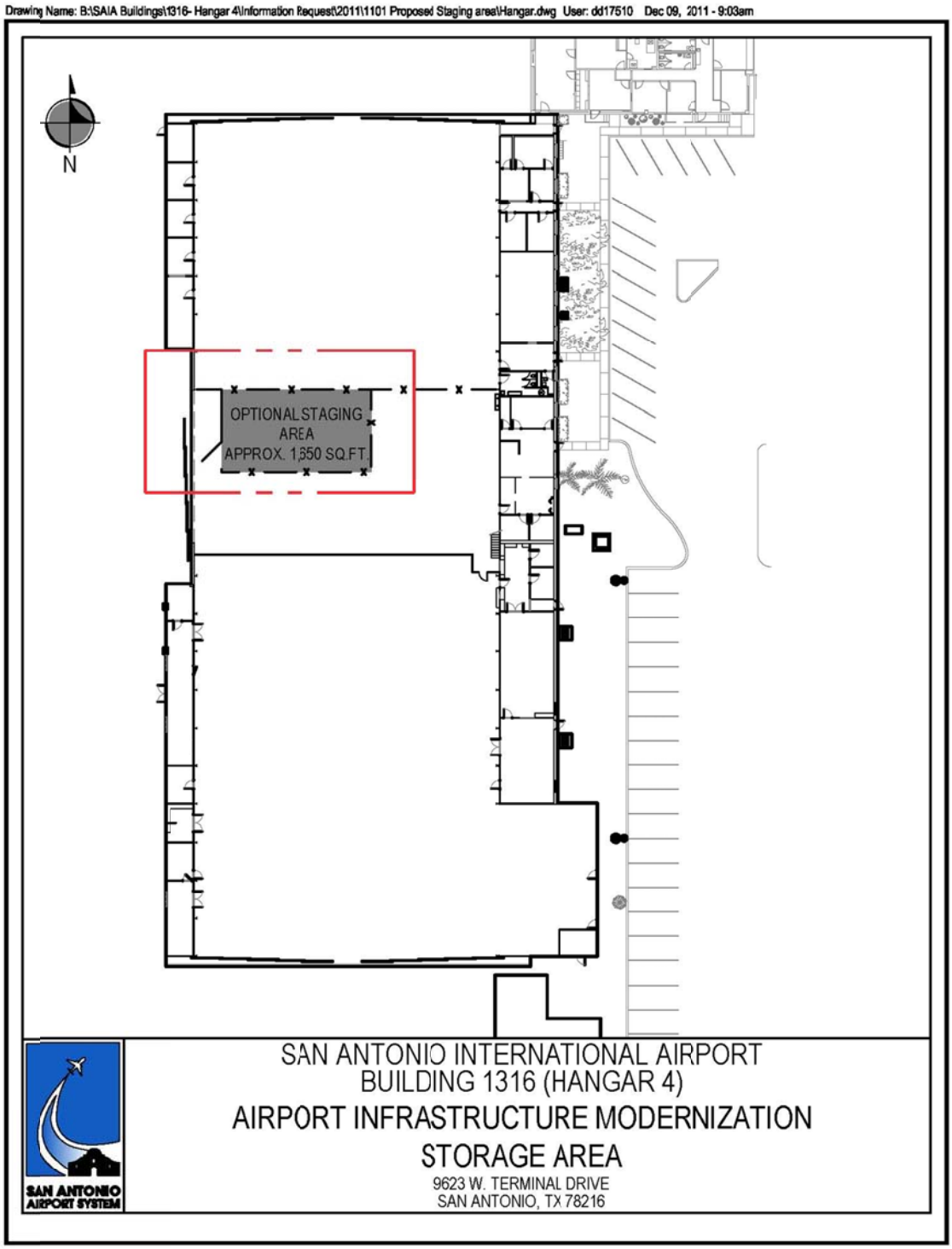
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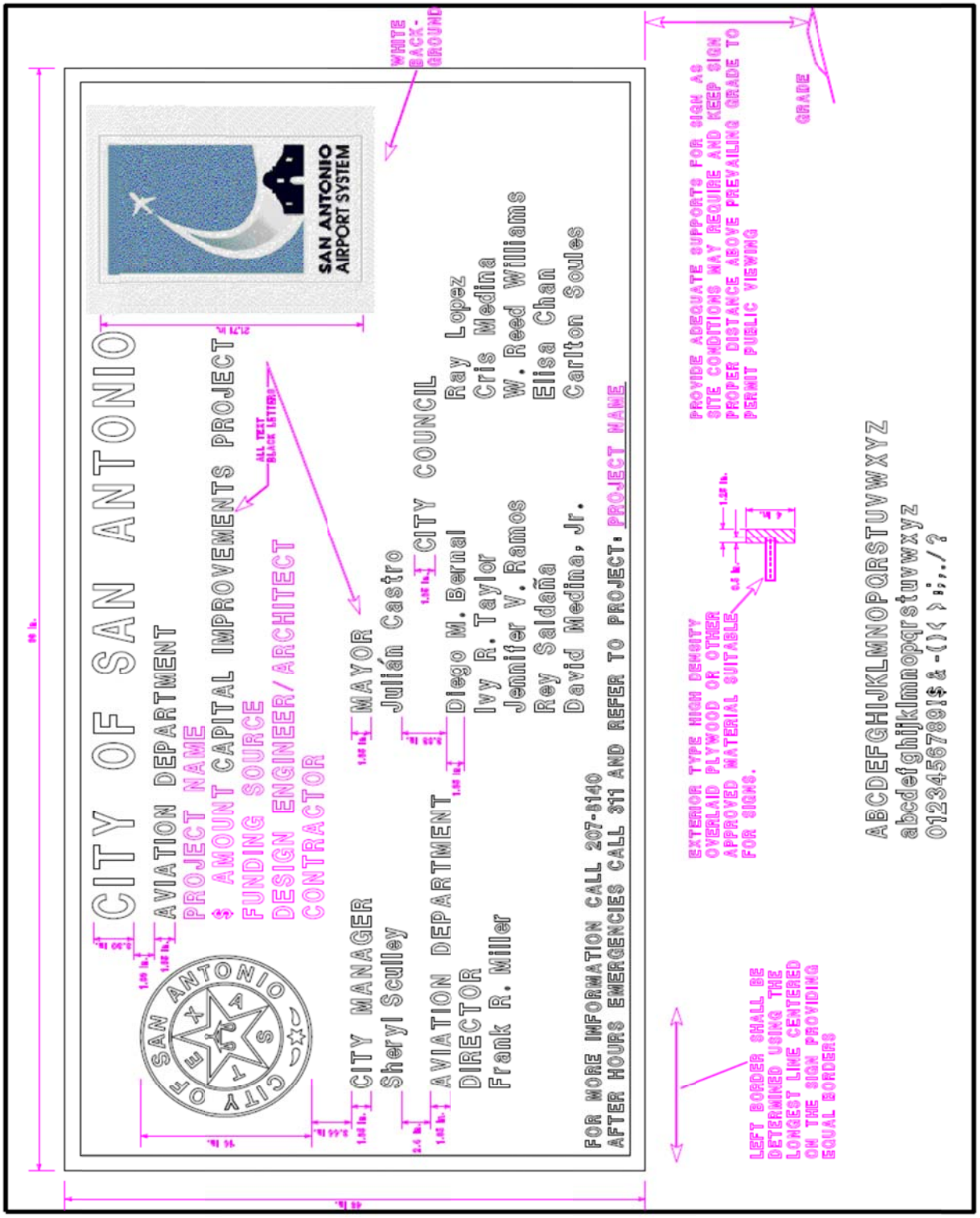
N
OPTIONAL STAGING AREA
APPROX. 1,350 SQ.FT.
SAN ANTONIO INTERNATIONAL AIRPORT
BUILDING 1316 (HANGAR 4)
AIRPORT INFRASTRUCTURE MODERNIZATION
STORAGE AREA
9623 W. TERMINAL DRIVE
SAN ANTONIO, TX 78216
SAN ANTONIO AIRPORT SYSTEM



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SECTION 01 60 00
MATERIALS AND EQUIPMENT

1.00 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section specifies administrative and procedural requirements governing the Contractor's selection of products for use in the Project.

B. The Contractor's Construction Schedule and the Schedule of Submittals are included under Section "Submittals."

C. Standards: Refer to Section "Definitions and Standards" for applicability of industry standards to products specified.

1.3 DEFINITIONS

A. Definitions used in this Article are not intended to change the meaning of other terms used in the Contract Documents, such as "specialties," "systems," "structure," "finishes," "accessories," and similar terms. Such terms are self-explanatory and have well recognized meanings in the construction industry.

1. "Products" are items purchased for incorporation in the Work, whether purchased for the Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.

   a. "Named Products" are items identified by manufacturer's product name, including make or model designation, indicated in the manufacturer's published product literature, that is current as of the date of the Contract Documents.

2. "Materials" are products that are substantially shaped, cut, worked, mixed, finished, refined or otherwise fabricated, processed, or installed to form a part of the Work.
3. "Equipment" is a product with operational parts, whether motorized or manually operated, that requires service connections such as wiring or piping.

1.4 SUBMITTALS

A. Product List Schedule: Prepare a schedule showing products specified in a tabular form acceptable to the Construction Administration Manager. Include generic names of products required. Include the manufacturer's name and proprietary product names for each item listed.

1. Coordinate the product list schedule with the Contractor's Construction Schedule and the Schedule of Submittals.
2. Completed Schedule: Within 60 days after date of commencement of the Work, submit via e-mail the completed product list schedule.

Provide a written explanation for omissions of data, and for known variations from Contract requirements.

3. Construction Administration Manager's Action: The Construction Administration Manager will respond in writing to the Contractor within 2 weeks of receipt of the completed product list schedule. No response within this time period constitutes no objection to listed manufacturers or products, but does not constitute a waiver of the requirement that products comply with Contract Documents. The Construction Administration Manager's response will include the following:

   a. A list of unacceptable product selections, containing a brief explanation of reasons for this action.

1.5 QUALITY ASSURANCE

A. Source Limitations: To the fullest extent possible, provide products of the same kind, from a single source.

1. When specified products are available only from sources that do not or cannot produce a quantity adequate to complete project requirements in a timely manner, consult with the Construction Administration Manager for a determination of the most important product qualities before proceeding. Qualities may include attributes relating to visual appearance, strength, durability, or compatibility. When a determination has been made, select products from sources that produce products that possess these qualities, to the fullest extent possible.

B. Compatibility of Options: When the Contractor is given the option of selecting between two or more products for use on the Project, the product selected shall be compatible with products previously selected, even if previously selected products were also options.

C. Nameplates: Except for required labels and operating data, do not attach or imprint manufacturer's or producer's nameplates or trademarks on exposed surfaces of products which will be exposed to view in occupied spaces or on the exterior.

1. Labels: Locate required product labels and stamps on a concealed surface or, where required for observation after installation, on an accessible surface that is not conspicuous.
2. Equipment Nameplates: Provide a permanent nameplate on each item of service-connected or power-operated equipment. Locate on an easily accessible surface which is inconspicuous in occupied spaces. The nameplate shall contain the following information and other essential operating data:

   a. Name of product and manufacturer.
   b. Model and serial number.
   c. Capacity.
   d. Speed.
   e. Ratings.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store and handle products in accordance with the manufacturer's recommendations, using means and methods that will prevent damage, deterioration and loss, including theft.

1. Schedule delivery to minimize long-term storage at the site and to prevent overcrowding of construction spaces.
2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft and other losses.
3. Deliver products to the site in the manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting and installing.
4. Inspect products upon delivery to ensure compliance with the Contract Documents, and to ensure that products are undamaged and properly protected.
5. Store products at the site in a manner that will facilitate inspection and measurement of quantity or counting of units.
6. Store heavy materials away from the Project structure in a manner that will not endanger the supporting construction.
7. Store products subject to damage by the elements above ground, under cover in a weathertight enclosure, with ventilation adequate to prevent condensation. Maintain temperature and humidity within range required by manufacturer's instructions.

2.00 PRODUCTS

2.1 PRODUCT SELECTION

A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, unused at the time of installation.

1. Provide products complete with all accessories, trim, finish, safety guards and other devices and details needed for a complete installation and for the intended use and effect.
2. Standard Products: Where available, provide standard products of types that have been produced and used successfully in similar situations on other projects.

B. Product Selection Procedures: Product selection is governed by the Contract Documents and governing regulations, not by previous Project experience. Procedures governing product selection include the following:

1. Proprietary Specification Requirements: Where only a single product or manufacturer is named and no "or equal" statement is made, provide the product indicated. No substitutions will be permitted.
2. Semiproprietary Specification Requirements: Where two or more products or manufacturers are named and no "or equal" statement is made, provide one of the products indicated. No substitutions will be permitted.

   a. Where products or manufacturers are specified by name, accompanied by the term "or equal," or "or approved equal" comply with the Contract Document provisions concerning "substitutions" to obtain approval for use of an unnamed product.

3. Non-Proprietary Specifications: When the Specifications list “Basis of Design”, products or manufacturers that are available and may be incorporated in the Work, but do not restrict the Contractor to use of these products only, the Contractor may propose any available product that complies with Contract requirements. Comply with Contract Document provisions concerning "substitutions" to obtain approval for use of an unnamed product.
4. Descriptive Specification Requirements: Where Specifications describe a product or assembly, listing exact characteristics required, with or without use of a brand or trade name, provide a product or assembly that provides the characteristics and otherwise complies with Contract requirements.
5. Performance Specification Requirements: Where Specifications require compliance with performance requirements, provide products that comply with these requirements, and are recommended by the manufacturer for the application indicated. General overall performance of a product is implied where the product is specified for a specific application.
    a. Manufacturer's recommendations may be contained in published product literature, or by the manufacturer's certification of performance.
6. Compliance with Standards, Codes and Regulations: Where the Specifications only require compliance with an imposed code, standard or regulation, select a product that complies with the standards, codes or regulations specified.
7. Visual Matching: Where Specifications require matching an established Sample, the Construction Administration Manager's decision will be final on whether a proposed product matches satisfactorily.
    a. Where no product available within the specified category matches satisfactorily and also complies with other specified requirements, comply with provisions of the Contract Documents concerning "substitutions" for selection of a matching product in another product category, or for noncompliance with specified requirements.
8. Visual Selection: Where specified product requirements include the phrase "...as selected from manufacturer's standard colors, patterns, textures..." or a similar phrase, select a product and manufacturer that complies with other specified requirements. The Construction Administration Manager will select the color, pattern and texture from the product line selected.

2.2 SUBSTITUTIONS

A. Substitutions Requests Submittal: Requests for substitution will be considered if received within 60 days of the Contract award date. Requests received after the 60 day grace period may be considered or rejected at the discretion of the Construction Administration Manager.

1. Request for substitution must document to the Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities the Owner must assume.

2. Submit via e-mail each request for substitution for consideration. Submit requests in the form and in accordance with procedures required for Change Order proposals.
3. Identify the product, or the fabrication or installation method to be replaced in each request. Include related Specification Section and Drawing numbers. Provide complete documentation showing compliance with the requirements for substitutions, and the following information, as appropriate:

    a. Product Data, including Drawings and descriptions of products, fabrication and installation procedures.
    b. Samples, where applicable or requested.
    c. A detailed comparison of significant qualities of the proposed substitution with those of the Work specified. Significant qualities may include elements such as size, weight, durability, performance and visual effect.
    d. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by the Owner and separate Contractors, that will become necessary to accommodate the proposed substitution.
    e. A statement indicating the substitution's effect on the Contractor's Construction Schedule compared to the schedule without approval of the substitution. Indicate the effect of the proposed substitution on overall Contract Time.
    f. Cost information, including a proposal of the net change, in the Contract Sum.
    g. Certification by the Contractor that the substitution proposed is equal-to or better in every significant respect to that required by the Contract Documents, and that it will perform adequately in the application indicated. Include the Contractor's waiver of rights to additional payment or time, that may subsequently become necessary because of the failure of the substitution to perform adequately.

B. Review Period for Substitutions: The Architect/Engineer will require one (1) week to review substitution submittals after received from the Construction Administration Manager.

C. Conditions Of Substitutions: The Contractor's substitution request will be received and considered by the Construction Administration Manager and Architect/Engineer when the following conditions are satisfied, as determined by the Construction Administration Manager; otherwise requests will be returned without action except to record noncompliance with these requirements.

1. Extensive revisions to Contract Documents are not required.
2. Proposed changes are in keeping with the general intent of Contract Documents.
3. The request is timely, fully documented and properly submitted.
4. The request is directly related to an "or equal" clause or similar language in the Contract Documents.
5. The specified product or method of construction cannot be provided within the Contract Time. The request will not be considered if the product or method cannot be provided as a result

of failure to pursue the Work promptly or coordinate activities properly.

6. The specified product or method of construction cannot be provided in a manner that is compatible with other materials, and where the Contractor certifies that the substitution will overcome the incompatibility.
7. The specified product or method of construction cannot be coordinated with other materials, and where the Contractor certifies that the proposed substitution can be coordinated.
8. Contractor is required to document all efforts to secure the required product, material or method, including earliest date effort began.

D. The Contractor's submittal and Construction Administration Manager's acceptance of Shop Drawings, Product Data or Samples that relate to construction activities not complying with the Contract Documents does not constitute an acceptable or valid request for substitution, nor does it constitute approval.

3.00 EXECUTION

3.1 INSTALLATION OF PRODUCTS

A. Comply with manufacturer's instructions and recommendations for installation of products in the applications indicated. Anchor each product securely in place, accurately located and aligned with other Work.

1. Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

END OF SECTION 01 60 00

SECTION 01 73 00
EXECUTION REQUIREMENTS

1.00 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes general procedural requirements governing execution of the Work including, but not limited to, the following:

1. Construction layout.
2. Field engineering and surveying.
3. General construction.
4. Coordination of Owner-removed items.
5. Progress cleaning.
6. Protection of adjacent construction.

B. Related Sections include the following:

1. Division 1 Section "Project Management and Coordination" for procedures for coordinating field engineering with other construction activities.
2. Division 1 Section "Submittal Procedures" for submitting surveys.

1.3 SUBMITTALS

A. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.

2.00 PRODUCTS (Not Applicable)

3.00 EXECUTION

3.1 EXAMINATION

A. Existing Conditions: The existence and location of utilities, and other construction indicated as existing are not guaranteed. Before beginning work, investigate and verify the existence and location of mechanical and electrical systems and other construction affecting the Work.

1. Before construction, verify the location and points of connection of utility services.

B. Existing Utilities: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning work, investigate and verify the existence and location of utilities and other construction affecting the Work.

1. Before construction, verify the location and invert elevation at points of connection of storm sewer, and water-service piping; and electrical services.
2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

C. Acceptance of Conditions: Examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

1. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:

a. Description of the Work.
b. List of detrimental conditions, including substrates.
c. List of unacceptable installation tolerances.
d. Recommended corrections.

3.2 PREPARATION

A. Existing Utility Information: Furnish information to Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

B. Existing Utility Interruptions: 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 Owner not less than 21 days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Architect's and Owner's written permission. E-mail qualifies for “written” approval.

C. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information (RFI) to Construction Administration Manager. Include a detailed description of problem encountered, together with recommendations for changing the Contract Documents.

3.3 LAYOUT

A. Verification: Before proceeding with construction, verify layout information shown on Drawings. If discrepancies are discovered, notify Construction Administration Manager promptly.

B. Building Lines and Levels: Locate and lay out control lines and levels for structures, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels.

3.4 FIELD ENGINEERING

A. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.

1. Do not change or relocate existing benchmarks or control points without prior written approval of Construction Administration Manager. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent

benchmarks or control points to Construction Administration Manager before proceeding.

2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.

3.5 PROTECTION OF ITEMS TO REMAIN

A. Provide final protection and maintain conditions that ensure items to remain are without damage at time of Substantial Completion.

END OF SECTION 01 73 00

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SECTION 01 73 29
CUTTING AND PATCHING

1.00 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes procedural requirements for cutting and patching.

B. Related Sections include the following:

1. Divisions 2 through 41 Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.

1.3 DEFINITIONS

A. Cutting: Removal of existing construction necessary to permit installation or performance of other Work.

B. Patching: Fitting and repair work required to restore surfaces to original conditions after installation of other Work.

1.4 QUALITY ASSURANCE

A. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio.

B. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.

C. Miscellaneous Elements: Do not cut and patch the following elements or related components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.

1. Water, moisture, or vapor barriers.
2. Membranes and flashings.
3. Exterior fenestration construction.
4. Equipment supports.
5. Piping, ductwork, vessels, and equipment.
6. Noise- and vibration-control elements and systems.

D. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in Construction Administration Manager’s or the Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

2.00 PRODUCTS

2.1 MATERIALS

A. General: Comply with requirements specified in other Sections of these Specifications.

3.00 EXECUTION

3.1 EXAMINATION

A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.

1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

3.2 PREPARATION

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

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

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

D. Existing Services: Where existing services are required to be removed, relocated, or abandoned, bypass such services before cutting to avoid interruption of services to occupied areas.

3.3 PERFORMANCE

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

1. Cut existing construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

B. Cutting: Cut existing construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
2. Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.

3. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
4. Proceed with patching after construction operations requiring cutting are complete.

C. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections of these Specifications.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.

   a. Where patching occurs in a painted surface, apply primer and intermediate paint coats over the patch and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.

4. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition.

END OF SECTION 01 73 29

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SECTION 01 77 00
CLOSEOUT PROCEDURES

1.00 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:

1. Inspection procedures.
2. Project Record Documents.

B. Related Sections include the following:

1. Division 1 Section "Progress Documentation" for submitting Final Completion construction photographs and digital files.
2. Division 1 Section "Execution Requirements" for progress cleaning of Project site.

1.3 SUBSTANTIAL COMPLETION

A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete in request.

1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
2. Prepare and submit Project Record Documents, operation and maintenance manuals, damage or settlement surveys, property surveys, and similar final record information.
3. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.

B. Inspection: Submit a written request for inspection for Substantial Completion. On receipt of request, Construction Administration Manager will either proceed with inspection or notify Contractor of unfulfilled requirements. Construction Administration Manager 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 Construction Administration Manager, 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.

1.4 FINAL COMPLETION

A. Preliminary Procedures: Before requesting final inspection for determining date of Final Completion, complete the following:

1. Submit a final Application for Payment according to Division 1 Section "Payment Procedures."
2. Submit certified copy of Construction Administration Manager's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Construction Administration Manager. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.

1.5 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

A. Preparation: Submit list via e-mail. 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. Include the following information at the top of each page:

a. Project name.
b. Date.
c. Name of Construction Administration Manager.
d. Name of Contractor.
e. Page number.

2.00 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.

3.00 EXECUTION

3.1 FINAL CLEANING

A. General: Provide 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 a Class ‘A’ commercial office 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 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. Remove tools, construction equipment, machinery, and surplus material from Project site.

C. Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from Project site and dispose of lawfully.

END OF SECTION 01 77 00

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SECTION 01 78 23
OPERATION AND MAINTENANCE DATA

1.00 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:

1. Operation and maintenance documentation directory.
2. Emergency manuals.
3. Operation manuals for systems, subsystems, and equipment.
4. Maintenance manuals for the care and maintenance of products, finishes, and systems and equipment.

B. Related Sections include the following:

1. Division 1 Section "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
2. Division 1 Section "Closeout Procedures" for submitting operation and maintenance manuals.
3. Division 1 Section "Project Record Documents" for preparing Record Drawings for operation and maintenance manuals.
4. Divisions 2 through 41 Sections for specific operation and maintenance manual requirements for products in those Sections.

1.3 DEFINITIONS

A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.

B. Subsystem: A portion of a system with characteristics similar to a system.

1.4 SUBMITTALS

A. Initial Submittal: Submit 2 draft copies of each manual at least 15 days before requesting inspection for Substantial Completion. Include a complete operation and maintenance directory. Construction Administration Manager will return 1 copy of draft and mark whether general scope and content of manual are acceptable.

B. Final Submittal: Submit 1 copy of each manual in final form at least 15 days before final inspection. Construction Administration Manager will return copy with comments within 15 days after final inspection.

1. Correct or modify each manual to comply with Construction Administration Manager's comments. Submit 4 copies of each corrected manual within 15 days of receipt of Construction Administration Manager's comments. Construction Administration Manager will retain a copy and forward 3 copies to the Owner.

1.5 COORDINATION

A. Where operation and maintenance documentation includes information on installations by more than one factory-authorized service representative, assemble and coordinate information furnished by representatives and prepare manuals.

2.00 PRODUCTS

2.1 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

A. Organization: Include a section in the directory for each of the following:

1. List of documents.
2. List of systems.
3. List of equipment.
4. Table of contents.

B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.

C. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.

D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with the same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4,"Preparation of Operating and Maintenance Documentation for Building Systems."

2.2 MANUALS, GENERAL

A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:

1. Title page.
2. Table of contents.
3. Manual contents.

B. Title Page: Enclose title page in transparent plastic sleeve. Include the following information:

1. Subject matter included in manual.
2. Name and address of Project.
3. Name and address of Owner.
4. Date of submittal.
5. Name, address, and telephone number of Contractor.
6. Name and address of Construction Administration Manager.
7. Cross-reference to related systems in other operation and maintenance manuals.
8. Date of substantial completition.

C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.

1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.

D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.

1. Binders: Heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.

a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.

2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
3. Supplementary Text: Prepared on 8-1/2-by-11-inch, 20-lb/sq. ft. white bond paper.
4. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.

a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.

2.3 EMERGENCY MANUALS

A. Content: Organize manual into a separate section for each of the following:

1. Type of emergency.
2. Emergency instructions.
3. Emergency procedures.

B. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:

1. Fire.
2. Flood.
3. Gas leak.

4. Water leak.
5. Power failure.
6. Water outage.
7. System, subsystem, or equipment failure.
8. Chemical release or spill.

C. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.

D. Emergency Procedures: Include the following, as applicable:

1. Instructions on stopping.
2. Shutdown instructions for each type of emergency.
3. Operating instructions for conditions outside normal operating limits.
4. Required sequences for electric or electronic systems.
5. Special operating instructions and procedures.

2.4 OPERATION MANUALS

A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:

1. System, subsystem, and equipment descriptions.
2. Performance and design criteria if Contractor is delegated design responsibility.
3. Operating standards.
4. Operating procedures.
5. Operating logs.
6. Wiring diagrams.
7. Control diagrams.
8. Piped system diagrams.
9. Precautions against improper use.
10. License requirements including inspection and renewal dates.

B. Descriptions: Include the following:

1. Product name and model number.
2. Manufacturer's name.
3. Equipment identification with serial number of each component.
4. Equipment function.
5. Operating characteristics.
6. Limiting conditions.
7. Performance curves.
8. Engineering data and tests.
9. Complete nomenclature and number of replacement parts.

C. Operating Procedures: Include the following, as applicable:

1. Startup procedures.
2. Equipment or system break-in procedures.
3. Routine and normal operating instructions.
4. Regulation and control procedures.
5. Instructions on stopping.
6. Normal shutdown instructions.
7. Seasonal and weekend operating instructions.

8. Required sequences for electric or electronic systems.
9. Special operating instructions and procedures.

D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

2.5 PRODUCT MAINTENANCE MANUAL

A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.

B. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.

C. Product Information: Include the following, as applicable:

1. Product name and model number.
2. Manufacturer's name.
3. Color, pattern, and texture.
4. Material and chemical composition.
5. Reordering information for specially manufactured products.

D. Maintenance Procedures: Include manufacturer's written recommendations and the following:

1. Inspection procedures.
2. Types of cleaning agents to be used and methods of cleaning.
3. List of cleaning agents and methods of cleaning detrimental to product.
4. Schedule for routine cleaning and maintenance.
5. Repair instructions.

E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

2.6 SYSTEMS AND EQUIPMENT MAINTENANCE MANUAL

A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.

B. Source Information: List each system, subsystem, and piece of equipment included in the manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.

C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:

1. Standard printed maintenance instructions and bulletins.
2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
3. Identification and nomenclature of parts and components.
4. List of items recommended to be stocked as spare parts.

D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:

1. Test and inspection instructions.
2. Troubleshooting guide.
3. Precautions against improper maintenance.
4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
5. Aligning, adjusting, and checking instructions.
6. Demonstration and training DVD, if available.

E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.

1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.

F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.

G. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

3.00 EXECUTION

3.1 MANUAL PREPARATION

A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.

B. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.

C. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.

1. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

D. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data includes more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.

1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.

E. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in Record Drawings to ensure correct illustration of completed installation.

1. Do not use original Project Record Documents as part of operation and maintenance manuals.
2. Comply with requirements of newly prepared Record Drawings in Division 1 Section "Project Record Documents."

F. Comply with Division 1 Section "Closeout Procedures" for the schedule for submitting operation and maintenance documentation.

END OF SECTION 01 78 23

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SECTION 01 78 39
PROJECT RECORD DOCUMENTS

1.00 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for Project Record Documents.

B. Project Record Documents required include the following:

1. Marked-up prints of Contract Drawings.
2. Marked-up copies of Shop Drawings.
3. Newly prepared drawings.
4. Marked-up copies of Specifications, addenda, and Change Orders.
5. Marked-up Product Data submittals.
6. Record Samples.

C. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 1 Section "Submittals" specifies general requirements for preparing and submitting Project Record Documents.
2. Division 1 Section "Contract Closeout" specifies general closeout requirements.
3. Divisions 3 through 41 Sections for specifying Project Record Document requirements for specific pieces of equipment or building operating systems.

D. Maintenance of Documents and Samples: Store record documents and Samples in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition. Make documents and samples available at all times for the Construction Administration Manager's inspections.

1.3 RECORD DRAWINGS

A. Markup Procedure: During construction, maintain a set of full-size prints of Contract Drawings and Shop Drawings for Project Record Document purposes.

1. Mark these Drawings to show the actual installation where the installation varies from the installation shown originally. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later. Items required to be marked include, but are not limited to, the following:

a. Dimensional changes to the Drawings.
b. Revisions to details shown on the Drawings.
c. Revisions to routing of piping and conduits.

d. Revisions to electrical circuitry.
e. Actual equipment locations.
f. Locations of concealed internal utilities.
g. Changes made by change order or Construction Change Directive.
h. Changes made following the Construction Administration Manager's written orders.
i. Details not on original Contract Drawings.

2. Mark record prints of Contract Drawings and Shop Drawings, completely and accurately. Where Shop Drawings are marked, show cross-reference on Contract Drawings location.
3. Mark record sets with red erasable colored pencil. Use other colors to distinguish between changes for different categories of the Work at the same location.
4. Mark important additional information that was either shown schematically or omitted from original Drawings.
5. Note Construction Change Directive numbers, alternate numbers, change-order numbers, and similar identification.

B. Responsibility for Markup: The individual or entity who obtained record data, whether the individual or entity is the Installer, subcontractor, or similar entity, shall prepare the markup on record drawings.

1. Accurately record information in an understandable drawing technique.
2. Record data as soon as possible after obtaining it. Record and check the markup prior to enclosing concealed installations.

C. Preparation of Mark-Up Prints: Immediately prior to inspecting Certification of Substantial Completion, review completed marked-up record drawings with the Construction Administration Manager and Architect/Engineer. When authorized, prepare a full set of mark-up Contract Drawings and Shop Drawings.

1. Refer instances of uncertainty to the Construction Administration Manager for resolution.
2. The Contractor is responsible for printing copies of the marked-up prints and other drawings as required.

a. The Contractor for General Construction is responsible for printing and distributing copies of the marked-up prints where the Drawing covers installations of other prime contractors and that of the Contractor for General Construction.

3. Review of Mark-Up Prints: Before copying and distributing, submit a copy of the corrected prints to the Construction Administration Manager for review. When acceptable, the Construction Administration Manager will initial and date the copy. Acceptance by the Construction Administration Manager indicates acceptance of general scope of changes, additional information recorded, and of the quality of drafting.

a. The Construction Administration Manager will return the copy of the marked-up prints to the Contractor for organizing into sets, copying, binding, and final submittal.

b. Final submittal to include an electronic copy (prepared by the Contractor) in pdf format of each drawing, whether or not changes and additional information were recorded.

D. Copies and Distribution: After completing the preparation of record drawings, make 5 prints of each drawing and 6 electronic copies (CD or flash drive), whether or not changes and additional information were recorded. Organize the copies into manageable sets. Bind each set with durable-paper cover sheets. Include appropriate identification, including titles, dates, and other information on the cover sheets.

1. Organize and bind original marked-up set of prints that were maintained during the construction period in the same manner.
2. Place these sets in durable tube-type drawing containers with end caps. Mark the end cap of each container with suitable identification.
3. Submit the marked-up record set, 3 copy sets, and 4 electronic copies (CD or flash drive) to the Construction Administration Manager for the Owner's records; the Construction Administration Manager and the Architect will each retain 1 copy set and one electronic copy of all record documents.

1.4 RECORD SPECIFICATIONS

A. During the construction period, maintain 3 copies of the Project Specifications, including addenda and modifications issued, for Project Record Document purposes.

1. Mark the Specifications to indicate the actual installation where the installation varies from that indicated in Specifications and modifications issued. Note related project record drawing information, where applicable. Give particular attention to substitutions, selection of product options, and information on concealed installations that would be difficult to identify or measure and record later.

2. Record the name of the manufacturer, supplier, installer, and other information necessary to provide a record of selections made and to document coordination with record Product Data submittals and maintenance manuals.

3. Note related record Product Data, where applicable. For each principal product specified, indicate whether record Product Data has been submitted in maintenance manual instead of submitted as record Product Data.

4. Upon completion of markup, submit record Specifications to the Construction Administration Manager for the Owner's records. Include record specifications in pdf format on CD or flash drive with Record Drawings.

5. The Contractor for General Construction is responsible for submitting the complete set of record Specifications as specified.

1.5 RECORD PRODUCT DATA

A. During the construction period, maintain one copy of each Product Data submittal for Project Record Document purposes.

1. Mark Product Data to indicate the actual product installation where the installation varies substantially from that indicated in Product Data submitted. Include significant changes in the product delivered to the site and changes in manufacturer's instructions and recommendations for installation.
2. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
3. Note related Change Orders and markup of record Drawings, where applicable.
4. Upon completion of markup, submit a complete set of record Product Data to the Construction Administration Manager for the Owner's records.
5. Where record Product Data is required as part of maintenance manuals, submit marked-up Product Data as an insert in the manual instead of submittal as record Product Data.

1.6 RECORD SAMPLE SUBMITTAL

A. Immediately prior to date of Substantial Completion meet with the Construction Administration Manager and the Owner's personnel at the site to determine which of the Samples maintained during the construction period shall be transmitted to the Owner for record purposes. Comply with the Construction Administration Manager's instructions for packaging, identification marking, and delivery to the Owner's Sample storage space. Dispose of other Samples in a manner specified for disposing surplus and waste materials.

1.7 MAINTENANCE MANUAL SUBMITTAL

A. When each construction activity that requires submittal of maintenance manuals is nominally complete, but before Substantial Completion, submit maintenance manuals specified.

1. Organize operation and maintenance manuals into suitable sets of manageable size.
2. Bind data into individual binders for each manual, properly identified on front and spine. For large manuals, provide an index sheet and thumb tabs for separate information categories.
3. Provide heavy-duty, 3-ring, vinyl-covered binders, 1 to 2 inch (25 to 50 mm) thick as required to contain information, sized for 8-1/2-by-11-inch (215-by-280-mm) paper with inside pockets or pocket folders for folded sheets.
4. In each maintenance manual, include information specified in individual Specification Sections and the following:

a. Emergency instructions.
b. Spare parts list.
c. Copies of specific warranties.
d. Wiring diagrams.
e. Recommended maintenance procedures and turn-around times.

f. Inspection and system-test procedures.
g. Copies of applicable Shop Drawings and Product Data.
h. Listing of required maintenance materials and services.
i. Names and addresses of sources of maintenance materials.
j. Maintenance drawings and diagrams.
k. Precautions against improper maintenance and exposure.

5. Each prime contractor is responsible for maintenance manuals for its own Work. Where a manual includes information on installations by more than one contract, the Contractor who is the principal source of information, as designated by the Construction Administration Manager, shall receive information from other contractors, coordinate and collate information for a unified manual, and provide binders and submittal as specified.

1.8 MISCELLANEOUS RECORD SUBMITTALS

A. Refer to other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Immediately prior to Substantial Completion, complete miscellaneous records and place in good order, properly identified and bound or filed, ready for use and reference. Submit to the Construction Administration Manager for the Owner's records.

1. Categories of requirements resulting in miscellaneous records include, but are not limited to, the following:

a. Field records on foundations.
b. Field records on underground construction and similar work.
c. Survey showing locations and elevations of underground lines.
d. Invert elevations of drainage piping.
e. Surveys establishing building lines and levels.
f. Authorized measurements utilizing unit prices or allowances.
g. Ambient and substrate condition tests.
h. Certifications received in lieu of labels on bulk products.
i. Batch mixing and bulk delivery records.
j. Testing and qualification of tradesmen.
k. Documented qualification of installation firms.
l. Load and performance testing.
m. Inspections and certifications by governing authorities.
n. Leakage and water-penetration tests.
o. Fire-resistance and flame-spread test results.
p. Final inspection and correction procedures.

2.00 PRODUCTS (Not Applicable)

3.00 EXECUTION

3.1 RECORDING

A. Post changes and modifications to the Documents as they occur. Do not wait until the end of the Project.

END OF SECTION 01 78 39

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SECTION 02 41 19
SELECTIVE DEMOLITION

1.00 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.2 DESCRIPTION OF WORK

A. Extent of selective demolition work is indicated on drawings.

B. Types of Selective Demolition Work: Demolition requires the selective removal and subsequent off site disposal of the following:

1. Portions of building construction indicated on drawings and as required to accommodate new construction.
2. Area of interior partition.
3. Removal of doors and frames indicated "remove".
4. Removal of ceiling tiles indicated "remove".

C. Related work specified elsewhere:

1. Remodeling construction work and patching is included within the respective sections of specifications, including removal of materials for re-use and incorporated into remodeling or new construction.
2. Relocation of pipes, conduits, ducts, other mechanical and electrical work are specified by respective trades.

1.3 HAZARDOUS MATERIALS ABATEMENT

A. All work shall conform to the Contract Documents. The Contractor shall review the Airport’s Terminal 1 Asbestos Survey Report dated May 2011 to determine the areas where asbestos containing materials are noted. Remediation of the floor tile and mastic in Room M040 shall be performed by others prior to this Contract. Do not disturb materials identified as asbestos containing in Survey Report; this includes, but is not limited to, the asbestos containing sealant on the upper wall of the Arrivals Level.

B. Notify the Owner’s Representative and the Construction Administration Manager immediately if an unstable building component and/or a hazardous material is encountered that was not previously identified.

C. Asbestos Containing Material: Do not disturb asbestos or any material suspected of containing asbestos. As materials are discovered in the course of demolition or construction that the Contractor suspects may contain asbestos, stop work on that component of the building and notify the Owner's Representative immediately.

D. Comply with applicable local, state, and federal codes and regulations pertaining to safety of persons, property, and environmental protection.

1.4 SUBMITTALS

A. Schedule: Submit a detailed work schedule for each milestone showing the inter-relation of all trades, and access to the work. Include coordination for shut-off, capping, and continuation of utility services as required, together with details for dust and noise control protection.

1.5 JOB CONDITIONS

A. Occupancy: Building Owner will not be vacated and decommissioned during construction.

B. Condition of Structures: Owner assumes no responsibility for actual condition of items or structures to be demolished.

1. Conditions existing at time of commencement of contract will be maintained by Owner insofar as practicable. However, variations within structure may exist.

C. Partial Demolition and Removal: Items indicated to be removed but of salvable value to Contractor may be removed from structure as work progresses. Transport salvaged items from site as they are removed.

1. Storage or sale of removed items on site will not be permitted.

D. Protections: Provide temporary barricades and other forms of protection as required to protect Owner's personnel and general public from injury due to selective demolition work.

1. Provide protective measures as required to provide passage of Owner's personnel to and from occupied portions of building.
2. Provide interior and exterior shoring, bracing, or support to prevent movement, settlement, or collapse of structure or element to be demolished, and adjacent facilities or work to remain.
3. Protect from damage to existing finish work that is to remain in place and becomes exposed during demolition operations.
4. Protect floors with suitable coverings when necessary.
5. Remove protections at completion of work.

E. Damages: Promptly repair damages caused to adjacent facilities by demolition work at no cost to Owner.

F. Traffic: Conduct selective demolition operations and debris removal in a manner to ensure minimum interference with exits, roads, streets, walks, and other adjacent occupied or used facilities.

1. Do not close, block or otherwise obstruct streets, walks or other occupied or used facilities without written permission from authorities having jurisdiction. Provide

alternate routes around closed or obstructed traffic ways if required by governing regulations.

G. Explosives: Use of explosives will not be permitted.

H. Utility Services: Maintain existing utilities indicated to remain, keep in service, and protect against damage during demolition operations.

1. Do not interrupt existing utilities serving occupied or used facilities, except when authorized in writing by authorities having jurisdiction. Provide temporary services during interruptions to existing utilities, as acceptable to governing authorities and to the Owner.

I. Environmental Controls: Use temporary enclosures, and other suitable methods to limit dust and dirt rising and scattering in air to lowest practical level. Comply with governing regulations pertaining to environmental protection.

2.00 PRODUCTS (Not Applicable).

3.00 EXECUTION

3.1 INSPECTION

A. Prior to commencement of selective demolition work, inspect areas in which work will be performed. Photograph existing conditions to structure surfaces, equipment or to surrounding properties which could be misconstrued as damage resulting from selective demolition work; file with Owner's Representative prior to starting work. Measure on-site conditions which are critical to the work and report any discrepancies to the Owner's Representative for resolution.

3.2 PREPARATION

A. Provide shoring, bracing, or support to prevent movement, settlement or collapse of structures.

1. Cease operations and notify the Owner's Representative immediately if safety of structure appears to be endangered. Take precautions to support structure until determination is made for continuing operations.

B. Cover and protect furniture, equipment and fixtures to remain from soiling or damage when demolition work is performed in rooms or areas from which such items have not been removed.

C. Erect and maintain dust-proof partitions and closures as required to prevent spread of dust or fumes to occupied portions of the building.

D. Locate, identify, stub off and disconnect utility services that are not indicated to remain.

1. Provide by-pass connections as necessary to maintain continuity of service to occupied areas of building. Provide minimum of 72 hours advance notice to Owner if shut-down of service is necessary during change-over.

3.3 DEMOLITION

A. Perform selective demolition work in a systematic manner. Use such methods as required to complete work indicated on Drawings in accordance with demolition schedule and governing regulations.

1. Promptly remove debris.
2. Provide services for effective air and water pollution controls as required by local authorities having jurisdiction.
3. Use removal methods that will not crack or structurally disturb adjacent slabs or partitions. Use power saw where possible.

B. If unanticipated mechanical, electrical or structural elements which conflict with intended function or design are encountered, investigate and measure both nature and extent of the conflict. Submit report to Owner's Representative in written, accurate detail. Pending receipt of directive from Owner's Representative rearrange selective demolition schedule as necessary to continue overall job progress without delay.

3.4 SALVAGE MATERIALS

A. Salvage Items: Where indicated on Drawings as "Remove and Salvage for Reinstallation", carefully remove indicated items, clean, store for reinstallation as specified in another specification section.

1. Those items to be removed and not noted to be retained by the Owner, or to be reinstalled, become the property of the Contractor for immediate removal from the site. Notify Owner's Representative if such items are encountered and obtain acceptance regarding method of removal and salvage for Owner.

3.5 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove debris, rubbish and other materials resulting from demolition operations from building site. Transport and legally dispose of materials off site.

1. If hazardous materials are encountered during demolition operations, comply with applicable regulations, laws, and ordinances concerning removal, handling and protection against exposure or environmental pollution.
2. Burning of removed materials is not permitted on project site.
3. The Contractor may not engage in the sale of demolished or removed materials at the site.

3.6 CLEAN-UP AND REPAIR

A. Upon completion of demolition work, remove tools, equipment and demolished materials from site. Remove protections and leave interior areas broom clean.

B. Repair demolition performed in excess of that required. Return structures and surfaces to remain to condition existing prior to commencement of selective demolition work. Repair adjacent construction or surfaces soiled or damaged by selective demolition work.

END OF SECTION 02 41 19

SECTION 03 30 00
CAST-IN-PLACE CONCRETE

1.0 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
   1. Footings, including drilled piers.
   2. Foundation walls.
   3. Slabs-on-grade.
   4. Suspended slabs.
   5. Corrugated paper void forms.

B. Related Sections:
   1. Division 31 Section "Earth Moving" for drainage fill under slabs-on-grade.
   2. Division 32 Section "Concrete Paving" for concrete pavement and walks.

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

B. Flowable Fill: Non-settling backfill mixtures described as Controlled Low Strength Material (CLSM). A flowable material consisting of Portland cement, fly ash and/or sand with an 28 day and long term unconfined compressive strength around 100 pounds per square inch.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
   1. Indicate amounts of mixing water to be withheld for later addition at Project site.
   2. Submit design mixes on form provided with these specifications.

C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.

D. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
   1. Location of construction joints is subject to approval of the Construction Administration Manager.

E. Beam and Slab Penetration Drawings:
   1. Location of penetrations greater than 3” in diameter.

F. Samples: For waterstops.

G. Qualification Data: For Installer, manufacturer.

H. Material Certificates: For each of the following, signed by manufacturers:
   1. Cementitious materials.
   2. Admixtures.
   3. Form materials and form-release agents.
   4. Steel reinforcement and accessories.
   5. Fiber reinforcement.
   6. Waterstops.
   7. Curing compounds.
   8. Floor and slab treatments.
   9. Bonding agents.
   10. Adhesives.
   11. Semirigid joint filler.
   12. Joint-filler strips.
   13. Repair materials.
   14. Flowable fill.

I. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:
   1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.

J. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.

K. Field quality-control reports.

L. Minutes of preinstallation conference.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.

B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
   1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

C. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.

D. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
   1. ACI 301, "Specifications for Structural Concrete," Sections 1 through 5.
   2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

E. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

F. Preinstallation Conference: Conduct conference at Project site.
   1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
      a. Contractor's superintendent.
      b. Independent testing agency responsible for concrete design mixtures.
      c. Ready-mix concrete manufacturer.
      d. Concrete subcontractor.
      e. Special concrete finish subcontractor.
   2. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, semirigid joint fillers, forms and form removal limitations, shoring and reshoring procedures, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, floor and slab flatness and levelness measurement, concrete repair procedures, and concrete

protection.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.

B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
   1. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
      a. High-density overlay, Class 1 or better. (where indicated on drawings)
      b. Structural 1, B-B or better; mill oiled and edge sealed.

B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

C. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.

D. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.

E. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
   1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

F. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
   1. Furnish units that will leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
   2. Furnish ties that, when removed, will leave holes no larger than 1 inch in

diameter in concrete surface.

3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

2.2 PREFABRICATED GENERAL VOID FORM MATERIALS AND ACCESSORIES

A. Void Form System: This section includes corrugated paper void form materials and accessories to properly create a temporary support for the placement of structural concrete over expansive soils.

1. Function: used to create void space directly under structural concrete slabs and beams.
2. The void form composition must be of corrugated paper material with a moisture resistant exterior, and having an interior fabrication of a uniform, cellular configuration, composed of components with an appropriate moisture response.
3. Depth: 8” deep
4. All products must be capable of sustaining the vertical loads applied until they become self-supporting, while maintaining full void depths as indicated on drawings. The void form strength must be capable of sustaining an average working load of 20 psf.
5. Accessories:
   a. Drilled Pier Forms
   b. Protective Cover Boards
   c. Retainer Boards
6. Acceptable Products/Manufacture: SlabVoid Products, Inc., Fort Worth, TX (888) 803-VOID.

2.3 STEEL REINFORCEMENT

A. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 60 percent.

B. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 or Grade 75, deformed.

C. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed.

D. Plain-Steel Wire: ASTM A 82/A 82M, as drawn.

E. Deformed-Steel Wire: ASTM A 496/A 496M.

F. Deformed-Steel Welded Wire Reinforcement: ASTM A 497/A 497M, flat sheet.

2.4 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.

B. Zinc Repair Material: ASTM A 780, zinc-based solder, paint containing zinc dust, or sprayed zinc.

C. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
   1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.

2.5 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
   1. Portland Cement: ASTM C 150, Type I/II, Supplement with the following:
      a. Fly Ash: ASTM C 618, Class F or C, Minimum 20-25%

B. Normal-Weight Aggregates: ASTM C 33, coarse aggregate or better, graded. Provide aggregates from a single source with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.
   1. Maximum Coarse-Aggregate Size: typically 3/4” nominal diameter, u.n.o. in Structural drawings.
   2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

C. Lightweight Aggregate: ASTM C 330.

D. Water: ASTM C 94/C 94M and potable.

E. Flowable Fill: Use the following materials specified:

   1. Portland Cement: ASTM C 150, Type I/II, or III, Supplement with the following:
      a. Fly Ash: ASTM C 618, Class F or C.
   2. Fine Aggregate/Mineral Filler: Any ASTM or non-ASTM sands or mineral fillers with 100% passing the ½” sieve may be considered which produce an acceptable flow and desired performance characteristic.
   3. Air Entraining Admixtures as per manufacturer’s specifications.
   4. Light Weight Cellular Admixture as per manufacturer’s specifications.
   5. Water: potable.

2.6 ADMIXTURES

A. Air-Entraining Admixture: ASTM C 260.

B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
   1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
   2. Retarding Admixture: ASTM C 494/C 494M, Type B.
   3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
   4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
   5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
   6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

C. Color Pigment: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, free of carbon black, nonfading, and resistant to lime and other alkalis.
   1. Color: As selected by Construction Administration Manager from manufacturer's full range.

2.7 WATERSTOPS

A. Flexible Rubber Waterstops: CE CRD-C 513, with factory-installed metal eyelets, for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.
   1. Profile: Ribbed with center bulb.
   2. Dimensions: 4 inches by 3/16 inch thick (100 mm by 4.75 mm thick).

B. Flexible PVC Waterstops: CE CRD-C 572, with factory-installed metal eyelets, for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.
   1. Profile: Ribbed with center bulb.
   2. Dimensions: 4 inches by 3/16 inch thick (100 mm by 4.75 mm thick).

C. Self-Expanding Butyl Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, 3/4 by 1 inch.

2.8 VAPOR RETARDERS

A. Plastic Vapor Retarder: ASTM E 1745, Class B. Include manufacturer's recommended adhesive or pressure-sensitive tape.

1. Available Products:
   a. Fortifiber Corporation; Moistop Ultra.
   b. Raven Industries Inc.; Vapor Block 10.
   c. Stego Industries, LLC; Stego Wrap, 15 mils.

2.9 FILLS ASSOCIATED WITH BELOW SLAB VAPOR RETARDERS

A. Granular Fill: Clean mixture of crushed stone or crushed or uncrushed gravel; ASTM D 448, Size 57, with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.

B. Fine-Graded Granular Material: Clean mixture of crushed stone, crushed gravel, and manufactured or natural sand; ASTM D 448, Size 10, with 100 percent passing a 3/8-inch sieve, 10 to 30 percent passing a No. 100 sieve, and at least 5 percent passing No. 200 sieve; complying with deleterious substance limits of ASTM C 33 for fine aggregates.

2.10 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

D. Water: Potable.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

2.11 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork.

B. Bonding Agent: ASTM C 1059/C 1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

C. Reglets: Fabricate reglets of not less than 0.022-inch- thick, galvanized-steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.

D. Dovetail Anchor Slots: Hot-dip galvanized-steel sheet, not less than 0.034 inch thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

2.12 REPAIR MATERIALS

A. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.
   1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
   2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
   3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
   4. Compressive Strength: Not less than 5000 psi (34.5 MPa) at 28 days when tested according to ASTM C 109/C 109M.

2.13 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
   1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.

B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
   1. Fly Ash: 25 percent.
   2. Combined Fly Ash or Pozzolans, Ground Granulated Blast-Furnace Slag, and Silica Fume: 50 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.

C. Limit water-soluble, chloride-ion content in hardened concrete to 0.06 in Prestressed Concrete areas, and 0.30 otherwise as a percent by weight of cement.

D. Admixtures: Use admixtures according to manufacturer's written instructions.
   1. Use water-reducing or high-range water-reducing admixture in concrete, as required, for placement and workability.
   2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
   3. Use water-reducing admixture in pumped concrete, concrete for heavy-use

industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.

E. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

2.14 CONCRETE MIXTURES FOR BUILDING ELEMENTS

Required w/c ratio shall be based on specified strengths listed in the following mixes:

A. Drilled Piers: Proportion normal-weight concrete mixture as follows:
   1. Minimum Compressive Strength: 4000 psi at 28 days
   2. Slump Limit: 5-7 inches.
   3. 1-1/2” max coarse aggregate size.

B. Slabs-on-Grade: Proportion normal-weight concrete mixture as follows:
   1. Minimum Compressive Strength: 4000 psi at 28 days.
   2. Slump Limit: 3-5 inches.
   3. 1” max coarse aggregate size.
   4. Air Content: Do not allow air content of troweled finished floors to exceed 3 percent.

C. Elevated Slabs and Beams: Proportion normal-weight concrete mixture as follows:
   1. Minimum Compressive Strength: 4000 psi at 28 days.
   2. Slump Limit: 3-5 inches.
   3. 3/4” max coarse aggregate size.
   4. Air Content: Do not allow air content of troweled finished floors to exceed 3 percent.

D. Walls: Proportion normal-weight concrete mixture as follows:
   1. Minimum Compressive Strength: 4000 psi at 28 days.
   2. Slump Limit: 4 inches.
   3. 1” max coarse aggregate size.

E. Flowable Fill: Proportion normal-weight flowable fill as follows:
   1. Minimum Compressive Strength: 100 psi at 28 days.
   2. Air Content: 0-70%

2.15 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.16 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to

ASTM C 94/C 94M, and furnish batch ticket information.

1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.
2. When air temperature is above 90 deg F, concreting shall conform in addition to ASTM C 94, to ACI 305.1 – Specification for Hot Weather Concreting

PART 3 - EXECUTION

3.1 FORMWORK

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:
   1. Class B, 1/4 inch (6 mm) for smooth-formed finished surfaces.
   2. Class C, 1/2 inch (13 mm) for rough-formed finished surfaces.

D. Construct forms tight enough to prevent loss of concrete mortar.

E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
   1. Install keyways, reglets, recesses, and the like, for easy removal.
   2. Do not use rust-stained steel form-facing material.

F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

H. Chamfer exterior corners and edges of permanently exposed concrete.

I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 SLAB VOID FORMS

A. Store void forms and accessories in accordance with manufacturer’s recommendations.

B. Prepare ground surface on an even plane.

C. Install void forms and accessories in accordance with manufacturer’s recommendations.

D. Place a layer of protective cover board over void forms to distribute working load, bridge small gaps, and protect them from puncture and other damage during concrete placement.

E. Protect void forms from moisture, and replace wet or damaged pieces before placing concrete.

F. Maintain moisture and humidity levels beneath the slab after the concrete sets.

3.3 EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."
   2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels,

shelf angles, and other conditions.

3. Install dovetail anchor slots in concrete structures as indicated.

3.4 REMOVING AND REUSING FORMS

A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations and curing and protection operations need to be maintained.

1. Formwork supporting conventionally reinforced concrete shall not be removed until concrete has attained 85% of its specified 28-day compressive strength as established by tests of field-cured cylinders. In the absence of cylinder tests, supporting formwork shall remain in place until the concrete has cured at a temperature of at least 50 degrees Fahrenheit (10 degrees Celsius) for the minimum cumulative time periods given in ACI 347, Section 3.7.2.3. When the surrounding air temperature is below 50 degrees Fahrenheit (10 degrees Celsius), that time period shall be added to the minimum listed time period.
2. Minimum cumulative curing times may be reduced by the use of high early-strength cement or forming systems which allow form removal without disturbing shores, but only after the Contractor has demonstrated to the satisfaction of the Construction Administration Manager that the early removal of forms will not cause excessive sag, distortion, or damage to the concrete elements.
3. Forms for post-tensioned concrete shall not be removed until tensioning operations have been completed.
4. Wood forms shall be completely removed. Provide temporary openings if required.
5. Provide adequate methods of curing and thermal protection of exposed concrete if forms are removed prior to completion of specified curing time.
6. Areas required to support construction loads in excess of 20 psf shall be reshored to properly distribute construction loading. Construction loads up to the rated live load capacity may be placed on unshored construction provided the concrete has attained the specified 28 day compressive strength.
7. Obtaining concrete compressive strength tests for the purposes of form removal shall be the responsibility of the Contractor.
8. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Construction Administration Manager.

3.5 SHORES AND RESHORES

A. Comply with ACI 318 and ACI 301 for design, installation, and removal of shoring and reshoring.
   1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.

B. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.6 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
   1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
   1. Weld reinforcing bars according to AWS D1.4/D 1.4M, where indicated.

D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.7 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Construction Administration Manager.
   1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement

through sides of strip placements of floors and slabs.

2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
5. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
7. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.

D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants, specified in Division 07 Section "Joint Sealants," are indicated.
3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.8 WATERSTOPS

A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm. Install in longest lengths practicable. Support and protect exposed waterstops during progress of the Work. Field fabricate joints in waterstops according to manufacturer's written instructions.

B. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated, according to manufacturer's written instructions, adhesive bonding,

mechanically fastening, and firmly pressing into place. Install in longest lengths practicable.

3.9 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

B. Water may be added at site only if specifically withheld at time of batching and specifically noted on batch ticket.

C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.
   1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
   1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
   2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
   3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
   1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
   2. Maintain reinforcement in position on chairs during concrete placement.
   3. Screed slab surfaces with a straightedge and strike off to correct elevations.
   4. Slope surfaces uniformly to drains where required.
   5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

F. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

G. Hot-Weather Placement: Comply with ACI 305.1 and as follows:
1. Maintain concrete temperature in accordance with ACI 305.1 at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.10 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
1. Apply to concrete surfaces not exposed to public view.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
1. Apply to concrete surfaces exposed to public view, to receive a rubbed finish, or to be covered with a coating or covering material applied directly to concrete.

C. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete where concrete is exposed to view and where otherwise indicated:
1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.

D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.11 FINISHING FLOORS AND SLABS

A. General: Comply with ACI 302.1R recommendations for screeding, restraightening,

and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch in one direction.
   1. Apply scratch finish to surfaces indicated and to receive concrete floor toppings, or to receive mortar setting beds for bonded cementitious floor finishes.

C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.
   1. Apply float finish to surfaces indicated to receive trowel finish and to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.

D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
   1. Apply a trowel finish to surfaces indicated or exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
   2. Finish surfaces to the following tolerances, according to ASTM E 1155, for a randomly trafficked floor surface:
      a. Specified overall values of flatness, F(F) 35; and of levelness, F(L) 25; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 17; for slabs-on-grade.
      b. Specified overall values of flatness, F(F) 30; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 15; for suspended slabs.

E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces indicated or where ceramic or quarry tile is to be installed by either thickset or thin-set method. While concrete is still plastic, slightly scarify surface with a fine broom.
   1. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.

F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.
   1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Construction Administration Manager before application.

3.12 MISCELLANEOUS CONCRETE ITEMS

A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as

specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.

D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Screed, tamp, and trowel finish concrete surfaces.

3.13 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.

D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
   1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
      a. Water.

b. Continuous water-fog spray.
c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
   a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
   b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
   c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.
3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
   a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.
4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.14 JOINT FILLING

A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
   1. Defer joint filling until concrete has aged at least [one] [six] month(s). Do not fill joints until construction traffic has permanently ceased.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.

C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.15 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Construction

Administration Manager. Remove and replace concrete that cannot be repaired and patched to Construction Administration Manager's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
   1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete. Limit cut depth to 3/4 inch. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
   2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
   3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Construction Administration Manager.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
   1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
   2. After concrete has cured at least 14 days, correct high areas by grinding.
   3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
   4. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
   5. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact,

and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.

6. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Construction Administration Manager's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Construction Administration Manager's approval.

3.16 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Inspections:
1. Steel reinforcement placement.
2. Steel reinforcement welding.
3. Headed bolts and studs.
4. Verification of use of required design mixture.
5. Concrete placement, including conveying and depositing.
6. Curing procedures and maintenance of curing temperature.
7. Formwork and shoring construction.
8. Verification of concrete strength before removal of shores and forms from beams and slabs.

C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
1. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. or fraction thereof of each concrete mixture placed each day.
   a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
5. Unit Weight: ASTM C 567, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
6. Compression Test Specimens: ASTM C 31/C 31M.
   a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
   b. Cast and field cure two sets of two standard cylinder specimens for each composite sample.
7. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.
   a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.
   b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
8. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
9. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
10. Test results shall be reported in writing to Construction Administration Manager, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
11. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Construction Administration Manager but will not be used as sole basis for approval or rejection of concrete.
12. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Construction Administration Manager. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Construction Administration Manager.
13. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
14. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

D. Measure floor and slab flatness and levelness according to ASTM E 1155 within 24 hours of finishing.

3.17 PROTECTION OF LIQUID FLOOR TREATMENTS

A. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.

END OF SECTION

SECTION 03 53 00
CONCRETE TOPPING

1.00 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:

1. Concrete toppings placed on existing concrete.

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1. Indicate amounts of mixing water to be withheld for later addition at Project site.

C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.

D. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.

1. Location of construction joints is subject to approval of the Construction Administration Manager.

E. Material Certificates: For each of the following, signed by manufacturers:

1. Cementitious materials.
2. Admixtures.

3. Form materials and form-release agents.
4. Steel reinforcement and accessories.
5. Waterstops.
6. Curing compounds.
7. Semirigid joint filler.
8. Joint-filler strips.

F. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:

G. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.

B. Testing Agency Qualifications: An independent agency, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

1. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.

C. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.

D. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:

1. ACI 301, "Specifications for Structural Concrete," Sections 1 through 5.
2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

E. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

2.00 PRODUCTS

2.1 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.

1. Plywood, metal, or other approved panel materials.

B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

2.2 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.

B. Deformed-Steel Welded Wire Reinforcement: ASTM A 497/A 497M, flat sheet.

2.3 REINFORCEMENT ACCESSORIES

A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

1. For zinc-coated reinforcement, use galvanized wire or dielectric-polymer-coated wire bar supports.

2.4 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:

1. Portland Cement: ASTM C 150, Type I, gray. Supplement with the following:

a. Fly Ash: ASTM C 618, Class F.

B. Normal-Weight Aggregates: ASTM C 33, Class 3M coarse aggregate or better, graded. Provide aggregates from a single source.

1. Maximum Coarse-Aggregate Size: 3/4 inch nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

C. Water: ASTM C 94/C 94M and potable.

2.5 ADMIXTURES

A. Air-Entraining Admixture: ASTM C 260.

B. Non-Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, non-set-accelerating, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. BASF Construction Chemicals - Building Systems; Rheocrete 222+.
b. Cortec Corporation; MCI- 2005NS.
c. Grace Construction Products, W. R. Grace & Co.; DCI-S.
d. Sika Corporation; FerroGard 901.

2.6 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. ChemMasters; SprayFilm.
b. Conspec by Dayton Superior; Aquafilm.
c. Dayton Superior Corporation; Sure Film (J-74).
d. L&M Construction Chemicals, Inc.; E-CON.
e. Meadows, W. R., Inc.; EVAPRE.
f. Sika Corporation; SikaFilm.
g. Symons by Dayton Superior; Finishing Aid.
h. Unitex; PRO-FILM.

B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

C. Water: Potable.

D. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. BASF Construction Chemicals - Building Systems; Kure 1315.
b. ChemMasters; Polyseal WB.
c. Conspec by Dayton Superior; Sealcure 1315 WB.
d. Edoco by Dayton Superior; Cureseal 1315 WB.

e. Euclid Chemical Company (The), an RPM company; Super Diamond Clear VOX; LusterSeal WB 300.
f. Kaufman Products, Inc.; Sure Cure 25 Emulsion.
g. Lambert Corporation; UV Safe Seal.
h. L&M Construction Chemicals, Inc.; Lumiseal WB Plus.
i. Meadows, W. R., Inc.; Vocomp-30.
j. Metalcrete Industries; Metcure 30.
k. Right Pointe; Right Sheen WB30.
l. Symons by Dayton Superior; Cure & Seal 31 Percent E.
m. Vexcon Chemicals, Inc.; Vexcon Starseal 1315.

2.7 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork.

B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, aromatic polyurea with a Type A shore durometer hardness range of 90 to 95 per ASTM D 2240.

C. Bonding Agent: ASTM C 1059/C 1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

2.8 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.

1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.

B. Cementitious Materials: Use fly ash as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 40 percent. Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:

1. Fly Ash: 25 percent.

C. Limit water-soluble, chloride-ion content in hardened concrete to 0.06 percent by weight of cement.

D. Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
2. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
3. Use corrosion-inhibiting admixture in concrete mixtures where indicated.

E. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

2.9 CONCRETE TOPPINGS

A. Concrete Toppings: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 5000 psi at 28 days.
2. Minimum Cementitious Materials Content: 520 lb/cu. yd.
3. Slump Limit: 5 inches, plus or minus 1 inch.
4. Air Content: Do not allow air content of trowel-finished toppings to exceed 3 percent.
5. Steel-Fiber Reinforcement: Add to concrete mixture, according to manufacturer's written instructions, at a rate of 50 lb/cu. yd.

2.10 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.11 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and ASTM C 1116/C 1116M, and furnish batch ticket information.

1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

3.00 EXECUTION

3.1 FORMWORK

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:

1. Class A, 1/8 inch for smooth-formed finished surfaces.
2. Class C, 1/2 inch for rough-formed finished surfaces.

D. Construct forms tight enough to prevent loss of concrete mortar.

E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.

1. Install keyways, reglets, recesses, and the like, for easy removal.
2. Do not use rust-stained steel form-facing material.

F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

H. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

I. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

J. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

K. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."

3.3 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.

D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.4 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Construction Administration Manager.

1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
2. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
3. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
4. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
5. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

3.5 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Construction Administration Manager.

C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.

D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.

3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
2. Maintain reinforcement in position on chairs during concrete placement.
3. Screed slab surfaces with a straightedge and strike off to correct elevations.
4. Slope surfaces uniformly to drains where required.
5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

F. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

G. Hot-Weather Placement: Comply with ACI 301 and as follows:

1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.6 FINISHING CONCRETE TOPPINGS

A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Trowel and Fine-Broom Finish: Apply a first trowel finish to concrete topping surfaces. While concrete is still plastic, slightly scarify surface with a fine broom.

1. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.

3.7 MISCELLANEOUS CONCRETE ITEMS

A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.

3.8 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Cure concrete according to ACI 308.1, by one or a combination of the following methods:

1. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

   a. Moisture cure or use moisture-retaining covers to cure concrete topping surfaces.

3.9 JOINT FILLING

A. Prepare, clean, and install joint filler according to manufacturer's written instructions.

1. Defer joint filling until concrete has aged at least one month(s). Do not fill joints until construction traffic has permanently ceased.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.

C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.10 FIELD QUALITY CONTROL

A. Testing and Inspecting: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

B. Inspections:

1. Steel reinforcement placement.
2. Verification of use of required design mixture.
3. Concrete placement, including conveying and depositing.
4. Curing procedures and maintenance of curing temperature.
5. Verification of concrete strength before removal of shores and forms from beams and slabs.

C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 2 cu. yd., but less than 10 cu. yd., plus one set for each additional 10 cu. yd. or fraction thereof.
2. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. or fraction thereof of each concrete mixture placed each day.

   a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

3. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
4. Air Content: ASTM C 231, pressure method, for normal-weight concrete; ASTM C 173/C 173M, volumetric method, for structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
5. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
6. Compression Test Specimens: ASTM C 31/C 31M.

   a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.

7. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.

   a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.
   b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.

8. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.

9. Test results shall be reported in writing to Construction Administration Manager, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
10. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Construction Administration Manager but will not be used as sole basis for approval or rejection of concrete.
11. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Construction Administration Manager. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Construction Administration Manager.
12. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
13. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

D. Measure floor and slab flatness and levelness according to ASTM E 1155 within 24 hours of finishing.

END OF SECTION 03 53 00

SECTION 04 20 00
UNIT MASONRY

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 unit masonry assemblies consisting of the following:

1. Concrete masonry units (CMUs).
2. Mortar and grout.
3. Reinforcing steel.
4. Masonry joint reinforcement.
5. Embedded flashing.
6. Miscellaneous masonry accessories.

B. Related Sections include the following:

1. Division 07 Section "Sheet Metal Flashing and Trim" for exposed sheet metal flashing.
2. Division 07 Section "Penetration Firestopping" for firestopping at openings in masonry walls.
3. Division 07 Section "Fire-Resistive Joint Systems" for fire-resistive joint systems at heads of masonry walls.
4. Division 07 Section "Joint Sealants" for sealing control and expansion joints in unit masonry.

C. Products furnished, but not installed, under this Section include the following:

1. Anchor sections of adjustable masonry anchors for connecting to structural frame, installed under Division 05 Section "Structural Steel Framing."

D. Products installed, but not furnished, under this Section include the following:

1. Steel lintels and shelf angles for unit masonry, furnished under Division 05 Section "Metal Fabrications."

1.3 DEFINITIONS

A. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.4 PERFORMANCE REQUIREMENTS

A. Provide structural unit masonry that develops indicated net-area compressive strengths (f'_m) at 28 days.

B. Determine net-area compressive strength (f'_m) of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.

C. Determine net-area compressive strength (f'_m) of masonry by testing masonry prisms according to ASTM C 1314.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For the following:

1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
2. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement
3. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.

C. Samples for Verification: For each type and color of the following:

1. Exposed concrete masonry units.

D. Qualification Data: For testing agency.

E. Material Certificates: Include statements of material properties indicating compliance with requirements including compliance with standards and type designations within standards. Provide for each type and size of the following:

1. Masonry units.

a. Include material test reports substantiating compliance with requirements.
b. For masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.

2. Cementitious materials. Include brand, type, and name of manufacturer.
3. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
4. Grout mixes. Include description of type and proportions of ingredients.

5. Reinforcing bars.
6. Joint reinforcement.

F. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.

1. Include test reports, per ASTM C 780, for mortar mixes required to comply with property specification.
2. Include test reports, per ASTM C 1019, for grout mixes required to comply with compressive strength requirement.

G. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.

H. Cold-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with cold-weather requirements.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency qualified according to ASTM C 1093 for testing indicated, as documented according to ASTM E 548.

B. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, through one source from a single manufacturer for each product required.

C. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from a single manufacturer for each cementitious component and from one source or producer for each aggregate.

D. Preconstruction Testing Service: Contractor will engage a qualified independent testing agency to perform preconstruction testing indicated below. Retesting of materials that fail to meet specified requirements shall be done at Contractor's expense.

1. Concrete Masonry Unit Test: For each type of unit required, per ASTM C 140.
2. Mortar Test (Property Specification): For each mix required, per ASTM C 780.
3. Grout Test (Compressive Strength): For each mix required, per ASTM C 1019.
4. Prism Test: For each type of construction required, per ASTM C 1314.

E. Fire-Resistance Ratings: Where indicated, provide materials and construction identical to those of assemblies with fire-resistance ratings determined per ASTM E 119 by a testing and inspecting agency, by equivalent concrete masonry thickness, or by other means, as acceptable to authorities having jurisdiction.

F. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

D. Deliver preblended, dry mortar mix in moisture-resistant containers designed for lifting and emptying into dispensing silo. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in a metal dispensing silo with weatherproof cover.

E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.8 PROJECT CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

1. Extend cover a minimum of 24 inches down both sides and hold cover securely in place.

B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least 3 days after building masonry walls or columns.

C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.

1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
2. Protect sills, ledges, and projections from mortar droppings.
3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit

masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and above and will remain so until masonry has dried, but not less than 7 days after completing cleaning.

E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
2. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 MASONRY UNITS, GENERAL

A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to exceed tolerances and to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not uses units where such defects, including dimensions that vary from specified dimensions by more than stated tolerances, will be exposed in the completed Work or will impair the quality of completed masonry.

2.3 CONCRETE MASONRY UNITS (CMUs)

A. Shapes: Provide shapes indicated and as follows:

1. Provide special shapes for lintels, corners, jambs, movement joints, headers, bonding, and other special conditions.
2. Provide square-edged units for outside corners, unless otherwise indicated.

B. Integral Water Repellent: Provide units made with integral water repellent.

1. Integral Water Repellent: Liquid polymeric, integral water-repellent admixture that does not reduce flexural bond strength. Units made with integral water repellent, when tested as a wall assembly made with mortar containing integral water-repellent manufacturer's mortar additive according to ASTM E 514, with test period extended to 24 hours, show no visible water or leaks on the back of test specimen.

a. Available Products:

1) Addiment Incorporated; Block Plus W-10.
2) Grace Construction Products, a unit of W. R. Grace & Co. - Conn.; Dry-Block.
3) Master Builders, Inc.; Rheopel.

C. Concrete Masonry Units: ASTM C 90.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength as indicated in drawings.
2. Weight Classification: Light weight, unless otherwise indicated.
3. Size (Width): Manufactured to dimensions 3/8 inch less than nominal dimensions.
4. Exposed Faces: Provide texture matching the range represented by Construction Administration Manager.

2.4 CONCRETE AND MASONRY LINTELS

A. General: Provide either masonry lintels, where indicated, complying with requirements below.

B. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam concrete masonry units with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

2.5 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color cement.

B. Hydrated Lime: ASTM C 207, Type S.

C. Portland Cement-Lime Mix: Packaged blend of portland cement complying with ASTM C 150, Type I or Type III, and hydrated lime complying with ASTM C 207, Type S.

D. Masonry Cement: ASTM C 91.

For colored pigmented mortars use premixed colored masonry cements of formulation required to produce color indicated, or if not indicated, as selected from manufacturer's standard formulations.

E. Mortar Cement: ASTM C 1329.

1. Available Products:

a. Lafarge North America Inc.; Lafarge Mortar Cement or Magnolia Superbond Mortar Cement.

F. Aggregate for Mortar: ASTM C 144.

1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
2. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.
3. White-Mortar Aggregates: Natural white sand or crushed white stone.
4. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.

G. Aggregate for Grout: ASTM C 404.

H. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.

1. Available Products:

a. Addiment Incorporated; Mortar Kick.
b. Euclid Chemical Company (The); Accelguard 80.
c. Grace Construction Products, a unit of W. R. Grace & Co. - Conn.; Morset.
d. Sonneborn, Div. of ChemRex; Trimix-NCA.

I. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with concrete masonry units, containing integral water repellent by same manufacturer.

1. Available Products:

a. Addiment Incorporated; Mortar Tite.
b. Grace Construction Products, a unit of W. R. Grace & Co. - Conn.; Dry-Block Mortar Admixture.
c. Master Builders, Inc.; Color Cure Mortar Admix or Rheomix Rheopel.
d. Water: Potable.

2.6 REINFORCEMENT

A. Uncoated Steel Reinforcing Bars: ASTM A 615 or ASTM A 996, Grade 60 .

B. Masonry Joint Reinforcement, General: ASTM A 951 .

1. Interior Walls: Hot-dip galvanized, carbon steel.
2. Exterior Walls: Hot-dip galvanized, carbon steel.
3. Wire Size for Side Rods: W1.7 or 0.148-inch diameter.
4. Wire Size for Cross Rods: W1.7 or 0.148-inch diameter.
5. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.

6. Provide in lengths of not less than 10 feet, with prefabricated corner and tee units.

C. Masonry Joint Reinforcement for Single-Wythe Masonry: Either ladder or truss type with single pair of side rods.

2.7 MISCELLANEOUS ANCHORS

A. Unit Type Inserts in Concrete: Cast-iron or malleable-iron wedge-type inserts.

B. Anchor Bolts: Headed or L-shaped steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers; hot-dip galvanized to comply with ASTM A 153/A 153M, Class C; of dimensions indicated.

C. Post-installed Anchors: Provide chemical anchors, with capability to sustain, without failure, a load equal to six times the load imposed when installed in solid or grouted unit masonry and equal to four times the load imposed when installed in concrete, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.

1. Corrosion Protection: Carbon-steel components zinc plated to comply with ASTM B 633, Class Fe/Zn 5 (5 microns) for Class SC 1 service condition (mild).
2. Corrosion Protection: Stainless-steel components complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2 for bolts and nuts; ASTM A 666 or ASTM A 276, Type 304 or 316, for anchors.

2.8 EMBEDDED FLASHING MATERIALS

A. Metal Flashing: Provide metal flashing, where flashing is exposed or partly exposed and where indicated, complying Division 07 Section "Sheet Metal Flashing and Trim" and as follows:

1. Stainless Steel: ASTM A 240/A 240M, Type 304, 0.016 inch thick.
2. Copper: ASTM B 370, Temper H00 or H01, cold-rolled copper sheet, 10-oz./sq. ft. (weight or 0.0135 inch thick for fully concealed flashing; 16-oz./sq. ft. weight or 0.0216 inch thick elsewhere.
3. Fabricate continuous flashings in sections 96 inches long minimum, but not exceeding 12 feet. Provide splice plates at joints of formed, smooth metal flashing.
4. Fabricate through-wall metal flashing embedded in masonry with ribs at 3-inch intervals along length of flashing to provide an integral mortar bond.

   a. Available Products:

      1) Cheney Flashing Company;
      2) Keystone Flashing Company, Inc.; Keystone 3-Way Interlocking Thruwall Flashing.

5. Fabricate through-wall flashing with snaplock receiver on exterior face where indicated to receive counterflashing.
6. Fabricate through-wall flashing with drip edge unless otherwise indicated. Fabricate by extending flashing 1/2 inch out from wall, with outer edge bent down 30 degrees.
7. Fabricate through-wall flashing with sealant stop unless otherwise indicated. Fabricate by bending metal back on itself 3/4 inch at exterior face of wall and down into joint 3/8 inch to form a stop for retaining sealant backer rod.
8. Fabricate metal drip edges and sealant stops for ribbed metal flashing from plain metal flashing of same metal as ribbed flashing and extending at least 3 inches into wall with hemmed inner edge to receive ribbed flashing and form a hooked seam. Form hem on upper surface of metal so that completed seam will shed water.
9. Metal Drip Edges: Fabricate from stainless steel. Extend at least 3 inches into wall and 1/2 inch out from wall, with outer edge bent down 30 degrees.
10. Metal Flashing Terminations: Fabricate from stainless steel. Extend at least 3 inches into wall and out to exterior face of wall. At exterior face of wall, bend metal back on itself for 3/4 inch and down into joint 3/8 inch to form a stop for retaining sealant backer rod.
11. Metal Expansion-Joint Strips: Fabricate to shapes indicated.

B. Flexible Flashing: For flashing not exposed to the exterior, use one of the following, unless otherwise indicated:

1. Copper-Laminated Flashing: 7-oz./sq. ft. copper sheet bonded with asphalt between 2 layers of glass-fiber cloth. Use only where flashing is fully concealed in masonry.

   a. Available Products:

      1) Advanced Building Products Inc.; Copper Fabric Flashing.
      2) AFCO Products Inc.; Copper Fabric.
      3) Hohmann & Barnard, Inc.; H & B C-Fab Flashing.
      4) Phoenix Building Products; Type FCC-Fabric Covered Copper.
      5) Polytite Manufacturing Corp.; Copper Fabric Flashing.
      6) Sandell Manufacturing Co., Inc.; Copper Fabric Flashing.
      7) York Manufacturing, Inc.; York Copper Fabric Flashing.

2. Asphalt-Coated Copper Flashing: 7-oz./sq. ft. copper sheet coated with flexible asphalt. Use only where flashing is fully concealed in masonry.

   a. Available Products:

      1) Advanced Building Products Inc.; Cop-R-Cote.
      2) AFCO Products Inc.; Cop-A-Cote.
      3) Hohmann & Barnard, Inc.; H & B C-Coat Flashing.
      4) Phoenix Building Products; Type ACC-Asphalt Bituminous Coated.
      5) Polytite Manufacturing Corp.; Coated Copper Flashing.
      6) Sandell Manufacturing Co., Inc.; Coated Copper Flashing.
      7) York Manufacturing, Inc.; Copperseal.

3. Rubberized-Asphalt Flashing: Composite flashing product consisting of a pliable, adhesive rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall thickness of not less than 0.040 inch.

   a. Available Products:

      1) Advanced Building Products Inc.; Peel-N-Seal.
      2) Carlisle Coatings & Waterproofing; CCW-705-TWF Thru-Wall Flashing.
      3) Dayton Superior Corporation, Dur-O-Wal Division; Dur-O-Barrier-44.
      4) Grace Construction Products, a unit of W. R. Grace & Co. - Conn.; Perm-A-Barrier Wall Flashing.
      5) Heckmann Building Products Inc.; No. 82 Rubberized-Asphalt Thru-Wall Flashing.
      6) Hohmann & Barnard, Inc.; Textroflash.
      7) Polyguard Products, Inc.; Polyguard 300.
      8) Polytite Manufacturing Corp.; Poly-Barrier Self-Adhering Wall Flashing.
      9) Williams Products, Inc.; Everlastic MF-40.

4. EPDM Flashing: Sheet flashing product made from ethylene-propylene-diene terpolymer, complying with ASTM D 4637, 0.040 inch thick.

   a. Available Products:

      1) Carlisle Coatings & Waterproofing; Pre-Kleened EPDM Thru-Wall Flashing.
      2) Firestone Building Products; FlashGuard.
      3) Heckmann Building Products Inc.; No. 81 EPDM Thru-Wall Flashing.

C. Single-Wythe CMU Flashing System: System of CMU cell flashing pans and interlocking CMU web covers made from high-density polyethylene incorporating chemical stabilizers that prevent UV degradation. Cell flashing pans have integral weep spouts that are designed to be built into mortar bed joints and weep collected moisture to the exterior of CMU walls and that extend into the cell to prevent clogging with mortar.

   1. Product: Subject to compliance with requirements, provide "Blok-Flash" by Advanced Building Products Inc.

D. Solder and Sealants for Sheet Metal Flashings: As specified in Division 07 Section "Sheet Metal Flashing and Trim**."**

   1. Solder for Stainless Steel: ASTM B 32, Grade Sn60, with acid flux of type recommended by stainless-steel sheet manufacturer.
   2. Solder for Copper: ASTM B 32, Grade Sn50, 50 percent tin and 50 percent lead.
   3. Elastomeric Sealant: ASTM C 920, chemically curing sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

E. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

2.9 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene, urethane, or PVC.

B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 or PVC, complying with ASTM D 2287, Type PVC-65406 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.

C. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).

D. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells with loops for holding reinforcing bars in center of cells. Units are formed from 0.142-inch steel wire, hot-dip galvanized after fabrication. Provide units with either two loops or four loops as needed for number of bars indicated.

1. Available Products:

a. Dayton Superior Corporation, Dur-O-Wal Division; D/A 810, D/A 812 or D/A 817.
b. Heckmann Building Products Inc.; No. 376 Rebar Positioner.
c. Hohmann & Barnard, Inc.; #RB or #RB-Twin Rebar Positioner.
d. Wire-Bond; O-Ring or Double O-Ring Rebar Positioner.

2.10 MASONRY CLEANERS

A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.

1. Available Manufacturers:

a. Diedrich Technologies, Inc.
b. EaCo Chem, Inc.
c. ProSoCo, Inc.

2.11 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.
2. Limit cementitious materials in mortar to portland cement and lime.
3. Limit cementitious materials in mortar for exterior and reinforced masonry to portland cement and lime.
4. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

C. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated.

D. Mortar for Unit Masonry: Comply with ASTM C 270, Property Specification.

E. Grout for Unit Masonry: Comply with ASTM C 476.

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
2. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143/C 143M.

F. Epoxy Pointing Mortar: Mix epoxy pointing mortar to comply with mortar manufacturer's written instructions.

2.12 SOURCE QUALITY CONTROL

A. A qualified independent testing agency will perform source quality-control testing indicated below:
1. Retesting of materials failing to comply with specified requirements shall be done at Contractor's expense.

B. Clay Masonry Unit Test: For each type of unit furnished, per ASTM C 67.

C. Concrete Masonry Unit Test: For each type of unit furnished, per ASTM C 140.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.

1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
2. Verify that foundations are within tolerances specified.
3. Verify that reinforcing dowels are properly placed.

B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Thickness: Build single-wythe walls to actual widths of masonry units, using units of widths indicated.

B. Build chases and recesses to accommodate items specified in this and other Sections.

C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.

D. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

E. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.

1. Mix units from several pallets or cubes as they are placed.

F. Matching Existing Masonry: Match coursing, bonding, color, and texture of existing masonry.

G. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested per ASTM C 67. Allow units to absorb water so they are damp but not wet at time of laying.

H. Comply with construction tolerances in ACI 530.1/ASCE 6/TMS 602 and with the following:

1. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet 1/2 inch maximum.
2. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet , or 1/2 inch maximum.
3. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, or 1/2 inch maximum.
4. For exposed bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch. Do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
5. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch. Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch.
6. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch except due to warpage of masonry units within tolerances specified for warpage of units.
7. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch from one masonry unit to the next.

3.3 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.

C. Stopping and Resuming Work: Stop work by racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.

D. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

E. Fill space between steel frames and masonry solidly with mortar, unless otherwise indicated.

F. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below and rod mortar or grout into core.

G. Fill cores in hollow concrete masonry units with grout 24 inches under bearing plates, beams, lintels, posts, and similar items, unless otherwise indicated.

H. Build non-load-bearing partitions full height of story to underside of solid floor structure above, unless otherwise indicated.

1. Install compressible filler in joint between top of partition and underside of structure above.
2. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly around plastic tubes of anchors and push tubes down into grout to provide 1/2-inch clearance between end of anchor rod and end of tube. Space anchors 48 inches o.c., unless otherwise indicated.
3. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Division 07 Section "Fire-Resistive Joint Systems."

3.4 MORTAR BEDDING AND JOINTING

A. Lay hollow concrete masonry units as follows:

1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
2. With webs fully bedded in mortar in grouted masonry, including starting course on footings.
3. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.

B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness, unless otherwise indicated.

3.5 MASONRY JOINT REINFORCEMENT

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.

1. Space reinforcement not more than 16 inches o.c.
2. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings.

    a. Reinforcement above is in addition to continuous reinforcement.

B. Interrupt joint reinforcement at control and expansion joints, unless otherwise indicated.

C. Provide continuity at wall intersections by using prefabricated T-shaped units.

D. Provide continuity at corners by using prefabricated L-shaped units.

E. Cut and bend reinforcing units as directed by manufacturer for continuity at corners, returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.6 ANCHORING MASONRY TO STRUCTURAL MEMBERS

A. Anchor masonry to structural members where masonry abuts or faces structural members to comply with the following:

1. Provide an open space not less than 1 inch in width between masonry and structural member, unless otherwise indicated. Keep open space free of mortar and other rigid materials.
2. Anchor masonry to structural members with anchors embedded in masonry joints and attached to structure.
3. Space anchors as indicated, but not more than 24 inches o.c. vertically and 36 inches o.c. horizontally.

3.7 CONTROL AND EXPANSION JOINTS

A. General: Install control and expansion joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.

B. Form control joints in concrete masonry as follows:

1. Fit bond-breaker strips into hollow contour in ends of concrete masonry units on one side of control joint. Fill resultant core with grout and rake out joints in exposed faces for application of sealant.
2. Install preformed control-joint gaskets designed to fit standard sash block.
3. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar or rake out joint for application of sealant.
4. Install temporary foam-plastic filler in head joints and remove filler when unit masonry is complete for application of sealant.

C. Provide horizontal, pressure-relieving joints by either leaving an air space or inserting a compressible filler of width required for installing sealant and backer rod specified in Division 07 Section "Joint Sealants," but not less than 3/8 inch.

1. Locate horizontal, pressure-relieving joints beneath shelf angles supporting masonry.

3.8 LINTELS

A. Install steel lintels where indicated.

B. Provide masonry lintels where shown and where openings of more than 24 inches for block-size units are shown without structural steel or other supporting lintels.

C. Provide minimum bearing of 8 inches at each jamb, unless otherwise indicated.

3.9 FLASHING

A. General: Install embedded flashing in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated.

B. Install flashing as follows, unless otherwise indicated:

1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
2. At lintels and shelf angles, extend flashing a minimum of 6 inches into masonry at each end. At heads and sills, extend flashing 6 inches at ends and turn up not less than 2 inches to form end dams.
3. Interlock end joints of ribbed sheet metal flashing by overlapping ribs not less than 1-1/2 inches or as recommended by flashing manufacturer, and seal lap with elastomeric sealant complying with requirements in Division 07 Section "Joint Sealants" for application indicated.
4. Install metal drip edges and sealant stops with ribbed sheet metal flashing by interlocking hemmed edges to form hooked seam. Seal seam with elastomeric sealant complying with requirements in Division 07 Section "Joint Sealants" for application indicated.
5. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall and adhere flexible flashing to top of metal drip edge.
6. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall and adhere flexible flashing to top of metal flashing termination.
7. Cut flexible flashing off flush with face of wall after masonry wall construction is completed.

C. Install single-wythe CMU flashing system in bed joints of CMU walls where indicated to comply with manufacturer's written instructions. Install CMU cell pans with upturned edges located below face shells and webs of CMUs above and with weep spouts aligned with face of wall. Install CMU web covers so that they cover upturned edges of CMU cell pans at CMU webs and extend from face shell to face shell.

D. Install nailers for flashing and other related construction where they are shown to be built into masonry.

3.10 REINFORCED UNIT MASONRY INSTALLATION

A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.

1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other temporary loads that may be placed on them during construction.

B. Placing Reinforcement: Comply with requirements in ACI 530.1/ASCE 6/TMS 602.

C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.

1. Comply with requirements in ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
2. Limit height of vertical grout pours to not more than 60 inches.

3.11 FIELD QUALITY CONTROL

A. Inspectors: Contractor will engage qualified independent inspectors to perform inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform inspections.

1. Place grout only after inspectors have verified compliance of grout spaces and grades, sizes, and locations of reinforcement.

B. Testing Agency: Contractor will engage a qualified independent testing and inspecting agency to perform field tests and inspections indicated below and prepare test reports:

1. Payment for these services will be made by Contractor.
2. Retesting of materials failing to comply with specified requirements shall be done at Contractor's expense.

C. Testing Frequency: One set of tests for each 5000 sq. ft. of wall area or portion thereof.

D. Concrete Masonry Unit Test: For each type of unit provided, per ASTM C 140.

E. Mortar Test (Property Specification): For each mix provided, per ASTM C 780. Test mortar for mortar air content and compressive strength.

F. Grout Test (Compressive Strength): For each mix provided, per ASTM C 1019.

G. Prism Test: For each type of construction provided, per ASTM C 1314 at 7 days and at 28 days.

3.12 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Construction Administration Manager's approval of sample cleaning before proceeding with cleaning of masonry.
3. Protect adjacent nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
5. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.

3.13 MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

END OF SECTION

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SECTION 05 12 00
STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Structural steel.
   2. Grout for structural steel applications.

B. Related Sections:
   1. Division 01 Section "Quality Requirements" for independent testing agency procedures and administrative requirements.
   2. Division 05 Section "Metal Fabrications" for steel lintels and shelf angles not attached to structural-steel frame miscellaneous steel fabrications and other metal items not defined as structural steel.
   3. Division 09 “Painting and Coating” Sections for surface-preparation and priming requirements.

1.3 DEFINITIONS

A. Structural Steel: Elements of structural-steel frame, as classified by AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

B. Other Sections: plates, angles

1.4 PERFORMANCE REQUIREMENTS

A. Select and complete connections using schematic details indicated.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show fabrication of structural-steel components.
   1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
   2. Include embedment drawings.
   3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
   4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical high-strength bolted connections.

C. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for each welded joint whether prequalified or qualified by testing, including the following:
   1. Power source (constant current or constant voltage).
   2. Electrode manufacturer and trade name, for demand critical welds.

D. Qualification Data: For qualified Installer and fabricator.

E. Welding certificates.

F. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

G. Mill test reports for structural steel, including chemical and physical properties.

H. Product Test Reports: For the following:
   1. Bolts, nuts, and washers including mechanical properties and chemical analysis.
   2. Direct-tension indicators.
   3. Tension-control, high-strength bolt-nut-washer assemblies.
   4. Shop primers.
   5. Nonshrink grout.

I. Source quality-control reports.

1.6 QUALITY ASSURANCE

A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program.

B. Installer Qualifications: A qualified installer who participates in the AISC Quality

Certification Program.

C. Shop-Painting Applicators: Qualified according to AISC's Sophisticated Paint Endorsement P1 or SSPC-QP 3, "Standard Procedure for Evaluating Qualifications of Shop Painting Applicators."

D. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

E. Comply with applicable provisions of the following specifications and documents:
   1. AISC 303.
   2. AISC 360.
   3. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

F. Preinstallation Conference: Conduct conference at Project site.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
   1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
   1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
   2. Clean and relubricate bolts and nuts that become dry or rusty before use.
   3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

1.8 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

PART 2 - PRODUCTS

2.1 STRUCTURAL-STEEL MATERIALS

A. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 50 percent

B. Regional Materials: Provide recycled materials extracted and manufactured within 500 miles of the project site. For recycled materials, the recycling location is considered to be the point of extraction.

C. Materials for W-Shapes, Channels, Angles, plate and bar, cold formed hollow structural sections, steel pipe, and steel castings: See Structural Notes.

D. Welding Electrodes: Comply with AWS requirements.

2.2 PRIMER

A. Primer: Comply with Division 09 painting Sections. Primer to be compatible with intumescent painting where exposed to view.

B. Galvanizing Repair Paint: MPI#18, MPI#19, or SSPC-Paint 20.

C. See Division 09 for repairs to intumescent paint.

2.3 GROUT

A. Metallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, metallic aggregate grout, mixed with water to consistency suitable for application and a 30-minute working time.

B. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.4 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC 360.
   1. Camber structural-steel members where indicated.
   2. Fabricate beams with rolling camber up.
   3. Identify high-strength structural steel according to ASTM A 6/A 6M and maintain markings until structural steel has been erected.
   4. Mark and match-mark materials for field assembly.
   5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.

B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
   1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.

C. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.

D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 2, "Hand Tool Cleaning."

F. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel framing members.

G. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
   1. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
   2. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.5 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
   1. Joint Type: Snug tightened.

B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

1. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances in AISC 303 for mill material.

2.6 SHOP PRIMING

A. Shop prime steel surfaces except the following:
   1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
   2. Surfaces to be field welded.
   3. Surfaces to be high-strength bolted with slip-critical connections.
   4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
   5. Galvanized surfaces.

B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
   1. SSPC-SP 3, "Power Tool Cleaning."

C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
   1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
   2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

2.7 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123/A 123M.
   1. Fill vent and drain holes that will be exposed in the finished Work unless they will function as weep holes, by plugging with zinc solder and filing off smooth.
   2. Galvanize lintels, shelf angles, exterior exposed channels, and welded door frames attached to structural-steel frame and located in exterior walls.

2.8 SOURCE QUALITY CONTROL

A. Testing Agency: Owner will engage an independent testing and inspecting agency to perform shop tests and inspections and prepare test reports.
   1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.

B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

C. Bolted Connections: Shop-bolted connections will be tested and inspected according

to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

D. Welded Connections: In addition to visual inspection, shop-welded connections will be tested and inspected according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
   1. Liquid Penetrant Inspection: ASTM E 165.
   2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
   3. Ultrasonic Inspection: ASTM E 164.
   4. Radiographic Inspection: ASTM E 94.

E. In addition to visual inspection, shop-welded shear connectors will be tested and inspected according to requirements in AWS D1.1/D1.1M for stud welding and as follows:
   1. Bend tests will be performed if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
   2. Tests will be conducted on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1/D1.1M.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify, with steel Erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
   1. Prepare a certified survey of bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.
   1. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

3.3 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.

B. Base Bearing and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
   1. Set plates for structural members on wedges, shims, or setting nuts as required.
   2. Weld plate washers to top of baseplate.
   3. Snug-tighten Pretension anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
   4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

C. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."

D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
   1. Level and plumb individual members of structure.
   2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.

E. Splice members only where indicated.

F. Do not use thermal cutting during erection.

G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

H. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.

3.4 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.

1. Joint Type: Snug tightened.

B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
   1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
   2. Remove backing bars or runoff tabs, back gouge, and grind steel smooth.
   3. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances in AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect field welds and high-strength bolted connections.

B. Bolted Connections: Bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

C. Welded Connections: Field welds will be visually inspected according to AWS D1.1/D1.1M.
   1. In addition to visual inspection, field welds will be tested and inspected according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
      a. Liquid Penetrant Inspection: ASTM E 165.
      b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
      c. Ultrasonic Inspection: ASTM E 164.
      d. Radiographic Inspection: ASTM E 94.

D. In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:
   1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
   2. Conduct tests on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1/D1.1M.

E. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

3.6 REPAIRS AND PROTECTION

A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and

repair galvanizing to comply with ASTM A 780.

B. Touchup Painting: Immediately after erection, clean exposed areas where primer is damaged or missing and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
   1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

END OF SECTION

SECTION 05 31 00
STEEL DECKING

1.0 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 the following:
   1. Intermediate rib roof deck.

B. Related Sections include the following:
   1. Division 05 Section "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.
   2. Division 09 painting Sections for repair painting of primed deck.

1.3 SUBMITTALS

A. Product Data: For each type of deck, accessory, and product indicated.

B. Shop Drawings: Show layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

C. Product Certificates: For each type of steel deck, signed by product manufacturer.

D. Welding certificates.

E. Field quality-control test and inspection reports.

F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that each of the following complies with requirements:

   1. Power-actuated mechanical fasteners.
   2. Acoustical roof deck.

G. Research/Evaluation Reports: For steel deck.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency qualified according to ASTM E 329 for testing indicated.

B. Welding: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code - Sheet Steel."

C. Fire-Test-Response Characteristics: Where indicated, provide steel deck units identical to those tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.

1. Fire-Resistance Ratings: Indicated by design designations of applicable testing and inspecting agency.
2. Steel deck units shall be identified with appropriate markings of applicable testing and inspecting agency.

D. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."

E. FMG Listing: Provide steel roof deck evaluated by FMG and listed in its "Approval Guide, Building Materials" for Class 1 fire rating and Class 1-90 windstorm ratings.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

1. Protect and ventilate acoustical cellular roof deck with factory-installed insulation to maintain insulation free of moisture.

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:

1. Steel Deck:

a. ASC Profiles, Inc.
b. Canam Steel Corp.;The Canam Manac Group.

c. Consolidated Systems, Inc.
d. DACS, Inc.
e. D-Mac Industries Inc.
f. Epic Metals Corporation.
g. Marlyn Steel Decks, Inc.
h. New Millennium Building Systems, LLC.
i. Nucor Corp.; Vulcraft Division.
j. Roof Deck, Inc.
k. United Steel Deck, Inc.
l. Valley Joist; Division of EBSCO Industries, Inc.
m. Verco Manufacturing Co.
n. Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.

2.2 ACCESSORIES

A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.

B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.

C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.

D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.

E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

F. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck, unless otherwise indicated.

G. Piercing Hanger Tabs: Piercing steel sheet hanger attachment devices for use with floor deck.

H. Weld Washers: Uncoated steel sheet, shaped to fit deck rib, 0.0598 inch thick, with factory-punched hole of 3/8-inch minimum diameter.

I. Galvanizing Repair Paint: ASTM A 780, with dry film containing a minimum of 94 percent zinc dust by weight.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.

3.2 INSTALLATION, GENERAL

A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 30, manufacturer's written instructions, and requirements in this Section.

B. Install temporary shoring before placing deck panels, if required to meet deflection limitations.

C. Locate deck bundles to prevent overloading of supporting members.

D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.

E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.

F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.

G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.

H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

I. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.

3.3 ROOF-DECK INSTALLATION

A. Fasten roof-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated or arc seam welds with an equal perimeter that is not less than 1-1/2 inches long, and as follows:

1. Weld Diameter: 5/8 inch, nominal.
2. Weld Spacing: Weld edge and interior ribs of deck units with a minimum of two welds per deck unit at each support. Space welds as indicated.

B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of 1/2 of the span or 36 inches, and as follows:

1. Mechanically fasten with self-drilling, No. 10 diameter or larger, carbon-steel screws.

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:

1. End Joints: Lapped 2 inches.

D. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. Weld or mechanically fasten to substrate to provide a complete deck installation.

1. Weld cover plates at changes in direction of roof-deck panels, unless otherwise indicated.

E. Flexible Closure Strips: Install flexible closure strips over partitions, walls, and where indicated. Install with adhesive according to manufacturer's written instructions to ensure complete closure.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Field welds will be subject to inspection.

C. Testing agency will report inspection results promptly and in writing to Contractor and Construction Administration Manager.

D. Remove and replace work that does not comply with specified requirements.

E. Additional inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

3.5 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

END OF SECTION

SECTION 05 41 00
STRUCTURAL METAL STUD FRAMING

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 the following:
   1. Interior non-load-bearing wall framing.

B. Related Sections include the following:
   1. Division 05 Section "Metal Fabrications" for masonry shelf angles and connections.
   2. Division 09 Section "Non-Structural Metal Framing" for interior non-load-bearing, metal-stud framing and ceiling-suspension assemblies.
   3. Division 09 Section "Gypsum Board Shaft Wall Assemblies" for interior non-load-bearing, metal-stud-framed wall and shaft-wall assemblies.

1.3 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide cold-formed metal framing capable of withstanding design loads within limits and under conditions indicated.

B. Design Loads: As required per 2009 IBC and Engineer of Record's construction documents.

C. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:

D. Interior Non-Load-Bearing Framing: Horizontal deflection of 1/600 of the wall height.
   1. Design framing systems to provide for movement of framing members without damage or overstressing, sheathing failure, connection failure, undue strain on

fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F.

2. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:
   a. Upward and downward movement of 3/4 inch (13 mm).

E. Cold-Formed Steel Framing, General: Design according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions."
   1. Headers: Design according to AISI's "Standard for Cold-Formed Steel Framing - Header Design."
   2. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.

1.4 SUBMITTALS

A. Product Data: For each type of cold-formed metal framing product and accessory indicated.

B. Shop Drawings: Show layout, spacings, sizes, thicknesses, and types of cold-formed metal framing; fabrication; and fastening and anchorage details, including mechanical fasteners. Show reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.
   1. For cold-formed metal framing indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

C. Welding certificates if applicable.

D. Qualification Data: For professional engineer.

E. Product Test Reports: From a qualified testing agency, unless otherwise stated, indicating that each of the following, if applicable, complies with requirements, based on evaluation of comprehensive tests for current products:
   1. Steel sheet.
   2. Expansion anchors.
   3. Power-actuated anchors.
   4. Mechanical fasteners.
   5. Vertical deflection clips.
   6. Horizontal drift deflection clips
   7. Miscellaneous structural clips and accessories.

F. Research/Evaluation Reports: For cold-formed metal framing.

1.5 QUALITY ASSURANCE

A. Engineering Responsibility: Preparation of Shop Drawings, design calculations, and other structural data by a qualified professional engineer.

B. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of cold-formed metal framing that are similar to those indicated for this Project in material, design, and extent.

C. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM E 329 to conduct the testing indicated.

D. Product Tests: Mill certificates or data from a qualified independent testing agency indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, ductility, and metallic-coating thickness.

E. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code--Steel," and AWS D1.3, "Structural Welding Code--Sheet Steel."

F. AISI Specifications and Standards: Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" and its "Standard for Cold-Formed Steel Framing - General Provisions."
   1. Comply with AISI's "Standard for Cold-Formed Steel Framing - Header Design."

G. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Store cold-formed metal framing, protect with a waterproof covering, and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.

B. Regional Content: Provide recycled materials extracted and manufactured within 500 miles of the project site. For recycled materials, the recycling location is considered to be the point of extraction.

C. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:
   1. Grade: As required by structural performance.
   2. Coating: G60 (Z180).

D. Steel Sheet for Vertical Deflection and Drift Clips: ASTM A 653/A 653M, structural steel, zinc coated, of grade and coating as follows:
   1. Grade: As required by structural performance.
   2. Coating: G90.

2.2 INTERIOR NON-LOAD-BEARING WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
   1. Minimum Base-Metal Thickness: 0.0428 inch (1.09 mm).
   2. Minimum Flange Width: 1-5/8 inches (41 mm).

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:
   1. Minimum Base-Metal Thickness: 0.0428 inch (1.09 mm).
   2. Minimum Flange Width: 1-1/4 inches (32 mm).

C. Vertical Deflection Clips: Manufacturer's standard bypass or head clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.

D. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal and lateral loads and transfer them to the primary structure, and as follows:
   1. Minimum Base-Metal Thickness: 0.0538 inch (1.37 mm).

2. Minimum Flange Width: 1 inch (25 mm) plus twice the design gap.

E. Double Deflection Tracks: Manufacturer's double, deep-leg, U-shaped steel tracks, consisting of nested inner and outer tracks; unpunched, with unstiffened flanges.
1. Outer Track: Of web depth to allow free vertical movement of inner track, with flanges designed to support horizontal and lateral loads and transfer them to the primary structure, and as follows:
a. Minimum Base-Metal Thickness: 0.0538 inch (1.37 mm).
b. Minimum Flange Width: 1 inch (25 mm) plus twice the design gap.

2. Inner Track: Of web depth indicated, and as follows:
a. Minimum Base-Metal Thickness: 0.0538 inch (1.37 mm).
b. Minimum Flange Width: equal to sum of outer deflection track flange width plus 1 inch (25 mm).

F. Drift Clips: Manufacturer's standard bypass or head clips, capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure.

2.3 FRAMING ACCESSORIES

A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.

B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:
1. Supplementary framing.
2. Bracing, bridging, and solid blocking.
3. Web stiffeners.
4. Anchor clips.
5. End clips.
6. Foundation clips.
7. Gusset plates.
8. Stud kickers, knee braces, and girts.
9. Joist hangers and end closures.
10. Hole reinforcing plates.
11. Backer plates.

2.4 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123/A 123M.

B. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times design load, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.

C. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times design load, as determined by testing per ASTM E 1190 conducted by a qualified independent testing agency.

D. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping steel drill screws.
   1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.

E. Welding Electrodes: Comply with AWS standards.

2.5 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: SSPC-Paint 20 or DOD-P-21035.
B. Cement Grout: Portland cement, ASTM C 150, Type I; and clean, natural sand, ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.

C. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, and plasticizing and water-reducing agents, complying with ASTM C 1107, with fluid consistency and 30-minute working time.

D. Shims: Load bearing, high-density multimonomer plastic, nonleaching.

E. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to match width of bottom track or rim track members.

2.6 FABRICATION

A. Fabricate cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.
   1. Fabricate framing assemblies using jigs or templates.
   2. Cut framing members by sawing or shearing; do not torch cut.

3. Fasten cold-formed metal framing members by welding, screw fastening, clinch fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.
   a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
   b. Locate mechanical fasteners and install according to Shop Drawings, with screw penetrating joined members by not less than three exposed screw threads.
4. Fasten other materials to cold-formed metal framing by welding, bolting, or screw fastening, according to Shop Drawings.

B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.

C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:
   1. Spacing: Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
   2. Squareness: Fabricate each cold-formed metal framing assembly to a maximum out-of-square tolerance of 1/8 inch.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance.
   1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Install load bearing shims or grout between the underside of wall bottom track or rim track and the top of foundation wall or slab at stud or joist locations to ensure a uniform bearing surface on supporting concrete or masonry construction.
B. Install sealer gaskets to isolate the underside of wall bottom track or rim track and the top of foundation wall or slab at stud or joist locations.

3.3 INSTALLATION, GENERAL

A. Cold-formed metal framing may be shop or field fabricated for installation, or it may be field assembled.

B. Install cold-formed metal framing according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions" and to manufacturer's written instructions unless more stringent requirements are indicated.

C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.
   1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch.

D. Install cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened.
   1. Cut framing members by sawing or shearing; do not torch cut.
   2. Fasten cold-formed metal framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.
      a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
      b. Locate mechanical fasteners and install according to Shop Drawings, and complying with requirements for spacing, edge distances, and screw penetration.

E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.

F. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

G. Do not bridge building expansion and control joints with cold-formed metal framing. Independently frame both sides of joints.

H. Install insulation, specified in Division 07 Section "Thermal Insulation," in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.

I. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's standard punched openings.

J. Erection Tolerances: Install cold-formed metal framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:
   1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.4 INTERIOR NON-LOAD-BEARING WALL INSTALLATION

A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure as indicated.

B. Fasten both flanges of studs to bottom track, unless otherwise indicated. Space studs as follows:
   1. Stud Spacing: As required to meet design criteria, 16” o.c. maximum.

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.

D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
   1. Install single-leg deflection tracks and anchor to building structure.
   2. Install double deep-leg deflection tracks and anchor outer track to building structure.
   3. Connect vertical deflection clips to bypassing or infill studs and anchor to building structure.
   4. Connect drift clips to cold formed metal framing and anchor to building structure.

E. Install horizontal bridging in wall studs, spaced in rows indicated on Shop Drawings but not more than 48 inches apart. Fasten at each stud intersection.
   1. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 18 inches (450 mm) of single deflection track. Install a combination of flat, taut, steel sheet straps of width and thickness indicated and stud or stud-track solid blocking of width and thickness matching studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
   2. Install solid blocking at 96-inch (2440-mm) centers.
   3. Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
   4. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
   5. Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.

F. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, fasteners, and stud girts, to provide a complete and stable wall-framing system.

3.5 FIELD QUALITY CONTROL

A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Field and shop welds will be subject to testing and inspecting.

C. Testing agency will report test results promptly and in writing to Contractor and Construction Administration Manager.

D. Remove and replace work where test results indicate that it does not comply with specified requirements.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.6 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed metal framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, ensure that cold-formed metal framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION

SECTION 05 50 00
METAL FABRICATIONS

1.00 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Steel and aluminum walkway grating.
2. Loose steel lintels.
3. Steel framing and supports for mechanical and electrical equipment.
4. Steel framing and supports for applications where framing and supports are not specified in other Sections.
5. Miscellaneous metal trim.

B. Related Sections include the following:

1. Division 5 Section "Structural Steel" for structural-steel framing system components.
2. Division 9 Section “Exterior Painting” for exterior primers and field applied coatings.

1.3 SUBMITTALS

A. Product Data: For the following:

1. Paint products.
2. Grout.

B. Shop Drawings: Detail fabrication and erection of each metal fabrication indicated. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.

1. Provide templates for anchors and bolts specified for installation under other Sections.

C. Welding Certificates: Copies of certificates for welding procedures and personnel.

1.4 QUALITY ASSURANCE

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

B. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.1, "Structural Welding Code--Steel."
2. AWS D1.3, "Structural Welding Code--Sheet Steel."
3. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

1.5 PROJECT CONDITIONS

A. Field Measurements: Where metal fabrications are indicated to fit walls and other construction, verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.6 COORDINATION

A. Coordinate installation of anchorages for metal fabrications. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

2.00 PRODUCTS

2.1 METALS, GENERAL

A. Metal Surfaces, General: For metal fabrications exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

B. Shop prime all metal fabrications planned for exterior locations with epoxy primer specified in Division 9 Section “Exterior Painting.”

2.2 FERROUS METALS

A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

B. Stainless-Steel Bars and Shapes: ASTM A 276, Type 304.

C. Steel Tubing: Cold-formed steel tubing complying with ASTM A 500.

D. Gray-Iron Castings: ASTM A 48, Class 30, unless another class is indicated or required by structural loads.

E. Cast-in-Place Anchors in Concrete: Anchors of type indicated below, fabricated from corrosion-resistant materials capable of sustaining, without failure, the load imposed within a safety factor of 4, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.

1. Threaded or wedge type; galvanized ferrous castings, either ASTM A 47 malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, hot-dip galvanized per ASTM A 153/A 153M.

F. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

2.3 ALUMINUM

A. Aluminum Extrusions: ASTM B 221, alloy 6063-T6.

2.4 PAINT

A. Shop Primer for Ferrous Metal: Organic zinc-rich primer, complying with SSPC-Paint 20 and compatible with topcoat.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

a. Carboline 621; Carboline Company.
b. Aquapon Zinc-Rich Primer 97-670; PPG Industries, Inc.
c. Tneme-Zinc 90-97; Tnemec Company, Inc.

B. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.

C. Bituminous Paint: Cold-applied asphalt mastic complying with SSPC-Paint 12, except containing no asbestos fibers, or cold-applied asphalt emulsion complying with ASTM D 1187.

2.5 FASTENERS

A. General: Provide zinc-plated fasteners with coating complying with ASTM B 633, Class Fe/Zn 5 fasteners for exterior use and, where built into exterior walls.

B. Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers.

C. Anchor Bolts: ASTM F 1554, Grade 36.

D. Machine Screws: ASME B18.6.3.

E. Lag Bolts: ASME B18.2.1.

F. Wood Screws: Flat head, carbon steel, ASME B18.6.1.

G. Plain Washers: Round, carbon steel, ASME B18.22.1.

H. Lock Washers: Helical, spring type, carbon steel, ASME B18.21.1.

I. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and equal to four times the load imposed when installed in concrete, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.

1. Material: Carbon-steel components zinc-plated to comply with ASTM B 633, Class Fe/Zn 5.

J. Toggle Bolts: FS FF-B-588, tumble-wing type, class and style as needed.

2.6 GROUT

A. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.7 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Shear and punch metals cleanly and accurately. Remove burrs.

C. Ease exposed edges to a radius of approximately 1/32 inch, unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Weld corners and seams continuously to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

E. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

F. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

G. Fabricate joints that will be exposed to weather in a manner to exclude water, or provide weep holes where water may accumulate.

H. Allow for thermal movement resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening up of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

I. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges.

J. Remove sharp or rough areas on exposed traffic surfaces.

K. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Use exposed fasteners of type indicated or, if not indicated, Phillips flat-head (countersunk) screws or bolts. Locate joints where least conspicuous.

2.8 LOOSE BEARING AND LEVELING PLATES

A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.

2.9 LOOSE STEEL LINTELS

A. Fabricate loose structural-steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated.

B. Weld adjoining members together to form a single unit where indicated.

C. Size loose lintels to provide bearing length at each side of openings equal to one-twelfth of clear span, but not less than 8 inches, unless otherwise indicated.

D. Galvanize loose steel lintels located in exterior walls.

2.10 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports that are not a part of structural-steel framework as necessary to complete the Work.

B. Fabricate units from structural-steel shapes, plates, and bars of welded construction, unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction retained by framing and supports. Cut, drill, and tap units to receive hardware, hangers, and similar items.

C. Galvanize miscellaneous framing and supports where indicated.

2.11 MISCELLANEOUS STEEL TRIM

A. Unless otherwise indicated, fabricate units from structural-steel shapes, plates, and bars of profiles shown with continuously welded joints, and smooth exposed edges. Miter corners and use concealed field splices where possible.

B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work. Provide anchors, welded to trim, for embedding in concrete or masonry construction, spaced not more than 6 inches from each end, 6 inches from corners, and 24 inches o.c., unless otherwise indicated.

C. Galvanize miscellaneous steel trim in the following locations:

1. Exterior.
2. Interior, where indicated.

2.12 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish metal fabrications after assembly.

2.13 STEEL AND IRON FINISHES

A. All steel and iron fabrications located in exterior locations or non-air-conditioned spaces shall be hot-dip galvanized.

B. Galvanizing: Hot-dip galvanize items as indicated to comply with applicable standard listed below:

1. ASTM A 123, for galvanizing steel and iron products.
2. ASTM A 153/A 153M, for galvanizing steel and iron hardware.

C. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface-preparation specifications and environmental exposure conditions of installed metal fabrications:

1. Exteriors (SSPC Zone 1B): SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
2. Interiors (SSPC Zone 1A): SSPC-SP 3, "Power Tool Cleaning."

D. Apply shop primer to uncoated surfaces of metal fabrications, except those with galvanized finishes and those to be embedded in concrete or masonry, unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1," for shop painting.

1. Shop prime all metal fabrications planned for exterior locations with epoxy primer specified in Division 9 Section “Exterior Painting.”

2.14 ALUMINUM FINISHES

A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

B. As-Fabricated Finish: AA-M10 (Mechanical Finish: as fabricated, unspecified).

3.00 EXECUTION

3.1 INSTALLATION, GENERAL

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal fabrications to in-place construction. Include threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws, and other connectors.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

D. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

E. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

F. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with a heavy coat of bituminous paint.

3.2 SETTING BEARING AND LEVELING PLATES

A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.

B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.

1. Use nonshrink, nonmetallic grout.

3.3 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings, if any.

B. Support steel girders on solid grouted masonry, concrete, or steel pipe columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of pipe columns.

C. Install pipe columns on concrete footings with grouted baseplates. Position and grout column baseplates as specified above for setting and grouting bearing and leveling plates.

3.4 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0-mil dry-film thickness.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 05 50 00

SECTION 05 52 13
PIPE AND TUBE RAILINGS

1.00 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Steel pipe and tube handrails and guard railing systems.

B. Related Sections: Requirements relating to this Section are contained in the following Sections:

1. Division 3 Section "Cast-In-Place Concrete" for concrete stairs and ramps on which pipe and tube handrails and railing systems specified herein are to be installed.
2. Division 5 Section "Metal Fabrications" for metal components to anchor pipe and tube handrails and railing systems specified herein are to be installed.

1.3 DEFINITIONS

A. Definitions in ASTM E 985 for railing-related terms apply to this Section.

1.4 PERFORMANCE REQUIREMENTS

A. General: In engineering handrail and railing systems to withstand structural loads indicated, determine allowable design working stresses of materials based on the following:

1. Cold-Formed Structural Steel: AISI "Specification for the Design of Cold-Formed Steel Structural Members."

B. Structural Performance of Handrails and Railing Systems: Engineer, fabricate, and install handrails and railing systems to comply with requirements of ASTM E 985 for structural performance based on the following:

1. Testing performed according to ASTM E 894 and E 935.

1.5 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

B. Product data for mechanically connected handrails and railing systems, each kind of fitting, grout, anchoring cement, and paint products.

C. Shop drawings showing fabrication and installation of handrails and railing systems including plans, elevations, sections, details of components, and attachments to other units of Work.

D. Qualification data for firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include a list of completed projects with project names, addresses, names of architects and owners, and other information specified.

E. Test reports from an independent testing agency evidencing compliance of handrails and railing systems with ASTM E 985.

1.6 QUALITY ASSURANCE

A. Single-Source Responsibility: Obtain handrails and railing systems of each type and material from a single manufacturer.

B. Engineer Qualifications: Professional engineer legally authorized to practice in the jurisdiction where Project is located and experienced in providing engineering services of the kind indicated for handrails and railing systems similar to this Project in material, design, and extent, and that have a record of successful in-service performance.

1.7 STORAGE

A. Store handrails and railing systems inside a well-ventilated area, away from uncured concrete and masonry and protected from weather, moisture, soiling, abrasion, extreme temperatures, and humidity.

1.8 PROJECT CONDITIONS

A. Field Measurements: Where handrails and railing systems are indicated to fit to other construction, check actual dimensions of other construction by accurate field measurements before fabrication; show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.9 SEQUENCING AND SCHEDULING

A. Sequence and coordinate installation of wall handrails as follows:

1. Do not support handrails temporarily by any means not satisfying structural performance requirements.

2.00 PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering handrails and railing systems that may be incorporated in the Work include, but are not limited to, the following:

1. Steel Pipe and Tube Railings:

   a. Humane Equipment Co.
   b. Wagner: R & B Wagner, Inc.
   c. Julius Blum & Co., Inc.

2.2 METALS

A. General: Provide metals free from surface blemishes where exposed to view in the finished unit. Exposed-to-view surfaces exhibiting pitting, seam marks, roller marks, stains, discolorations, or other imperfections on finished units are not acceptable.

B. Steel and Iron: Provide steel and iron in the form indicated, complying with the following requirements:

1. Steel Pipe: ASTM A 53; finish, type, and weight class as follows:

   a. Galvanized finish for exterior installations and where indicated.
   b. Type F, or Type S, Grade A, standard weight (schedule 40), unless otherwise indicated, or another weight, type, and grade required by structural loads.

2. Steel Tubing: Product type (manufacturing method) and other requirements as follows:

   a. Cold-Formed Steel Tubing: ASTM A 500, grade as indicated below:
      1) Grade A, unless otherwise indicated or required by structural loads.
   b. Hot-Formed Steel Tubing: ASTM A 501.
   c. For exterior installations and where indicated, provide tubing with hot-dip galvanized coating per ASTM A 53.

3. Steel Plates, Shapes, and Bars: ASTM A 36 (ASTM A 36M).
4. Gray Iron Castings: ASTM A 48, Class 30.
5. Malleable Iron Castings: ASTM A 47, Grade 32510 (ASTM A 47M, Grade 22010).

C. Brackets, Flanges, and Anchors: Cast or formed metal of the same material and finish as supported rails, unless otherwise indicated.

2.3 WELDING MATERIALS, FASTENERS, AND ANCHORS

A. Welding Electrodes and Filler Metal: Provide type and alloy of filler metal and electrodes as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.

B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of the type, grade, and class required to produce connections that are suitable for anchoring railings to other types of construction indicated and capable of withstanding design loadings.

1. Use plated fasteners complying with ASTM B 633, Class Fe/Zn 25 for electrodeposited zinc coating.

C. Fasteners for Interconnecting Railing Components: Use fasteners of same basic metal as the fastened metal, unless otherwise indicated. Do not use metals that are corrosive or incompatible with materials joined.

1. Provide concealed fasteners for interconnecting railing components and their attachment to other work, except where otherwise indicated.
2. Provide Phillips flat-head machine screws for exposed fasteners, unless otherwise indicated.

D. Cast-in-Place and Postinstalled Anchors: Anchors of type indicated below, fabricated from corrosion-resistant materials, capable of sustaining, without failure, a load equal to 6 times the load imposed when installed in unit masonry and equal to 4 times the load imposed when installed in concrete, as determined by testing per ASTM E 488, conducted by a qualified, independent testing agency.

1. Cast-in-place anchors.
2. Chemical anchors.
3. Expansion anchors.

2.4 PAINT

A. Shop Primers: Provide primers to comply with applicable requirements of Division 9 Section "Painting."

B. Shop Primer for Ferrous Metal: Fast-curing, lead- and chromate-free, universal modified-alkyd primer, selected for good resistance to normal atmospheric corrosion, compatibility with finish paint systems indicated, and capability to provide a sound foundation for field-applied topcoats despite prolonged exposure, complying with performance requirements of FS TT-P-664.

C. Bituminous Paint: Cold-applied asphalt mastic complying with SSPC-Paint 12, except containing no asbestos fibers.

2.5 GROUT AND ANCHORING CEMENT

A. Nonshrink, Nonmetallic Grout: Premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

B. Erosion-Resistant Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound. Provide formulation that is resistant to erosion from water exposure without need for protection by a sealer or waterproof coating and is recommended for exterior use by manufacturer.

C. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:

1. Nonshrink, Nonmetallic Grouts:

a. B-6 Construction Grout; W.R. Bonsal Co.
b. Diamond-Crete Grout; Concrete Service Materials Co.
c. Supreme; Cormix Construction Chemicals.
d. Sure-grip High Performance Grout; Dayton Superior Corp.
e. Euco N-S Grout; Euclid Chemical Co.
f. Five Star Grout; Five Star Products.
g. Vibropruf #11; Lambert Corp.
h. Crystex; L & M Construction Chemicals, Inc.
i. Masterflow 928 and 713; Master Builders Technologies, Inc.
j. Sealtight 588 Grout; W.R. Meadows, Inc.
k. Sonogrout 14; Sonneborn Building Products--ChemRex, Inc.
l. Kemset; The Spray-Cure Company.

2. Erosion-Resistant Anchoring Cement:

a. Bonsal Anchor Cement; W.R. Bonsal Co.
b. Super Por-Rok; Minwax Construction Products Division.
c. Thorogrip; Thoro Systems Products.

2.6 FABRICATION

A. General: Fabricate handrails and railing systems to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of hollow members, post spacings, and anchorage, but not less than those required to support structural loads.

B. Assemble handrails and railing systems in the shop to the greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

C. Form changes in direction of members as follows:

1. As detailed.

D. Form simple and compound curves by bending pipe in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross section of pipe throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of pipe.

E. Welded Connections: Fabricate handrails and railing systems for connection of members by welding. For connections made during fabrication, weld corners and seams continuously to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At tee and cross intersections, cope ends of intersecting members to fit contour of pipe or tube to which end is joined, and weld all around.
5. At exposed connections, finish exposed welds and surfaces smooth and blended so that no roughness shows after finishing and welded surface matches contours of adjoining surfaces.

F. Nonwelded Connections: Fabricate handrails and railing systems by connecting members with railing manufacturer's standard concealed mechanical fasteners and fittings, unless otherwise indicated. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.

1. Fabricate splice joints for field connection using epoxy structural adhesive where this represents manufacturer's standard splicing method.

G. Brackets, Flanges, Fittings, and Anchors: At typical locations, provide manufacturer's standard wall brackets, flanges, miscellaneous fittings, and anchors to interconnect handrail and railing system members to other construction.

H. Provide inserts and other anchorage devices to connect handrails and railing systems to concrete. Fabricate anchorage devices capable of withstanding loads imposed by handrails and railing systems. Coordinate anchorage devices with supporting structure.

I. For railing posts set in concrete, provide preset sleeves of steel, not less than 6 inches (150 mm) long with inside dimensions not less than 1/2 inch (12 mm) greater than outside dimensions of post, and steel plate forming bottom closure.

J. Shear and punch metals cleanly and accurately. Remove burrs from exposed cut edges.

K. Ease exposed edges to a radius of approximately 1/32 inch (1 mm), unless otherwise indicated. Form bent-metal corners to the smallest radius possible without causing grain separation or otherwise impairing work.

L. Cut, reinforce, drill, and tap components, as indicated, to receive finish hardware, screws, and similar items.

M. Provide wall returns at ends of wall-mounted handrails, unless otherwise indicated.

N. Fillers: Provide steel sheet or plate fillers, of thickness and size indicated or required to support structural loads of handrails, where needed to transfer wall bracket loads through wall finishes to structural supports. Size fillers to suit wall finish thicknesses to produce adequate bearing to prevent bracket rotation and overstressing substrate.

2.7 FINISHES, GENERAL

A. Comply with NAAMM "Metal Finishes Manual" for recommendations relative to applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering prior to shipment.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one half of the range of approved samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved samples and they are assembled or installed to minimize contrast.

D. Provide exposed fasteners with finish matching appearance, including color and texture, of handrails and railing systems.

2.8 STEEL FINISHES

A. For nongalvanized steel handrails and railing systems, provide nongalvanized ferrous metal fittings, brackets, fasteners, and sleeves, except provide galvanized anchors where embedded in exterior masonry and concrete construction.

B. Preparation for Shop Priming: Prepare uncoated ferrous metal surfaces to comply with minimum requirements indicated below for SSPC surface-preparation specifications and environmental exposure conditions of installed railings:

1. Interiors (SSPC Zone 1A): SSPC-SP 7 "Brush-Off Blast Cleaning."

C. Apply shop primer to prepared surfaces of handrails and railing components, unless otherwise indicated. Comply with requirements of SSPC-PA 1 "Paint Application Specification No. 1" for shop painting. Primer need not be applied to surfaces to be embedded in concrete.

1. Stripe paint all edges, corners, crevices, bolts, welds, and sharp edges.

3.00 EXECUTION

3.1 PREPARATION

A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installing anchorages, such as sleeves, concrete inserts, anchor bolts, and miscellaneous items having integral anchors, that are to be embedded in concrete construction. Coordinate delivery of such items to Project site.

3.2 INSTALLATION, GENERAL

A. Fit exposed connections accurately together to form tight, hairline joints.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing handrails and railing systems. Set handrails and railing systems accurately in location, alignment, and elevation, measured from established lines and levels and free from rack.

1. Do not weld, cut, or abrade surfaces of handrails and railing components that have been coated or finished after fabrication and are intended for field connection by mechanical or other means without further cutting or fitting.
2. Set posts plumb within a tolerance of 1/4 inch in 12 feet (2 mm in 1 m).
3. Align rails so that variations from level for horizontal members and from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet (2 mm in 1 m).

C. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so that no roughness shows after finishing, and welded surface matches contours of adjoining surfaces.

D. Adjust handrails and railing systems prior to anchoring to ensure matching alignment at abutting joints. Space posts at interval indicated but not less than that required by design loadings.

E. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing handrails and railing systems and for properly transferring loads to in-place construction.

3.3 RAILING CONNECTIONS

A. Nonwelded Connections: Use mechanical joints for permanently connecting railing components. Locate exposed fasteners in least conspicuous locations. Seal recessed holes of exposed locking screws with plastic filler, cement colored to match finish of handrails and railing systems.

B. Welded Connections: Use fully welded joints for permanently connecting railing components by welding. Cope or butt components to provide 100 percent contact, or use fittings designed for this purpose.

C. Expansion Joints: Install expansion joints at required locations but not further apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2 inches (50 mm) beyond joint on either side; fasten internal sleeve securely to one side; locate joint within 6 inches (150 mm) of post.

3.4 ANCHORING POSTS

A. Anchor posts in concrete with pipe sleeves preset and anchored into concrete. After posts have been inserted into sleeves, solidly fill annular space between post and sleeve with the following anchoring material, mixed and placed to comply with anchoring material manufacturer's directions.

B. Leave anchorage joint exposed, wipe off surplus anchoring material, and leave 1/8-inch (3-mm) buildup, sloped away from post.

C. Anchor posts to metal surfaces with oval flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:

1. Weld flanges to post and bolt to metal supporting surfaces.

3.5 ANCHORING RAIL ENDS

A. Anchor rail ends into concrete with round flanges connected to rail ends and anchored into wall construction with post installed anchors and bolts.

B. Anchor rail ends to metal surfaces with oval or round flanges.

1. Weld flanges to rail ends.

3.6 ATTACHING HANDRAILS TO WALLS

A. Attach handrails to wall with wall brackets and end fittings. Provide bracket with 1-1/2-inch (38-mm) clearance from inside face of handrail to finished wall surface.

B. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.

C. Secure wall brackets and wall return fittings to building construction as follows:

1. Use type of bracket with flange tapped for concealed anchorage to threaded hanger bolt.

3.7 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material.

3.8 PROTECTION

A. Protect finishes of handrails and railing systems from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

B. Restore finishes damaged during installation and construction period so that no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION 05 52 13

SECTION 06 10 00

ROUGH CARPENTRY

1.00 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 the following:

1. Wood blocking and nailers.
2. Wood furring.
3. Plywood backing panels.

1.3 DEFINITIONS

A. Rough Carpentry: Carpentry work not specified in other Sections and not exposed, unless otherwise indicated.

B. Lumber grading agencies, and the abbreviations used to reference them, include the following:

1. NELMA - Northeastern Lumber Manufacturers Association.
2. NLGA - National Lumber Grades Authority.
3. RIS - Redwood Inspection Service.
4. SPIB - Southern Pine Inspection Bureau.
5. WCLIB - West Coast Lumber Inspection Bureau.
6. WWPA - Western Wood Products Association.

1.4 SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used, net amount of preservative retained, and chemical treatment manufacturer's written instructions for handling, storing, installing, and finishing treated material.
2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials, both before and after exposure to elevated temperatures when tested according to ASTM D 5516 and ASTM D 5664.
3. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

B. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the American Lumber Standards Committee Board of Review.

C. Research/Evaluation Reports: For the following, showing compliance with building code in effect for Project:

1. Preservative-treated wood.
2. Fire-retardant-treated wood.
3. Power-driven fasteners.
4. Powder-actuated fasteners.
5. Expansion anchors.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, with the experience and capability to conduct the testing indicated, as documented according to ASTM E 548.

B. Source Limitations for Fire-Retardant-Treated Wood: Obtain each type of fire-retardant-treated wood product through one source from a single producer.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Stack lumber, plywood, and other panels; place spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

2.00 PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of lumber grading agencies certified by the American Lumber Standards Committee Board of Review.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
3. Provide dressed lumber, S4S, unless otherwise indicated.
4. Provide dry lumber with 19 percent maximum moisture content at time of dressing for 2-inch nominal thickness or less, unless otherwise indicated.

2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

A. Preservative Treatment by Pressure Process: AWPA C2 (lumber) and AWPA C9 (plywood), except that lumber that is not in contact with the ground and is continuously protected from liquid water may be treated according to AWPA C31 with inorganic boron (SBX).

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and the following:

a. Chromated copper arsenate (CCA).
b. Ammoniacal copper zinc arsenate (ACZA).
c. Ammoniacal, or amine, copper quat (ACQ).
d. Copper bis (dimethyldithiocarbamate) (CDDC).

e. Ammoniacal copper citrate (CC).
f. Copper azole, Type A (CBA-A).
g. Oxine copper (copper-8-quinolinolate) in a light petroleum solvent.

B. Kiln-dry material after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood. Do not use material that is warped or does not comply with requirements for untreated material.

C. Mark each treated item with the treatment quality mark of an inspection agency approved by the American Lumber Standards Committee Board of Review.

D. Application: Treat items indicated on Drawings, and the following:

1. Wood nailers, blocking, stripping, and similar members in connection with roofing and flashing.
2. Wood blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.

2.3 FIRE-RETARDANT-TREATED MATERIALS

A. General: Where fire-retardant-treated materials are indicated, provide materials that comply with performance requirements in AWPA C20 (lumber). Identify fire-retardant-treated wood with appropriate classification marking of UL, U.S. Testing, Timber Products Inspection, or another testing and inspecting agency acceptable to authorities having jurisdiction.

1. Use treatment for which chemical manufacturer publishes physical properties of treated wood after exposure to elevated temperatures, when tested by a qualified independent testing agency according to ASTM D 5664, for lumber and ASTM D 5516, for plywood.
2. Use treatment that does not promote corrosion of metal fasteners.
3. Use Exterior type for exterior locations and where indicated.
4. Use Interior Type A High Temperature (HT), unless otherwise indicated.

2.4 MISCELLANEOUS LUMBER

A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

1. Blocking.
2. Nailers.
3. Furring.

B. For items of dimension lumber size, provide Construction or No. 2 grade lumber with 19 percent maximum moisture content of any species.

C. For concealed boards, provide lumber with 19 percent maximum moisture content and any of the following species and grades:

1. Mixed southern pine, No. 3 grade; SPIB.
2. Eastern softwoods, No. 3 Common grade; NeLMA.
3. Northern species, No. 3 Common grade; NLGA.
4. Western woods, Standard or No. 3 Common grade; WCLIB or WWPA.

2.5 PLYWOOD BACKING PANELS

A. Equipment Backing Panels: DOC PS 1, Exposure 1, C-D Plugged, in thickness indicated or, if not indicated, not less than 1/2-inch nominal thickness.

2.6 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified.

1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.

B. Power-Driven Fasteners: NES NER-272.

C. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.

3.00 EXECUTION

3.1 INSTALLATION

A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate furring, nailers, blocking, and similar supports to comply with requirements for attaching other construction.

B. Framing Standard: Comply with AF&PA's "Details for Conventional Wood Frame Construction," unless otherwise indicated.

C. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

D. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated.

3.2 WOOD BLOCKING AND NAILER INSTALLATION

A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces, unless otherwise indicated.

3.3 WOOD FURRING INSTALLATION

A. Install level and plumb with closure strips at edges and openings. Shim with wood as required for tolerance of finish work.

1. Fire block furred spaces of walls and at ceiling, with wood blocking or noncombustible materials accurately fitted to close furred spaces.

3.4 PROTECTION

A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 06 10 00

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SECTION 06 16 00
SHEATHING

1.00 GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Wall sheathing.
2. Sheathing joint-and-penetration treatment.
3. Flexible flashing at openings in sheathing.

B. Related Sections include the following:

1. Division 6 Section "Rough Carpentry" for plywood backing panels.

1.2 DELIVERY, STORAGE, AND HANDLING

A. Stack plywood and other panels flat with spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

2.00 PRODUCTS

2.1 EXTERIOR WALL SHEATHING

A. Glass-Mat Gypsum Wall Sheathing: ASTM C 1177/1177M.

1. Product: Subject to compliance with requirements, provide "Dens-Glass Gold" by G-P Gypsum Corporation.
2. Type and Thickness: Regular, 1/2 inch thick.
3. Size: 48 by 96 inches for vertical installation.

2.2 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.

1. For roof sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.

B. Nails, Brads, and Staples: ASTM F 1667.

C. Power-Driven Fasteners: NES NER-272.

D. Wood Screws: ASME B18.6.1.

E. Screws for Fastening Gypsum Sheathing to Cold-Formed Metal Framing: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing board to be attached, with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117.

1. For steel framing less than 0.0329 inch thick, attach sheathing to comply with ASTM C 1002.
2. For steel framing from 0.033 to 0.112 inch thick, attach sheathing to comply with ASTM C 954.

2.3 WEATHER-RESISTANT SHEATHING PAPER

A. Building Paper: ASTM D 226, Type 1 (No. 15 asphalt-saturated organic felt), unperforated.

B. Building Wrap: ASTM E 1677, Type I air retarder; with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, when tested according to ASTM E 84; UV stabilized; and acceptable to authorities having jurisdiction.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

   a. Dow Chemical Company (The); Styrofoam Weathermate Plus Brand Housewrap.
   b. DuPont (E. I. du Pont de Nemours and Company); Tyvek CommercialWrap.
   c. Ludlow Coated Products; Barricade Building Wrap.
   d. Pactiv, Inc.; GreenGuard Ultra Wrap.
   e. Raven Industries Inc.; Rufco-Wrap.
   f. Reemay, Inc.; Typar HouseWrap.

2. Water-Vapor Permeance: Not less than 152 g through 1 sq. m of surface in 24 hours per ASTM E 96, Desiccant Method (Procedure A).
3. Allowable UV Exposure Time: Not less than three months.

C. Building-Wrap Tape: Pressure-sensitive plastic tape recommended by building-wrap manufacturer for sealing joints and penetrations in building wrap.

2.4 SHEATHING JOINT-AND-PENETRATION TREATMENT MATERIALS

A. Sealant for Glass-Mat Gypsum Sheathing Board: Elastomeric, medium-modulus, neutral-curing silicone joint sealant compatible with joint substrates formed by gypsum sheathing and other materials, recommended by sheathing manufacturer for application indicated, and complying with requirements for elastomeric sealants specified in Division 7 Section "Joint Sealants."

B. Sheathing Tape for Glass-Mat Gypsum Sheathing Board: Self-adhering glass-fiber tape, minimum 2 inches wide, 10 by 10 or 10 by 20 threads/inch, of type recommended by sheathing and tape manufacturers for use with silicone emulsion sealant in sealing joints in glass-mat gypsum sheathing board and with a history of successful in-service use.

2.5 MISCELLANEOUS MATERIALS

A. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall thickness of not less than 0.040 inch.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

   a. Carlisle Coatings & Waterproofing; CCW-705-TWF Thru-Wall Flashing.
   b. Grace Construction Products, a unit of W. R. Grace & Co. - Conn.; Vycor V40 Weather Barrier Strips.
   c. Polyguard Products, Inc.; Polyguard 300.
   d. Protecto Wrap Company; PS-45.

B. Primer for Flexible Flashing: Product recommended by manufacturer of flexible flashing for substrate.

C. Adhesives for Field Gluing Panels to Framing: Formulation complying with ASTM D 3498 that is approved for use with type of construction panel indicated by manufacturers of both adhesives and panels.

1. Use adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

3.00 EXECUTION

3.1 INSTALLATION, GENERAL

A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction, unless otherwise indicated.

C. Securely attach to substrate by fastening as indicated, complying with the following:

1. NES NER-272 for power-driven fasteners.
2. Table 2304.9.1, "Fastening Schedule," in ICC's "International Building Code."
3. Table 23-II-B-1, "Nailing Schedule," and Table 23-II-B-2, "Wood Structural Panel Roof Sheathing Nailing Schedule," in ICBO's "Uniform Building Code."
4. Table 2305.2, "Fastening Schedule," in BOCA's "BOCA National Building Code."
5. Table 2306.1, "Fastening Schedule," in SBCCI's "Standard Building Code."
6. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's "International Residential Code for One- and Two-Family Dwellings."
7. Table 602.3(1), "Fastener Schedule for Structural Members," and Table 602.3(2), "Alternate Attachments," in ICC's "International One- and Two-Family Dwelling Code."

D. Coordinate sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.

E. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.2 GYPSUM SHEATHING INSTALLATION

A. Comply with GA-253 and with manufacturer's written instructions.

1. Fasten gypsum sheathing to cold-formed metal framing with screws.
2. Install boards with a 3/8-inch gap where non-load-bearing construction abuts structural elements.
3. Install boards with a 1/4-inch gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.

B. Apply fasteners so heads bear tightly against face of sheathing boards but do not cut into facing.

3.3 WEATHER-RESISTANT SHEATHING-PAPER INSTALLATION

A. General: Cover sheathing with weather-resistant sheathing paper as follows:

1. Cut back barrier 1/2 inch on each side of the break in supporting members at expansion- or control-joint locations.
2. Apply barrier to cover vertical flashing with a minimum 4-inch overlap, unless otherwise indicated.

B. Building Paper: Apply horizontally with a 2-inch overlap and a 6-inch end lap; fasten to sheathing with galvanized staples or roofing nails.

C. Building Wrap: Comply with manufacturer's written instructions.

1. Seal seams, edges, fasteners, and penetrations with tape.

3.4 SHEATHING JOINT-AND-PENETRATION TREATMENT

A. Seal sheathing joints according to sheathing manufacturer's written instructions.

1. Apply elastomeric sealant to joints and fasteners and trowel flat. Apply sufficient quantity of sealant to completely cover joints and fasteners after troweling. Seal other penetrations and openings.
2. Apply glass-fiber sheathing tape to glass-mat gypsum sheathing board joints, and apply and trowel silicone emulsion sealant to embed entire face of tape in sealant. Apply sealant to exposed fasteners with a trowel so fasteners are completely covered. Seal other penetrations and openings.

3.5 FLEXIBLE FLASHING INSTALLATION

A. Apply flexible flashing where indicated to comply with manufacturers written instructions.

1. Prime substrates as recommended by flashing manufacturer.
2. Lap seams and junctures with other materials at least 4 inches, except that at flashing flanges of other construction, laps need not exceed flange width.
3. After flashing has been applied, roll surfaces with a hard rubber or metal roller to ensure that flashing is completely adhered to substrates.

END OF SECTION 06 16 00

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SECTION 06 82 00

FIBERGLASS REINFORCED PLASTIC UNITS

1.00 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.2 SUMMARY

A. Extent of pultruded fiberglass reinforced plastic units is shown on drawings, including basic layout and type of units required for an equipment ramp and landing with ralings.

B. This Section includes the following types of fiberglass reinforced plastic units:

1. Two-way span pultruded gratings.
2. Tubing system.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's specifications and installation instructions for each type of grating, grating legs, each structural shape and each resin system. Include manufacturer's certification that joists comply with the specifications.

B. Shop Drawings: Submit detailed drawings showing layout of units, special connections, joining and accessories. Include mark, number, type, location and spacing of components.

1. Provide templates or location drawings for installation of connectors and bearing plates.
2. Provide calculation sealed by a professional engineer registered in the State of Texas.

C. Samples: Submit two 12-inch long samples of each type of grating, grating legs, and structural shape required by the project. Grating samples shall show edge conditions, receiver angles, connectors and hold-down clips; submit studs, bolts, bearing plates and other units required for proper installation of structural shaped units.

1.4 DELIVERY, STORAGE AND HANDLING

A. Deliver, store and handle fiberglass reinforced plastic units as recommended by the manufacturer. Handle and store in a manner to avoid the units being subjected to excessive stresses or sunlight.

1.5 DEFINITIONS

A. Definitions in ASTM E 985 for railing-related terms apply to this section.

1.6 SYSTEM PERFORMANCE REQUIREMENTS

A. Structural Performance of Handrails and Railing Systems: Design, engineer, fabricate, and install handrails and railing systems to comply with requirements of ASTM E 985 for structural performance based on testing performed in accordance with ASTM E 894 and E 935. Coordinate design with Systems Chemistry, Inc., 3901 Burton Drive, Santa Clara, CA 95054 408/496-1177.

1. Top Rail of Guardrail Systems: Capable of withstanding the following loads applied as indicated:

a. Concentrated load of 300 lbf applied at any point nonconcurrently, vertically downward, or horizontally.
b. Uniform load of 100 lbf per linear ft. applied nonconcurrently, vertically downward or horizontally.
c. Concentrated and uniform loads above need not be assumed to act concurrently.

2. Handrails Not Serving as Top Rails: Capable of withstanding the following loads applied as indicated:

a. Concentrated load of 200 lbf applied at any point nonconcurrently, vertically downward or horizontally.
b. Uniform load of 50 lbf per linear foot applied nonconcurrently, vertically downward or horizontally.
c. Concentrated and uniform loads above need not be assumed to act concurrently.

3. Infill Area of Guardrail Systems: Capable of withstanding a horizontal concentrated load of 200 lbf applied to one sq. ft. at any point in the system including panels, intermediate rails balusters, or other elements composing the infill area.

a. Above load need not be assumed to act concurrently with uniform horizontal loads on top rails of railing systems in determining stress on guard.

2.00 PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design: Provide Safe-T-Span® in 30-inch and 48-inch wide units as manufactured by Fibergrate Composite Structures Inc. or, subject to compliance with requirements, provide Construction Administration Manager approved equal gratings manufactured by one of the following:

1. American Grating. LLC.
2. Fibergrate Composite Structures Inc.
3. Glastrusions, Inc., Div. of Morrison Molded Fiber Glass Company.
4. Chemgrate Corporation.

2.2 MATERIALS

A. Resins:

1. Fire retardant isophthalic polyester resin a filler of 3-5% antimony oxide..
2. Isophthalic polyester.
3. Fire retardant vinyl ester with a flame spread of 25 or less in accordance with ASTM E84.
4. Epoxy.

B. Reinforcement:

1. Fiberglass rovings and continuous strand mat.
2. Graphite fibers.
3. Aramid fibers.

C. Connectors and miscellaneous components:

1. Fiberglass reinforced plastic studs, bolts and plates for structural shapes.
2. Fiberglass reinforced plastic angle frames, stainless steel clips, saddle clips, studs and bolts for gratings.
3. Fiberglass reinforced plastic handrail components consisting of baseplates, posts, rails and kickplates.
4. Steel connecting plugs and rods for handrail system.
5. Fiberglass grating legs and adjustable legs.

D. Design Requirements:

1. The anti-slip grit top surface of the grating shall be integral with the glass fiber reinforced substrate. The grit shall be tightly packed with particle-to-particle contact to minimum depth of 1/8-inch.
2. The resin shall be a chemical grade thermoset resin appropriate for the structural performance and fire resistance required of the unit.
3. Provide standard gray stock color units.
4. Landing, ramps and railings shall be designed and fabricated so that they can be disassembled and reinstalled easily when required for access to utility trench below area where ramps and landings will be installed.

2.3 FABRICATED UNITS

A. Handrail System:

1. Provide fiberglass reinforced plastic handrail system components fabricated from pultruded posts, rails, kickplates and base plates having not less than 60% resin content and a maximum of 40% fiberglass content by weight. Ends of cut shapes shall be thoroughly sealed to prevent corrosion during the service life of the unit. Use steel connecting lugs and 1/2-inch diameter steel rods as internal connectors and reinforcing members.

2. The 3-rail, OSHA compliant handrail system shall comply with the loading requirements specified hereinbefore.

2.4 PULTRUDED GRATING

A. Manufacture: Grating components shall be high strength and high stiffness pultruded elements having a maximum of 70% and a minimum of 60% glass content (by weight) of continuous roving and continuous strand mat fiberglass reinforcements. The finished surface of the product shall be provided with a surfacing veil to provide a resin rich surface which improves corrosion resistance and **resistance to ultraviolet degradation**. Bearing bars shall be interlocked and epoxied in place with a two piece cross rod system to provide a mechanical and chemical lock. Cross rods should be below the walking surface of the grating. Gratings with cross rods that are flush with the walking surface are excluded.

B. Non-slip surfacing: Grating shall be provided with a quartz grit bonded and baked to the top surface of the finished grating product.

C. Fire rating: Grating shall be fire retardant with a tested flame spread rating of 25 or less when tested in accordance with ASTM E 84. Manufacturer may be required to provide certification of ASTM E84 test on grating panels from an independent testing laboratory. Test data shall be from full scale testing of actual production grating, of the same type and material supplied on the project. Test data performed only on the base resin shall not be acceptable.

D. Resin system: The resin system used in the manufacture of the grating shall be ISOFR. Manufacturer may be required to submit corrosion data from tests performed on actual grating products in standard chemical environments. Corrosion resistance data of the base resin from the manufacturer is not a true indicator of grating corrosion resistance and shall not be accepted.

E. Color: Gray.

F. Depth: 1-1/2" deep load bars with a tolerance of plus or minus 1/32".

G. Mesh Configuration: 1" load bar spacing, 6" tie bar spacing on centers. Grating shall be SAFE-T-SPAN® I4015V as manufactured by Fibergrate Composite Structures Incorporated.

H. Load/Deflection: Grating shall meet manufacturers published safe recommended loadings with deflection not to exceed the following:

1. Uniform distributed load over a 48" span: 50 pounds per square foot, with a maximum deflection of 0.04".
2. Uniform distributed load over a 30" span: 50 pounds per square foot, with a maximum deflection of < 0.01".

I. Substitutions: Other products of equal strength, stiffness, corrosion and UV resistance and overall quality may be submitted with the proper supporting data to the Construction Administration Manager for approval.

2.5 GRATING FABRICATION

A. Measurements: Grating supplied shall meet the minimum dimensional requirements as shown or specified. The Contractor shall provide and/or verify measurements in field for work fabricated to fit field conditions as required by grating manufacturer to complete the work. Determine correct size and locations of required holes or cutouts from field dimensions before grating fabrication.

B. Layout: Each grating section shall be readily removable. Manufacturer to provide openings and holes where located on the contract drawings. Grating supports shall be provided at openings in the grating by contractor where necessary to meet load/deflection requirements specified herein. Grating openings which fit around protrusions (pipes, cables, machinery, etc.) shall be discontinuous at approximately the centerline of opening so each section of grating is readily removable.

C. Sealing: All shop fabricated grating cuts shall be coated with vinyl ester resin to provide maximum corrosion resistance. All field fabricated grating cuts shall be coated similarly by the contractor in accordance with the manufacturer's instructions.

D. Hardware: Type 316 stainless steel hold-down clips shall be provided and spaced at a maximum of four feet apart with a minimum of four per piece of grating, or closer as recommended by the manufacturer.

3.00 EXECUTION

3.1 PREPARATION

A. Inspect supporting members for correct layout and alignment.

B. Clean surfaces to receive fiberglass reinforced plastic units to a condition appropriate for the installation technique required.

C. Verify measurements to assure proper fit of units.

3.2 INSTALLATION

A. Do not start placement of grating units until fiberglass supporting work is in place and secured. Place on fiberglass supporting work, adjust and align in accurate locations and spacing before permanently fastening. Fiberglass supporting work included with fiberglass gratings and railings for a complete system at ramp and landing.

B. Set the work accurately in location, alignment and elevation; and plumb, level, true and free from rack.

C. Coat field-cut or sanded surfaces with resin furnished by the manufacturer, applying in strict accordance with the manufacturer's instructions.

D. Gratings Installation:

1. Fit grating panels together to form 1/4-inch joints at adjoining panels and 1/2-inch joints at perimeter of grated area.
2. Align bars of adjoining panels of gratings. Bottom support or end panel connectors are required where panels butt together.
3. Secure grating panels using stainless steel saddle clips spaced as recommended by the manufacturer.

END OF SECTION 06 82 00

SECTION 07 21 00
BUILDING INSULATION

1.00 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Building insulation in blanket form.
2. Spray polyurethane foam insulation.

1.3 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

B. Product data for each type of insulation product specified.

C. Product test reports from and based on tests performed by qualified independent testing laboratory evidencing compliance of insulation products with requirements including R-Values, fire performance characteristics, perm ratings, water absorption ratings, and other properties, based on comprehensive testing of current products.

1.4 QUALITY ASSURANCE

A. Fire Performance Characteristics: Provide insulation materials identical to those whose indicated fire performance characteristics have been determined per the ASTM test method indicated below, by UL or other testing and inspecting agency acceptable to authorities having jurisdiction. Identify products with appropriate markings of applicable testing and inspecting organization.

1. Surface Burning Characteristics: ASTM E 84.
2. Fire Resistance Ratings: ASTM E 119.
3. Combustion Characteristics: ASTM E 136.

B. Single-Source Responsibility for Insulation Products: Obtain each type of building insulation from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work.

1.5 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 recommendations for handling, storage and protection during installation.

2.00 PRODUCTS

2.1 GLASS FIBER BLANKET INSULATION

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include, but are not limited to, the following:

1. Glass Fiber Insulation:

a. CertainTeed Corp.
b. Knauf Fiber Glass GmbH.
c. Manville: Building Insulation Div., Manville Sales Corp.
d. Owens-Corning Fiberglas Corp.

B. Insulation System: Provide insulating materials in thickness that provides an R-value of 19 or greater in exterior walls. The total R-value for the roof from top of roof membrane to the interior space below the insulation shall be R-38 or greater.

1. Preformed Units: Sizes to fit applications indicated, selected from manufacturer's standard thicknesses, widths and lengths.

C. Where glass-fiber blanket insulation is indicated by the following thicknesses, provide blankets in batt or roll form with thermal resistances indicated:

1. 5-1/2 inches thick with a thermal resistance of R-19.

D. Unfaced Mineral Fiber Blanket/Batt Insulation in Walls: Thermal insulation produced by combining mineral fibers of type described below with thermosetting resins to comply with ASTM C 665 for Type I (blankets without membrane facing); and as follows:

1. Mineral Fiber Type: Fibers manufactured from glass.
2. Surface Burning Characteristics: Maximum flame spread and smoke developed values of 25 and 50, respectively.

E. Polypropylene-Scrim-Kraft-Faced, Glass-Fiber Blanket Insulation in area below roof deck: 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).

2.2 SPRAY POLYURETHANE FOAM INSULATION

A. Closed-Cell Polyurethane Foam Insulation: ASTM C 1029, Type II, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following

a. BASF Corporation.
b. Bay Systems North America, LLC.
c. Dow Chemical Company (The).
d. ER Systems, Inc.
e. Gaco Western Inc.
f. Henry Company.
g. NCFI; Division of Barnhardt Mfg. Co.
h. SWD Urethane Company.
i. Volatile Free, Inc.

2. Minimum density of 1.5 lb/cu. ft., thermal resistivity of 6.2 deg F x h x sq. ft./Btu x in. at 75 deg F.

2.3 AUXILIARY INSULATING MATERIALS

A. Adhesive for Pin Anchors: Product with demonstrated capability to bond mechanical anchors securely to substrates indicated without damaging or corroding either insulation, anchors, or substrates.

B. Adhesively Attached Pin Anchors: Perforated plate, 2 inches square, welded to projecting pin, with self-locking washer, complying with the following requirements:

1. Sheet Steel Plate: Zinc-plated steel, 0.030 inch thick.
2. Pin: Copper-coated low carbon steel, fully annealed, 0.105 inches in diameter, length to suit depth of insulation indicated and, with washer in place, to hold insulation tightly to substrate behind insulation.
3. Self-Locking Washer: Mild steel, 0.016 inch thick, size as required to hold insulation securely.
4. Where spindles will be exposed below, protect ends with capped self-locking washers. Do not leave spindles exposed where they may be exposed to human contact after installation.

3.00 EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions with Installer present, for compliance with requirements of the Sections in which substrates and related work are specified and to determine if other conditions affecting performance of insulation are satisfactory. Do not proceed with installation of insulation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrates of substances harmful to insulations or vapor retarders, including removal of projections which might puncture vapor retarders.

3.3 INSTALLATION, GENERAL

A. Comply with manufacturer's instructions applicable to products and application indicated. If printed instructions are not available or do not apply to project conditions, consult manufacturer's technical representative for specific recommendations before proceeding with installation of insulation.

B. Extend insulation full thickness as indicated to envelope entire area to be insulated. Cut and fit tightly around obstructions, and fill voids with insulation. Remove projections which interfere with placement.

C. Apply a single layer of insulation of required thickness, unless otherwise shown or required to make up total thickness.

3.4 INSTALLATION OF GENERAL BUILDING INSULATION

A. Apply insulation units to substrate by method indicated, complying with manufacturer's recommendations. If no specific method is indicated, 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, except as otherwise indicated.

C. Spray-Applied Insulation: Apply spray-applied insulation according to manufacturer's written instructions. Do not apply insulation until installation of pipes, ducts, conduits, wiring, and electrical outlets in walls is completed and electrical boxes, and other items not indicated to receive insulation are masked. After insulation is applied, make flush with face of studs by using method recommended by insulation manufacturer.

3.5 PROTECTION

A. General: Protect installed insulation and vapor retarders from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation will be subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 07 21 00

SECTION 07 57 00
COATED FOAMED ROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Spray-applied, coated, polyurethane foam roofing.
2. Walkways.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for wood blocking and nailers.
2. Section 079200 "Joint Sealants" for joint sealants, fillers, and preparation.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to coated foamed roofing including, but not limited to, the following:

a. Load limitations on in-place roofing.
b. Construction schedule. Verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
c. Minimum curing period.
d. Forecasted weather conditions.
e. Special details and sheet flashings.
f. Repairs.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include manufacturer's written instructions for evaluating, preparing, and treating substrate; technical data; and tested physical and performance properties.

B. Samples for Verification: For coated foamed roofing, prepared on Samples of size indicated below:

1. Samples, 12 by 12 inches, on rigid backing, showing polyurethane foam of thickness required and stepped coatings in colors required to illustrate buildup of coated foamed roofing.
2. Include Samples of auxiliary materials and accessories to verify color and finish selected.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For SPFA-qualified Installer.

B. Product Certificates: For each type of coated foam roofing.

C. Evaluation Reports: For coated foamed roofing, from ICC-ES.

D. Field quality-control reports.

E. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For coated foamed roofing to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who is approved, authorized, or licensed by coating manufacturer for installation of manufacturer's product of polyurethane foam.

1. Engage an installer who participates in and who has fulfilled requirements of the SPFA Accreditation Program for company accreditation and individual applicator accreditation for personnel assigned to work on Project.

B. Comply with recommendations in SPFA AY-104, "Spray Polyurethane Foam Systems for New and Remedial Roofing."

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site with manufacturer's name, product brand name and type, date of manufacture, shelf life, and directions for storing and mixing with other components.

B. Store materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by manufacturer.

C. Remove and replace material that cannot be applied within its stated shelf life.

1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace coated foamed roofing at no additional cost to Owner that does not comply with requirements or that does not remain watertight within specified warranty period.

1. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Material Compatibility: Provide polyurethane foam, coatings, substrate board, and auxiliary materials that are compatible with one another and with substrate under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

B. Source Limitations for Coated Foamed Roofing System: Obtain coating and polyurethane foam from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. General Performance: Coated foamed roofing shall withstand exposure to weather without failure due to defective manufacture, installation, or other defects in construction. Membrane roofing shall remain watertight.

B. Fire-Test-Response Characteristics: Provide coated foamed roofing with the fire-test-response characteristics indicated, as determined by testing identical systems according to test methods below for deck type and slopes indicated by a qualified testing and inspecting agency that is acceptable to authorities having jurisdiction.

1. Class A roof covering according to ASTM E 108 or UL 790.
2. Surface-Burning Characteristics: Comply with ASTM E 84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

   a. Flame-Spread Index: 75 or less.

3. Fire-Resistance Ratings: Comply with ASTM E 119 or UL 263; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

C. Roofing-System Design: Provide a coated foamed roofing system that is identical to systems that have been successfully tested by a qualified testing and inspecting agency to resist uplift pressure calculated according to ASCE/SEI 7 for the San Antonio, Texas area.

D. FM Approvals Listing: Provide roofing system and component materials that comply with requirements in FM Approvals 4450 for steel roof decks and FM Approvals 4470 for roof covers as part of a foamed roofing system and that are listed in FM Global's "Approval Guide" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Global markings.

1. Fire/Windstorm Classification: Class 1A- 90.
2. Hail-Resistance Classification: MH.

E. Energy Performance: Initial Solar Reflectance Index of not less than 78 when calculated according to ASTM E 1980 based on the testing of identical products by a qualified testing agency.

F. Energy Performance: Provide coated foam roofing that is listed on the EPA/DOE's "ENERGY STAR Roof Product List" for low-slope roof products.

G. Energy Performance: Provide roofing system or top coating with an initial Solar Reflectance Index of not less than 0.78 and emissivity of not less than 0.75 when tested according to CRRC-1.

2.3 POLYURETHANE FOAM

A. Polyurethane Foam: Rigid, cellular polyurethane; complying with ASTM C 1029, Type III or Type IV; spray applied, with fire retardants as required, and acceptable to coating manufacturer.

1. Basis of Design: Provide Bayseal Spray Foam Roofing System as manufactured by BaySystems North America or, subject to compliance with requirements, provide Construction Administration Manager approved equal products by one of the following:

   a. BASF Polyurethane Foam Enterprises LLC.
   b. BaySystems North America; a subsidiary of Bayer Material Science AG.
   c. Elastomeric Roofing Systems, Inc.; an ITW company.
   d. Gaco Western LLC.
   e. HydroSeal Polymers, Inc.
   f. National Coatings Corporation.
   g. NCFI Polyurethanes; Div. of Barnhardt Mfg. Co.
   h. SWD Urethane.
   i. Volatile Free, Inc.

2. In-Place Density: 2.8 to 3.0 lb/cu. ft.; ASTM D 1622.

3. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

   a. Flame-Spread Index: 75 or less.

2.4 URETHANE COATINGS

A. Urethane Coating: Liquid urethane elastomeric coating system specifically formulated for coating sprayed polyurethane-foam roofing. One-component urethanes shall comply with ASTM D 6947.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Elastomeric Roofing Systems, Inc.; an ITW company.
   b. Gaco Western LLC.
   c. HydroSeal Polymers, Inc.
   d. Neogard; Div. of Jones-Blair Company.
   e. United Coatings; a subsidiary of Quest Specialty Chemicals.
   f. Volatile Free, Inc.

2. Base Coat: Two-component urethane, color contrasting with topcoat.
3. Topcoat: One- or two-component urethane.

   a. Color: White.
   b. Color at Walkways: White.

4. Tensile Strength: 600 psi minimum according to ASTM D 2370.
5. Elongation: 350 percent minimum according to ASTM D 412 after 1000 hours accelerated weathering according to ASTM D 4798/D 4798M.
6. Water Absorption: 3 percent maximum by weight according to ASTM D 471.
7. Fungal Resistance: Zero rating according to ASTM G 21.
8. Tear Resistance: 100 lbf/inch minimum according to ASTM D 624.
9. Low-Temperature Flexibility: Pass 0.5-inch mandrel at minus 15 deg F according to ASTM D 522.
10. Permeance: Minimum 0.7 perm at 20 mils thick according to ASTM E 96/E 96M.

2.5 SUBSTRATE BOARD

A. Thermal Barrier Basis of Design: Provide DensDeck DuraGuard Water-resistant gypsum board with fiberglass mat laminated to both sides, ASTM C 1177/C 1177M, 1/2 inch as manufactured by Georgia-Pacific Gypsum, LLC or Construction Administration Manager approved equal by one of the following:

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Georgia-Pacific Gypsum LLC; DensDeck DuraGuard.
   b. CertainTeed Corp.; GlasRoc Sheathing.
   c. National Gypsum Company; Gold Bond, e(2)XP.
   d. USG Corporation; Securock Glass Mat Sheathing.

B. Thermal-Barrier Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, and designed and sized for fastening thermal barrier to substrate.

2.6 AUXILIARY MATERIALS

A. Primer: Polyurethane foam manufacturer's standard factory-formulated primer.

B. Vapor Retarder: As recommended by coated foamed roofing manufacturer.

C. Mineral Granules: Ceramic-coated roofing granules, No. 11 screen size with 100 percent passing No. 8 sieve and 98 percent of mass retained by No. 40 sieve.

1. Color: Buff white.

D. Reinforcement: Flexible polyester or fiberglass mat of weight, type, and composition recommended by coating manufacturer for embedment in liquid coating.

E. Walkway Pads: Factory formed of nonwoven PVC strands, porous, UV stabilized, of 5/16-inch nominal thickness, and approved by coating manufacturer. Provide pad sizes indicated.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Western Plastics, Inc.; Yellow Spaghetti.

2. Color: Gray.

F. Sealant: ASTM C 920, Class 25, Use NT, Grade NS, Type M, multicomponent urethane, and as recommended by coated foamed roofing manufacturer for substrate and joint conditions and for compatibility with roofing materials.

1. Sealants that are not on the exterior side of weather barrier shall have VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

G. Sheet Flashing and Accessories: Types recommended by coated foamed roofing manufacturer, provided at locations indicated and as recommended by coated foamed roofing manufacturer.
1. 1/8" Thick metal angles are required at 3 sides of roof to protect polyurethane foam from UV damage and from damage during roof access using ladders. No angle is required at the low or drain side of roof. Provide drip flashing in this area.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that related work is complete. Do not install coated foamed roofing until roof openings, curbs, and parapets, if any, are complete.

B. Examine substrates, areas, and conditions under which coated foamed roofing will be applied, with Installer present, for compliance with requirements.

C. Proceed with installation only after unsatisfactory conditions have been corrected and substrates are dry.

D. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing work to be performed according to manufacturer's written instructions and warranty requirements.

1. Apply materials within the range of ambient and substrate temperatures recommended by material manufacturers, but not below 50 deg F.
2. Apply materials within range of relative humidity recommended by manufacturer of each component, but not when relative humidity exceeds 85 percent, or when temperatures are less than 5 deg F above dew point.
3. Do not apply materials to damp or wet surfaces.
4. Do not apply primers, polyurethane foam, or coatings in snow, rain, fog, or mist, or when such weather conditions are imminent during the application and curing period.
5. Do not apply polyurethane foam when wind conditions result in surface finish textures not complying with requirements.
6. Do not apply coatings when wind conditions prevent uniform coating application.

3.2 SUBSTRATE BOARD

A. General: Install substrate board with long joints in continuous straight lines, perpendicular to roof slopes with end joints staggered between rows. Tightly butt substrate boards together.

B. Thermal Barrier: Fasten to top flanges of steel deck according to recommendations in FM Global's "Approval Guide" and its FM Global Property Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification.

C. Thermal Barrier: Fasten to top flanges of steel deck to resist uplift pressure at corners, perimeter, and field of roof according to coated foamed roofing manufacturer's written instructions.

3.3 SURFACE PREPARATION

A. General: Clean and prepare substrate according to coated foamed roofing manufacturer's written instructions. Provide clean, dust-free, dew-free, and dry substrate for coated foamed roofing application.

B. Remove grease, oil, form-release agents, curing compounds, and other contaminants from substrate.

C. Cover and mask adjoining surfaces not receiving coated foamed roofing to prevent overspray or spillage affecting other construction.

1. Remove masking after polyurethane foam application; cover and re-mask adjoining surfaces before coating polyurethane foam.

D. Prime substrate as recommended by coated foamed roofing manufacturer.

E. Fill, cover, or tape joints and cracks in substrate that exceed a width of 1/4 inch. Remove dust and dirt from narrower joints and cracks before applying polyurethane foam.

F. Install vapor retarder according to coated foamed roofing manufacturer's written instructions.

3.4 POLYURETHANE FOAM APPLICATION

A. General: Mix and apply polyurethane foam according to ASTM D 5469 and coated foamed roofing manufacturer's written instructions.

1. Fill irregularities and depressions to prevent ponding water.
2. Apply the required full thickness of sloping polyurethane foam in any specific area on same day.
3. Apply only the area of polyurethane foam that can be covered with required base coating on same day or within 24 hours.
4. Apply polyurethane foam to avoid overspray beyond immediate area of work.

B. Apply polyurethane foam in lift thicknesses not less than 1/2 inch and not more than 1-1/2 inches.

C. Uniformly apply total thickness of polyurethane foam indicated, but not less than 1 inch, to a surface tolerance of plus 1/4 inch and no minus.

1. Slope to Drain: Vary thickness uniformly and fill low spots to achieve minimum 1/8 inch per foot slope to drain.

D. Apply polyurethane foam to terminations, and vertical surfaces as indicated.

E. Surface Finish: Provide finished surface of polyurethane foam within the following range of surface textures as defined by ASTM D 5469:

1. Texture: Smooth to orange peel.

F. Remove and replace polyurethane foam not complying with surface-texture limitations. Remove defective thickness and prepare and reapply polyurethane foam with acceptable, uniform results.

3.5 COATING APPLICATION

A. Allow polyurethane foam substrate to cure for a minimum of two hours before coating, and apply coating system to polyurethane foam no later than 24 hours after the application of the foam. Remove dust, dirt, water, and other contaminants before applying coating system.

B. Apply coating system to polyurethane foam by spray, roller, or other suitable application method according to coating manufacturer's written instructions.

C. Apply base coat and one or more topcoats to obtain a uniform, seamless membrane free of blisters and pinholes. Apply each coat at right angles to preceding coat, using contrasting color tints for successive coats.

1. Apply topcoat(s) after removing dust, dirt, water, and other contaminants from base coat.
2. Urethane Coating: Apply coating system to a minimum dry film thickness recommended by coated foamed roofing manufacturer.

D. Mineral Granules: Apply mineral granules over wet topcoat using pressure equipment at the rate of 0.5 lb/sq. ft.. Remove excess granules after topcoat has cured.

E. Sealant: Apply sealant to perimeter and other terminations where required by coated foamed roofing manufacturer.

F. Walkways: Install roof walkways in pattern and locations indicated and as follows:
1. Fabric-Reinforced, Granule-Coated Walkways: Mask off completed coating adjacent to walkways, and apply one additional topcoat to achieve a minimum dry film thickness recommended by coated foamed roofing manufacturer. Lay reinforcing fabric into wet coating and apply another topcoat, completely filling fabric. Spread mineral granules uniformly at a rate of 0.5 lb/sq. ft. into final wet coating. Remove masking and excess granules after topcoat has cured.

3.6 CURING, PROTECTING, AND CLEANING

A. Cure coatings according to manufacturer's written instructions, taking care to prevent contamination and damage during application stages and curing. Do not permit traffic on uncured coatings.

B. Protect coated foamed roofing from damage and wear during remainder of construction period.

C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 07 57 00

SECTION 07 81 23

INTUMESCENT FIREPROOFING

1.00 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes intumescent fire-resistive coatings (MIFRC).

1.3 SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Structural framing plans indicating the following:

1. Extent of fireproofing for each construction and fire-resistance rating.
2. Applicable fire-resistance design designations of a qualified testing and inspecting agency acceptable to authorities having jurisdiction.
3. Minimum fireproofing thicknesses needed to achieve required fire-resistance rating of each structural component and assembly.
4. Treatment of fireproofing after application.

C. Qualification Data: For Installer and testing agency.

D. Product Certificates: For each type of fireproofing.

E. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: A firm or individual certified, licensed, or otherwise qualified by fireproofing manufacturer as experienced and with sufficient trained staff to install manufacturer's products according to specified requirements.

1.5 FIELD CONDITIONS

A. Environmental Limitations: Do not apply fireproofing when ambient or substrate temperature is 50 deg F (10 deg C) or lower unless temporary protection and heat are provided to maintain temperature at or above this level for 24 hours before, during, and for 24 hours after product application.

B. Ventilation: Ventilate building spaces during and after application of fireproofing, providing complete air exchanges according to manufacturer's written instructions. Use natural means or, if they are inadequate, forced-air circulation until fireproofing dries thoroughly.

2.00 PRODUCTS

2.1 MATERIALS, GENERAL

A. Assemblies: Provide two-hour fireproofing assemblies, including auxiliary materials, according to requirements of each fire-resistance design and manufacturer's written instructions.

B. Fire-Resistance Design: Indicated on Drawings, tested according to ASTM E 119 or UL 263 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Steel members are to be considered unrestrained unless specifically noted otherwise.

C. Asbestos: Provide products containing no detectable asbestos.

2.2 MASTIC AND INTUMESCENT FIRE-RESISTIVE COATINGS

A. MIFRC: Manufacturer's standard, factory-mixed, multicomponent system consisting of intumescent base coat and topcoat, and complying with indicated fire-resistance design.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   a. Albi Manufacturing, Division of StanChem Inc.; Albi Clad 800 and Albi Clad TF.
   b. Carboline Company, subsidiary of RPM International, Fireproofing Products Div.; AD Firefilm III.
   c. International Paint Limited, subsidiary of Akzo Nobel N. V.; Chartek 7.
   d. Isolatek International; Cafco SprayFilm-WB 3.

2. Application: Designated for "interior general purpose" and "conditioned interior space purpose" use by a qualified testing agency acceptable to authorities having jurisdiction.
3. Thickness: As required for fire-resistance design indicated, measured according to requirements of fire-resistance design.
4. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

   a. Flame-Spread Index: 25 or less.
   b. Smoke-Developed Index: 450 or less.

5. Hardness: Not less than 45, Type D durometer, according to ASTM D 2240.
6. Finish: As selected by Construction Administration Manager from manufacturer's standard finishes.

   a. Color and Gloss: As selected by Construction Administration Manager from manufacturer's full range.

2.3 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that are compatible with fireproofing and substrates and are approved by UL or another testing and inspecting agency acceptable to authorities having jurisdiction for use in fire-resistance designs indicated.

B. Substrate Primers: Primers approved by fireproofing manufacturer and complying with required fire-resistance design by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.

C. Topcoat: Suitable for application over applied fireproofing; of type recommended in writing by fireproofing manufacturer for each fire-resistance design.

3.00 EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrates and other conditions affecting performance of the Work and according to each fire-resistance design. Verify compliance with the following:

1. Substrates are free of dirt, oil, grease, release agents, rolling compounds, mill scale, loose scale, incompatible primers, paints, and encapsulants, or other foreign substances capable of impairing bond of fireproofing with substrates under conditions of normal use or fire exposure.
2. Objects penetrating fireproofing, including clips, hangers, support sleeves, and similar items, are securely attached to substrates.
3. Substrates receiving fireproofing are not obstructed by ducts, piping, equipment, or other suspended construction that will interfere with fireproofing application.

B. Conduct tests according to fireproofing manufacturer's written recommendations to verify that substrates are free of substances capable of interfering with bond.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Cover other work subject to damage from fallout or overspray of fireproofing materials during application.

B. Clean substrates of substances that could impair bond of fireproofing.

C. Prime substrates where included in fire-resistance design and where recommended in writing by fireproofing manufacturer unless compatible shop primer has been applied and is in satisfactory condition to receive fireproofing.

D. For applications visible on completion of Project, repair substrates to remove surface imperfections that could affect uniformity of texture and thickness in finished surface of fireproofing. Remove minor projections and fill voids that would telegraph through fire-resistive products after application.

3.3 APPLICATION

A. Construct fireproofing assemblies that are identical to fire-resistance design indicated and products as specified, tested, and substantiated by test reports; for thickness, primers, topcoats, finishing, and other materials and procedures affecting fireproofing work.

B. Comply with fireproofing manufacturer's written instructions for mixing materials, application procedures, and types of equipment used to mix, convey, and apply fireproofing; as applicable to particular conditions of installation and as required to achieve fire-resistance ratings indicated.

C. Coordinate application of fireproofing with other construction to minimize need to cut or remove fireproofing.

1. Do not begin applying fireproofing until clips, hangers, supports, sleeves, and other items penetrating fireproofing are in place.
2. Defer installing ducts, piping, and other items that would interfere with applying fireproofing until application of fireproofing is completed.

D. Install auxiliary materials as required, as detailed, and according to fire-resistance design and fireproofing manufacturer's written recommendations for conditions of exposure and intended use. For auxiliary materials, use attachment and anchorage devices of type recommended in writing by fireproofing manufacturer.

E. Spray apply fireproofing to maximum extent possible. Following the spraying operation in each area, complete the coverage by trowel application or other placement method recommended in writing by fireproofing manufacturer.

F. Extend fireproofing in full thickness over entire area of each substrate to be protected.

G. Install body of fireproofing in a single course unless otherwise recommended in writing by fireproofing manufacturer.

H. Provide a uniform finish complying with description indicated for each type of fireproofing material and matching finish approved for required mockups.

I. Cure fireproofing according to fireproofing manufacturer's written recommendations.

J. Do not install enclosing or concealing construction until after fireproofing has been applied, inspected, and tested and corrections have been made to deficient applications.

K. Finishes: Where indicated, apply fireproofing to produce the following finishes:

1. Manufacturer's Standard Finishes: Finish according to manufacturer's written instructions for each finish selected.

2. Skip-Troweled Finish: Even leveled surface produced by troweling spray-applied finish to smooth out the texture and neaten edges.

3.4 FIELD QUALITY CONTROL

A. Special Inspections: Engage a qualified special inspector to perform the following special inspections:

1. Test and inspect as required by the IBC, 1704.11.

B. Perform the tests and inspections of completed Work in successive stages. Do not proceed with application of fireproofing for the next area until test results for previously completed applications of fireproofing show compliance with requirements. Tested values must equal or exceed values as specified and as indicated and required for approved fire-resistance design.

C. Fireproofing will be considered defective if it does not pass tests and inspections.

1. Remove and replace fireproofing that does not pass tests and inspections, and retest.
2. Apply additional fireproofing, per manufacturer's written instructions, where test results indicate insufficient thickness, and retest.

D. Prepare test and inspection reports.

3.5 CLEANING, PROTECTING, AND REPAIRING

A. Cleaning: Immediately after completing spraying operations in each containable area of Project, remove material overspray and fallout from surfaces of other construction and clean exposed surfaces to remove evidence of soiling.

B. Protect fireproofing, according to advice of manufacturer and Installer, from damage resulting from construction operations or other causes, so fireproofing will be without damage or deterioration at time of Substantial Completion.

C. As installation of other construction proceeds, inspect fireproofing and repair damaged areas and fireproofing removed due to work of other trades.

D. Repair fireproofing damaged by other work before concealing it with other construction.

E. Repair fireproofing by reapplying it using same method as original installation or using manufacturer's recommended trowel-applied product.

END OF SECTION 07 81 23

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SECTION 07 84 13
PENETRATION FIRESTOPPING

1.00 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes fire stopping for the following:

1. Fire stopping materials shall be furnished and installed at all penetrations in fire rated assemblies to maintain an effective barrier against spread of flame, smoke and gases. Fire rated assemblies shall be as indicated on the drawings, which shall include all walls, and partitions that are part of an enclosure having a fire rating. Fire stopping shall be used but shall not be limited to the following locations:

   a. At tops of fire rated partitions and walls.
   b. Ductwork, conduit, tubing and piping penetrations through fire rated floor slabs, wall, and partitions.
   c. Penetrations of any other material through any fire-rated construction.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 7 Section "Joint Sealants" for non-fire-resistive-rated joint sealants.
2. Division 15 Sections specifying ducts and piping penetrations.
3. Division 16 Sections specifying cable and conduit penetrations.

1.3 SYSTEM PERFORMANCE REQUIREMENTS

A. General: Provide fire stopping systems that are produced and installed to resist the spread of fire, according to requirements indicated, and the passage of smoke and other gases.

B. F-Rated Through-Penetration Firestop Systems: Provide through-penetration firestop systems with F ratings indicated, as determined per ASTM E 814, but not less than that equaling or exceeding the fire-resistance rating of the constructions penetrated.

C. T-Rated Through-Penetration Firestop Systems: Provide through-penetration firestop systems with T ratings indicated, as determined per ASTM E 814, where indicated and where systems protect penetrating items exposed to contact with adjacent materials in occupiable floor areas. T-rated assembblies are required where the following conditions exist:

1. Where firestop systems protect penetrations located outside of wall cavities.
2. Where firestop systems protect penetrations located outside fire-resistive shaft enclosures.
3. Where firestop systems protect penetrations located in construction containing doors required to have a temperature-rise rating.
4. Where firestop systems protect penetrating items larger than a 4-inch-diameter nominal pipe or 16 sq. inches in overall cross-sectional area.

D. Fire-Resistive Joint Sealants: Provide joint sealants with fire-resistance ratings indicated, as determined per ASTM E 119, but not less than that equaling or exceeding the fire-resistance rating of the construction in which the joint occurs.

E. For fire stopping exposed to view, traffic, moisture, and physical damage, provide products that do not deteriorate when exposed to these conditions.

1. For piping penetrations for plumbing systems, provide moisture-resistant through-penetration firestop systems.
2. For penetrations involving insulated piping, provide through-penetration firestop systems not requiring removal of insulation.

1.4 SUBMITTALS

A. General: Submit the following according to Conditions of Contract and Division 1 Specification Sections.

B. Product data for each type of product specified.

1. Certification by fire stopping manufacturers that products supplied comply with local regulations controlling use of volatile organic compounds (VOCs) and are nontoxic to building occupants.

C. Shop drawings detailing materials, installation methods, and relationships to adjoining construction for each through-penetration firestop system. Include firestop design designation of qualified testing and inspecting agency evidencing compliance with requirements for each condition indicated.

D. Product certificates signed by manufacturers of fire stopping products certifying that their products comply with specified requirements.

E. Product test reports from, and based on tests performed by, a qualified testing and inspecting agency evidencing compliance of fire stopping with requirements based on comprehensive testing of current products.

1.5 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: Provide fire stopping that complies with the following requirements and those specified under the "System Performance Requirements" article:

1. Fire stopping tests are performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is UL, or anothter agency performing testing and follow-up inspection services for firestop systems that is acceptable to authorities having jurisdiction.
2. Fire-resistive joint sealant systems are identical to those tested for fire-response characteristics per ASTM E 119 under conditions where the positive furnace pressure differential is at least 0.01 inch of water, as measured 0.78 inch from the face exposed to furnace fire. Provide systems complying with design designations listed by UL in their "Fire Resistance Directory" or by another qualified testing and inspecting agency.

B. Installer Qualifications: Engage an experienced Installer who has completed fire stopping that is similar in material, design, and extent to that indicated for Project and that has performed successfully.

C. Single-Source Responsibility: Obtain through-penetration firestop systems for each kind of penetration and construction conditions from a single manufacturer.

D. Provide fire stopping products containing no detectable asbestos as determined by the method specified in 40 CFR 763, Subpart F, Appendix A, Section 1, "Polarized Light Microscopy."

E. Coordinating Work: Coordinate construction of openings and penetrating items to ensure that designated through-penetration firestop systems are instatlled per specified requirements.

F. Preinstallation Conference: Conduct conference at Project site to comply with requirements of Division 1 Sections.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver fire stopping products to Project site in original, unopened containers or packages with intact and legible manufacturers' labels identifying product and manufacturer; date of manufacture; lot number; shelf life, if applicable; qualified testing and inspecting agency's classification marking applicable to Project; curing time; and mixing instructions for multicomponent materials.

B. Coordinate delivery of materials with scheduled installation date to allow minimum storage time.

C. Storage of products shall comply with manufacturer's requirements.

D. Store and handle fire stopping materials to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

2.00 PRODUCTS

2.1 FIRE STOPPING, GENERAL

A. Compatibility: Provide fire stopping composed of components that are compatible with each other, the substrates forming openings, and the items, if any, penetrating the fire stopping under conditions of service and application, as demonstrated by fire stopping manufacturer based on testing and field experience.

B. Accessories: Provide components for each fire stopping system that are needed to install fill materials and to comply with "System Performance Requirements" article in Part 1. Use only components specified by the fire stopping manufacturer and approved by the qualified testing and inspecting agency for the designated fire-resistance-rated systems. Accessories include but are not limited to the following items:

1. Permanent forming/damming/backing materials including the following:

    a. Semirefractory fiber (mineral wool) insulation.
    b. Ceramic fiber.
    c. Sealants used in combination with other forming/damming materials to prevent leakage of fill materials in liquid state.
    d. Fire-rated formboard.
    e. Joint fillers for joint sealants.

2. Temporary forming materials.
3. Substrate primers.
4. Collars.
5. Steel sleeves.

C. Applications: Provide fire stopping systems composed of materials specified in this Section that comply with system performance and other requirements.

2.2 MANUFACTURERS

A. Approved Manufacturers: Subject to compliance with requirements of this section, provide products from one of the following manufacturers:

1. USG Interiors, Inc.
2. Fibrex.
3. Termco.
4. Thermal Ceramics.
5. GE Silicones.
6. Flammadur Corp. of America
7. Hilti.
8. Bio Fireshield, Inc.
9. Standard Oil.
10. 3M Brand.
11. Dow Corning.
12. Nelson.
13. Flame Stop, Inc.

B. Substitutions will be reviewed if they are equal to, or greater than, specified products.

2.3 FIRE STOPPING MATERIALS

A. Ratings: The fire resistance ratings shall be a minimum of one hour but not less than the fire resistance rating of the assembly being penetrated.

B. Large Space Fiber Insulation:

1. USG Interiors, Inc. "Thermafiber" safing insulation; 4 lb. density.
2. Fibrex "FBX" safing insulation.

C. Ceramic Fiber Insulation:

1. Tremco "Cerablanket - FS."
2. Thermal Ceramics "Kaowool Fire Master Blanket."
3. Standard Oil "Fiberfrax."

D. Foamed Insulation:

1. Dow Corning Foam: Catalog #2001.
2. GE Silicones "Pensil 200 Firestop Foam."

E. High Temperature Caulking Compounds:

1. 3M Brand "Interam Fire Dam 150 Caulk."
2. Dow Corning Sealant #2000.
3. Nelson "FSP Firestop Putty."
4. Flame Stop, Inc. "Flame Stop V Caulk."
5. Bio Fireshield, Inc. "Biotherm Firestop Sealant."
6. GE Silicones "Pensil 100 Firestop Sealant."
7. Flammadur Corp. of America A107/E473.
8. Hilti CS240 Firestop - Sealant.

2.4 MIXING

A. For those products requiring mixing prior to application, comply with fire stopping manufacturer's directions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other procedures needed to produce fire stopping products of uniform quality with optimum performance characteristics for application indicated.

3.00 EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of fire stopping. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning: Clean out openings and joints immediately prior to installing fire stopping to comply with recommendations of fire stopping manufacturer and the following requirements:

1. Remove all foreign materials from surfaces of opening and joint substrates and from penetrating items that could interfere with adhesion of fire stopping.
2. Clean opening and joint substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with fire stopping. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form release agents from concrete.

B. Priming: Prime substrates where recommended by fire stopping manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migation onto exposed surfaces.

C. Masking Tape: Use masking tape to prevent fire stopping from contacting adjoining surfaces that will remain exposed upon completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from fire stopping materials. Remove tape as soon as possible to do so without disturbing fire stopping's seal with substrates.

3.3 INSTALLATION

A. General: Comply with the "System Performance Requirements" article in Part 1 and the through-penetration firestop manufacturer's installation instructions and drawings pertaining to products and applications indicated.

B. Install material and systems in accordance with the manufacturer's printed instructions.

C. Observations: Work by steps that permit observation of each step before it is covered up. When the work requires immediate cover, give notice early enough to arrange for observation in progress.

D. Installation of Large Space Fiber Insulation:

1. Thickness, as required, minimum of 4 inches.
2. Compress material before placing so a tight friction fit is formed.
3. Where material spans a horizontal gap in excess of material thickness or any danger exists of sagging with displacement, support or galvanized iron or on spikes.

3.4 INSTALLING FIRE-RESISTIVE JOINT SEALANTS

A. General: Comply with the "System Performance Requirements" article in Part 1, with ASTM C 1193, and with the sealant manufacturer's installation instructions and drawings pertaining to products and applications indicated.

B. Install joint fillers to provide support of sealants during application and at position required to produce the cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability and develop fire-resistance rating required.

C. Install sealants by proven techniques that result in sealants directly contacting and fully wetting joint substrates, completely filling recesses provided for each joint configuration, and providing uniform, cross-sectional shapes and depths relative to joint width that optimum sealant movement capability. Install sealants at the same time joint fillers are installed.

D. Tool nonsag sealants immediately after sealant application and prior to the time skinning or curing begins. Form smooth, uniform beads of configuration indicated or required to produce fire-resistance rating, as well as to eliminate air pockets, and to ensure contact and adhesion of sealants with sides of joint. Remove excess sealant from surfaces to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.

3.5 CLEANING

A. Clean off excess fill materials and sealants adjacent to openings and joints as work progresses by methods and with cleaning materials approved by manufacturers of fire stopping products and of products in which opening and joints occur.

B. Protect fire stopping during and after curing period from contact with contaminating substances or from damage resulting from construction operations or other causes so that they are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated fire stopping immediately and install new materials to produce fire stopping complying with specified requirements.

END OF SECTION 07 84 13

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SECTION 07 92 00
JOINT SEALANTS

1.00 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. Extent of each form and type of joint sealer is indicated on drawings and schedules.

B. This Section includes joint sealants for the following locations:

1. Exterior joints in vertical surfaces and nontraffic horizontal surfaces as indicated below.

   a. Joints between different materials.
   b. Perimeter joints between frames of doors and adjacent materials.
   c. Other joints as indicated.

2. Exterior joints in horizontal traffic surfaces as indicated below:

   a. Joints where concrete abuts vertical surfaces.
   b. Joints between different materials.
   c. Other joints as indicated.

3. Interior joints in vertical surfaces and horizontal nontraffic surfaces as indicated below:

   a. Perimeter joints of exterior openings where indicated.
   b. Joints on underside of concrete beams and joists.
   c. Perimeter joints between interior wall surfaces and frames of interior doors.
   d. Other joints as indicated.

1.3 SYSTEM PERFORMANCES

A. Provide joint sealants that have been produced and installed to establish and maintain watertight and airtight continuous seals.

1.4 SUBMITTALS

A. Product Data from manufacturers for each joint sealant product required, including instructions for joint preparation and joint sealant application.

B. Samples for Initial Selection Purposes: Manufacturer's standard bead sample charts.

C. Certificates from manufacturers of joint sealants attesting that their products comply with specification requirements and are suitable for the use indicated.

D. Compatibility and adhesion test reports from elastomeric sealant manufacturer indicating that materials forming joint substrates and joint sealant backings have been tested for compatibility and adhesion with joint sealants. Include sealant manufacturer's interpretation of test results relative to sealant performance and recommendations for primers and substrate preparation needed to obtain adhesion.

E. Product test reports for each type of joint sealants indicated, evidencing compliance with requirements specified.

F. Preconstruction field test reports indicating which products and joint preparation methods demonstrated acceptable adhesion to joint substrates.

G. Joint Sealant Schedule: Submit contractor's joint sealant schedule indicating type of sealant and installation locations.

1.5 QUALITY ASSURANCE

A. Single Source Responsibility for Joint Sealant Materials: Obtain joint sealant materials from a single manufacturer for each different product required.

B. Preconstruction Compatibility and Adhesion Testing: Submit samples of all materials that will contact or affect joint sealants to joint sealant manufacturers for compatibility and adhesion testing, as indicated below:

1. Use test methods standard with manufacturer to determine if priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
2. Submit not less than 3 pieces of each type of material, including joint substrates, shims, joint sealant backings, secondary seals, and miscellaneous materials.
3. Schedule sufficient time for testing and analysis of results to prevent delay in the progress of the Work.
4. Investigate materials failing compatibility or adhesion tests and obtain joint sealant manufacturer's written recommendations for corrective measures, including use of specially formulated primers.
5. Testing will not be required when joint sealant manufacturer is able to submit joint preparation data required above which is acceptable to Owner's Representative and is based on previous testing of current sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted.

C. Product Testing: Provide comprehensive test data for each type of joint sealant based on tests conducted by a qualified independent testing laboratory on current product formulations within a 24-month period preceding date of Contractor's submittal of test results to Owner's Representative.

1. Test elastomeric sealants for compliance with requirements specified by reference to ASTM C 920. Include test results for hardness, stain resistance, adhesion and cohesion under cyclic movement (per ASTM C 719), low-temperature flexibility, modulus of elasticity at 100 percent strain, effects of heat aging, and effects of accelerated weathering.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in original unopened containers or bundles with labels informing about manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multicomponent materials.

B. Store and handle materials in compliance with manufacturers' recommendations to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.7 PROJECT CONDITIONS

A. Environmental Conditions: Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside the limits permitted by joint sealant manufacturers.
2. When joint substrates are wet due to rain, frost, condensation, or other causes.

B. Joint Width Conditions: Do not proceed with installation of joint sealants where joint widths are less than allowed by joint sealant manufacturer for application indicated.

C. Joint Substrate Conditions: Do not proceed with installation of joint sealants until contaminants capable of interfering with their adhesion are removed from joint substrates.

2.00 PRODUCTS

2.1 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, joint fillers and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.

B. Curing Characteristics: All sealants used on this Project shall be cured by reaction of the sealant chemicals (oxidation) with moisture from the air. Solvent-release, chemical reaction by oxidation curing methods are not acceptable.

C. Colors: As selected by Construction Administration Manager from manufacturer's standard colors.

2.2 ELASTOMERIC JOINT SEALANTS

A. Elastomeric Sealant Standard: Provide manufacturer's standard moisture activated curing, elastomeric sealant of base polymer indicated which complies with ASTM C 920 requirements, including those referenced for Type, Grade, Class, and Uses.

B. One-Part Nonacid-Curing Silicone Sealant: Type S, Grade NS, Class 25; Uses NT, M, G, A, and, as applicable to joint substrates indicated, O.

C. One-Part Pourable Urethane Sealant for Use T: Type S, Grade P, Class 25, and complying with the following requirements for Uses:

1. Uses T, M and, as applicable to joint substrates indicated, O.

D. Pigmented Small Joint Sealant: Manufacturer's standard, moisture- release-curing, pigmented, synthetic rubber sealant formulated for sealing joints 3/16" or smaller in width.

E. Products: Subject to compliance with requirements, provide one of the following:

1. One-Part Nonacid-Curing Silicone Sealant:

a. "Chem-Calk N-Cure 2000"; Bostik Construction Products Div.
b. "Silpruf SCS 2000"; General Electric Co.
c. "864"; Pecora Corp.
d. "Rhodorsil 5C"; Rhone-Poulenc Inc.
e. "Spectrum 1"; Tremco, Inc.
f. "Dow Corning 795"; Dow Corning Corp.
g. "Omniseal"; Sonneborn Building Products Div., Rexnord Chemical Products Inc.

2. One-Part Pourable Urethane Sealant for Use T:

a. "Chem-Calk 950"; Bostik Construction Products Div.
b. "Vulkem 45"; Mameco International, Inc.
c. "NR-201 Urexpan"; Pecora Corp.
d. "Sonolastic SL-1"; Sonneborn Building Products Div., Rexnord Chemical Products Inc.

3. Pigmented Small Joint Sealant:

a. "PTI 200"; Protective Treatments, Inc.
b. "Tremco Seam Sealer"; Tremco Inc.

2.3 LATEX JOINT SEALANTS

A. Acrylic-Emulsion Sealant: Manufacturer's standard, one part, nonsag, mildew-resistant, acrylic-emulsion sealant complying with ASTM C 834, formulated to be paintable and recommended for exposed applications on interior and on protected exterior locations involving joint movement of not more than plus or minus 5 percent.

B. Products: Subject to compliance with requirements, provide one of the following:

1. "Chem-Calk 600"; Bostik Construction Products Div.
2. "AC-20"; Pecora Corp.
3. "Sonolac"; Sonneborn Building Products Div.; Rexnord Chemical Products, Inc.
4. "Tremco Acrylic Latex 834"; Tremco Inc.

2.4 MISCELLANEOUS JOINT SEALANTS

A. Butyl-Polyisobutylene Sealant: Manufacturer's standard, solvent-free, butyl-polyisobutylene sealant complying with AAMA 809.2, recommended for concealed joints.

B. Butyl-Polyisobutylene Tape Sealant: Manufacturer's standard, solvent-free, butyl-polyisobutylene tape sealant with a solids content of 100 percent; complying with AAMA 804.1; formulated to be nonstaining, paintable, and nonmigrating in contact with nonporous surfaces; packaged on rolls with a release paper on one side; with or without reinforcement thread to prevent stretch.

C. Products: Subject to compliance with requirements, provide one of the following:

1. Butyl-Polyisobutylene Sealant:

a. "PTI 606"; Protective Treatments, Inc.

2. Butyl-Polyisobutylene Tape Sealant:

a. "Extru-Seal Tape"; Pecora Corp.
b. "Shim-Seal Tape"; Pecora Corp.
c. "PTI 606"; Protective Treatments, Inc.
d. "Tremco 440 Tape"; Tremco Inc.

2.5 EPOXY JOINT SEALANTS

A. Epoxy Sealant: Manufacturer's standard, two part, pourable, traffic resistant, epoxy sealant, recommended for exposed applications on interior sawn control joints in floor slabs involving joint movement of not more than plus or minus 5 percent.

B. Products: Subject to compliance with requirements, provide one of the following:

1. MM-80 as manufactured by Metzer/McGuire or Construction Administration Manager approved equal.

2.6 JOINT SEALANT BACKING

A. General: Provide sealant backings of material and type which are nonstaining; are compatible with joint substrates, sealants, primers and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Plastic Foam Joint Fillers: Preformed, compressible, resilient, nonwaxing, nonextruding strips of flexible, nongassing plastic foam of material indicated below; nonabsorbent to water and gas; and of size, shape and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

1. Closed-cell polyethylene foam, subject to approval of sealant manufacturer, for cold-applied sealants only.

C. Elastomeric Tubing Joint Fillers: Neoprene, butyl, EPDM, or silicone tubing complying with ASTM D 1056, nonabsorbent to water and gas, capable of remaining resilient at temperatures down to -26 deg F (-15 deg C). Provide products with low compression set and of size and shape to provide a secondary seal, to control sealant depth, and otherwise contribute to optimum sealant performance.

D. Bond-Breaker Tape: Polyethylene tape or other plastic tape as recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.7 MISCELLANEOUS MATERIALS

A. Primer: Provide type recommended by joint sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Provide nonstaining, chemical cleaners of type which are acceptable to manufacturers of sealants and sealant backing materials, which are not harmful to substrates and adjacent nonporous materials, and which do not leave oily residues or otherwise have a detrimental effect on sealant adhesion or in-service performance.

C. Masking Tape: Provide nonstaining, nonabsorbent type compatible with joint sealants and to surfaces adjacent to joints.

2.8 JOINT FILLERS FOR CONCRETE PAVING

A. Provide Sponge Rubber Joint Filler: Preformed strips complying with ASTM D 1752 for Type I.

3.00 EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances and other conditions affecting joint sealant performance. Do not proceed with installation of joint sealants until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with recommendations of joint sealant manufacturers and the following requirements:

1. Remove all foreign material from joint substrates which could interfere with adhesion of joint sealant, including dust; paints, except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer; old joint sealants; oil; grease; waterproofing; water repellants; water; surface dirt; and frost.
2. Clean concrete, masonry, unglazed surfaces of porous joint substrate surfaces, by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining from above cleaning operations by vacuuming or blowing out joints with oil-free compressed air.
3. Clean metal, and other nonporous surfaces by chemical cleaners or other means which are not harmful to substrates or leave residues capable of interfering with adhesion of joint sealants.

B. Joint Priming: Prime joint substrates where indicated or where recommended by joint sealant manufacturer based on preconstruction joint sealer-substrate tests or prior experience. Apply primer to comply with joint sealant manufacturer's recommendations. Confine primers to areas of joint sealant bond, do not allow spillage or migration onto adjoining surfaces.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint sealant manufacturers' printed installation instructions applicable to products and applications indicated, except where more stringent requirements apply.

B. Elastomeric Sealant Installation Standard: Comply with recommendations of ASTM C 962 for use of joint sealants as applicable to materials, applications and conditions indicated.

C. Solvent-Release-Curing Sealant Installation Standard: Comply with requirements of ASTM C 804 for use of solvent-release-curing sealants.

D. Latex Sealant Installation Standard: Comply with requirements of ASTM C 790 for use of latex sealants.

E. Installation of Sealant Backings: Install sealant backings to comply with the following requirements:

1. Install joint fillers of type indicated to provide support of sealants during application and at position required to produce the cross-sectional shapes and depths of installed sealants relative to joint widths which allow optimum sealant movement capability.

a. Do not leave gaps between ends of joint fillers.
b. Do not stretch, twist, puncture, or tear joint fillers.
c. Remove absorbent joint fillers which have become wet prior to sealant application and replace with dry material.

2. Install bond breaker tape between sealants and joint fillers, or back of joints where adhesion of sealant to surfaces at back of joints would result in sealant failure.
3. Install compressible seals serving as sealant backings to comply with requirements indicated above for joint fillers.

F. Installation of Sealants: Install sealants by proven techniques that result in sealants directly contacting and fully wetting joint substrates, completely filling recesses provided for each joint configuration, and providing uniform, cross-sectional shapes and depths relative to joint widths which allow optimum sealant movement capability.

G. Tooling of Nonsag Sealants: Immediately after sealant application and prior to time skinning or curing begins, tool sealants to form smooth, uniform beads of configuration indicated, to eliminate air pockets, and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents which discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.

1. Provide concave joint configuration per Figure 6A in ASTM C 962, unless otherwise indicated.

H. Installation of Preformed Foam Sealants: Install each length of sealant immediately after removing protective wrapping, taking care not to pull or stretch material, and to comply with sealant manufacturer's directions for installation methods, materials, and tools which produce seal continuity at ends, turns, and intersections of joints. For applications at low ambient temperatures where expansion of sealant requires acceleration to produce seal, apply heat to sealant in conformance with sealant manufacturer's recommendations.

I. Installation of Preformed Hollow Neoprene Gaskets: Install gaskets, with minimum number of end joints, in joint recesses with edges free of spalls and sides straight and parallel, both within tolerances specified by gasket manufacturer. Apply manufacturer's recommended adhesive to joint substrates immediately prior to installing gaskets. For straight sections provide gaskets in continuous lengths; where changes in direction occur, adhesively splice gasket together to provide watertight joint. Recess gasket below adjoining joint surfaces by 1/8 inch to 1/4 inch.

3.4 CLEANING

A. Clean off excess sealants or sealant smears adjacent to joints as work progresses by methods and with cleaning materials approved by manufacturers of joint sealants and of products in which joints occur.

3.5 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances or from damage resulting from construction operations or other causes.

3.6 SCHEDULE OF SEALANTS

A. Use fire-rated sealants in accordance with Section 07 84 13 at fire-rated walls.

B. Use One-Part Nonacid-Curing Silicone Sealant at all joints in exterior materials except horizontal surfaces where foot or vehicle traffic is expected.

C. Use One-Part Pourable Urethane Sealant for Use T in exterior walking surfaces (walks, decks, entry courts, etc.).

D. Use Acrylic Emulsion Sealant in interior joints in surfaces to receive field applied paint.

E. Use Two-Part Epoxy Sealant in interior concrete floor slab sawn control joints.

F. Use Buty-Poluisobutylene Sealant in concealed joints and joints to seal air tight exterior walls.

G. Use Buty-Poluisobutylene Tape Sealant in exposed joints in non-porous surfaces to receive field applied paint.

H. Use Plastic Foam Joint Fillers in joints to control sealant depth as recommended by the manufacturer of the sealant for the specific joint configuration and application.

I. Use Elastomeric Tubing Joint Fillers in joints to control sealant depth as recommended by the manufacturer of the sealant for the specific joint configuration and application.

J. Use Bond-Breaker Tape in joints as recommended by the sealant manufacturer of the sealant used.

K. Use Sponge Rubber Joint Filler in joints in concrete paving to control sealant depth as recommended by the manufacturer of the sealant for the specific joint configuration and application.

END OF SECTION 07 92 00

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SECTION 08 11 13
STEEL DOORS AND FRAMES

1.00 GENERAL

1.1 RELATED DOCUMENTS

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

B. Electrical specifications and drawings are to be reviewed for information relating to electrified door frames.

1.2 SUMMARY

A. Extent of steel doors, frames and windows is indicated and scheduled on drawings.

1. All frames are electrified.
2. This work includes insulated, 90-minute rated steel doors and frames.
3. Drawing and Scheduling Designations: This section applies to doors and frames referenced on the drawings and schedules using the terms "Hollow Metal Door", "Hollow Metal Frame", "Steel Door" and "Steel Frame".

B. Finish hardware is specified elsewhere in Division-8.

C. Sealants used during installation of doors and windows are specified in Division-7.

D. Building in of anchors and grouting of frames is specified in Divisions 4 and 9.

1.3 QUALITY ASSURANCE

A. Provide doors and frames complying with Steel Door Institute "Recommended Specifications: Standard Steel Doors and Frames" (SDI-100) and as herein specified.

B. Fire-Rated Door Assemblies: Fire-rated door assemblies are required, provide fire-rated door and frame assemblies that comply with NFPA 80 "Standard for Fire Doors and Windows", and have been tested, listed, and labeled in accordance with ASTM E 152 "Standard Methods of Fire Tests of Door Assemblies" by a nationally recognized independent testing and inspection agency acceptable to authorities having jurisdiction.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data substantiating that products comply with requirements.

1. For each type of product indicated, provide one hard copy of the operation and maintenance instructions.

B. Shop Drawings: Submit for fabrication and installation of steel doors and frames. Include details of each frame type, elevations of door design types, conditions at openings, details of construction, location and installation requirements of finish hardware and reinforcements, and details of joints and connections. Show anchorage and accessory items.

1. Provide schedule of doors and frames using same reference numbers for details and openings as those on contract drawings.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver hollow metal work cartoned or crated to provide protection during transit and job storage. Provide additional sealed plastic wrapping for factory-finished doors.

B. Inspect hollow metal work upon delivery for damage. Minor damages may be repaired provided refinished items are equal in all respects to new work and acceptable to Construction Administration Manager; otherwise, remove and replace damaged items as directed.

C. Store doors and frames at building site under cover. Place units on wood blocking. Avoid use of non-vented plastic or canvas shelters which could create humidity chamber. If cardboard wrapper on door becomes wet, remove carton immediately. Provide spaces between stacked doors to promote air circulation.

2.00 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering steel doors and electrified frames which may be incorporated in the work include; but are not limited to, the following:

1. Ceco Corp.
2. Copco Door Co.
3. Curries Mfg., Inc.
4. Deansteel, Mfg., Inc.
5. Fenestra Corp.
6. Mesker Industries, Inc.
7. Pioneer Bldrs. Products Corp./Div. CORE Industries, Inc.
8. Tex-Steel Corp.
9. Nadcor (North American Door Corporation).

2.2 MATERIALS

A. Hot-Rolled Steel Sheets and Strip: Commercial quality carbon steel, pickled and oiled, complying with ASTM A 569 and ASTM A 568.

B. Cold-Rolled Steel Sheets: Commercial quality carbon steel, complying with ASTM A 366 and ASTM A 568.

C. Galvanized Steel Sheets: Zinc-coated carbon steel sheets of commercial quality, complying with ASTM A 526, with ASTM A 525, G60 zinc coating, mill phosphatized.

D. Supports and Anchors: Fabricate of not less than 18-gage galvanized sheet steel.

E. Inserts, Bolts, and Fasteners: Manufacturer's standard units, except hot-dip galvanize items to be built into exterior walls, complying with ASTM A 153, Class C or D as applicable.

F. Material - Electrified Doors:
   1. All doors required for application of electronic locks, remote monitoring, door position switches, etc. which require the door to have wires through the door shall be provided pre-wired withElectroLynx, a factory installed quick connect system manufactured by Ceco Door Products (Basis of Design). The use of non-wired conduit in the door is not acceptable.

G. Materials - Electrified Frames:
   1. Provide all hollow metal frames receiving electrified hardware with ElectroLynx (Basis of Design) through-frame wiring harness and concealed plug connectors on each end to accommodate up to twelve wires.
   2. Coordinate ElectroLynx (Basis of Design) connectors on each end of the wiring harness to p[lug directly into the electrified hardware and the electric hinge.

H. Shop Applied Paint:

   1. Primer: Rust-inhibitive enamel or paint, either air-drying or baking, suitable as a base for specified finish paints.

2.3 FABRICATION, GENERAL

A. Fabricate steel door and frame units to be rigid, neat in appearance and free from defects, warp or buckle. Wherever practicable, fit and assemble units in manufacturer's plant. Clearly identify work that cannot be permanently factory-assembled before shipment, to assure proper assembly at project site. Comply with SDI-100 requirements as follows:

   1. Doors: SDI-100, Grade II, heavy-duty, Model 1, minimum 18-gage faces; and where indicated Types as indicated on the drawings.

B. Fabricate 'TS' steel door units to be rigid, neat in appearance and free from defects, warp or buckle. Wherever practicable, fit and assemble units in manufacturer's plant. Clearly identify work that cannot be permanently factory-assembled before shipment, to assure proper assembly at project site.

C. Fabricate exposed faces of doors and panels, including stiles and rails of nonflush units, from only cold-rolled steel.

D. Fabricate frames, concealed stiffeners, reinforcement, edge channels and moldings from either cold-rolled or hot-rolled steel (at fabricator's option).

E. Exposed Fasteners: Unless otherwise indicated, provide countersunk flat Phillips heads for exposed screws and bolts.

F. Finish Hardware Preparation: Prepare doors and frames to receive mortised and concealed finish hardware in accordance with final Finish Hardware Schedule and templates provided by hardware supplier. Comply with applicable requirements of ANSI A115 series specifications for door and frame preparation for hardware.

G. Reinforce doors and frames to receive surface-applied hardware. Drilling and tapping for surface-applied finish hardware may be done at project site.

H. Locate finish hardware as indicated on final shop drawings or, if not indicated, in accordance with "Recommended Locations for Builder's Hardware", published by Door and Hardware Institute.

I. Shop Painting:

1. Clean, treat, and paint exposed surfaces of steel door and frame units, including galvanized surfaces.
2. Clean steel surfaces of mill scale, rust, oil, grease, dirt, and other foreign materials before application of paint.
3. Apply shop coat of prime paint of even consistency to provide a uniformly finished surface ready to receive finish paint.

2.4 DOORS

A. General: Provide doors of sizes, thicknesses, and designs indicated.

B. Provide doors complying with requirements indicated below by referencing ANSI 250.8 for level and model and ANSI A250.4 for physical-endurance level:

1. Level 2 and Physical Performance Level B (Heavy Duty), Model 1 (Full Flush).

2.5 FRAMES

A. General: Provide steel frames for doors that comply with ANSI A250.8 and with details indicated for type and profile. Conceal fastenings, unless otherwise indicated.

B. Frames of 0.053-inch- thick steel sheet for:

1. Level 2 steel doors.

C. Weatherstripping: Provide weatherstripping at all doors.

D. Plaster Guards: Provide 0.016-inch- thick, steel sheet plaster guards or mortar boxes to close off interior of openings; place at back of hardware cutouts where mortar or other materials might obstruct hardware operation.

E. Supports and Anchors: Fabricated from not less than 0.042-inch- thick, electrolytic zinc-coated or metallic-coated steel sheet.

1. Wall Anchors in Masonry Construction: 0.177-inch- diameter, steel wire complying with ASTM A 510 may be used in place of steel sheet.

F. Inserts, Bolts, and Fasteners: Manufacturer's standard units. Where zinc-coated items are to be built into exterior walls, comply with ASTM A 153/A 153M, Class C or D as applicable.

3.00 EXECUTION

3.1 DOOR INSTALLATION

A. General: Install standard sheet doors, frames, and accessories in accordance with final shop drawings, manufacturer's data, and as herein specified.

B. Placing Frames: Comply with provisions of SDI-105 "Recommended Erection Instructions For Steel Frames", unless otherwise indicated.

1. Place frames prior to construction of enclosing walls and ceilings. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is completed, remove temporary braces and spreaders leaving surfaces smooth and undamaged.
2. At in-place masonry construction, set frames and secure to adjacent construction with machine screws and anchorage devices.
3. Install fire-rated frames in accordance with NFPA Std. No. 80.
4. Install 4 wall anchors in hinge jamb, and 3 wall anchors in strike jamb; two at top hinge level of hinge jamb, and one each at hinge and strike levels. In steel stud partitions, attach wall anchors to studs with tapping screws. Install one floor anchor at each jamb.

C. Door Installation:

1. Place fire-rated doors with clearances as specified in NFPA Standard No. 80.

3.2 ADJUST AND CLEAN

A. Prime Coat Touch-Up: Immediately after erection, sand smooth any rusted or damaged areas of prime coat and apply touch-up of compatible air-drying primer.

B. Final Adjustments: Check and readjust operating finish hardware items, leaving steel doors and frames undamaged and in complete and proper operating condition.

END OF SECTION 08 11 13

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SECTION 08 71 00
DOOR HARDWARE

1.00 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. All doors are 90-minute fire rated. Provide hardware for each door that complies with the requirements of 90-minute ratings.
2. All door hardware indicated on the schedule shown on the Drawings.

1.3 SUBMITTALS

A. Make the following submittals in the order indicated, unless submitted simultaneously.

B. Supplier Qualifications: To the Construction Administration Manager.

C. Installer Qualifications: To the Construction Administration Manager.

D. Product Data: Manufacturer's data for each different piece of hardware, with installation instructions.

E. Hardware Schedule: Show manufacturer's complete identification for every item for every door.

1. Cross-reference to item names and designations in contract documents.
2. Indicate door/frame materials and sizes.
3. Explain number codes and abbreviations.
4. Indicate hardware mounting heights or locations, if different from those specified.
5. Indicate finish for each item.
6. Preliminary schedule will be reviewed if accompanied by product data.
7. Identification of all reused hardware as indicated on the Drawings.

F. Keying Schedule: Separate schedule showing how each lock is keyed.

G. Operation and Maintenance Data: For operating parts and finishes.

H. Maintenance Agreement.

1.4 QUALITY ASSURANCE

A. Qualifications of Supplier: A supplier of architectural finish hardware who has been supplying hardware for at least 5 years and who employs an architectural hardware consultant (AHC).

B. Qualifications of Architectural Hardware Consultant(s) (AHC): Certified by the Door and Hardware Institute.

1.5 PROJECT CONDITIONS

A. Sequence submittal of hardware schedule and door and frame submittals, allowing adequate time for review and resubmittal, if required, so that construction is not delayed; provide adequate information for review.

B. Provide hardware installation templates to installers of hardware and to fabricators of other work which is required to be prepared in the shop or factory for hardware installation.

C. Coordinate shop drawings of other work so that proper preparation is made.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver hardware at the times and to the locations required for timely installation.

B. Package each item separately or in container with items of same set only.

C. Mark each item or package with hardware set number from hardware schedule.

D. Provide a locked storage area controlled by the contractor for hardware not yet installed; take special care to prevent loss of long-lead items.

1.7 MAINTENANCE

A. Provide all adjustment and maintenance tools recommended by hardware manufacturers.

B. Installer shall provide letter agreement to the owner that, approximately 6 months after substantial completion, the installer shall visit the project, with the representative of the manufacturer(s) of locking devices, and accomplish the following:

1. Readjust all hardware.
2. Evaluate maintenance procedures and recommended changes or additions and instruct the owner's personnel.
3. Identify items that have deteriorated or failed.
4. Submit a written report; identify problems that are likely to recur.

2.00 PRODUCTS

2.1 GENERAL HARDWARE REQUIREMENTS

A. In addition to requirements of the hardware schedule, comply with the requirements below.

B. Coordinate hardware requirements with door operators specified elsewhere in Division 8. Division 8 Section 08 11 13 includes provisions for proprietary pre-wiring of doors and frames. Coordinate hardware to be compatible with proprietary pre-wiring system.

2.2 MATERIALS - GENERAL

A. Manufacturers:

1. Obtain all items of each type from the same manufacturer.

B. Manufacturer's Names and Trade Names: Display of names, logos, or other identification is acceptable on lock or hinge edge of door, but not where visible on either face of door.

1. Exception: Manufacturer's name or other identification on rim of lock cylinders.

C. Fasteners: Provide hardware prepared by the manufacturer with fastener holes for machine screws, unless otherwise indicated.

1. Provide all fasteners required for secure installation.
2. Select fasteners appropriate to substrate and material being fastened.
3. Use flathead Phillips screws unless otherwise indicated.
4. Use fasteners impervious to corrosion on all doors.
5. Exposed screws: Match hardware finish.
6. Where it is not possible to reinforce substrate adequately for screws, use through-bolts with sleeves or use sex bolts.

    a. Do not use where head or nut would be exposed on face of door, unless specifically indicated or made necessary by other requirements, and with prior approval.
    b. Finish exposed heads and nuts the same as hardware on that side of the door.

D. Finish on All Exposed Metal Items: Satin stainless steel (630). If not available in satin stainless steel, then satin chrome plated (626).

1. Items specified with the same finish shall match as closely as possible using standard manufactured products.
2. Provide finishes matching ANSI/BHMA A156.18 designations.

2.3 HINGES

A. Manufacturers:

1. Butt hinges: Provide scheduled hinges manufactured by Hager Hinge Company, or equal products complying with requirements of the contract documents and made by one of the following:

   a. Lawrence Brothers, Inc.
   b. McKinney Products Company.
   c. Henry Soss and Company, Inc.
   d. Stanley Hardware Division/The Stanley Works.

2.4 LOCKS, LATCHES, AND BOLTS

A. Locksets and Latchsets - General: Provide scheduled locksets and latchsets manufactured by Best Lock Corp., no substitutions.

1. New locksets and latchsets shall be heavy-duty cylindrical.
2. Where indicated to be keyed to existing keying system, use only type which can accept cylindrical locksets and latches.
3. Provide lever handles.

B. Strikes: Provide strike for each latch bolt and lock bolt.

1. Finish to match other hardware on door.
2. Use wrought box strikes with curved lips unless otherwise indicated.
3. In floors, use dustproof strikes unless threshold incorporates a raised latch strike.

2.5 LOCK CYLINDERS AND KEYING

A. Keying:

1. Key all locks identically.
2. Key to the owner's existing grandmaster key system, with all new locks keyed to a new master key.
3. Removable-core cylinders: Interchangeable core pin-tumbler insert type cylinders.

B. Keys: Nickel silver.

1. Stamp each key with manufacturer's change symbol and embossed with: DUPLICATION PROHIBITED on one side of the bow.
2. Provide 5 change keys keyed alike (Owner will make changes later).
3. Each master key system: 5 master keys.
4. Each grandmaster key system: 1 grandmaster keys.
5. Extra blanks: 1 for each lock.
6. Provide 12 "Blank" construction master keys for use by the Contractor and provide one to Owner.

2.6 SEALS AND THRESHOLDS

A. Manufacturers:

1. Weatherstripping: Provide scheduled weatherstripping manufactured by National Guard Products, Inc., or equal products complying with requirements of the contract documents and made by one of the following:

   a. A. J. May, Inc.
   b. Pemko Manufacturing Company.
   c. Zero International, Inc.

2. Thresholds: Provide scheduled weatherstripping manufactured by National Guard Products, Inc., or equal products complying with requirements of the contract documents and made by one of the following:

   a. A. J. May, Inc.
   b. Pemko Manufacturing Company.
   c. Zero International, Inc.

2.7 CLOSERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Corbin Russwin Architectural Hardware; Div. of Yale Security Inc. (CR).
   2. DORMA Door Controls Inc.; Member of The DORMA Group (DC).
   3. LCN Closers; an Ingersoll-Rand Company (LCN).
   4. Norton Door Controls; Div. of Yale Security Inc. (NDC).
   5. Rixson-Firemark, Inc.; Div. of Yale Security Inc. (RIX).
   6. Sargent Manufacturing Company; Div. of ESSEX Industries, Inc. (SGT).
   7. Yale Security Inc.; Div. of Williams Holdings (YAL).

B. Standards: Comply with the following:
   1. Closers: BHMA A156.4.
   2. Closer Holder Release Devices: BHMA A156.15.

C. Surface Closers: BHMA Grade 1.

D. Concealed Closers: BHMA Grade 1.

E. Size of Units: Unless otherwise indicated, comply with manufacturer's written recommendations for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.

2.8 KICKPLATES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Baldwin Hardware Corporation (BH).

2. Hager Companies (HAG).
3. IPC Door and Wall Protection Systems, Inc. (IPC).
4. Ives: H. B. Ives (IVS).
5. Pawling Corporation (PAW).
6. Triangle Brass Manufacturing Company, Inc. (TBM).

B. Standard: Comply with BHMA A156.6.

C. Materials: Fabricate protection plates from the following:
1. Stainless Steel: 0.050 inch thick; beveled top and 2 sides.

D. Fasteners: Provide manufacturer's standard exposed fasteners for door trim units consisting of either machine or self-tapping screws.

E. Furnish protection plates sized 1-1/2 inches less than door width on push side and 1/2 inch less than door width on pull side, by height specified in Door Hardware Schedule.

3.00 EXECUTION

3.1 PREPARATION

A. Factory- or shop-prepare all work for installation of hardware.

3.2 INSTALLATION

A. Follow hardware manufacturer's recommendations and instructions.

B. Provide the services of an architectural hardware consultant (AHC) to advise on proper installation, to inspect the finished work, and either to adjust or to instruct those who are adjusting.

C. Install surface-mounted items after substrates have been completely finished; install recessed items and recessed portions of items before finishes are applied and provide suitable, effective protection.

1. When surface-mounted items are installed before final finish, remove, store, and reinstall, or apply suitable effective protection.

D. Mount at heights specified in the Door and Hardware Institute's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."

1. Exception(s):

a. As required by applicable regulations.

E. Install hardware in correct location, plumb and level.

F. Reinforce substrates as required for secure attachment and proper operation.

G. Thresholds: Apply continuous bead of sealant to all contact surfaces before installing.

3.3 ADJUSTMENT

A. Adjust each operable unit for correct function and smooth, free operation.

B. Adjust door closers to overcome air pressure produced by HVAC systems.

C. If hardware adjustment is completed more than one month before substantial completion, readjust hardware not more than one week before substantial completion.

3.4 CLEANING

A. Clean hardware; clean other work soiled during hardware installation.

3.5 CONTRACT CLOSEOUT

A. Deliver all keys to the owner.

B. Deliver extra blanks to the owner.

3.6 HARDWARE SCHEDULE - REFER TO THE DRAWINGS

END OF SECTION 08 71 00

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SECTION 09 22 16
NON-STRUCTURAL METAL FRAMING

1.00 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 non-load-bearing steel framing members for the following applications:

1. Interior framing systems (e.g., supports for partitions, framed soffits, furring, etc.).
2. All walls are 2-hour rated. Provide all components that meet the requirements of the ratings of the assemblies noted on the Drawings.

B. Related Sections include the following:

1. Division 7 Section "Building Insulation" for insulation installed in walls and ceilings.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

1.4 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

2.00 PRODUCTS

2.1 NON-LOAD-BEARING STEEL FRAMING, GENERAL

A. Framing Members, General: Comply with ASTM C 754 for conditions indicated.

1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal, unless otherwise indicated.
2. Protective Coating: ASTM A 653/A 653M, G60, hot-dip galvanized zinc coating, unless otherwise indicated.

2.2 STEEL FRAMING FOR FRAMED ASSEMBLIES

A. Steel Studs and Runners: ASTM C 645.

1. Minimum Base-Metal Thickness: As indicated on Drawings.

B. Slip-Type Head Joints: Where indicated, provide the following:

1. Double-Runner System: ASTM C 645 top runners, inside runner with 2-inch- deep flanges in thickness not less than indicated for studs and fastened to studs, and outer runner sized to friction fit inside runner.

2.3 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards.

1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

B. Isolation Strip at Exterior Walls: Provide the following:

1. Foam Gasket: Two-hour rated, adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch thick, in width to suit steel stud size.

3.00 EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.

1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

3.3 INSTALLATION, GENERAL

A. Installation Standard: ASTM C 754.

1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.

B. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, or similar construction.

C. Install bracing at terminations in assemblies.

D. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.4 INSTALLING FRAMED ASSEMBLIES

A. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install rated isolation strip between studs and exterior wall.

B. Install studs so flanges within framing system point in same direction.

C. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.

1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.

    a. Install two studs at each jamb, unless otherwise indicated.
    b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint in finished assembly.
    c. Extend jamb studs to underside of overhead structure where noted on the Drawings.

3. Other Framed Openings: Frame openings other than door openings the same as required for door openings, unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.

D. Direct Furring:

1. Screw to metal framing.
2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.

E. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

END OF SECTION 09 22 16

SECTION 09 29 00
GYPSUM BOARD

1.00 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 the following:

1. Interior gypsum board.
2. Exposed surface leveling finish.
3. All walls and ceilings are 2-hour rated. Provide all components that meet the requirements of the ratings of the assemblies noted on the Drawings.

B. Related Sections include the following:

1. Division 7 Section "Joint Sealants" for sealants installed in assemblies that incorporate gypsum board.
2. Division 7 Section "Fire-Resistive Joint Sealants" for sealants installed in rated partitions and ceilings.
3. Division 9 painting Sections for primers applied to gypsum board surfaces.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples: For the following products:

1. Smooth Finishes: Manufacturer's standard size for smooth finish indicated and on same backing indicated for Work.

1.4 STORAGE AND HANDLING

A. Store materials inside under cover and keep them dry and protected against damage from weather, condensation, direct sunlight, construction traffic, and other causes. Stack panels flat to prevent sagging.

1.5 PROJECT CONDITIONS

A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.

B. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

2.00 PRODUCTS

2.1 PANELS, GENERAL

A. Size: Provide in maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.2 INTERIOR GYPSUM BOARD

A. General: Complying with ASTM C 36/C 36M or ASTM C 1396/C 1396M, as applicable to type of gypsum board indicated and whichever is more stringent.

1. 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:

a. G-P Gypsum.
b. National Gypsum Company.
c. Temple.
d. USG Corporation.

B. Moisture- and Mold-Resistant Gypsum Board: ASTM C 1396/C 1396M. With moisture- and mold-resistant core and paper surfaces.

1. Core (Typical Locations): 5/8 inch (15.9 mm), Type X.
2. Core (At Shaftwall in M040 only): 1/2 inch (12.7 mm), Type C.
3. Long Edges: Tapered.
4. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

C. Gypsum Shaftliner Board, Moisture- and Mold-Resistant Type X: ASTM C 1396/C 1396M; manufacturer's proprietary fire-resistive liner panels with moisture- and mold-resistant core and surfaces.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. CertainTeed Corp.; ProRoc Moisture and Mold Resistant Shaftliner.
b. Georgia-Pacific Gypsum LLC, Subsidiary of Georgia Pacific; Dens-Glass Ultra Shaftliner.
c. Lafarge North America, Inc.; Firecheck Moldcheck Type X Shaftliner.
d. National Gypsum Company; Gold Bond Brand Fire-Shield Shaftliner XP.

e. PABCO Gypsum; Pabcore Mold Curb Shaftliner Type X.
f. Temple-Inland Inc.; Fire-Rated SilentGuard TS Mold-Resistant Gypsum Shaftliner System.
g. USG Corporation; Sheetrock Brand Mold Tough Gypsum Liner Panel.

2. Thickness: 1 inch.
3. Long Edges: Double bevel.
4. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

2.3 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.

1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized steel sheet.
2. Shapes:

a. Cornerbead.
b. LC-Bead: J-shaped; exposed long flange receives joint compound.
c. Expansion (control) joint.

2.4 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.

B. Joint Tape:

1. Interior Gypsum Wallboard: Paper.

C. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.
   a. Use setting-type compound for installing paper-faced metal trim accessories.
3. Fill Coat: For second coat, use setting-type, sandable topping compound.

2.5 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.

B. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.

1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.

2.6 FINISHES

A. Refer to the Finish Schedule on the Drawings..

3.00 EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames and framing, for compliance with requirements and other conditions affecting performance.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLYING AND FINISHING PANELS, GENERAL

A. Comply with ASTM C 840.

B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.

D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

E. Form control and expansion joints with space between edges of adjoining gypsum panels.

F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.

1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
2. Fit gypsum panels around ducts, pipes, and conduits.
3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- wide joints to install sealant.

G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- wide spaces at these locations, and

trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with sealant.

3.3 APPLYING INTERIOR GYPSUM BOARD

A. Install interior gypsum board in the following locations:

1. Moisture- and Mold-Resistant Type X: All locations.

B. Multilayer Application:

1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints one framing member, 16 inches minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
3. Fastening Methods: Fasten base layers and face layers separately to supports with screws.

C. Shaftwall Installation: Install gypsum board shaft wall assemblies to comply with requirements of fire-resistance-rated assemblies indicated, manufacturer's written installation instructions, and ASTM C 754 other than stud-spacing requirements.
1. Do not bridge building expansion joints with shaft wall assemblies; frame both sides of expansion joints with furring and other support.
2. Install supplementary framing in gypsum board shaft wall assemblies around openings and as required for blocking, bracing, and support of gravity and pullout loads of fixtures, equipment, services, heavy trim, furnishings, wall-mounted door stops, and similar items that cannot be supported directly by shaft wall assembly framing.

   a. Reinforcing: Where items or equipment directly attach to gypsum board shaft wall assemblies, provide galvanized steel reinforcing strip with 0.033-inch minimum thickness of base metal (uncoated), accurately positioned and secured behind at least one layer of face panel.

3. Penetrations: At penetrations in shaft wall, maintain fire-resistance rating of shaft wall assembly by installing supplementary steel framing around perimeter of penetration and fire protection behind boxes containing wiring devices, and similar items.
4. Isolate perimeter of gypsum panels from building structure to prevent cracking of panels, while maintaining continuity of fire-rated construction.
5. Firestop Tracks: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
6. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Construction Administration Manager while maintaining fire-resistance rating of gypsum board shaft wall assemblies.

7. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

3.4 INSTALLING TRIM ACCESSORIES

A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

B. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Construction Administration Manager for visual effect.

C. Interior Trim: Install in the following locations:

1. Cornerbead: Use at outside corners, unless otherwise indicated.
2. LC-Bead: Use at exposed panel edges.

3.5 FINISHING GYPSUM BOARD

A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

B. Prefill open joints, rounded or beveled edges, and damaged surface areas.

C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.

D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:

1. Level 3: Above ceilings where fire ratings are required and in unoccupied spaces.
2. Level 4 (with leveling skim coat): At panel surfaces that will be exposed to view, unless otherwise indicated.

   a. Primer and its application to surfaces are specified in other Division 9 Sections.

3.6 PROTECTION

A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

B. Remove and replace panels that are wet, moisture damaged, and mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 09 29 00

SECTION 09 51 13
ACOUSTICAL PANEL CEILINGS

1.00 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes:

1. Acoustical panel ceilings installed with exposed suspension systems for Rooms M040 and IDF5. Reuse existing grid in M040.

B. Related Sections: The following sections contain requirements that relate to this section:

1. Division 23 for grilles, registers, and diffusers in acoustical ceilings.
2. Division 26 for lighting fixtures in acoustical ceilings.

1.3 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 specified.

C. Coordination drawings for reflected ceiling plans drawn accurately to scale and coordinating penetrations and ceiling-mounted items. Show the following:

1. Ceiling suspension members.
2. Method of attaching hangers to building structure.
3. Ceiling-mounted items including light fixtures; air outlets and inlets; speakers; and special moldings at walls, column penetrations, and other junctures with adjoining construction.
4. Scale: 1/8 inch = 1'-0".

D. Samples for verification purposes of each type of exposed finish required, prepared on samples of size indicated below and of same thickness and material indicated for final unit of Work. Where finishes involve normal color and texture variations, include sample sets showing full range of variations expected.

1. 6-inch-square samples of each acoustical panel type, pattern, and color.
2. Set of 12-inch-long samples of exposed suspension system members, including moldings, for each color and system type required.

E. Product test reports from qualified independent testing laboratory that are based on its testing of current products for compliance of acoustical ceiling systems and components with requirements.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced Installer who has successfully completed acoustical ceilings similar in material, design, and extent to those indicated for Project.

B. Fire-Performance Characteristics: Provide acoustical ceilings that are identical to those tested for the following fire-performance characteristics, per ASTM test method indicated below, by UL or other testing and inspecting organizations acceptable to authorities having jurisdiction. Identify acoustical ceiling components with appropriate markings of applicable testing and inspecting organization.

1. Surface Burning Characteristics: Tested per ASTM E 84:

a. Flame Spread: 25 or less.
b. Smoke Developed: 50 or less.

C. Single-Source Responsibility for Ceiling Units: Obtain each type of acoustical ceiling unit from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work.

D. Single-Source Responsibility for Suspension System: Obtain each type of suspension system from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work.

E. Coordination of Work: Coordinate layout and installation of acoustical ceiling units and suspension system components with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, and fire-suppression system components (if any).

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical ceiling units to project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical ceiling units, permit them to reach room temperature and a stabilized moisture content.

C. Handle acoustical ceiling units carefully to avoid chipping edges or damaging units in any way.

1.6 PROJECT CONDITIONS

A. Space Enclosure: Do not install interior acoustical ceilings until space is enclosed and weatherproof, wet-work in space is completed and nominally dry, work above ceilings is complete, and ambient conditions of temperature and humidity will be continuously maintained at values near those indicated for final occupancy.

1.7 EXTRA MATERIALS

A. Deliver extra materials to Owner. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with appropriate labels.

1. Acoustical Ceiling Units: Furnish quantity of full-size units equal to 5.0 percent of amount installed.
2. Exposed Suspension System Components: Furnish quantity of each exposed component equal to 5.0 percent of amount installed.

2.00 PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, products which may be incorporated in the Work include, but are not limited to, the following:

1. Metal Ceiling Panels, Non-Fire-Resistance Rated:

a. Basis of Design: USG Interiors, Inc.
b. Other manufacturers' products that meet the requirements of this Section as approved by the Construction Administration Manager.

2. Non-Fire-Resistance-Rated Wide-Face Double-Web Steel Suspension Systems:

a. Basis of Design: USG Interiors, Inc.
b. Other manufacturers' products that meet the requirements of this Section as approved by the Construction Administration Manager.

2.2 ACOUSTICAL CEILING PANELS

A. Acoustical Ceiling Panels Basis of Design: Provide Panz Metal Lay-in ceiling panels:
1. Manufactured by USG (United States Gypsum Company, USG Interiors), Chicago, IL, USA.
2. Aluminum panels manufactured from premium metal, painted metal, and formed into panels. Installed into a compatible DONN® Brand DX/DXL or DXT/DXLT CENTRICITEE Suspension System.
3. Panel finishes shall be premium in color/finish as selected by the Owner's Representative.

4. Sizes:
   a. Squares: 2'x2' for IDFE.
   b. Panels: 2' x 4' for M040..
   c. Edges: Square (SQ).

2.3 METAL SUSPENSION SYSTEMS, GENERAL

A. Standard for Metal Suspension System for Room ISF5 only: Provide manufacturer's standard metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable ASTM C 635 requirements.

B. Finish and Color: Match panels.

C. Attachment Devices: Size for 5 times design load indicated in ASTM C 635, Table 1, Direct Hung unless otherwise indicated.

D. Wire for Hangers and Ties: ASTM A 641, Class 1 zinc coating, soft temper.

   1. Gage: Provide wire sized so that stress at 3 times hanger design load (ASTM C 635, Table 1, Direct-Hung), will be less than yield stress of wire, but provide not less than 0.106-inch diameter (12 gage).

E. Hanger Rods: Mild steel, zinc coated, or protected with rust-inhibitive paint.

F. Flat Hangers: Mild steel, zinc coated, or protected with rust inhibitive paint.

G. Angle Hangers: Angles with legs not less than 7/8 inch wide, formed with 0.0365-inch-thick galvanized steel sheet complying with ASTM A 446, Coating Designation G90, with bolted connections and 5/16-inch-diameter bolts.

H. Edge Moldings and Trim: Metal or extruded aluminum of types and profiles indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that fit type of edge detail and suspension system indicated.

2.4 MISCELLANEOUS MATERIALS

A. Sealant: Nondrying, nonhardening, nonskinning, nonstaining, nonbleeding, gunnable sealant complying with requirement specified in Division 7 Section "Joint Sealers."

B. Edge Sealer: Latex adhesive designed for the purpose of sealing field-cut edges of acoustical panels as manufactured by Kelly-Moore, Inc., or equal.

3.00 EXECUTION

3.1 EXAMINATION

A. Examine substrates and structural framing to which ceiling system attaches or abuts, with Installer present, for compliance with requirements specified in this and other sections that affect installation and anchorage of ceiling system. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Coordination: Furnish layouts for clips, and other ceiling anchors whose installation is specified in other sections.

1. Furnish anchors and similar devices to other trades for installation well in advance of time needed for coordination of other work.

B. Comply with reflected ceiling plans such that layout is identical.

3.3 INSTALLATION

A. General: Install acoustical ceiling systems to comply with installation standard referenced below, per manufacturer's instructions and CISCA "Ceiling Systems Handbook."

1. Standard for Installation of Ceiling Suspension Systems: ASTM C 636.

B. Arrange acoustical units and orient directionally patterned units in a manner shown by reflected ceiling plans.

C. Layout panels to minimize waste.

D. Suspend ceiling hangers from building structural members and as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or ceiling suspension system. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with the location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.
3. Secure wire hangers by looping and wire-tying, either directly to structures to eyescrews, or other devices that are secure and appropriate for substrate, and in a manner that will not cause them to deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
4. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eyescrews, or other devices that are secure and appropriate for structure to which hangers are attached as well as for type of hanger involved, and in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
5. Attach hangers to structural members.
6. Space hangers not more than 4'-0" o.c. along each member supported directly from hangers, unless otherwise shown, and provide hangers not more than 8 inches from ends of each member.

E. Install edge moldings of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical units.

   1. Screw-attach moldings to substrate at intervals not over 16 inches o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to tolerance of 1/8 inch in 12'-0". Miter corners accurately and connect securely.

F. Install acoustical panels in coordination with suspension system, with edges concealed by support of suspension members. Scribe and cut panels to fit accurately at borders and at penetrations.

   1. Install hold-down clips in areas within a 20 foot radius of any exterior door; space as recommended by panel manufacturer, unless otherwise indicated or required.

3.4 CLEANING

A. Clean exposed surfaces of acoustical ceilings, including trim, edge moldings, and suspension members. Comply with manufacturer's instructions for cleaning and touch-up of minor finish damage. Remove and replace work that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 09 51 13

SECTION 09 65 13
RESILIENT WALL BASE

1.00 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Resilient base.

1.3 SUBMITTALS

A. Product Data

1. For each type of product indicated, provide one hard copy of the operation and maintenance instructions.

B. Samples for Verification: For each type of product indicated, in manufacturer's standard-size Samples but not less than 6 inches long, of each resilient product color, and pattern required.

1.4 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.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F.

1.6 PROJECT CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive resilient products during the following time periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.

C. Install resilient products after other finishing operations, including painting, have been completed.

2.00 PRODUCTS

2.1 RESILIENT BASE

A. Rubber Base - 4" high as manufactured by one of the following:

1. Armstrong World Industries, Inc
2. Azrock Commercial Flooring.
3. Mannington Mills, Inc.
4. Tarkett, Inc.

B. Resilient Base Standard: ASTM F 1861.

1. Material Requirement: Type TS (rubber, vulcanized thermoset).
2. Manufacturing Method: Group I (solid, homogeneous).

C. Minimum Thickness: 0.080 inch.

D. Lengths: Coils in manufacturer's standard length.

E. Outside Corners: Preformed.

F. Inside Corners: Job formed.

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 resilient products and substrate conditions indicated.

3.00 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 resilient products.

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. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.

C. Do not install resilient products until they are same temperature as the space where they are to be installed.

1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.

D. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.3 RESILIENT BASE INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient base.

B. Apply resilient base to walls, columns, pilasters, and other permanent fixtures in rooms and areas where base is indicated or called out.

C. Install resilient base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.

D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

E. Do not stretch resilient base during installation.

F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.

3.4 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protection of resilient products.

B. Perform the following operations immediately after completing resilient product installation:

1. Remove adhesive and other blemishes from exposed surfaces.

2. Sweep and vacuum surfaces thoroughly.
3. Damp-mop surfaces to remove marks and soil.

C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Cover resilient products until Substantial Completion.

END OF SECTION 09 65 13

SECTION 09 65 36
STATIC-CONTROL RESILIENT FLOORING

1.00 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Static-dissipative, vinyl composition floor tile.

B. Related Sections:

1. Division 09 Section "Resilient Base" for resilient base installed with static-control resilient floor coverings.

1.3 PERFORMANCE REQUIREMENTS

A. Static-Dissipative Properties: Provide floor coverings with static-control properties indicated as determined by testing identical products per test method indicated by an independent testing and inspecting agency.

1. Electrical Resistance: Test per ASTM F 150 with 100-V applied voltage.

a. Average greater than 1 megohm and less than or equal to 1000 megohms when test specimens are tested surface to ground.

2. Static Generation: Less than 300 V when tested per AATCC-134 at 20 percent relative humidity with conductive footwear.
3. Static Decay: 5000 to 0 V in less than 0.25 seconds when tested per FED-STD-101C/4046.1.

1.4 SUBMITTALS

A. Product Data: For each product indicated.

B. Shop Drawings: For each floor covering. Include floor covering layouts, edges, columns, doorways, enclosing partitions, and cutouts.

1. Submit grounding diagram showing location of grounding strips and connections.

C. Samples for Verification: For floor covering indicated and of size indicated below:

1. Floor Tile: Full-size units.

D. Qualification Data: For qualified Installer.

E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for floor coverings.

F. Maintenance Data: For each floor covering to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in techniques required by manufacturer for floor covering installation indicated.

1. Engage an installer who employs workers for this Project who are trained or certified by manufacturer for installation techniques required.

B. 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 coverings and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer but not less than 50 deg F or more than 90 deg F.

1. Floor Tile: Store on flat surfaces.

1.7 PROJECT CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 85 deg F, in spaces to receive floor coverings during the following time periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. Close spaces to traffic during floor covering installation.

C. Close spaces to traffic for 48 hours after floor covering installation.

D. Install floor coverings after other finishing operations, including painting, have been completed.

2.00 PRODUCTS

2.1 STATIC-DISSIPATIVE RESILIENT FLOOR COVERINGS

A. Static-Dissipative, Vinyl Composition Floor Tile: ASTM F 1066 (vinyl composition floor tile, nonasbestos formulated), Class 2 (through-pattern tile).

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   a. Armstrong World Industries, Inc.; Excelon SDT.

2. Thickness: Not less than 0.125 inch.
3. Size: 12 by 12 inches.
4. Colors and Patterns: #51951 Armor Gray.

2.2 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.

B. Static-Control Adhesive: Provided or approved by manufacturer; type that maintains electrical continuity of floor covering system to ground connection.

   1. VCT and Asphalt Tile Adhesives: Not more than 50 g/L.

C. Grounding Strips: Provided or approved by manufacturer; type and size that maintains electrical continuity of floor covering system to ground connection.

3.00 EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer and manufacturer's representative 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 or static-control characteristics of floor coverings.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written instructions and with oversight by manufacturer's representative to ensure adhesion of floor coverings and electrical continuity of floor covering systems.

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 floor covering adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
   3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
   4. Moisture Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.

C. 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.

D. Do not install floor coverings until they are same temperature as space where they are to be installed.

1. Move floor coverings 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 floor coverings immediately before installation.

3.3 INSTALLATION, GENERAL

A. Install static-control resilient floor covering according to manufacturer's written instructions and with oversight by manufacturer's representative.

B. Embed grounding strips in static-control adhesive. Extend grounding strips beyond perimeter of static-control resilient floor covering surfaces to ground connections.

C. Scribe, cut, and fit floor coverings to butt neatly and tightly to vertical surfaces and permanent fixtures including cabinets, pipes, outlets, and door frames.

D. Extend floor coverings into toe spaces, door reveals, closets, and similar openings. Extend floor covering to center of door openings.

E. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor coverings as marked on substrates. Use chalk or other nonpermanent, nonstaining marking device.

F. Adhere floor coverings to substrates using a full spread of static-control 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 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 floor tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half floor tile at perimeter.

3.5 FIELD QUALITY CONTROL

A. Testing: Contractor will engage a qualified testing agency to test electrical resistance of static-control resilient floor covering systems for compliance with requirements.

1. Arrange for testing after static-control adhesives have fully cured and floor covering systems have stabilized to ambient conditions and after ground connections are completed.

B. Static-control resilient floor coverings will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports and turn over to Owner's Representative.

3.6 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protection of floor coverings.

B. Perform the following operations immediately after completing floor covering installation:

1. Remove static-control 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 coverings from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

1. Do not wax static-control resilient floor coverings.

D. Cover floor coverings until Substantial Completion.

END OF SECTION 09 65 36

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SECTION 09 91 13
EXTERIOR PAINTING

1.00 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 surface preparation and the application of paint systems on the following exterior substrates:

1. Metal doors and frames.
2. Galvanized metal flashing.
3. Miscellaneous metal as noted on the Drawings.
4. Concrete masonry units.
5. Concrete walls.

B. Related Sections include the following:

1. Division 5 Sections for shop priming of metal substrates with primers specified in this Section.
2. Division 8 Sections for factory priming doors with primers specified in this Section.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples for Initial Selection: For each type of topcoat product indicated.

C. Samples for Verification: For each type of paint system and each color and gloss of topcoat indicated.

1. Submit Samples on rigid backing, 8 inches square.
2. Step coats on Samples to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

D. Product List: For each product indicated, include the following:

1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
2. Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.

1.4 QUALITY ASSURANCE

A. MPI Standards:

1. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."
2. Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting Specification Manual" for products and paint systems indicated.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.6 PROJECT CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.

B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

2.00 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:

1. Benjamin Moore & Co.
2. PPG Architectural Finishes, Inc.
3. Sherwin-Williams Company (The).

2.2 PAINT, GENERAL

A. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.

B. Colors:

1. Refer to the Finish Schedule on the Drawings.

2.3 PRIMERS/SEALERS

A. Alkali-Resistant Primer: MPI #3.

1. VOC Content: E Range of E3.
2. Products: Provide one of the following:

   a. DU-1502 Interior 100% Acrylic Primer/Sealer as manufactured by Diamond Vogel.
   b. W 6315 Flexible Crack-Resistant Prime as manufactured by Dunn-Edwards.
   c. 9145 Epo Tilt as manufactured by Parker Paint CGI.
   d. 4600 Uniprime II as manufactured by Vista Paint.

2.4 METAL PRIMERS

A. Alkyd Anticorrosive Metal Primer: MPI #79.

1. VOC Content: E Range of E2.
2. Products: Provide one of the following:

   a. 661 Interior Exterior Alkyd Primer as manufactured by Frazee Paint CGI.
   b. 1710-120 Alkyd Rust Inhibitive Primer as manufactured by Kelly-Moore.

B. Quick-Drying Alkyd Metal Primer: MPI #76.

1. VOC Content: E Range of E2 or E3.
2. Products: Provide one of the following:

   a. 661 Metal Prime as manufactured by Frazee Paint CGI.
   b. 330 Q.D. Alkyd Rust Inhibitive Primer as manufactured by Hallman Lindsay.
   c. 1679 Overlay Red Primer as manufactured by Parker Paint CGI.

C. Waterborne Galvanized-Metal Primer: MPI #134.

1. VOC Content: E Range of E3.
2. Products: Provide one of the following:

   a. 703 Series EcoLogic Rustex Primer as manufactured by Cloverdale Paint.
   b. MC-series Acrylic Maintenance Primer Finish as manufactured by Diamond Vogel.
   c. 4020 Devflex as manufactured by ICI Paints (Canada).
   d. 1821 Galvanized Iron Primer as manufactured by Parker Paint CGI.
   e. 4800 Metal Pro - White as manufactured by Vista Paint.

2.5 EXTERIOR LATEX PAINTS

A. Latex, Exterior Semi-Gloss (Gloss Level 5): MPI #11.

1. AkzoNobel, Glidden Professional, Ultra-Hide 150 Exterior Acrylic Semi-Gloss
2. Benjamin Moore, Aura, Exterior Paint, Semi-Gloss Finish.
3. Kwal Paint, Accu Shield, 100% Acrylic Semi-Gloss Finish.
4. PPG, Speedhide Exterior 100% Acrylic Latex Semi-Gloss.
5. Pratt & Lambert, ProHide Gold, Exerior Latex Semi-Gloss, SOCW.
6. Sherwin-Williams, A-100, Exterior Latex Gloss.

B. Latex, Exterior, Gloss (Gloss Level 6: MPI #119.

1. Behr Paint, Premium Plus, Interior/Exterior Hi-Gloss Enamel.
2. Dunn-Edwards, Spartashield Gloss, Exterior/Interior 100% Acrylic.
3. Kelly-Moore, Kelly-Moore Premium, 100% Acrylic Interior.Exterior Gloss Enamel.
4. Sherwin-Williams, All Surface Enamel, Zero VOC Acrylic Gloss.
5. Vista Paint, Vista Carefree, Carefree Gloss Finish.

3.00 EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.

B. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

C. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.

1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.

B. Remove plates, machined surfaces, and similar items already in place that are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
2. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

C. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.

D. Steel Substrates: Remove rust and loose mill scale. Clean using methods recommended in writing by paint manufacturer.

E. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions.

1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

3.4 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Construction Administration Manager, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.5 EXTERIOR PAINTING SCHEDULE

A. CMU Substrates:

1. Latex System:

   a. Prime Coat: Block filler, latex, interior/exterior, MPI #4.
   b. Intermediate Coat: Latex, exterior, matching topcoat.
   c. Topcoat: Latex, exterior semi-gloss (Gloss Level 5), MPI #11.

B. Concrete Substrates, Nontraffic Surfaces:

1. Latex System:

   a. Prime Coat: Primer, alkali resistant, water based, MPI #3.
   b. Intermediate Coat: Latex, exterior, matching topcoat.
   c. Topcoat: Latex, exterior semi-gloss (Gloss Level 5), MPI #11.

C. Steel Substrates:

1. Quick-Drying Enamel System: MPI EXT 5.1A.

   a. Prime Coat: Quick-drying alkyd metal primer.
   b. Intermediate Coat: Latex, exterior matching topcoat.
   c. Topcoat: Latex, Exterior, Gloss (Gloss Level 6), MPI #119.

D. Galvanized-Metal Substrates:

1. Latex Over Water-Based Primer System: MPI EXT 5.3H.

   a. Prime Coat: Waterborne galvanized-metal primer.
   b. Intermediate Coat: Exterior latex matching topcoat.
   c. Topcoat: Latex, Exterior, Gloss (Gloss Level 6), MPI #119.

END OF SECTION 09 91 13

SECTION 09 91 23
INTERIOR PAINTING

1.00 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 surface preparation and the application of paint systems on the following interior substrates:

1. Steel.
2. Galvanized metal.
3. Wood.
4. Gypsum board.

B. Related Sections include the following:

1. Division 5 Sections for shop priming of metal substrates with primers specified in this Section.
2. Division 6 Sections for shop priming carpentry with primers specified in this Section.
3. Division 8 Sections for factory priming doors and frames with primers specified in this Section.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples for Verification: For each type of paint system and in each color and gloss of topcoat indicated.

1. Submit Samples on rigid backing, 8 inches square.
2. Step coats on Samples to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

C. Product List: For each product indicated, include the following:

1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
2. Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.

1.4 QUALITY ASSURANCE

A. MPI Standards:

1. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."
2. Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting Specification Manual" for products and paint systems indicated.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.6 PROJECT CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.

B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

2.00 PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design: Provide Aura® Waterborne Interior Paint with Color Lock® Technology as manufactured by Benjamin Moore & Co. or, subject to compliance with requirements, Construction Administration Manager approved equal manufactured by one of the following:

1. Benjamin Moore & Co.
2. ICI Paints.
3. PPG Architectural Finishes, Inc.
4. Sherwin-Williams Company (The).

2.2 PAINT, GENERAL

A. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

B. Colors: Refer to the Finish Schedule on the Drawings.

2.3 PRIMERS/SEALERS

A. Interior Latex Primer/Sealer: MPI #50.

1. VOC Content: 150 g/L.
2. Environmental Performance Rating: EPR 2.

B. Interior Alkyd Primer/Sealer: MPI #45.

1. VOC Content: 150 g/L.

C. Wood-Knot Sealer: Sealer recommended in writing by topcoat manufacturer for use in paint systems indicated.

2.4 METAL PRIMERS

A. Alkyd Anticorrosive Metal Primer: MPI #79.

1. VOC Content: 250 g/L.

B. Quick-Drying Alkyd Metal Primer: MPI #76.

1. VOC Content: 50 g/L.

C. Waterborne Galvanized-Metal Primer: MPI #134.

1. VOC Content: 250 g/L.
2. Environmental Performance Rating: EPR 2.

2.5 WOOD PRIMERS

A. Interior Latex-Based Wood Primer: MPI #39.

1. VOC Content: 150 g/L.
2. Environmental Performance Rating: EPR 2.

2.6 LATEX PAINTS

A. Interior Latex (Flat): MPI #53 (Gloss Level 1).

1. VOC Content: 50 g/L.
2. Environmental Performance Rating: EPR 1.5.

B. Interior Latex (Low Sheen): MPI #44 (Gloss Level 2).

1. VOC Content: 50 g/L.
2. Environmental Performance Rating: EPR 2.

C. Interior Latex (Eggshell): MPI #52 (Gloss Level 3).

1. VOC Content: 150 g/L.
2. Environmental Performance Rating: EPR 2.

D. Interior Latex (Satin): MPI #43 (Gloss Level 4).

1. VOC Content: 150 g/L.
2. Environmental Performance Rating: EPR 2.

E. Interior Latex (Semigloss): MPI #54 (Gloss Level 5).

1. VOC Content: 150 g/L.
2. Environmental Performance Rating: EPR 2.

F. Interior Latex (Gloss): MPI #114 (Gloss Level 6, except minimum gloss of 65 units at 60 deg).

1. VOC Content: 150 g/L.
2. Environmental Performance Rating: EPR 2.

G. High-Performance Architectural Latex (Low Sheen): MPI #138 (Gloss Level 2).

1. VOC Content: 50 g/L.
2. Environmental Performance Rating: EPR 4.

H. High-Performance Architectural Latex (Eggshell): MPI #139 (Gloss Level 3).

1. VOC Content: 50 g/L.
2. Environmental Performance Rating: EPR 5.

I. High-Performance Architectural Latex (Satin): MPI #140 (Gloss Level 4).

1. VOC Content: 150 g/L.
2. Environmental Performance Rating: EPR 4.5.

J. High-Performance Architectural Latex (Semigloss): MPI #141 (Gloss Level 5).

1. VOC Content: 150 g/L.
2. Environmental Performance Rating: EPR 5.

3.00 EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Masonry (Clay and CMU): 12 percent.
2. Wood: 15 percent.
3. Gypsum Board: 12 percent.

C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

D. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.

1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.

B. Remove plates, machined surfaces, and similar items already in place that are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
2. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

C. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.

D. Concrete Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

E. Steel Substrates: Remove rust and loose mill scale. Clean using methods recommended in writing by paint manufacturer.

F. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

G. Wood Substrates:

1. Scrape and clean knots, and apply coat of knot sealer before applying primer.

2. Sand surfaces that will be exposed to view, and dust off.
3. Prime edges, ends, faces, undersides, and backsides of wood.
4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

H. Gypsum Board Substrates: Do not begin paint application until finishing compound is dry and sanded smooth.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions.

1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces.
3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

E. Painting Mechanical and Electrical Work: If above ceiling or in equipment rooms, do not paint unless required for surface protection:

1. Mechanical Work:

a. Uninsulated metal piping.
b. Uninsulated plastic piping.
c. Pipe hangers and supports.
d. Tanks that do not have factory-applied final finishes.
e. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
f. Mechanical equipment that is indicated to have a factory-primed finish for field painting.

2. Electrical Work:

a. Switchgear.
b. Panelboards.
c. Electrical equipment that is indicated to have a factory-primed finish for field painting.

3.4 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Construction Administration Manager, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.5 INTERIOR PAINTING SCHEDULE

A. Concrete Masonry (CMU) Substrates, Nontraffic Surfaces:

1. Latex System: MPI INT 3.1E.

   a. Prime Coat: Interior Latex Primer/Sealer: MPI #50.
   b. Intermediate Coat: Interior latex matching topcoat.
   c. Topcoat: High-Performance Architectural Latex (Low Sheen): MPI #138.

B. Steel Substrates:

1. Water-Based Dry-Fall System: MPI INT 5.1C.

   a. Prime Coat: Alkyd anticorrosive metal primer.
   b. Topcoat: Latex dry fog/fall (semi-gloss).

2. Latex Over Alkyd Primer System: MPI INT 5.1Q.

   a. Prime Coat: Alkyd anticorrosive metal primer.
   b. Intermediate Coat: Interior latex matching topcoat.
   c. Topcoat: Interior latex (semi-gloss).

C. Galvanized-Metal Substrates:

1. Latex Over Waterborne Primer System: MPI INT 5.3J.

   a. Prime Coat: Waterborne galvanized-metal primer.
   b. Intermediate Coat: Interior latex matching topcoat.
   c. Topcoat: Interior latex (low sheen).

D. Wood Panel Substrates: Including painted plywood.

1. High-Performance Architectural Latex System: MPI INT 6.4S.

a. Prime Coat: Interior latex-based wood primer.
b. Intermediate Coat: High-performance architectural latex matching topcoat.
c. Topcoat: High-performance architectural latex (eggshell).

E. Gypsum Board Substrates:

1. Latex System: MPI INT 9.2A.

a. Prime Coat: Interior latex primer/sealer.
b. Intermediate Coat: Interior latex matching topcoat.
c. Topcoat: Interior latex (low sheen).

END OF SECTION 09 91 23

SECTION 10 14 00
SIGNS

1.00 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. Extent of signs is shown on the drawings.

B. Forms of signs required include the following:

1. Interior Panel signs with room names and numbers for EDF, IDF, IDF2, IDF3 & IDF4.
2. Exterior building address per City of San Antonio, TX Building Code and IBC Amendment 501.2 and Airport Building numbers for two new buildings.
3. Signs for IDF5 and MOUD to be provided by Owner and installed by Contractor.

1.3 SUBMITTALS

A. Shop Drawings: Submit shop drawings for fabrication and erection of signs. Include plans, elevations, and large scale details of sign wording and lettering layout. Show anchorages and accessory items. Furnish location template drawings for items supported or anchored to permanent construction.

1. Provide message list for each type of sign required, including large-scale details of wording and layout of lettering.
2. For signs supported by or anchored to permanent construction, provide setting drawings, templates, and directions for installation of anchor bolts and other anchors to be installed as a unit of work in other Sections.

B. Product Data: Submit manufacturer's technical data and installation instructions for each type of sign required.

1. For each type of product indicated, provide one hard copy of the operation and maintenance instructions. Also provide one elecgtronic copy in pdf format of this information.

1.4 QUALITY ASSURANCE

A. Uniformity of Manufacturer: For each sign form and graphic image process indicated furnish products of a single manufacturer.

1.5 COORDINATION

A. Coordinate placement of anchorage devices with templates for installing signs.

2.00 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Interior Panel Signs: Match existing Airport room signaged approved signage system manufactured by one of the listed manufacturers.

B. Exterior Building Address and Building Numbers: Match existing signage on adjacent building subject to an approved signage system manufactured by one of the following:

1. ABC Signing Division of Nelson-Harkins Industries.
2. Andco Industries Corp.
3. ASI Sign Systems, Inc.
4. Austin Architectural Graphics.
5. Best Manufacturing Co.
6. Spandex, USA
7. Spanjer Brothers, Inc.
8. Vomar Products, Inc.

2.2 DIMENSIONAL CHARACTERS

A. Fabricated Channel Characters: Form exposed faces and sides of characters to produce surfaces free from warp and distortion. Include mounting anchors and accessories. Comply with the following requirements:

1. Aluminum Bars:

a. Finish: Brushed aluminum.

2. Provide manufacturer's hardware for projection mounting of solid characters at distance from wall surface indicated.

3.00 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 work.

B. Verify that items, including anchor inserts, are sized and located to accommodate signs.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Locate sign units and accessories where shown or scheduled, using mounting methods of the type described and in compliance with the manufacturer's instructions.

1. Install sign units level, plumb and at the height indicated, with sign surfaces free from distortion or other defects in appearance.

B. Wall-Mounted Signs: Comply with sign manufacturer's written instructions except where more stringent requirements apply.

1. Silicone-Adhesive Mounting: Attach signs to irregular, porous, or vinyl-covered surfaces.
2. Shim Plate Mounting: Provide 1/8-inch- thick, concealed aluminum shim plates with predrilled and countersunk holes, at locations indicated, and where other mounting methods are not practicable. Attach plate with fasteners and anchors suitable for secure attachment to substrate. Attach panel signs to plate using method specified above.
3. Mechanical Fasteners: Use nonremovable mechanical fasteners placed through predrilled holes. Attach signs with fasteners and anchors suitable for secure attachment to substrate as recommended in writing by sign manufacturer.

C. Dimensional Characters: Mount characters using standard fastening methods to comply with manufacturer's written instructions for character form, type of mounting, wall construction, and condition of exposure indicated. Provide heavy paper template to establish character spacing and to locate holes for fasteners.

1. Projected Mounting: Mount characters at projection distance from wall surface indicated.

3.3 CLEANING AND PROTECTION

A. At completion of the installation, clean sign surfaces in accordance with the manufacturer's instructions. Protect units from damage until acceptance by the Owner.

END OF SECTION 10 14 00

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SECTION 10 41 16
FIRE EXTINGUISHERS

1.00 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes portable, hand-carried fire extinguishers for installation on fire extinguisher brackets.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher.

1. For each type of product indicated, provide one hard copy of the operation and maintenance instructions.
2. For wall brackets, provide available brackets for selection by Construction Administration Manager.

B. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

C. Warranty: Sample of special warranty.

1.4 QUALITY ASSURANCE

A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."

B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

1. Provide fire extinguishers approved, listed, and labeled by FMG.

C. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to fire extinguishers including, but not limited to, the following:

a. Schedules and coordination requirements.

1.5 COORDINATION

A. Coordinate type and capacity of fire extinguishers with fire protection cabinets to ensure fit and function.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Failure of hydrostatic test according to NFPA 10.
b. Faulty operation of valves or release levers.

2. Warranty Period: Six years from date of Substantial Completion.

2.00 PRODUCTS

2.1 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

A. Fire Extinguishers: Type, size, and capacity for each fire protection cabinet indicated.

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. Fire End & Croker Corporation.
b. J. L. Industries, Inc.; a division of Activar Construction Products Group.
c. Larsen's Manufacturing Company.
d. Potter Roemer LLC.
e. Pyro-Chem; Tyco Safety Products.

2. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B and bar coding for documenting fire extinguisher location, inspections, maintenance, and recharging.

B. Clean-Agent Type in Steel Container (Halotron I Type or FM-200): UL-rated 5-B:C, 10-lb nominal capacity, with HFC blend agent and inert material in enameled-steel container; with pressure-indicating gage.

C. Fire Extinguisher Bracket: Provide wall mounting type bracket recommended by extinguisher manufacturer for each fire extinguisher.

3.00 EXECUTION

3.1 EXAMINATION

A. Examine fire extinguishers for proper charging and tagging.

1. Remove and replace damaged, defective, or undercharged fire extinguishers.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install fire extinguishers and brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.

END OF SECTION 10 41 16

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SECTION 13 34 23
FABRICATED STRUCTURES

1.00 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Pre-engineered fabricated concrete structures work includes shop-assembled precast concrete structure, delivery and placement at the project site. This work includes design and engineering to comply with local and national codes. Structure will include redundant HVAC where noted on the Drawings.

1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Manufacturers must have ten (10) years successful experience in the manufacture of pre-engineered/pre-fabricated modular structures that are delivered to the site 95+% complete and crained onto site-built structural pads.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's product literature and installation sequence for each type of equipment and accessory indicated; include material charts where selection is required.

B. Shop Drawings: Shop drawings shall be coordinated with field measurements and foundation. Include a list of all relevant codes and calculations indicating compliance. Submit mechanical calculations and proposed equipment.

C. Samples: Submit the following:

1. Concrete finishes for walls and roof.

D. Maintenance Data: Submit detailed instructions indicating proper means for maintaining each type of material, equipment and accessory required.

2.00 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Basis of Design:

1. Modular Connections, LLC, 1090 Industrial Blvd., Bessemer, AL 35022.

2.2 OVERALL DESIGN

A. Design: All structure, including steel reinforcing, lifting points, utility access details, interior wall and ceiling insulation and finish materials, and finish flooring. Include manufacturer's 10 year NDL warranty.

1. Comply with local, state and national codes.
2. Provide foundation designer with loading information and data for proper foundation design.
3. Coordinate connection details with foundation designer. Responsibility of the design of the connection will be with the engineer of record for the building/structure.
4. Design and provide HVAC electrical panels, and meet the requirement of the equipment the structure is intended to house as provided by the IT consultant.

B. Size: 12' by 15' by 9' high. Sizes represent interior minimum dimensions and are subject to refinement during the shop drawing process.

2.3 MATERIALS

A. Structure: Precast concrete, ribbed on exterior walls.

B. Walls and ceilings: Exposed, prefinised 3/4" thick fire retardant treated (FRT) plywood panel system with joint and corner battens over rigid polyisocyanurate insulation board (R - 19) minimum at walls, R-38 minimum polyisocyanurate insulation board below roof.

C. Floor: Static-dissipative resilient composition tile as specified in Division 9 Section "Static-Control Resilient Flooring."

D. Equipment:

1. Electrical Components:

   a. Panel boards.
   b. Light fixtures and bulbs:
      1) Interior: Fluorescent strips.
      2) Exterior: LED type.

2. Doors and Frames: Commercial 16 gauge as specified in Division 8 Section "Steel Doors and Frames."
3. Door Hardware: Provide the following as specified in Division 8 Section "Door Hardware":

   a. Hinges.
   b. Door closers.
   c. Locksets, deadbolts, panic exit devices.
   d. Door gaskets, thresholds and sweeps.
   e. Drip caps.

4. Concrete Construction and Maintenance Materials:

   a. Fasteners and mechanical anchors.
   b. Finishing and sealing.
   c. Concrete cutting and drilling tools.
   d. Caulk and sealants.

5. Grounding and Lightning Protection:

    a. Ground bars and accessories.
    b. Ground conductors.
    c. Ground electrodes.
    d. Ground straps and jumpers.

6. Roofing Materials:

    a. Concrete roof coating.

7. HVAC Equipment:

    a. Wall mount units as specified in Division 23 sections
    b. Thermostats and controllers.

8. Plywood Products:

    a. 3/4" thick FRT plywood
    b. Composit structural insulated panels.
    c. Trim components.

9. Fire Suppression:

    a. Hand held extinguishers as specified in Division 10 Section "Fire Extinguishers."
    b. Fire suppression systems as specified in Division 21 section 21 22 00.

10. Security and Access Control System Components:

    a. Card and proximity access.

11. Cable Management: Cable trays.

2.4 PAINT

A. Paint in accordance with Division 9 Section "Exterior Paint" as scheduled in the Finish Schedule on the Drawings.

3.00 EXECUTION

3.1 INSTALLATION

A. Install pre-engineered fabricated structures to comply with manufacturer's instructions and final shop drawings by factory trained personnel experienced in pre-fabricated, pre-engineered structure construction. Provide accessories and equipment indicated and anchors, inserts, and other items required for installation of units and attachment of adjoining construction.

3.2 ADJUSTMENT AND CLEANING

A. Clean installed pre-engineered structure of all debris, and excess fill caused by work of this section. Touch-up shop applied finishes to restore damaged surfaces.

END OF SECTION 13 34 23

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SECTION 21 13 19
PREACTION SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Related Documents:
1. Drawings and general provisions of the Subcontract apply to this Section.
2. Review these documents for coordination with additional requirements and information that apply to work under this Section.

B. Section Includes:
1. Design, provision, and installation of a pre-action sprinkler system.

C. Related Sections:
1. Division 01 Section "General Requirements."
2. Division 01 Section "Special Procedures."

1.2 REFERENCES

A. General:
1. The following documents form part of the Specifications to the extent stated. Where differences exist between codes and standards, the one affording the greatest protection shall apply.
2. Unless otherwise noted, the referenced standard edition is the current one at the time of commencement of the Work.
3. Refer to Division 01 Section "General Requirements" for the list of applicable regulatory requirements.
4. Refer to Division 21 Section "Common Results for Fire Suppression" for codes and standards, and other general requirements.

B. U.S. Department of Labor:
1. Code of Federal Regulation 29 CFR 1910.7: Definitions and Requirements for a Nationally Recognized Testing Laboratory (NRTL)

C. National Fire Protection Association:
1. NFPA 13 Installation of Sprinkler Systems 2007 Edition

1.3 SYSTEM DESCRIPTION

A. Double Interlock Preaction Fire Sprinkler System to provide coverage for building areas noted on Construction Drawings.

B. Interface system with building fire and smoke alarm system.

C. Provide system in accordance with NFPA 13 Ordinary Hazard, Group 2 occupancy requirements.

D. System includes compressed air and detection system to activate sprinkler system, and fire and smoke alarm system.

1.4 SUBMITTALS

A. Submit under provisions of Division 21 Section "Common Results for Fire Suppression - Review of Materials" and Division 01 Section "General Requirements."

B. Shop Drawings: Develop and submit drawings required for the construction, commissioning, and maintenance of the system including detailed pipe layout, hangers and supports, piping components, valve and sprinkler head locations, and accessories. The drawings shall be stamped by a licensed Responsible Managing Employee (RME-G).

1. Electronic files of the Subcontract drawings will be provided by owner or Architect for the Subcontractor's use in developing the detailed shop drawings for this project upon request. drawings prepared by the Subcontractor shall be developed using the AutoCADTM computer-aided drafting program. drawings shall be a maximum ANSI size D. notations, dimensions, and lettering shall be no smaller than 1/8" on 'D' size drawings. Font style shall be Simplex or RomanS. The correct orientation (North arrow) and elevation shall be shown on plan views. The title block shall bear the names and signatures of the employees who drew, checked, and approved each drawing.
2. The drawings shall be sequenced in a logical order, such as building and floor numbers in ascending order. With the exception of common construction details, each drawing shall depict work within a single building. Floor plans of existing buildings provided by owner or Architect shall be shown faded on the drawings so that the new work is highlighted.

C. Calculations: The Subcontractor shall produce and submit detailed hydraulic calculations to prove that the system has been designed in accordance with NFPA 13. The calculations shall bear the stamp of approval of a Responsible Managing Employee (RME-G). The sprinkler contractor shall be licensed to perform such work by the State of Texas. For this project, the following data shall be used in the design calculations.

1. Static pressure: 70 psi.
2. Flow: 1200 gpm at 65 psi.

D. Product Data: Submit technical product specification sheets for each system component and device which include data needed to prove compliance with this specification. Clearly indicate the exact model of each component to be provided. Include manufacturer's installation Instruction for components being provided under this section.

E. Pump Data:
1. Indicate pump type, capacity, power requirements, and affected adjacent construction.
2. Submit certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable.

F. Installer Qualifications: Submit evidence that the installer is regularly engaged in the installation of automatic fire sprinkler equipment and systems with at least 5 years of experience, and that they are licensed by the State of Texas to do such construction.

G. Operation and Maintenance Data:
1. Include written maintenance data and servicing requirements for components of the system.
2. Include pump operation, maintenance, and inspection data, replacement part numbers and availability, and location and telephone numbers of service depot.

H. Project Record Documents:
1. Submit electronic files developed for this project including shop drawings and calculations. The shop drawings shall be revised to show the "as-built" conditions including actual locations of system components and affected equipment including piping, sprinkler heads, risers, laterals, supports, and points of connection. The shop drawings files shall be submitted in PDF format.

1.5 QUALITY ASSURANCE

A. Design and installation to conform to and comply with NFPA 13.

B. Equipment and components shall be in accordance with the requirements of a nationally recognized testing laboratory (NRTL) recognized under 29 CFR part 1910.7.

C. Welding materials and procedures shall conform to and comply with ASME standards.

D. Provide pumps labeled with manufacturer's name, model number, and rating/capacity.

1.6 EXTRA MATERIALS

A. Provide extra sprinklers under provisions of NFPA 13.

B. Provide suitable wrenches for each sprinkler type.

C. Provide metal storage cabinet in location designated.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Aboveground Inside Building Piping: As permitted by NFPA 13.

2.2 PIPING SPECIALTIES

A. Automatic Sprinkler Valve: Flow detector with alarm circuits, pressure switch, pressure-retard chamber.

2.3 SPRINKLER HEADS

A. Suspended Ceiling Type: Semi-recessed or Recessed pendant with chrome-plated finish, with matching escutcheon.

B. Exposed Area Type: Standard upright type with chrome-plated finish.

C. Fusible Link: Temperature rated for specific area hazard.

D. Guards: Finish to match sprinkler head, if provided

2.4 AIR COMPRESSOR

A. Single unit, electric-motor driven, ASME-rated horizontal receiver tank, air-pressure-operated electric switch, motor, motor starter safety valves, check valves, automatic tank drain, muffler, filter, belt guard, and controls.

2.5 DETECTION SYSTEM

A. Detection System: Single Hazard Control Panel shall serve as the control system for the Preaction system.

B. Photoelectric smoke detectors will be used and spaced according to NFPA 72.

C. Double interlock function will be achieved either through electric/electric or electric/pneumatic actuation.

D. System shall report to the Building Fire Alarm Control Panel for Alarm, Trouble and Supervisory conditions.

PART 3 - EXECUTION

3.1 PREPARATION

A. Coordinate work of this section with other affected work.

3.2 INSTALLATION - PIPING

A. Provide double check valve assembly at sprinkler system water source connection.

B. Place pipe runs to minimize obstructions to other work.

C. Place piping in concealed spaces above finished ceilings.

D. Center sprinklers in the ceiling tiles.

E. Ensure that concealed sprinkler cover plates do not receive field paint finish.

3.3 INSTALLATION - AIR COMPRESSOR

A. Install air compressor on vibration isolators specified in Division 21 Section "Vibration and Seismic Controls for Fire Suppression Piping and Equipment".

B. Pipe receiver tank drain to nearest floor drain.

3.4 CLEANING AND TESTING

A. Flush entire piping system of foreign matter.

B. Hydrostatically test entire system.

C. Test shall be witnessed by local AHJ.

D. Test control sequence for operation.

E. Submit a completed Subcontractor’s material and test certificate to the local AHJ prior to requesting approval of the installation.

END OF SECTION 21 13 19

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Section 21 22 00
Clean-Agent Fire-Extinguishing Systems

Clean Agent Fire Extinguishing utilizing Halocarbon Agents and Conventional Control Panel and Detection System

SECTION 1 – GENERAL SPECIFICATIONS

I. SCOPE

This specification outlines the requirements for a “Total Flooding” clean agent fire extinguishing system using halocarbon agents and utilizing a conventional detection and control system. The work described in this specification includes all engineering, labor, materials, equipment and services required to install and test the clean agent fire extinguishing and control system.

II. APPLICABLE STANDARDS AND PUBLICATIONS

The design, equipment, installation, testing and maintenance of the Clean Agent Suppression System shall be in accordance with the applicable requirements set forth in the latest edition of the following codes and standards.

A. NFPA 2001 - Clean Agent Fire Extinguishing Systems.

B. NFPA 70 - National Electric Code.

C. NFPA 72 – National Fire Alarm and Signaling Code.

D. FM - Factory Mutual Approval Guide.

E. UL - Fire Protection Equipment Directory.

F. NEMA - Enclosures for Industrial Controls and Systems.

G. Department of Transportation (DOT) Title 49 Code of Federal Regulations

H. All Requirements of Authority Having Jurisdiction (AHJ)

The standards listed, as well as all other applicable codes, standards, and good engineering practices shall be used as "minimum" design standards.

III. REQUIREMENTS

The Suppression System installation shall be made in accordance with the drawings, specifications and applicable standards. Should a conflict occur between the drawings and specifications, the specifications shall prevail.

IV. EXCLUSIONS

The work listed below shall be provided by others, or under other sections of this specification:

A. 120 VAC or 220 VAC power supply to the system control panel.

B. Interlock wiring and conduit for shutdown of HVAC, dampers and/or electric power supplies, relays or shunt trip breakers.

C. Connection to local/remote fire alarm systems or listed central alarm station(s).

V. QUALITY ASSURANCE

A. MANUFACTURER

1) The manufacturer of the suppression system hardware and detection components shall be ISO 9001 and 14001 registered.

2) The name of the manufacturer shall appear on all major components.

3) All devices, components and equipment shall be the products of the same manufacturer.

4) All devices, components and equipment shall be new, standard products of the manufacturer's latest design and suitable to perform the functions intended.

5) All devices and equipment shall be UL Listed and/or FM Approved.

B. INSTALLER

1) The installing contractor shall be trained by the supplier to design, install, test and maintain fire suppression systems.

2) When possible, the installing contractor shall employ a NICET certified special hazard designer, Level II or above, who will be responsible for this project.

3) The installing contractor shall be an experienced firm regularly engaged in the installation of automatic Clean Agent, or similar, fire suppression systems in strict accordance with all applicable codes and standards.

4) The installing contractor must have a minimum of five (5) years of experience in the design, installation and testing of Clean Agent, or similar, fire suppression systems. A list of systems of a similar nature and scope shall be provided on request.

5) The installing contractor shall show evidence that his company carries a minimum $2,000,000.00 liability and completed operations insurance policy. These limits shall supersede limits required in the general conditions of the specifications.

6) The installing contractor shall maintain, or have access to, a Clean Agent recharging station. The installing contractor shall provide proof of this ability to recharge the largest Clean Agent system within 24 hours after a discharge. Include the amount of bulk agent storage available.

7) The installing contractor shall be an authorized stocking distributor of the Clean Agent system equipment so that immediate replacement parts are available from inventory.

8) The installing contractor shall show proof of emergency service available on a twenty-four-hour-a-day, seven-day-a-week basis.

C. SUBMITTALS

1) The installing contractor shall submit the following design information and drawings for approval prior to starting installation on this project.

a. Working plans indicating detailed layout of system, locating each component (e.g. agent cylinder, control panel, electric/manual pull station, audible and visual alarms). Include control diagrams, wiring diagrams, written sequence of operation or cause to effect matrix along with battery calculations, and pipe locations including size and length. Refer to NFPA 2001 Section 5.1.2.

b. Product data for each piece of equipment comprising the system including storage cylinders, control valves and pilot controls, control panels, nozzles, push-button stations, detectors, alarm bells or horns, switches, and annunciators.

c. Design calculations derived from the manufacturers UL listed computer program written specifically for the halocarbon agent utilized and verified by both Underwriters Laboratories and Factory Mutual. Analysis shall include calculations to verify system terminal pressures, nozzle flow rates, orifice code number, piping pressure losses, component flow data, and pipe sizes considering actual and equivalent lengths of pipe and elevation changes. Flow calculation shall also supply pressure venting estimates as required by NFPA 2001. In addition, the flow calculation software shall print specifications of all piping used in the design (mass, ID, etc). Designers using this software shall be trained and certified by the manufacturer.

d. Manufacturer's installation and operation manual.

2) Submit drawings, calculations and system component data sheets for approval to the local fire prevention agency, owner’s insurance underwriter, and all other authorities having jurisdiction before starting installation. Submit approved plans to the architect/engineer for record.

SECTION 2 – SYSTEM REQUIREMENTS

I. SYSTEM DESCRIPTION AND OPERATION

A. The fire protection system shall be a Total Flooding System utilizing halocarbon agents. System is a fixed installation where equipment is designed and installed to provide fire extinguishing capability for hazards described.

B. The system shall provide a minimum agent design concentration per the requirements of NFPA 2001, in all areas and/or protected spaces, at the minimum anticipated temperature within the protected area. The system should be designed to discharge its liquid contents in 10 seconds or less. System design shall not exceed prescribed percent by volume per NFPA 2001 for normally occupied spaces, adjusted for maximum space temperature anticipated, with provisions for room evacuation before agent release. Concentration may vary depending on the AHJ.

C. The system shall be complete in all ways. It shall include all mechanical and electrical installation, all detection and control equipment, agent storage cylinders, halocarbon agent, discharge nozzles, pipe and fittings, manual release and abort stations, audible and visual alarm devices, auxiliary devices and controls, shutdowns, alarm interface, caution/advisory signs, functional checkout and testing, training and all other operations necessary for a functional, UL Listed and/or FM Approved Clean Agent Suppression System for use with the agent selected.

D. The system(s) shall be actuated by a combination of ionization and/or photoelectric detectors installed for maximum area coverage of 250 sq. ft. (23.2 m2) per detector, in both the room and above ceiling protected spaces. Photoelectric detectors shall be installed in underfloor protected spaces. If the airflow is one air change per minute, photoelectric detectors only shall be installed for maximum area coverage of 125 sq. ft. (11.6 m2) per detector. (Ref. NFPA 72).

E. Detectors shall be Cross-Zoned detection requiring two detectors to be in alarm before release.

F. Automatic operation of each protected area shall be as follows:

1) Actuation of one (1) detector, within the system, shall:

a. Flash the COMMON ALARM lamp and corresponding zone lamp on the control panel face.

b. Display “DETECTION ZONE #” on the control panel LCD.

c. Energize an alarm bell and/or an optional visual indicator.

d. Transfer auxiliary contacts which can perform auxiliary system functions such as:

i. Operate door holder/closures on access doors

ii. Transmit a signal to a fire alarm system

iii. Shutdown HVAC equipment

2) Actuation of a 2nd detector, within the system, shall:

a. Flash the PRE-DISCHARGE lamp on the control panel face.

b. Display “PREDISCHARG OUTPUT #” on the control panel LCD.

c. Energize a pre-discharge horn or horn/strobe device.

d. Shut down the HVAC system and/or dampers.

e. Start time-delay sequence (not to exceed 60 seconds) as displayed on the control panel LCD.

f. System abort sequence is enabled at this time.

3) After completion of the time-delay sequence, the cylinder electric actuator shall activate, the Clean Agent system shall discharge and the following shall occur:

a. Illuminate the “DISCHARGED” lamp on the control panel face.

b. Display “RELEASING OUTPUT #” on the control panel LCD.

c. Shutdown of all power to high-voltage equipment.

d. Energize a visual indicator(s) outside the hazard in which the discharge occurred.

4) The system shall be capable of being actuated by manual discharge devices located at each hazard exit. Operation of a manual device shall duplicate the sequence description above except that the time delay and abort functions shall be bypassed. The manual discharge station shall be of the electrical actuation type and shall be supervised at the main control panel.

II. MATERIALS AND EQUIPMENT

A. GENERAL REQUIREMENTS

1) The Clean Agent System materials and equipment shall be standard products of the supplier’s latest design and suitable to perform the functions intended. When one or more pieces of equipment must perform the same function(s), they shall be duplicates produced by one manufacturer.

2) All devices and equipment shall be UL Listed and/or FM approved.

3) The fire suppression agent shall be a halocarbon agent; clean dry, non-corrosive, non-damaging, non-deteriorating, and meeting the requirements of NFPA 2001. The agent shall be

suitable for use in normally occupied spaces. Agent shall be listed as “Acceptable” on the EPA’s SNAP list.

B. CLEAN AGENT STORAGE AND DISTRIBUTION

1) Each system shall have its own supply of clean agent.

2) The system design can be modular, central storage, or a combination of both design criteria.

3) Systems shall be designed in accordance with the manufacturer’s guidelines.

4) Each supply shall be located within the hazard area, or as near as possible, to reduce the amount of pipe and fittings required to install the system.

5) The clean agent shall be stored in the applicable manufacturers storage cylinders. Cylinders shall be super-pressurized with dry nitrogen to an operating pressure of 360 psi @ 70°F (24.8 bar @ 20°C). Cylinders shall be of high-strength low alloy steel construction and conform to NFPA 2001 and the regulations of the US Department of Transportation (USDOT), Transport Canada and/or CE.

6) Cylinders shall be fitted with a resilient pressure seat type forged brass valve and shall have a threaded steel anti-recoil protective cap or grooved style anti-recoil protective plate for handling and shipment.

7) The primary cylinder assembly(s) shall be actuated by a resettable electric actuator with optional mechanical override located at each primary agent cylinder or connected bank of cylinders. Non-resettable or explosive devices shall not be permitted.

8) Each primary cylinder shall be able to pneumatically actuate up to 15 slave cylinders. The distance between the primary cylinder and the farthest slave cylinder (including any rises or drops) shall not exceed 100 ft (30.48 m) in either direction when using flexible hose or copper tubing for pilot actuation. The distance between the primary cylinder and the farthest slave cylinder (including any rises or drops) shall not exceed 25 ft (7.62 m) in either direction when using 1/4 in (8 mm) schedule 40 pipe for pilot actuation.

9) The cylinders shall be mounted using wall racks on solid walls. The cylinders and racks shall be arranged to allow a service aisle for cylinder removal and cylinder weighing.

10) Cylinders of a maximum storage capacity greater than 130 lbs (59.0 kg) shall come fitted with Liquid Level Indicators.

11) Each cylinder assembly shall have a pressure gauge and low pressure switch to provide visual and electrical supervision of the cylinder pressure. The low pressure switch shall be wired to the control panel to provide an audible and visual supervisory condition signal in the event the cylinder pressure drops below 280 psi (19.3 bar). The pressure gauge shall be color coded to provide an easy, visual indication of cylinder pressure.

12) Each cylinder assembly shall have a pressure relief provision that automatically operates before the internal pressure exceeds 850 psi (58.6 bar) to 1000 psi (68.9 bar).

13) When more than one cylinder is connected to a common manifold, a check valve shall be provided with each cylinder.

14) Engineered discharge nozzles shall be provided within the manufacturer's guidelines to distribute the Novec 1230 fluid throughout the protected spaces. The nozzles shall be designed to provide proper agent quantity and distribution.

a. Nozzles shall be available in 3/8 in (10 mm) through 2 in (50 mm) pipe sizes. Each size shall be available in 90° Corner [Listed with a protection coverage area of 24' x 24' (7.31 m x 7.31 m)], 180° Sidewall [Listed with a protection coverage area of 39' x 39' (11.88 m x 11.88 m)], and 360° Center Room [Listed with a protection coverage area of 39' x 39' (11.88 m x 11.88 m)] distribution patterns.

b. Nozzles shall be of corrosion resistant construction and shall be designed specifically for application of Novec 1230 fire protection fluid.

c. Nozzles shall be permanently marked as to part number and orifice diameter.

d. Nozzles shall be listed at a maximum 18'4" (5.56 m) elevation and listed at a maximum 4'5" (1.37 m) distance below a ceiling while still achieving sufficient mixing.

e. Nozzles should be listed and/or approved to be used in the upright or pendant position.

f. Ceiling plates can be used with the nozzles to conceal pipe entry holes through ceiling tiles.

15) Distribution piping, and fittings, shall be installed in accordance with the manufacturer's requirements, NFPA 2001 and approved piping standards and guidelines. All distribution piping shall be installed by qualified individuals using accepted practices and quality procedures. All piping shall be adequately supported and anchored at all directional changes and nozzle locations. The piping shall be laid out to give maximum flow and to avoid possible mechanical, chemical or other damage. Installation shall follow drawings as closely as possible. System designer must be consulted for anything other than minor deviations in pipe routing.

a. Black or galvanized steel pipe shall be either ASTM A53 seamless or electric welded, Grade A or B or ASTM A-106, Grade A, B, or C. ASTM A-120, ordinary cast-iron pipe, aluminum pipe, or non-metallic pipe shall not be used. Stainless steel pipe shall be 304, 316, 304L, or 316L for threaded connections or 304L or 316L for welded connections.

b. Threaded fittings must comply with NFPA 2001 and be at a minimum class 300 malleable iron, class 300 ductile iron, or have a minimum rated working pressure of 416 psi (28.7 bar) at 70°F (21.1°C). Cast iron and Class 150 pound fittings shall not be used.

c. Grooved fittings and couplings must comply with NFPA 2001 and have a minimum rated working pressure of 416 psi (28.7 bar) at 70°F (21.1°C). Piping shall be rolled or cut grooved in accordance with the fitting or coupling manufacturer's guidelines.

d. Gaskets must be compatible with Novec 1230 fluid (typically EPDM having a temperature range of -30°F to 230°F [-34°C to 110°C]). Gasket lubricant must be in accordance with manufacturer's specifications.

e. The minimum allowable working pressure at 70°F (21.1°C) for pipe and fittings in closed sections of pipe must be greater than or equal to the maximum operating pressure of the discharge pipe safety relief valve rated at 450 psi (31.02 bar).

f. All pipe and fittings shall be new and of recent manufacture.

g. Reductions in pipe sizes may be accomplished using threaded or grooved concentric reducing fittings, steel or stainless steel concentric swage fittings, or steel or stainless steel reducing bushings. All such fittings must comply with NFPA 2001 and have a minimum rated working pressure of 416 psi (28.7 bar) at 70°F (21.1°C). Pipe reductions can be made using machined or forged steel hex bushings. Malleable and/or cast iron bushings are NOT to be used.

h. All piping shall be reamed, blown clear and swabbed with suitable solvents to remove burrs, mill varnish and cutting oils before assembly.

i. All screwed pipe shall be coated with Teflon tape or an appropriate pipe joint compound. When tape or pipe joint compound is used, coating of the threads must start at least two threads back from the pipe end. On small piping, care must be taken so as not to allow sealant to enter valves or controls.

j. All pipe must be thoroughly cleaned before installation. A wire flue brush should be pulled through the length several times, followed by clean cloth rags treated with a noncombustible metal cleaner designed for the purpose. All foreign matter and oil must be removed by this process.

k. All pipe and fittings installed out of doors or in corrosive areas must be galvanized or treated with a proper protective coating.

l. Piping shall be pneumatically tested in a closed circuit for a period of 10 minutes at 40 psi (2.76 bar) per the latest edition of NFPA 2001. At the end of 10 minutes, the pressure drop shall not exceed 20 percent of the test pressure. The pressure test shall be permitted to be omitted if the total piping contains no more than one change in direction fitting between the storage container and the discharge nozzle, and where all piping is physically tested for tightness.

16) Pressure Switches

a. The system shall include a normally open contact on a pressure switch actuated by the agent discharge to shut down equipment and sound alarm.

b. Switches shall be heavy duty, single pole, double throw.

c. Pressure switch shall require manual reset.

d. Pressure switch is only required when a manual valve actuator is supplied on the primary cylinder.

17) Pressure Operated Releases

a. The system shall include releases capable of holding maximum loads of 35 lbs (15.9 kg) to release self closing doors, dampers, windows, louvers, lids or valves upon agent discharge (All devices to be closed must be self-closing and capable of being held open by a cable or chain hooked to the release.)

b. Piping to pressure releases shall be as specified above for discharge piping. All take-offs for pressure release piping shall be from the top of the discharge piping.

C. CONTROL PANEL

1) The control panel shall be a Conventional Control Panel.

2) The Control System and its components shall be UL Listed and/or FM Approved for releasing service.

3) The Control System shall perform all functions necessary to operate the system detection, actuation and auxiliary functions as outlined.

4) The Control System shall be capable of providing 8.0 AH or 12.0 AH battery standby power supplies, providing from 24 to 90 hours standby.

5) The Control System shall be microprocessor based with hardware and software integration designed to guarantee reliability.

6) The Control System shall support Cross-Zoned, Single Detector Release and Manual Release detection/actuation methods.

7) The Control System shall provide the following capabilities and functions:

a. The Control System shall include four (4) input zones, four (4) output zones, one (1) abort, one (1) supervisory, one (1) form C alarm contact, one (1) form C trouble contact, one (1) form A supervisory contact, and one (1) form A water flow contact.

b. A 2 line 32 character alpha numeric liquid crystal display shows the condition, status and circuit for all Alarm, Supervisory and Trouble conditions

c. Individual LED indicators:

AC POWER:	Green LED
INPUT ALARM (4):	Red LED
OUTPUT (4):	Red LED
SUPERVISORY 1/ABORT:	Yellow LED
SUPERVISORY 2:	Yellow LED
SYSTEM TROUBLE:	Yellow LED
ALARM SILENCED:	Yellow LED
POWER TROUBLE:	Yellow LED
GROUND FAULT:	Yellow LED
PRE-DISCHARGE/DISCHARGE:	Yellow LED
SUPERVISORY/TROUBLE:	Yellow LED

d. Buzzer Silence: Press the scroll or scroll down buttons. Once all events in the trouble or supervisory queue have been viewed, the buzzer and appropriate outputs will silence. The applicable TROUBLE or SUPERVISORY LED will change from flashing to steady.
Note: Any continuous trouble conditions that have been silenced automatically resound 24 hours after the first trouble condition was silenced.

e. Signal Silence Switch: Activation of the Alarm Signal Silence Switch shall cause all silenceable Alarm Indicating Appliances to return to the normal condition after an alarm condition.

f. System Reset Switch: Activation of the System Reset Switch shall reset all alarm circuits if condition has been corrected.

g. Zone Status LEDs: The alarm, supervisory or trouble LED(s) shall flash until event(s) have been acknowledged and remain steady on. Any subsequent new alarm, supervisory or trouble condition will sound again all indications and flash new events.

h. Supervisory: A short circuit on this zone shall cause the supervisory LED to flash. The Signal Silence switch shall silence the alarm causing the supervisory LED to remain steady. An open circuit shall report as a zone trouble.

n. Battery/Earth fault supervision shall be provided.

o. Adjustable delay timer shall be available, zero to sixty seconds; the manual release defaults to 30 seconds.

p. Cross zone option shall be selectable (two zones in alarm before release).

q. 3 Abort Function options shall be selectable.

r. Initiating circuit disable feature.

s. A supervised manual release circuit shall be provided, which when activated shall override the Abort.

t. One-man walk test with automatic 30 minute restoration and releasing circuit disable.

u. The Power Supply for the Control Panel shall be integral to the Control Panel itself, and shall provide all control panel and peripheral device power needs.

v. Input power shall be universal 120 VAC, 60 Hz (165VA) or 220 VAC, 50/60 Hz (185 VA). The power supply shall provide an integral battery charger for use with batteries up to 12 AH.

w. The Power Supply shall be designed to meet UL and NFPA requirements for power-limited operation on all indicating and initiating circuits.

x. The control panel shall be housed in a cabinet designed for mounting directly to a wall or vertical surface. The back box and door shall be constructed of 18 gauge steel with provisions for electrical conduit connections into the sides and top. The door shall provide a key lock and shall include a glass or other transparent opening for viewing of all indicators. The cabinet shall be approximately 5 inches deep and 14.25 inches wide. Height shall be approximately 18.5 inches. Space shall be provided in the cabinet for 8.0 AH or 12.0 AH batteries.

D. DETECTORS

1) The detectors shall be spaced and installed in accordance with the manufacturer's specifications and the guidelines of NFPA 72.

2) Smoke detectors shall be 24VDC photoelectric.

3) Each detector shall contain a visual status and alarm indicator for 360° viewing.

4) The detector screen and cover assembly shall be easily removable for field cleaning of the detector chamber.

5) Built in magnetic detector sensitivity test feature.

6) Vandal resistant security lock.

7) Radio frequency and transient protection.

E. MANUAL RELEASE (ELECTRIC)

1) The electric manual release station shall be a dual action device which provides a means of manually discharging the clean agent fire extinguishing system when used in conjunction with the control system.

2) The manual release station shall be Janus Fire System P/N 18703.

3) The manual release station shall be a dual action device requiring two distinct operations to initiate a system actuation.

4) The manual release station shall bypass the time delay and abort functions, shall cause the system to discharge and shall cause all release and shutdown devices to operate in the same manner as if the system had operated automatically.

5) The manual release station faceplate shall include the type of agent to be discharged and operating instructions. The letters shall be silk-screened in a contrasting color.

6) A manual release station shall be located at each exit from the protected hazard.

F. MANUAL RELEASE (MECHANICAL)

1) Mechanical Manual Release shall be made available in the event all battery back-up and commercial power is lost. Consideration should be given for convenience of operation and egress from the hazard area(s).

G. ABORT STATION

1) The optional Abort Station shall be “Dead Man” type and shall be located next to each manual release station.

2) “Locking” or “Keyed” abort stations shall not be permitted.

4) Operating instructions shall be silk-screened onto the faceplate material in a contrasting color.

5) The (optional) Abort Station shall be located adjacent to each manual station and can be furnished with a Manual Release Switch. To avoid confusion, the Abort Station shall appear distinctly different from a fire alarm manual station.

H. AUDIBLE and VISUAL ALARMS

1) Audible alarm and visual signal devices shall operate from the Control Panel.

2) Alarms shall operate on 24 VDC nominal polarized.

3) Audible alarms shall provide continuous or interrupted tones with an output sound level of at least 90 dBA measured at 10 feet from the device.

4) A Strobe device shall be placed outside, and above, each exit door

I. BATTERIES

1) Shall be 12.0 volt, Gell Cell type (2 required).

2) Battery shall have sufficient capacity to power the fire alarm system for not less than twenty-four hours plus 5 minutes of alarm upon a normal AC power failure. Optional battery power for ninety hours

3) The batteries are to be completely maintenance free.

J. ELECTRICAL INSTALLATION

1) Installation shall be in accordance with the NFPA 70 (NEC), NFPA 72, NFPA 2001, local and state codes, as shown on the drawings, and as recommended by the major equipment manufacturer.

2) All conduit, junction boxes, conduit supports and hangers shall be concealed in finished areas and may be exposed in unfinished areas. Smoke detectors shall not be installed prior to the system programming and test period. If construction is ongoing during this period, measures shall be taken to protect smoke detectors from contamination and physical damage.

3) All fire detection and alarm system devices, control panels and remote annunciators shall be flush mounted when located in finished areas and may be surface mounted when located in unfinished areas.

4) At the final inspection a factory trained representative of the manufacturer of the major equipment shall perform the all tests required.

5) Conduit installation shall be in accordance with The National Electrical Code (NEC), local and state requirements

SECTION 3 – DOCUMENTATION AND TESTING

I. SYSTEM INSPECTION AND CHECKOUT

After the system installation has been completed, the entire system shall be checked out, inspected and functionally tested by qualified, trained personnel, in accordance with the manufacturer's recommended procedures and NFPA standards.

A. All containers and distribution piping shall be checked for proper mounting and installation.

B. All electrical wiring shall be tested for proper connection, continuity and resistance to earth.

C. The complete system shall be functionally tested, in the presence of the owner or his representative, and all functions, including system and equipment interlocks, must be operational at least five (5) days prior to the final acceptance tests.

1) Each detector shall be tested in accordance with the manufacturer's recommended procedures, and test values recorded.

2) All system and equipment interlocks, such as door release devices, audible and visual devices, equipment shutdowns, local and remote alarms, etc. shall function as required and designed.

3) Each control panel circuit shall be tested for trouble by inducing a trouble condition into the system.

II. TRAINING REQUIREMENTS

Prior to final acceptance, the installing contractor shall provide operational training to each shift of the owner's personnel. Each training session shall include control panel operation, manual and (optional) abort functions, trouble procedures, supervisory procedures, auxiliary functions and emergency procedures.

III. OPERATION AND MAINTENANCE

Prior to final acceptance, the installing contractor shall provide complete operation and maintenance instruction manuals, four (4) copies for each system, to the owner. All aspects of system operation and maintenance shall be detailed, including piping isometrics, wiring diagrams of all circuits, a written description of the system design, sequence of operation and drawing(s) illustrating control logic and equipment used in the system. Checklists and procedures for emergency situations, troubleshooting techniques, maintenance operations and procedures shall be included in the manual.

IV. AS-BUILT DRAWINGS

Upon completion of each system, the installing contractor shall provide four (4) copies of system "As-Built" drawings to the owner. The drawings shall show actual installation details including all equipment locations (e.g. control panel(s), agent container(s), detectors, alarms, manuals and aborts, etc.) as well as piping and conduit routing details. Show all room or facilities modifications, including door and/or damper installations completed.

V. ACCEPTANCE TESTS

A. At the time "As-Built" drawings and maintenance/operations manuals are submitted, the installing contractor shall submit a "Test Plan" describing procedures to be used to test the control system(s). The Test Plan shall include a step-by-step description of all tests to be performed and shall indicate the type and location of test apparatus to be employed. The tests shall demonstrate that the operational and installation requirements of this specification have been met. All tests shall be conducted in the presence of the owner and shall not be conducted until the Test Plan has been approved.

B. The tests shall demonstrate that the entire control system functions as designed and intended. All circuits shall be tested: automatic actuation, solenoid and manual actuation, HVAC and power shutdowns, audible and visual alarm devices and manual override of abort functions. Supervision of all panel circuits, including AC power and battery power supplies, shall be tested and qualified.

C. A room pressurization test shall be conducted, in each protected space, to determine the presence of openings which would affect the agent concentration levels. The test(s) shall be conducted using the Door Fan system with integrated computer program. All testing shall be in accordance with NFPA 2001, Appendix B.

D. If room pressurization testing indicates that openings exist which would result in leakage and/or loss of the extinguishing agent, the installing contractor shall be responsible for coordinating the proper sealing of the protected space(s) by the general contractor or his sub-contractor or agent. The general contractor shall be responsible for adequately sealing all protected space(s) against agent loss or leakage. The installing contractor shall inspect all work to ascertain that the protected space(s) have been adequately and properly sealed. THE SUPPRESSION SYSTEM INSTALLING CONTRACTOR SHALL BE RESPONSIBLE FOR THE SUCCESS OF THE ROOM PRESSURIZATION TESTS. If the first room pressurization test is not successful, in accordance with these specifications, the installing contractor shall direct the general contractor to determine, and correct, the cause of the test failure. The installing contractor shall conduct additional room pressurization tests, at no additional cost to the owner, until a successful test is obtained. Copies of successful test results shall be submitted to the owner for record. Upon acceptance by the owner, the completed system(s) shall be placed into service.

VI. SYSTEM INSPECTIONS

A. The installing contractor shall provide two (2) inspections of each system, installed under this contract, during the one-year warranty period. The first inspection shall be at the six-month interval, and the second inspection at the 12-month interval, after system acceptance. Inspections shall be conducted in accordance with the manufacturer's guidelines and the recommendations of NFPA 2001.

B. Documents certifying satisfactory system(s) operation shall be submitted to the owner upon completion of each inspection.

VII. WARRANTY

All components furnished and installed under this contract shall be warranted against defects in design, materials and workmanship for the full warranty period which is standard with the manufacturer, but in no case less than one (1) year from the date of system acceptance.

END OF SECTION 21 22 00

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SECTION 22 05 00
COMMON WORK RESULTS FOR PLUMBING

1.00 GENERAL

1.01 RELATED SECTIONS

A. The General Conditions of the Contract, Supplementary Conditions, and General Requirements are a part of and apply to this section. Consult them for additional conditions and requirements pertaining to this section.

1.02 SUMMARY

A. Section includes General Provisions applicable to Division 22 - Plumbing.

1. Provide all labor, equipment, and material necessary to complete the work as specified and as shown on the drawings.
2. Provide supervision, coordination, tools, and accessories and appurtenances necessary or required to perform and accomplish the work.

1.03 SUBMITTALS

A. Comply with Division 10 33 00.

1.04 QUALITY ASSURANCE

A. Chemical and physical properties, design, and performance characteristics of all material and equipment, and methods of construction shall be in accordance with the following applicable codes, regulations and standards. Current editions in effect 30 days prior to receipt of bids will apply.

1. Air Conditioning and Refrigeration Institute (ARI)
2. Air Movement and Control Association, Inc. (AMCA)
3. American National Standards Institute (ANSI)
4. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE)
5. American Society of Mechanical Engineers (ASME)
6. American Society for Testing and Materials (ASTM)
7. American Standard Code for Pressure Piping (ASCPP)
8. American Water Works Association (AWWA)
9. Environmental Protection Agency (EPA)
10. Factory Insurance Association (FIA)
11. Factory Mutual Laboratories (FM)
12. Manufacturer's Standards Institute (MSI)
13. National Certified Pipe Welding Bureau (NCPWB)
14. National Fire Protection Association (NFPA)
15. Sheet Metal and Air Conditioning Contractor's National Association (SMACNA)
16. Underwriters' Laboratories, Inc. (UL)
17. International Building Code (IBC), including City of San Antonio Amendments
18. Uniform Plumbing Code (UPC), including City of San Antonio Amendments

B. Comply with applicable local, state, and federal codes, rules, and regulations. As a minimum requirement, codes, rules and regulations take precedence over the drawings and specifications. Where the requirements of the drawings and specifications exceed those of applicable codes, rules and regulations, the drawings and specifications shall govern.

1.05 PRODUCTS

A. Material and equipment shall be new and free from defects.

B. Install all material and equipment in accordance with the manufacturer's current published recommendations.

C. Certain materials and equipment are specified by manufacturer and model or catalog number. Such specified items are the basis of design and establish a degree of quality, performance, and physical configuration. The Contractor shall be responsible for the quality, performance, and physical configuration of the work should he use products of a listed acceptable manufacturer in lieu of the specific product upon which the design is based.

1.06 SUBSTITUTIONS

A. Equipment and materials manufactured by any one of the manufacturers listed on the drawings or in the specifications will be acceptable.

B. Where no manufacturer is listed, provide a standard product meeting the requirements of the drawings and specifications, and manufactured by a firm regularly engaged in the manufacture of such products.

C. If the Contractor wishes to furnish or use a substitute item of material and/or equipment, he must submit a change order request to the Engineer within 15 working days of notice-to-proceed. The request for the change order shall itemize each of the proposed substitutions identified by applicable specification section, paragraph number, and/or drawing number. A price change (increase or decrease) shall be listed for each item along with complete data showing performance over entire range of operation, physical dimensions, electrical characteristics, material construction, operating weight, and other applicable data. The Engineer will review the change order request for equality, suitability, and reasonableness of price differential. A single substitution change order listing the approved items will be issued with the net cost of the change order being the sum of the approved item costs. No subsequent substitution change orders will be considered. The Engineer's decision will be final.

D. It shall be the responsibility of the Contractor to assure that the substitute material and/or equipment fits into the space provided, and the Contractor shall pay for all extra costs incurred by other trades for any and all changes necessitated by these substitutions. The Contractor shall also pay any costs incurred by the Engineer for incorporating a substituted item into the Design Drawings.

1.07 DELIVERY AND STORAGE OF EQUIPMENT AND MATERIAL

A. Make provisions for delivery and safe storage of equipment and materials.

B. Make arrangements for the introduction into the building of equipment too large to pass through finished openings and spaces.

1.08 PROTECTION

A. Protect all equipment, material, and completed work from damage. Repair or replace damaged items as necessary to establish conformance with requirements of the drawings and specifications.

B. Protect equipment, material, and completed work until acceptance by Owner.

C. Close open ends of work, and stored equipment and materials with temporary covers or plugs to prevent entry of foreign objects, dirt, water, or debris.

1.09 GUARANTEE

A. Guarantee all equipment, materials, workmanship, and proper operation of equipment and apparatus for a period of one year from date of final acceptance by the Owner or Final Certificate of Occupancy issued by the City.

B. Repair or replace, at no cost to the Owner, work which is judged defective by the Engineer or Owner during the guarantee period.

1.10 DEFINITIONS

A. Provide: Furnish and install complete and ready for use.

B. Contractor: Any contractor performing work under Division 22 of the specifications.

C. Plumbing: Applies to all work specified in Division 22 of the specifications.

D. Shall Secure or Other Performance Terms: Work shall be performed by the Plumbing Contractor.

1.11 DRAWINGS AND SPECIFICATIONS

A. Mechanical drawings are diagrammatic or pictorial in character, and do not indicate every required offset, valve, fitting, accessory, or appurtenance.

B. Review and consider all drawings and specifications relating to this project in preparation of bid.

C. Drawings and specifications are complementary. Whatever is required by either the drawings or specifications shall be provided.

D. Refer discrepancies between and within the drawings and specifications to the Engineer for resolution.

E. Do not scale drawings.

1.12 SAFETY AND HEALTH REQUIREMENTS

A. Comply with applicable provisions of the "Williams-Steiger Occupational Safety and Health Act of 1970, Public Law 91-596" and applicable amendments, and current State of Texas Labor and Industries Regulations.

1.13 PROOF OF PERFORMANCE

A. After test runs have been completed, the Contractor shall submit, in writing, to the Construction Administration Manager that all systems have been demonstrated to be satisfactory, and in compliance with requirements of the drawings and specifications. This report shall include verification of the installation from the manufacturer's representative. Report shall include any installation errors or other faults that would affect the performance of the equipment or system.

1.14 SUPERVISION

A. All work shall be under the direct supervision of an experienced superintendent.

1.15 WORKMANSHIP

A. Workmanship shall conform to the highest industry standard for each specific type of work.

B. Perform work in accordance with standard commercial practices.

1.16 OWNER ACCEPTANCE

A. At the time of acceptance of the work by the Owner, all mechanical equipment and systems shall be in accordance with requirements of the drawings and specifications to the satisfaction of the Engineer and Owner.

1.17 EXAMINATION OF SITE

A. The Contractor shall visit the project site and ascertain existing conditions prior to submitting bid. Include in bid all considerations necessary to accomplish the work under the existing conditions.

B. Additional charges will not be authorized due to the Contractor's failure to become familiar with the existing conditions.

1.18 PERMITS AND INSPECTIONS

A. Secure and pay for all required permits and licenses.

B. Pay all applicable royalties, inspection fees, and taxes.

C. File necessary plans, prepare necessary documents, and obtain necessary approvals from the Authorities Having Jurisdiction.

D. Upon completion of the work, furnish to the Owner and Engineer a certificate of inspection and final approval from each authority having jurisdiction for inspection and approval of the work.

1.19 RESPONSIBILITY OF CONTRACTOR

A. The Contractor is responsible for the complete installation and satisfactory operation of all work in accordance with requirements of the drawings and specifications.

B. Include in bid all incidentals, accessories, and appurtenant items required or necessary, even though not specified or indicated, to provide complete operating systems.

C. The component parts of the installation shall function together as workable systems. Each system shall be left with all parts adjusted and in proper working order.

1.20 OPERATION AND MAINTENANCE MANUAL

A. Furnish an Operation and Maintenance Manual (O&M) covering all equipment and systems installed under Division 22 of the specifications.

B. Submit one copy of the manual to the Engineer for preliminary review prior to production of the final manuals.

C. Following review of the preliminary manual by the Engineer:

1. Prepare final copies of the manual complying with the Engineer's comments noted on the preliminary manual.
2. Submit three copies of the final manual to the Construction Administration Manager for distribution to the Owner.

D. Bind information into 8-1/2” x 11”, three-ring or post binders having hard plastic covers.

1. Provide typed indexes to identify each item of equipment and each system.
2. Provide table of contents for each binder.

E. Provide three copies of the final O&M Manual on CD in PDF format, with tabs for each piece of individual equipment.

F. Include at least the following information:

1. Contractors' names, addresses, and telephone numbers.
2. Alphabetical list of all system components with the name, address, and 24-hour phone number of the company responsible for servicing each item during the first year of operation.
3. Guarantees and warranties of all equipment.
4. Manufacturer's data that are applicable to the installed equipment such as the following:

   a. Shop Drawings
   b. Product Data

c. Installation instructions
d. Lubrication instructions
e. Wiring diagrams
f. Parts list

5. Emergency procedures for equipment operation during a fire or following the failure of major equipment. Procedures for normal starting/operating/shutdown and long- term shutdown.
6. Maintenance instruction including valves, valve tag, and other identified equipment lists; proper lubricants and lubricating instruction for each piece of equipment; and necessary cleaning, replacing, and adjusting schedules.
7. Assembly, installation, alignment and adjustment instructions.
8. Temperature control diagrams, including an explanation of the control sequence of each system along with the following instruction wherever applicable:

   a. Emergency procedures for fire or failure of major equipment
   g. Normal starting, operating, and shutdown
   h. Summer or winter shutdown
   i. Interconnection with building and energy management systems

9. Valve tag list.
10. Equipment start-up documentation.
11. An outline of a preventative maintenance program for each system, which shall include a schedule of inspection and maintenance. It shall indicate the maintenance and inspection that should be performed by the Owner and that which should be done with outside service.
12. Guide to troubleshooting.
13. Piping system test certifications.
14. Proof-of-performance certifications.
15. Health department certification of compliance for domestic water.
16. Signed off permits.

1.21 RECORD DRAWINGS

A. Maintain a complete full-size set of prints of the project drawings and indicate in red ink all change to the original information.

   1. Include changes such as locations of equipment, system layout, and piping and duct sizes. Also include existing systems/utilities/equipment interface locations.

B. Submit drawings with final operation and maintenance manuals.

1.22 COORDINATION

A. Examine each drawing and specification section. Report, in writing, to the Engineer all discrepancies within and between the documents. Additional cost made necessary by the Contractor's neglect or failure to report discrepancies shall be borne by the Contractor.

B. Coordinate the work of each Division 22 section with each other specification section. Schedule work to ensure that the various parts fit together in an orderly sequence.

1.23 SCAFFOLDING, RIGGING, AND HOISTING

A. Provide all scaffolding, rigging, and hoisting necessary to accomplish the work.

1. Remove from premises when no longer needed.

B. Provide necessary services to deliver, erect, place, and install all equipment and apparatus furnished.

1.24 DAMAGED SURFACES

A. At completion of the work, all new material and equipment furnished, and existing spaces affected by new work shall be inspected for damage.

1. Repair damaged finishes to match adjacent, undamaged areas.
2. Replace deformed metal cabinets, jackets, ceiling tiles, and enclosures with new items. Finish shall match similar undamaged items.

1.25 CLEAN-UP

A. At completion of the work, check and thoroughly clean all equipment.

1. Clean under, in, and around equipment.
2. Clean exposed surfaces of piping, and hangers

1.26 IDENTIFICATON

A. Pressure sensitive markers:

1. Flexible plastic film identification markers and tape. Legend, sizes, and color in accordance with ANSI A13.1.

a. Brady 350 or equal

B. Semi-rigid plastic identification pipe markers:

1. Legend, size, and color in accordance with ANSI A13.1. Direction-of-flow arrows included on each marker.

a. 3/4 inch through five inches: Setmark type SNA or equal
b. 6 inches and larger: Setmark type STR or equal

C. Nameplates: Three-layer laminated plastic with engraved black letters on light-color contrasting background with the equipment tag number, equipment description, and the area served.

D. Valve Tags: Clear plastic pockets, with colored paper printed with area served, attached to the valve with a brass chain.

2.00 PRODUCTS

2.01 SLEEVES

A. Materials, General: Schedule 40 galvanized steel pipe with unthreaded ends, cast iron pipe, 4 or minimum 26 gage galvanized sheet steel. Use steel pipe for sleeves at floor slabs. 5 6

B. Sleeves and Firestopping in Fire and Smoke Rated Walls and Floors

1. Sleeves: Same material and thickness as used when firestopping material was 9 tested and as listed in the UL Fire Resistance Directory.
2. Firestopping: Material produced and installed as a system to resist spread of fire 11 and passage of smoke and to maintain fire resistance of assembly. Material in 12 accordance with ASTM E 814 and UL 1479. Johns Manville, Dow Corning, 13 3M Fire Protection Products, Nelson Firestop Products, STI-SpecSeal, US Gypsum, 14 or approved.

C. Below Grade Watertight Penetrations: Manufactured pipe-to-wall penetration closure. Thunderline "Link-Seal" or Advance Products & Systems "InnerLynx."

1. Description: Model C (Standard) modular mechanical type consisting of 29 interlocking synthetic rubber links shaped to continuously fill annular space 30 between pipe and wall opening. Seal constructed to provide electrical isolation 31 between pipe and wall, reducing cathodic reaction. Glass reinforced nylon pressure 32 plates with zinc plated nuts and bolts.
2. Sleeves for New Construction: Heavy wall welded or seamless steel pipe, full 34 circle welded waterstop plate and anchor collar, hot dip galvanized. Length to suit 35 wall thickness. Inside diameter to suit seal requirements
3. Openings for Existing Concrete Wall Construction: Core drill opening, inside 37 diameter to suit seal requirement.

3.00 EXECUTION

3.01 IDENTIFICATION

A. Piping

1. Identify all piping.
2. Thoroughly clean surfaces to receive markings. Remove dirt, dust, grease, rust, and moisture. Apply markers to clean, dry surface.
3. Use arrow marker for piping content legend.
4. Identify piping adjacent to equipment within 3 inches of each valve, at each partition and floor penetration, at each change in direction greater than 45 degrees, and at intervals not exceeding 30 feet.
5. Apply markings in the most legible position. Apply markings for overhead piping on the lower half of the pipe where the view is unobstructed.
6. Field and marking dimensions shall be as follows:

Insulation or Pipe Diameter Inches	Length of Color Field Inches	Size of Letters Inches
3/4 to 1-1/4	8	1/2
1-1/2 to 2	8	3/4

B. Valves

1. Identify all valves indicating service application.
2. Identify valves controlling branch mains or risers indicating service application and valve location number.
3. Identify valves with 1-1/2 inch diameter brass tag. Securely attach tag to valve handle with S-hook or chain.
4. Provide valve tag chart for inclusion in O&M Manual.

END OF SECTION

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SECTION 22 07 00
PLUMBING INSULATION

1.00 GENERAL

1.01 RELATED SECTIONS

A. The General Conditions of the Contract, Supplementary Conditions, and General Requirements are a part of and apply to this section. Consult them for additional conditions and requirements pertaining to this section.

1.02 SECTION INCLUDES

A. Insulation for pipes.

1.03 SUBMITTALS

A. Comply with Section 22 07 00.

B. Product Data

1. Pipe insulation and jacketing.

1.04 REFERENCES

A. All insulation shall be in accordance with ASHRAE Standard 90A.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Minimum of three years of experience installing insulation. Work similar in scope and application requirements.

B. Furnish insulation, supplies, and accessories to site bearing the manufacturer's label.

1.06 DEFINITIONS

A. Concealed: As used in this section refers to insulation in ceiling plenums, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, unexcavated areas, and crawl spaces.

B. Exposed: As used in this section refers to insulation which is not concealed.

2.00 PRODUCTS

2.01 GENERAL

A. All insulation, accessories, and supplies shall have fire hazard classification ratings in accordance with NFPA 220, NFPA 255, ASTM E84, or UL723. Maximum flame spread rating shall be 25 and maximum smoke developed rating shall be 50 for the specific product and thickness used. In addition, the products, when tested, shall not drip flame particles and flame shall not be progressive. Provide Underwriters' Laboratories, Inc. Factory Mutual label or listing or satisfactory certified test reports from an approved

testing laboratory to prove that fire hazard ratings for materials proposed for use do not exceed those specified.

B. Adhesives, sealants, facings, and vapor barriers shall be impervious to moisture.

2.02 ACCEPTABLE MANUFACTURERS

A. Insulation

1. Manville
2. CertainTeed
3. Armstrong
4. Pittsburgh Corning
5. Owens-Corning
6. Knauf
7. Rubatex

2.03 PIPE INSULATIONS

A. Glass Fiber

1. Rigid, molded, noncombustible, conforming to ASTM C547
2. K-Valve: 0.23 at 75ºF
3. Service Temperature Rating: Minimum of 850ºF
4. Vapor Retarder Jacket: Pressure sensitive, self-sealing tape lap system of white Kraft paper reinforced with glass fiber yarn and bonded to aluminum foil (Foil Scrim Kraft)
5. Manville Micro-Lok, APT 2000

B. Elastomeric Foam

1. Flexible, cellular, molded or sheet; conforming to ASTM C534
2. K-Value: 0.27 at 75ºF
3. Service Temperature Rating: Minimum of 220ºF
4. Connection Adhesive: Waterproof, vapor retarding, Armstrong 52D adhesive
5. UV Protective Coating: WB Armaflex finish
6. AP Armaflex pipe or sheet and roll insulation

2.04 FIELD-APPLIED PIPE AND FITTING JACKETING

A. Aluminum

1. 0.016-inch thick sheet with smooth or embossed finish, longitudinal slip joints with 2-inch laps
2. Fitting Covers: Die-shaped with factory attached protective liner

3.00 EXECUTION

3.01 EXAMINATION AND PREPARATION

A. Verify that piping has been tested and approved by the Authorities Having Jurisdiction prior to beginning the installation of insulation.

B. Verify that all surfaces which are to receive insulation are clean, dry and free of foreign materials.

3.02 INSTALLATION

A. Do not insulate cleanouts, access openings or identification plates. Neatly bevel insulation and finishes up to edges of such openings and seal edges as required.

B. Maintain highest level of workmanship. The appearance of the completed work is of equal importance to its technical performance.

C. Install insulation tightly over clean, dry surfaces which are free of foreign materials. Butt all edges firmly together.

D. Install insulation only after piping has been tested and approved by the Authorities Have Jurisdiction, and after all other tests and certifications which are required by the specifications have been satisfactorily completed.

E. Continue insulation vapor barriers through penetrations, except where prohibited by code.

F. Install pipe insulation continuous through wall and floor openings, except where the penetrated surfaces or assemblies are fire-resistance rated. Provide fire-stop insulation at penetrations of fire-rated surfaces and assemblies. Maintain fire-resistance ratings of penetrated surfaces and assemblies.

G. Install insulation on cold surfaces with a continuous, unbroken vapor seal. Insulate and vapor seal supports and anchors which are directly secured to cold surfaces.

H. Finish all exposed raw edges of insulation with finishing cement.

I. Do not use staples on vapor barrier jackets. Where staples must be used, thoroughly seal the vapor barrier penetrations with a white vapor barrier finish. Use of staples must be approved by the Engineer prior to installation.

J. Leave all insulation surfaces dry and clean, and ready for subsequent work.

3.03 INSTALLATION OF PIPING INSULATION

A. Install insulation and covers with seams in the least visible location.

B. Neatly finish insulation at supports, protrusions, and interruptions.

C. Verify that piping wells, taps, sight glasses, and P&Ts are extended so that they will be flush with the surface of the finished insulation.

D. For exposed piping in mechanical equipment rooms and exposed piping within 10 feet of the finished floor in finished spaces, finish with aluminum jacket.

E. For exterior applications, provide weather protection jacket or coating. Cover insulated pipe, fittings, joints, and valves with aluminum jacket. Locate jacket seams on bottom side of horizontal piping. Cover all valves, flanges, unions, accessories, and fittings with aluminum jacket. Seal jacket watertight and secure with lock type aluminum bands.

3.04 INSTALLATION OF INSULATION ON FITTINGS AND VALVES

A. Where factory pre-molded one piece PVC insulated fitting covers are used, the proper factory precut insulation shall be applied to the fitting using two layers for pipe temperatures above 250ºF or below 35ºF, single layer insulation is acceptable between 35ºF and 250ºF. The ends of the insulation shall be tucked snugly into the throat of the fitting and the edges adjacent to the pipe covering, tufted and tucked in, fully insulating the pipe fitting. Covers shall overlap the adjoining pipe insulation and jackets, and on cold pipes shall be sealed at all seam edges with vapor barrier adhesive. Sealed circumferential edges of all covers with pressure sensitive vinyl tape. The tape shall overlap the jacket and the cover at least 1 inch.

B. At locations where PVC covers are prohibited, the Contractor may use as an alternate of one of the following methods: Aluminum covers, one coat insulation cement, pre-molded fiberglass fitting covers, or mitered segments of pipe insulation. Finish for non-PVC or aluminum shall be glass fabric embedded in fire retardant mastic lapped 2 inches over piping insulation. Finish with second coat of mastic. Mastic shall be vinyl acrylic mastic Childers CP-11 or equal for hot piping and shall be Childers CP-30 or Fosters 30-35 for cold piping.

C. Valves may be insulated with sections of fiberglass pipe insulation complete with All Service Jacket. Raw ends shall be coated with vinyl acrylic mastic Childers CP-11 for hot piping or shall be coated with vapor barrier mastic Childers CP-30 or Fosters 30-35 for cold piping.

D. Balancing cocks, strainer drains, hose bibs, and equipment requiring periodic maintenance shall be insulated with segmental insulating with an integral vapor barrier. Insulation and vapor barrier shall be easy to remove and replace.

E. Fittings and valves may be insulated with elastomeric foam insulation and all joints shall be sealed with elastomeric sealant made by same manufacturer as the insulation. Templates for all fittings and valves may be acquired through Armstrong.

3.05 INSTALLATION OF FIRE-STOP INSULATION

A. Pack insulation into openings between fire-rated partitions where pipes penetrate. Compress to density recommended by manufacturer. Maintain fire-resistance ratings at penetrations of fire rated surfaces and assemblies.

B. Caulk with intumescent fire-stop caulk.

END OF SECTION

SECTION 22 11 00
FACILITY WATER DISTRIBUTION

1.00 GENERAL

1.01 RELATED DOCUMENTS

A. The General Conditions of the Contract, Supplementary Conditions, and General Requirements are a part of and apply to this section. Consult them for additional conditions and requirements pertaining to this section.

1.02 SECTION INCLUDES

A. Domestic water distribution system.

1.03 SUBMITTALS

A. Comply with Section 01 33 00.

2.00 PRODUCTS

2.01 PIPE AND FITTINGS

A. Domestic Water Piping

1. Above Grade

a. Type L hard-drawn copper tube with wrought copper fittings and low liquidus/solidus non-lead, non-antimony solder

2. Below Grade

a. Type K soft-drawn copper tube with wrought-copper fittings and silver brazed non-lead, non-antimony solder, flair or compression fittings.

2.02 HANGERS AND SUPPORTS

A. Two inches and smaller: Standard swivel loop hanger

1. Michigan 100 or equal.

B. 2-1/2 inches and larger: Standard clevis hanger

1. Michigan 401 or equal.

C. Thermal Hanger Shields: 360 degree insert of high density, 100 PSI, waterproofed calcium silicate encased in a 360 degree galvanized sheet metal shield with vapor barrier jacket. Calcium silicate shall be color coded indicating non-asbestos bearing composition.

D. Acceptable manufacturers:

1. Hangers and Supports

   a. B-line
   b. Elcen
   c. Fee and Mason
   d. Grinnell
   e. Mason Industries, Inc.
   f. Super Strut, Inc.
   g. Unistrut
   h. Nibco
   i. Powerstrut

2. Thermal Hanger Shields

   a. Pipe Shields, Inc.
   j. Insulshield
   k. Uni-Grip
   l. Value Engineered Products, Inc.
   m. Mechanical Pipe Shield

2.03 VALVES AND PIPING ACCESSORIES

A. Valves in each classification shall be the product of the same manufacturer.

B. Acceptable Manufacturers

1. Crane
2. NIBCO
3. Jenkins
4. Hammond
5. Milwaukee
6. Powell
7. Stockham

3.00 EXECUTION

3.01 DOMESTIC WATER PIPING INSTALLATION

A. Make arrangements with the local water authorities, including the agency that has jurisdictional control over the area within which the construction site is located, for connecting into the water distribution system and installing the water service as indicated on the drawings.

B. Install water service in strict accordance with the rules and regulations of the local water authorities and the agency that has jurisdictional control over the area within which the construction site is located.

C. Provide fixture stops at all fixtures, hose bibbs, and equipment.

D. Provide double-check backflow preventer at connection of cold water make-up line to chilled, heating water, cooling tower water systems, or any other non-potable system.

E. Provide ball valves and unions on all lines to equipment for isolation and removal.

F. Provide pipe hangers of the same material as the piping system or use coated hangers.

G. Provide dielectric unions at connections between dissimilar metals, such as iron valves and copper tubing.

H. Make solder joints between copper tubing and fittings for above grade locations using non-lead, non-antimony solder.

3.02 PIPE TESTING

A. Coordinate requirements for testing with Section 01 45 00.

B. Test all piping systems. Systems shall prove tight prior to concealment. Tests may be witnessed by the Owner's Representative.

C. All hydrostatic tests shall be held for a minimum of 8 hours without loss of pressure. All air tests shall be held for a minimum of one hour without loss of pressure.

D. When job site conditions do not permit the use of water, air may be used in lieu of water when approved by Owner or Engineer.

E. Test Procedures

1. Domestic Water: 150 PSIG hydrostatic test.

3.03 STERILIZATION

A. Prior to placing the potable water system in operation, but after all testing has been completed, the entire potable water system shall be filled with a solution containing not less than 50 PPM of available chlorine and allowed to stand 24 hours before flushing. During this period, a pressure of not less than 40 PSI shall be maintained on the system, and all valves and faucets shall be opened and closed several times to assure chlorine reaches all parts of the system. The residual chlorine content shall not be less than 10 PPM after 24 hours.

B. Following sterilization, thoroughly flush the system until the chlorine residual drops below 3 PPM.

C. Have sample checked by local health department or testing agency. Include report in O&M Manual.

END OF SECTION

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SECTION 22 13 00
FACILITY SANITARY SEWAGE

1.00 GENERAL

1.01 RELATED SECTIONS

A. The General Conditions of the Contract, Supplementary Conditions, and General Requirements are a part of and apply to this section. Consult them for additional conditions and requirements pertaining to this section.

1.02 SUBMITTALS

A. Comply with Section 01 33 00.

2.00 PRODUCTS

2.01 PIPE AND FITTINGS

A. Interior Soil and Waste Piping

1. Above Grade: Galvanized steel pipe with cast iron drainage fittings, or service weight cast-iron soil pipe with No-Hub fittings, or DWV copper pipe and fittings.
2. Below Grade: Service weight, cast iron soil pipe conforming with ASTM A888 or CISPI 301 with either hub-and-spigot fittings with neoprene compression gaskets or No-Hub fittings with HEAVY DUTY stainless steel shield and band hubless coupling conforming to CISPS 310.

B. Vent Piping

1. Above Grade: Galvanized steel pipe with malleable iron fittings, or service weight cast-iron soil pipe with No-Hub fittings, or DWV copper pipe and fittings.
2. Below Grade: Cast iron soil pipe with hub-and-spigot fittings with neoprene compression gaskets.

2.02 FLOOR DRAINS

A. Scheduled on drawings.

B. Acceptable Manufacturers

1. Josam
2. Smith
3. Zurn
4. Wade
5. Jonespec

2.03 CLEANOUTS

A. Standard: Fabricate in accordance with ASME A 112.36.2M.

B. Floor Cleanouts (FCO) in Finished Spaces: Coated cast iron body and frame, round adjustable secured nickel bronze top, taper thread, bronze plug. Include carpet clamping frame where installed in floors with carpet. Verify floor finish with room finish schedule on the Construction Administration Managerural drawings. Jay R. Smith Figure 4023S.

C. Floor Cleanouts (FCO) in Finished Spaces: Coated cast iron body and frame, square adjustable secured ni ckel bronze top, with 1/8-inch tile recess, taper thread bronze plug. Verify floor finish with room finish schedule indicated on the Construction Administration Managerural drawings. Jay R. Smith Figure 4163S.

D. Floor Cleanouts (FCO) in Unfinished Spaces: Coated cast iron body and frame, round adjustable scoriated cast iron top with non-tilt heavy duty cover, taper thread, bronze plug. Jay R. Smith Figures 4243S or 4253S.

E. Wall Cleanouts (WCO): Cast bronze plug with taper thread, round stainless steel cover and vandal-proof screw. Leanth of screw to suit installation requirements. Jay R. Smith Figure 4472T.

2.04 AIR ADMITTANCE VALVES

A. Standard: Fabricate in accordance with ASSE 1050 for vent stacks and ASSE 1051 Type A for single fixtures and Type B for branch piping.

B. Material: ABS with inside and outside screens, polystyrene protective cover, and ABS or PVC adaptor.

C. Manufacturers: Studor, Oatey or approved.l Locate as indicated on drawings or directed during construction.

3.00 EXECUTION

3.01 SANITARY SEWER INSTALLATION

A. Make arrangements with the local waste water authorities, including the agency that has jurisdictional control over the area within which the construction site is located, for connecting into the sanitary sewage collection system and installing the building sewer as indicated on the drawings.

B. Install building sewer in strict accordance with the rules and regulations of the local waste water authorities and the agency that has jurisdictional control over the area within which the construction site is located.

C. Lay piping true to line and grade so that sewer will have smooth and uniform invert throughout its length. Grade piping by measuring with rod from overhead grade line set horizontal and held taut between grade bars to prevent sagging. Verify elevations of existing sewer before starting work. Grade piping inside of building with a uniform grade of not less than 1/8-inch per foot for all horizontal piping.

D. Coordinate the elevation of the waste line with the invert indicated on the civil or Construction Administration Managerural drawings. Maintain a depth below the frost

line outside of the building footprint. Coordinate method of connecting line into sanitary sewer line.

E. Collect all soil and waste piping; make connections to all fixtures, floor drains and equipment requiring waste service; and extend piping as indicated on the drawings. Trap each fixture separately with an approved trap placed as near the fixture as possible, except fixtures which are indicated to have indirect connections.

F. For service weight (SV) cast iron pipe "No Hub System" use hubless cast iron soil pipe couplings certified to withstand a minimum of 13 PSIG internal pressure.

G. Make solder joints between copper tubing and fittings for soil, waste, and vent piping in above grade locations using 95 percent tin and 5 percent antimony solder.

3.02 VENT PIPING INSTALLATION

A. All vents through roof shall be 3-inch minimum.

B. Install vent caps on all vents through roof.

3.03 PIPE TESTING

A. Coordinate requirements for testing with Section 01 45 00.

B. Test Procedures

1. Drainage systems, including sanitary sewers, storm sewers, and sanitary vents:

a. Hydrostatic Test: All low points of such systems shall be plugged and filled with water to uppermost outlet or a minimum of 10 feet static pressure shall be applied to each joint. System shall stand full of water for 8 hours with no indication of leaks.
b. Air Test: Plug all openings and pressurize the piping to a minimum of 5 PSIG. System shall hold pressure for a minimum of 1 hour.

END OF SECTION

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SECTION 23 05 00
COMMON WORK RESULTS FOR HVAC

1.00 GENERAL

1.01 RELATED SECTIONS

A. The General Conditions of the Contract, Supplementary Conditions, and General Requirements are a part of and apply to this section. Consult them for additional conditions and requirements pertaining to this section.

1.02 SUMMARY

A. Section includes General Provisions applicable to Division 23 - HVAC.

1. Provide all labor, equipment, and material necessary to complete the work as specified and as shown on the drawings.
2. Provide supervision, coordination, tools, and accessories and appurtenances necessary or required to perform and accomplish the work.

1.03 SUBMITTALS

A. Comply with Division 10 33 00.

B. In addition to the requirements of Division 1, the following provisions apply:

1. Submit one (1) copy of submittal data in PDF format for mechanical material and equipment to the Engineer for review prior to ordering or fabrication of the material or equipment.
2. Submit data for items as indicated in each section.
3. Submittals will be reviewed by the Engineer only for the purpose of determining that the materials, equipment, and installation methods are in accordance with the project design concepts. The Contractor shall be responsible for space requirements, configurations, performance, bases, supports, structural members and openings in structure, and other apparatus that may be affected by the material, equipment, or installation.
4. Note any deviations from specified requirements.
5. Organize submittals to include, as a minimum, the following: Cover sheet indicating general contents by applicable specification section number and item name.
6. The data for each item submitted shall be thoroughly edited for the specific equipment and intended application and operation.
7. Include current published catalog and specification sheets pertaining to proposed material and equipment.
8. Identify each item with identification code identical to those used on the drawings and in the specifications.
9. Include electrical characteristics, wiring and control diagrams.
10. Drawings and specifications govern the work. Submittals shall not be construed as authorizing or requesting changes to the work. Where submittals indicate work that is at variance with the requirements of the drawings or specifications, the Contractor shall advise the Engineer of the discrepancy. Work that is at variance

with the requirements of the drawings and specifications shall be replaced by the Contractor at no cost to the Owner.

11. Include manufacturer's start-up forms.
12. Although some errors may be overlooked in the review, this does not grant the Contractor leave to proceed in error and, that regardless of any information contained in the shop drawings, the requirements of the drawings and specifications must be followed and are not waived or superseded in any way by the shop drawing review.

1.04 QUALITY ASSURANCE

A. Chemical and physical properties, design, and performance characteristics of all material and equipment, and methods of construction shall be in accordance with the following applicable codes, regulations and standards. Current editions in effect 30 days prior to receipt of bids will apply.

1. Air Conditioning and Refrigeration Institute (ARI)
2. Air Movement and Control Association, Inc. (AMCA)
3. American National Standards Institute (ANSI)
4. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE)
5. American Society of Mechanical Engineers (ASME)
6. American Society for Testing and Materials (ASTM)
7. American Standard Code for Pressure Piping (ASCPP)
8. American Water Works Association (AWWA)
9. Environmental Protection Agency (EPA)
10. Factory Insurance Association (FIA)
11. Factory Mutual Laboratories (FM)
12. Manufacturer's Standards Institute (MSI)
13. National Certified Pipe Welding Bureau (NCPWB)
14. National Electrical Code (NEC)
15. National Electrical Manufacturer's Association (NEMA)
16. National Fire Protection Association (NFPA)
17. Sheet Metal and Air Conditioning Contractor's National Association (SMACNA)
18. Texas State Energy Code, including City of San Antonio Amendments
19. Texas Ventilation and Indoor Air Quality Code
20. Underwriters' Laboratories, Inc. (UL)
21. International Building Code (IBC), including City of San Antonio Amendments
22. International Mechanical Code (IMC), including City of San Antonio Amendments

B. Comply with applicable local, state, and federal codes, rules, and regulations. As a minimum requirement, codes, rules and regulations take precedence over the drawings and specifications. Where the requirements of the drawings and specifications exceed those of applicable codes, rules and regulations, the drawings and specifications shall govern.

1.05 PRODUCTS

A. Material and equipment shall be new and free from defects.

B. Install all material and equipment in accordance with the manufacturer's current published recommendations.

C. Certain materials and equipment are specified by manufacturer and model or catalog number. Such specified items are the basis of design and establish a degree of quality, performance, and physical configuration. The Contractor shall be responsible for the quality, performance, and physical configuration of the work should he use products of a listed acceptable manufacturer in lieu of the specific product upon which the design is based.

1.06 SUBSTITUTIONS

A. Equipment and materials manufactured by any one of the manufacturers listed on the drawings or in the specifications will be acceptable.

B. Where no manufacturer is listed, provide a standard product meeting the requirements of the drawings and specifications, and manufactured by a firm regularly engaged in the manufacture of such products.

C. If the Contractor wishes to furnish or use a substitute item of material and/or equipment, he must submit a change order request to the Engineer within 15 working days of notice-to-proceed. The request for change order shall itemize each of the proposed substitutions identified by applicable specification section, paragraph number, and/or drawing number. A price change (increase or decrease) shall be listed for each item along with complete data showing performance over entire range of operation, physical dimensions, electrical characteristics, material construction, operating weight, and other applicable data. The Engineer will review the change order request for equality, suitability and reasonableness of price differential. A single substitution change order listing the approved items will be issued with the net cost of the change order being the sum of the approved item costs. No subsequent substitution change orders will be considered. The Engineer's decision will be final.

D. It shall be the responsibility of the Contractor to assure that the substitute material and/or equipment fits into the space provided and the Contractor shall pay for all extra costs incurred by other trades for any and all changes necessitated by these substitutions. The Contractor shall also pay any costs incurred by the Engineer for incorporating a substituted item into the Design Drawings.

1.07 DELIVERY AND STORAGE OF EQUIPMENT AND MATERIAL

A. Make provisions for delivery and safe storage of equipment and materials.

B. Make arrangements for the introduction into the building of equipment too large to pass through finished openings and spaces.

1.08 PROTECTION

A. Protect all equipment, material, and completed work from damage. Repair or replace damaged items as necessary to establish conformance with requirements of the drawings and specifications.

B. Protect equipment, material, and completed work until acceptance by Owner.

C. Close open ends of work, and stored equipment and materials with temporary covers or plugs to prevent entry of foreign objects, dirt, water, or debris.

1.09 GUARANTEE

A. Guarantee all equipment, materials, workmanship, and proper operation of equipment and apparatus for a period of one year from date of final acceptance by the Owner or Final certificate of occupancy issued by the City.

B. Repair or replace, at no cost to the Owner, work which is judged defective by the Engineer or Owner during the guarantee period.

1.10 DEFINITIONS

A. Provide: Furnish and install complete and ready for use.

B. Contractor: Any contractor performing work under Division 23 of the specifications.

C. Mechanical: Applies to all work specified in Division 23 of the specifications contractor.

1.11 DRAWINGS AND SPECIFICATIONS

A. Mechanical drawings are diagrammatic or pictorial in character and do not indicate every required offset, valve, fitting, accessory, or appurtenance.

B. Review and consider all drawings and specifications relating to this project in preparation of bid.

C. Drawings and specifications are complementary. Whatever is required by either the drawings or specifications shall be provided.

D. Refer discrepancies between and within the drawings and specifications to the Engineer for resolution.

E. Do not scale drawings.

1.12 SAFETY AND HEALTH REQUIREMENTS

A. Comply with applicable provisions of the "Williams-Steiger Occupational Safety and Health Act of 1970, Public Law 91-596" and applicable amendments; and current State of Texas Labor and Industries Regulations.

1.13 PROOF OF PERFORMANCE

A. After test runs have been completed, the Contractor shall submit, in writing, to the Construction Administration Manager that all systems have been demonstrated to be satisfactory and in compliance with requirements of the drawings and specifications. This report shall include verification of the installation from the manufacturer's representative. Report shall include any installation errors or other faults that would affect the performance of the equipment or system.

1.14 SUPERVISION

A. All work shall be under the direct supervision of an experienced superintendent.

1.15 WORKMANSHIP

A. Workmanship shall conform to the highest industry standard for each specific type of work.

B. Perform work in accordance with standard commercial practices.

1.16 OWNER ACCEPTANCE

A. At the time of acceptance of the work by the Owner, all mechanical equipment and systems shall be in accordance with requirements of the drawings and specifications to the satisfaction of the Engineer and Owner.

1.17 EXAMINATION OF SITE

A. The Contractor shall visit the project site and ascertain existing conditions prior to submitting bid. Include in the bid all considerations necessary to accomplish the work under the existing conditions.

B. Additional charges will not be authorized due to the Contractor's failure to become familiar with the existing conditions.

1.18 PERMITS AND INSPECTIONS

A. Secure and pay for all required permits and licenses.

B. Pay all applicable royalties, inspection fees, and taxes.

C. File necessary plans, prepare necessary documents, and obtain necessary approvals from the Authorities Having Jurisdiction.

D. Upon completion of the work, furnish to the Owner and Engineer a certificate of inspection and final approval from each authority having jurisdiction for inspection and approval of the work.

1.19 RESPONSIBILITY OF CONTRACTOR

A. The Contractor is responsible for the complete installation and satisfactory operation of all work in accordance with requirements of the drawings and specifications.

B. Include in bid all incidentals, accessories and appurtenant items required or necessary, even though not specified or indicated, to provide complete operating systems.

C. The component parts of the installation shall function together as workable systems. Each system shall be left with all parts adjusted and in proper working order.

1.20 OPERATING INSTRUCTIONS

A. Upon completion of the work and prior to final acceptance, equipment and system suppliers shall instruct the Owner on the operation and maintenance of all equipment and systems.

B. Use the Operation and Maintenance Manual as a guide for the instruction.

C. Provide a total of 8 hours for the HVAC systems and controls instrumentation and controls instruction. Advise the Owner of the time scheduled for the instruction period at least 2 weeks in advance.

D. Use the instruction period to demonstrate the proper operation of all equipment and systems.

1.21 OPERATION AND MAINTENANCE MANUAL

A. Furnish an Operation and Maintenance Manual (O&M Manual) covering all equipment and systems installed under Division 23 of the specifications.

B. Submit one copy of the manual to the Engineer for preliminary review prior to production of the final manuals.

C. Following review of the preliminary manual by the Engineer:

1. Prepare final copies of the manual complying with the Engineer's comments noted on the preliminary manual.
2. Submit three copies of the final manual to the Construction Administration Manager for distribution to the Owner.

D. Bind information into 8-1/2” x 11”, three-ring or post binders having hard plastic covers.

1. Provide typed indexes to identify each item of equipment and each system.
2. Provide table of contents for each binder.

E. Provide three copies of the final O&M Manual on CD in PDF format, with tabs for each piece of individual equipment.

F. Include at least the following information:

1. Contractors' names, addresses, and telephone numbers.
2. Alphabetical list of all system components with the name, address, and 24-hour phone number of the company responsible for servicing each item during the first year of operation.
3. Guarantees and warranties of all equipment.
4. Manufacturer's data that are applicable to the installed equipment such as the following:

   a. Shop drawings
   b. Product data
   c. Installation instructions
   d. Lubrication instructions
   e. Wiring diagrams

f. Parts list

5. Emergency procedures for equipment operation during a fire or following the failure of major equipment. Procedures for normal starting/operating/shutdown and long-term shutdown.
6. Maintenance instruction including valves, valve tag, and other identified equipment lists, proper lubricants and lubricating instruction for each piece of equipment, and necessary cleaning, replacing, and adjusting schedules.
7. Assembly, installation, alignment and adjustment instructions.
8. Temperature control diagrams, including an explanation of the control sequence of each system along with the following instruction wherever applicable:

   a. Emergency procedures for fire or failure of major equipment
   g. Normal starting, operating, and shutdown
   h. Summer or winter shutdown
   i. Interconnection with building and energy management systems

9. System balancing report.
10. Valve tag list.
11. Equipment start-up documentation.
12. An outline of a preventative maintenance program for each system, which shall include a schedule of inspection and maintenance. It shall indicate the maintenance and inspection that should be performed by the Owner and that which should be done with outside service.
13. Guide to troubleshooting.
14. Piping system test certifications.
15. Proof of performance certifications.
16. Health department certification of compliance for domestic water.
17. Signed off permits.
18. Final air and hydronic balancing report.

1.22 RECORD DRAWINGS

A. Maintain a complete full-size set of prints of the project drawings and indicate in red ink all change to the original information.

B. Include changes such as locations of equipment, system layout, and piping and duct sizes. Also include existing systems/utilities/equipment interface locations.

C. Submit drawings with final operation and maintenance manuals.

1.23 COORDINATION

A. Examine each drawing and specification section. Report, in writing, to the Engineer all discrepancies within and between the documents. Additional cost made necessary by the Contractor's neglect or failure to report discrepancies shall be borne by the Contractor.

B. Coordinate the work of each Division 23 section with each other specification section. Schedule work to ensure that the various parts fit together in an orderly sequence.

C. Cooperate with each other trade and assist in working out space allocations and minor construction details.

1. When necessary to ensure efficient use of space and orderly construction sequences, prepare composite coordination drawings. Prepare drawings at a scale of 1/4-inch equals 1 foot 0 inches or larger. Submit drawings to Engineer for review.
2. If Contractor installs work before coordinating with other trades and the work interferes with the work of other trades, the Contractor shall make necessary changes in his work to correct the condition. Additional charges will not be authorized because of the Contractor's failure to coordinate the work.

1.24 SCAFFOLDING, RIGGING, AND HOISTING

A. Provide all scaffolding, rigging, and hoisting necessary to accomplish the work.

1. Remove from premises when no longer needed.

B. Provide necessary services to deliver, erect, place, and install all equipment and apparatus furnished.

1.25 INDOOR AIR QUALITY MANAGEMENT

A. The Contractor shall apply their greatest skill and attention to anticipate and prevent conditions that could compromise indoor air quality due to construction means, methods, process, and materials.

1. Protect the ventilation system components during construction and clean contaminated components during and after construction.

B. For the construction and preoccupancy phases of the project, include provisions for the following as a minimum:

1. Meet or exceed the minimum requirements of the SMACNA IAQ Guidelines for Occupied Buildings under Construction 2007, Chapter 3.
2. Protect stored and installed absorptive materials from exposure to moisture and, where practical, provide a conditioning period in controlled environment to reduce moisture content of materials where protection failed or was otherwise ineffective.

1.26 DAMAGED SURFACES

A. At completion of the work, all new material and equipment furnished, and existing spaces affected by new work shall be inspected for damage.

1. Repair damaged finishes to match adjacent, undamaged areas.
2. Replace deformed metal cabinets, jackets, ceiling tiles, and enclosures with new items. Finish shall match similar undamaged items.

1.27 CLEAN-UP

A. At completion of the work, check and thoroughly clean all equipment.

B. Clean coils.

C. Clean under, in, and around equipment.

D. Clean exposed surfaces of piping, ducts, and hangers.

E. Clean equipment cabinets and enclosures

1.28 IDENTIFICATON

A. Pressure sensitive markers:

1. Flexible plastic identification markers and tape. Legend, sizes, and color in accordance with ANSI A13.1.

a. Brady 350 or equal

B. Semi-rigid plastic identification pipe markers:

1. Legend, size, and color in accordance with ANSI A13.1. Direction-of-flow arrows included on each marker.

a. 3/4 inch through five inches: Setmark type SNA or equal
b. 6 inches and larger: Setmark type STR or equal

C. Nameplates: Three-layer laminated plastic with engraved black letters on light-color contrasting background with the equipment tag number, equipment description, and the area served.

D. Valve Tags: Clear plastic pockets, with colored paper printed with area served, attached to the valve with a brass chain.

2.00 PRODUCTS

2.01 SLEEVES

A. Materials, General: Schedule 40 galvanized steel pipe with unthreaded ends, cast iron pipe, 4 or minimum 26 gage galvanized sheet steel. Use steel pipe for sleeves at floor slabs. 5 6

B. Sleeves and Firestopping in Fire and Smoke Rated Walls and Floors

1. Sleeves: Same material and thickness as used when firestopping material was 9 tested and as listed in the UL Fire Resistance Directory.
2. Firestopping: Material produced and installed as a system to resist spread of fire 11 and passage of smoke and to maintain fire resistance of assembly. Material in 12 accordance with ASTM E 814 and UL 1479. Johns Manville, Dow Corning, 13 3M Fire Protection Products, Nelson Firestop Products, STI-SpecSeal, US Gypsum, 14 or approved.

C. Below Grade Watertight Penetrations: Manufactured pipe-to-wall penetration closure. Thunderline "Link-Seal" or Advance Products & Systems "InnerLynx."

1. Description: Model C (Standard) modular mechanical type consisting of 29 interlocking synthetic rubber links shaped to continuously fill annular space 30 between pipe and wall opening. Seal constructed to provide electrical isolation 31 between pipe and wall, reducing cathodic reaction. Glass reinforced nylon pressure 32 plates with zinc plated nuts and bolts.
2. Sleeves for New Construction: Heavy wall welded or seamless steel pipe, full 34 circle welded waterstop plate and anchor collar, hot dip galvanized. Length to suit 35 wall thickness. Inside diameter to suit seal requirements
3. Openings for Existing Concrete Wall Construction: Core drill opening, inside 37 diameter to suit seal requirement.

3.00 EXECUTION

3.01 IDENTIFICATION

A. Piping

1. Identify all piping.
2. Thoroughly clean surfaces to receive markings. Remove dirt, dust, grease, rust, and moisture. Apply markers to clean, dry surface.
3. Use arrow marker for piping content legend.
4. Identify piping adjacent to equipment within 3 inches of each valve, at each partition and floor penetration, at each change in direction greater than 45 degrees, and at intervals not exceeding 30 feet.
5. Apply markings in the most legible position. Apply markings for overhead piping on the lower half of the pipe where the view is unobstructed.
6. Field and marking dimensions shall be as follows:

Insulation or Pipe Diameter Inches	Length of Color Field Inches	Size of Letters Inches
3/4 to 1-1/4	8	1/2
1-1/2 to 2	8	3/4

B. Ductwork

1. Identify all ductwork indicating the service application, areas served, and direction of flow.
2. Letters and arrows shall be at least 2 inches high. Arrows shall be at least 6 inches long. Identify ducts at each partition penetration and at intervals not exceeding 25 feet.

C. Valves

1. Identify all valves indicating service application.
2. Identify valves controlling branch mains or risers indicating service application and valve location number.

3. Identify valves with 1-1/2 inch diameter brass tag. Securely attach tag to valve handle with S-hook or chain.
4. Provide valve tag chart for inclusion in O&M Manual.

D. Equipment

1. Identify all equipment with engraved plastic nameplates indicating the equipment title, service and Owner's numbering system when applicable. Equipment titles shall be same as indicated on the drawings.

E. Controls and Electrical Equipment

1. Identify controls, electrical equipment, and instruments with engraved plastic nameplates. Lettering shall be at least 1/4-inch high.
2. Secure nameplates with brass or stainless steel pan-head screws. Adhesive backed nameplates or pressure sensitive embossed labels are not acceptable.

END OF SECTION

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SECTION 23 07 00
HVAC INSULATION

1.00 GENERAL

1.01 RELATED SECTIONS

A. The General Conditions of the Contract, Supplementary Conditions, and General Requirements are a part of and apply to this section. Consult them for additional conditions and requirements pertaining to this section.

1.02 SECTION INCLUDES

A. Insulation for ducts.

1.03 REFERENCES

A. All insulation shall be in accordance with ASHRAE Standard 90A.

1.04 QUALITY ASSURANCE

A. Installer qualifications; minimum of three years of experience installing insulation. Work similar in scope and application requirements.

2.00 PRODUCTS

2.01 GENERAL

A. All insulation, accessories, and supplies shall have fire hazard classification ratings in accordance with NFPA 220, NFPA 255, ASTM E84, or UL723. Maximum flame spread rating shall be 25 and maximum smoke developed rating shall be 50 for the specific product and thickness used. In addition, the products, when tested, shall not drip flame particles and flame shall not be progressive. Provide Underwriters' Laboratories, Inc. Factory Mutual label or listing or satisfactory certified test reports from an approved testing laboratory to prove that fire hazard ratings for materials proposed for use do not exceed those specified.

B. Adhesives, sealants, facings, and vapor barriers shall be impervious to moisture.

2.02 ACCEPTABLE MANUFACTURERS

A. Insulation

1. Manville
2. CertainTeed
3. Armstrong
4. Pittsburgh Corning
5. Owens-Corning
6. Knauf

2.03 DUCT INSULATION

A. Flexible Fiberglass Blanket

1. ASTM C553 type 1, class B-2
2. K-Value: 0.27 at 75ºF
3. Density: 0.75 pounds per cubic foot
4. Vapor Barrier Jacket: Aluminum foil reinforced with fiber-glass yarn and laminated to fire-resistant Kraft (Foil Scrim Kraft)
5. Manville Microlite Type 75

3.00 EXECUTION

3.01 EXAMINATION AND PREPARATION

A. Verify that ducts have been tested and approved by the authorities having jurisdiction prior to beginning the installation of insulation.

B. Verify that all surfaces which are to receive insulation are clean, dry and free of foreign materials.

3.02 INSTALLATION

A. Do not insulate access openings or identification plates. Neatly bevel insulation and finishes up to edges of such openings and seal edges as required.

B. Maintain highest level of workmanship. The appearance of the completed work is of equal importance to its technical performance.

C. Install insulation tightly over clean, dry surfaces which are free of foreign materials. Butt all edges firmly together.

D. Install insulation only ducts have been tested and approved by the authorities have jurisdiction, and after all other tests and certifications which are required by the specifications have been satisfactorily completed.

E. Continue insulation vapor barriers through penetrations, except where prohibited by code.

F. Install duct insulation continuous through wall and floor openings, except where the penetrated surfaces or assemblies are fire-resistance rated. Provide fire-stop insulation at penetrations of fire-rated surfaces and assemblies. Maintain fire-resistance ratings of penetrated surfaces and assemblies.

G. Install insulation on cold surfaces with a continuous, unbroken vapor seal. Insulate and vapor seal supports and anchors which are directly secured to cold surfaces.

H. Finish all exposed raw edges of insulation with finishing cement.

I. Do not use staples on vapor barrier jackets. Where staples must be used, thoroughly seal the vapor barrier penetrations with a white vapor-barrier finish. Do not weld insulation support pins to pressure vessels.

J. Leave all insulation surfaces dry and clean, and ready for subsequent work.

3.03 INSTALLATION OF BLANKET INSULATION

A. Apply insulation with edges tightly butted. Overlap facing at least 2 inches at joints. Seal joint in vapor seal with fire retardant adhesive. Secure insulation to duct with approximately 4-inch wide fire-retardant adhesive spaced at 8 inches on center

B. For ducts which exceed 30 inches in width, provide mechanical fasteners at 18 inches on center for the underside insulation in addition to the adhesive. Cut off the protruding ends of the fasteners flush after speed clips are installed and seal with vapor tape or mastic.

C. For insulated ducts which convey air of a temperature which is less than the ambient temperature, provide vapor retardant jacket. Seal jacket seams and penetrations with UL-listed tape or vapor retardant adhesive.

D. For insulated ducts which convey air of a temperature which is greater than the ambient temperature, bevel and seal ends of insulation where service access is required.

E. For ducts subject to physical abuse in mechanical equipment rooms and finished spaces, finish with aluminum jacket.

END OF SECTION

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SECTION 23 08 00
COMMISSIONING OF HVAC

1.00 GENERAL

1.01 SUMMARY

A. A.The purpose of this section is to specify the Division 23 responsibilities and participation in the commissioning process.

1. Organization of the commissioning program is primarily the responsibility of the Commissioning Authority. Execution of the program is primarily the responsibility of the Contractor with support from the Division 23 contractor for:

   a. Testing and start-up of the mechanical equipment.
   b. Completion and endorsement of prefunctional test checklists provided by the Commissioning Authority to assure that Division 23 equipment and systems are fully operational and ready for functional testing.
   c. Providing qualified personnel to assist the Commissioning Authority with functional testing to verify equipment/system performance.
   d. Providing equipment, materials, and labor necessary to correct deficiencies found during the commissioning process which fulfill contract and warranty requirements.
   e. Providing training for the systems specified in Division 23 with coordination of Owner by the Commissioning Authority.

B. Division 23 Contractor shall cooperate with the Commissioning Authority in the following manner:

1. Allow sufficient time before final completion dates so that test and balance, controls point-to-point checkout, and functional testing can be accomplished.
2. Provide labor and material to make corrections when required without undue delay.
3. Put all air conditioning systems and equipment into full operation, and continue the operation of the same during each working day of commissioning.

C. Related Sections

1. Division 22 - Plumbing
2. Division 26 - Electrical

2.00 PRODUCTS

2.01 TEST EQUIPMENT

A. Standard certified test equipment for commissioning will be provided by the Commissioning Authority.

B. Proprietary test equipment required by the manufacturer shall be provided by the manufacturer of the equipment. Manufacturer shall provide the test equipment,

demonstrate its use, and assist the Commissioning Authority in the commissioning process.

3.00 EXECUTION

3.01 WORK PRIOR TO COMMISSIONING

A. Specific precommissioning responsibilities of Division 23 are as follows:

1. Normal start-up services required to bring each system into a fully operational state. This includes motor rotational check, cleaning, filling, purging, control sequences of operation, leak testing, full-load and part-load performance, etc.
2. Normal testing, adjusting and balancing services required to verify each system is operating at design capacities.
3. Execute functional tests and complete prefunctional test checklists for the following equipment and systems:

   a. Air conditioning units
   b. Automated control systems
   c. Emergency power systems

B. Factory start-up services for key equipment and systems specified in Division 23. The Division 23 Contractor shall coordinate this work with the manufacturer and the Commissioning Authority.

3.02 PARTICIPATION IN COMMISSIONING

A. The Division 23 and 26 Contractors shall provide skilled technicians to start-up and debug all systems within the Division 23 work (particularly with controls equipment). These same technicians shall be made available to assist the Commissioning Authority in completing the commissioning program as it relates to each system and their technical specialty. Work schedules, time required for testing, etc., will be requested by the Commissioning Authority and coordinated by the Contractor. Contractor will ensure the qualified technician(s) are available and present during the agreed upon schedules, and of sufficient duration to complete the necessary tests, adjustments and/or problem resolutions.

B. The Commissioning Authority reserves the right to judge the appropriateness and qualifications of the technicians relative to each item of equipment, system, and/or sub-system. Qualifications of technicians include expert knowledge relative to the specific equipment involved, adequate documentation and tools to service/commission the equipment, and an attitude/willingness to work with the Commissioning Authority to get the job done. A liaison or intermediary between the Commissioning Authority and qualified factory representatives does not constitute the availability of a qualified technician for purposes of this work.

3.03 WORK TO RESOLVE DEFICIENCIES

A. Maladjustments, misapplied equipment, and/or deficient performance under varying loads will result in a system that does not meet Acceptable Performance. Correction of work will be completed under the direction of the Construction Administration Manager,

with input from the Contractor, Equipment Supplier, and Commissioning Authority. Whereas all members will have input and the opportunity to discuss, debate, and work out problems, the Construction Administration Manager-of-Record will have final jurisdiction on the necessary work to be done to achieve performance and/or design intent.

3.04 SEASONAL COMMISSIONING AND OCCUPANCY VARIATIONS

A. Seasonal commissioning pertains to testing under full-load conditions during peak heating and peak cooling seasons, as well as part-load conditions in the spring and fall. Initial commissioning will be done as soon as contract work is completed regardless of season. All equipment and systems will be tested and commissioned in a peak season to observe full-load performance. Cooling equipment will be tested during summer design extremes with a fully occupied building. The Contractor will be responsible to participate in the initial and the alternate peak season test of the systems required demonstrating performance.

3.05 TRAINING

A. The Division 23 Contractor will be required to participate in the training of the Owner's engineering and maintenance staff for each mechanical system and the related components. Training may be conducted in a classroom setting, with system and component documentation, and suitable classroom training aids, or in the field with the specific equipment. The type of training will be per the Owner's option.

END OF SECTION

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SECTION 23 09 00
INSTRUMENTATION AND CONTROL FOR HVAC

1.00 GENERAL

1.01 WORK INCLUDED

A. General - Building Management System (BMS) Contractor shall provide and install:

1. A fully integrated Building Automation System (BAS) incorporating direct digital control (DDC) for energy management, equipment monitoring from the existing site BAS System.
2. All wiring, conduit, panels, and accessories for a complete operational system.
3. BMS Contractor shall be responsible for all electrical work associated with the BMS.

    a. Perform all wiring in accordance with all local and national codes.
    b. Electrical contractor to provide 120 VAC. Owner to provide Ethernet Drop at panel location.

1.02 APPROVED CONTROL SYSTEM CONTRACTORS AND MANAGERS

A. The following are the approved Control System Contractors and Manufacturers:

1. Siemens Building Technologies

1.03 SYSTEM PERFORMANCE

A. Performance Standards: System shall conform to the following minimum standards over network connections. Systems shall be tested using manufacturer's recommended hardware and software for operator workstation (server and browser for web-based systems).

1.04 WARRANTY

A. Warrant labor and materials for specified control system free from defects for a period of 12 months after final acceptance. Failures on control systems that include all computer equipment, transmission equipment and all sensors and control devices 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.

B. 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.

C. If the Owner’s Representative determines that equipment and systems operate satisfactorily at the end of final start-up, testing, and commissioning phase, the Owner’s Representative 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.

D. Provide updates to existing operator workstation software, project-specific software, graphic software, database software, and firmware that resolve 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 the above-mentioned items. Do not install updates or upgrades without Owner's written authorization.

E. Exception

1. 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.

1.05 OWNERSHIP OF PROPRIETARY MATERIAL

A. Project specific software and documentation shall become Owner's property. This includes, but not limited to:

1. Graphics
2. Record drawings
3. Database
4. Application programming code

B. Documentation

1. General

a. Submit four (4) copies of owner's manuals upon completion of project.
b. Submit two (2) electronic copies of complete as-built documentation on CD ROM. All drawings shall be in standard AutoCAD 2012 format and other documentation shall be in standard MS Office format.
c. Update manuals with modifications made to system during guarantee period. Provide replacement pages or supplements in quantity stated above for "as built" manuals.
d. Assemble owner's manuals into multi-volume sets as necessary and required by the Owner.
e. Protect each volume with a heavy duty binder. Volumes to have plastic printed dividers between major sections and have oversized binders to accommodate up to ½-inch thick set of additional information.
f. Each binder to be printed with project name and volume title on front cover and binder.
g. On the first page of each manual identify with project name, manual title, owner's name, engineer's name, contractor's name, address and service phone number, and person who prepared manual.

2.00 PRODUCTS

2.01 PRODUCTS

A. All products used in this project installation shall be new and currently manufactured and shall have been applied in similar installations. Do not use this installation as a product test site unless explicitly approved in writing by Owner or Owner's Representative. Spare parts shall be available for at least five years after completion of this contract.

2.02 COMMUNICATION

A. System shall communicate via Lonworks™.

2.03 BUILDING CONTROLLER SOFTWARE

A. General

1. Furnish the following applications software to form a complete operating system for building and energy management as described in this specification.
2. All points, panels and programs shall be identified by a 30 character name. All points shall also be identified by a 16 character point descriptor. The same names shall be displayed at both Building Controller and the Operator Interface.
3. All digital points shall have a user defined two-state status indication with 8 characters minimum (e.g., Summer, Enabled, Disabled, Abnormal).
4. Each controller shall be provided with an interactive HELP function to assist operators using POTs and remote connected operators.

B. Temperature Sensors

1. Provide the following instrumentation as required by the monitoring, control and optimization functions. All temperature sensor shall use platinum RTD elements only, nickel or silicon are not acceptable. All control signals shall be via a 4-20 mA loop.

C. Local Control Panels

1. All indoor control cabinets shall be fully enclosed NEMA 1 construction with (hinged door) key-lock latch and removable sub panels. A single key shall be common to all field panels and sub panels.
2. Interconnections between internal and face mounted devices shall be prewired with color-coded stranded conductors neatly installed in plastic troughs and/or tie-wrapped. Terminals for field connections shall be UL-listed for 600 volt service, individually identified per control/ interlock drawings, with adequate clearance for field wiring. Control terminations for field connection shall be individually identified per control drawings.
3. Provide ON/OFF power switch with overcurrent protection for control power sources to each local panel.

2.04 COMMUNICATION AND CONTROL WIRING

A. General

1. Provide copper wiring, plenum cable, and raceways as specified in the applicable sections of Division 26 unless otherwise noted herein.

2. All insulated wire to be copper conductors, UL-labeled for 90°C minimum service.

B. Wire Sizing and Insulation

1. Wiring shall comply with minimum wire size and insulation based on services listed below:

Service	Minimum Gage/Type	Insulation Class
AC 24V Power	12 Ga Solid	600 Volt
DC 24V Power	10 Ga Solid	600 Volt
Class 1	14 Ga Stranded	600 Volt
Class 2	18 Ga Stranded	300 Volt

2. Provide plenum-rated cable when open cable is permitted in supply or return air plenum where allowed per execution specifications defined in Paragraph 3.07.

C. Control Wiring

1. Digital input/output wiring shall use Class 2 twisted pair, insulated.
2. Analog inputs shall use Class 2 twisted shielded pair, insulated and jacketed and require a grounded shield.
3. Actuators with tri-state control shall use 3 conductors with same characteristics.

D. Communication Wiring

1. Ethernet Cable shall be minimum CAT5.
2. Secondary level network shall be 24 gage, TSP, low capacitance cable.

E. Approved Cable Manufacturers

1. Wiring from the following manufacturers which meet the above criteria shall be acceptable:

   a. Anixter
   b. Belden

3.00 EXECUTION

3.01 EXAMINATION

A. The Contractor shall inspect the site to verify that equipment may be installed as shown. Any discrepancies, conflicts, or omissions shall be reported to the Engineer for resolution before rough-in work is started.

B. The Contractor shall examine the drawings and specifications for other parts of the work. If head room or space conditions appear inadequate, or if any discrepancies occur between the plans and the Contractor's work and the plans and the work of others, the Contractor shall report these discrepancies to the Engineer and shall obtain written instructions for any changes necessary to accommodate the Contractor's work with the work of others.

3.02 PROTECTION

A. The Contractor shall protect all work and material from damage by its employees and/or subcontractors and shall be liable for all damage caused.

B. The Contractor shall be responsible for its work and equipment until finally inspected, tested, and accepted.

3.03 COORDINATION

A. Site

1. The project coordination between trades is the responsibility of the Prime Contractor who is the one tier higher contractual partner, such as Mechanical Contractor, General Contractor, Construction Manager, Owner or owner's Representative as applicable.
2. The Controls Contractor shall follow Prime Contractor's job schedule and coordinate all project related activities through the Prime Contactor, except otherwise agreed or in minor job site issues. Reasonable judgment shall be applied.
3. Where the work will be installed in close proximity to, or will interfere with, work of other trades, the Contractor shall assist in working out space conditions to make a satisfactory adjustment.
4. If the Contractor deviates from the job schedule and installs work without coordinating with other trades, so as to cause interference with work of other trades, the Contractor shall make the necessary changes to correct the condition without extra charge.
5. Coordinate and schedule work with all other work in the same area, or with work that is dependent upon other work, to facilitate mutual progress.

3.04 GENERAL WORKMANSHIP

A. Install equipment, and wiring/raceway parallel to building lines (i.e., horizontal, vertical, and parallel to walls) wherever possible.

B. Provide sufficient slack and flexible connections to allow for vibration of piping and equipment.

C. Install all equipment in readily accessible locations as defined by Chapter 1, Article 100, Part A, of the National Electrical Code (NEC).

D. Verify integrity of all wiring to ensure continuity and freedom from shorts and grounds.

E. All equipment, installation, and wiring shall comply with acceptable industry specifications and standards for performance, reliability, and compatibility and be executed in strict adherence to local codes and standard practices.

3.05 WIRING

A. All control and interlock wiring shall comply with national and local electrical codes. Where the requirements of this section differ from those in Divisions 26 or 27, the requirements provide the higher standard or value shall take precedence.

B. All NEC Class 1 (line voltage) wiring shall be UL-Listed in approved conduit according to NEC and Division 26 and 27 requirements.

C. All low-voltage wiring shall meet NEC Class 2 requirements. (Low-voltage power circuits shall be sub fused when required to meet Class 2 current limit.)

D. Where NEC Class 2 (current limited) wires are in concealed and accessible locations, including ceiling return air plenums, approved cables not in conduit may be used provided that cables are UL-Listed for the intended application. For example, cables used in ceiling plenums shall be-UL Listed specifically for that purpose.

E. All wiring in mechanical, electrical, or service rooms, or where subject to mechanical damage, shall be installed in conduit.

F. Do not install Class 2 wiring in conduit containing Class 1 wiring. Boxes and panels containing high voltage wiring and equipment may not be used for low-voltage wiring, except for the purpose of interfacing the two (e.g., relays and transformers).

G. Do not install wiring in conduit containing tubing.

H. Where plenum rated cable is run exposed, wiring is to be run parallel along a surface or perpendicular to it and neatly tied at 3 m (10 ft) intervals.

I. Where plenum rated cable is used without conduit, it shall be supported from or anchored to structural members. Cables shall not be supported by or anchored to ductwork, electrical conduits, piping, or ceiling suspension systems.

J. All wire-to-device connections shall be made at a terminal block or wire nut. All wire-to-wire connections shall be at a terminal strip or wire nut.

K. All wiring within enclosures shall be neatly bundled and anchored to permit access and prevent restriction to devices and terminals.

L. Maximum allowable voltage for control wiring shall be 120 V. If only higher voltages are available, the Contractor shall provide step-down transformers or interposing relays.

M. All plenum rated wiring shall be installed as continuous lengths, with no splices permitted between termination points.

N. All wiring in conduit shall be installed as continuous lengths, with no splices permitted between termination points or junction boxes.

O. Maintain fire rating at all penetrations. Install plenum wiring in sleeves where it passes through walls and floors.

P. Size and type of conduit and size and type of wire shall be the responsibility of the Contractor, in keeping with the manufacturer's recommendations and NEC requirements, except as noted elsewhere.

Q. Include one pull string in each conduit ¾-inch. or larger.

R. Control and status relays are to be located in designated enclosures only. These enclosures can include packaged equipment control panel enclosures, unless they also contain Class 1 starters.

S. Conceal all conduit, except within mechanical, electrical, or service rooms. Install conduit to maintain a minimum clearance of 15 cm (6 in.) from high-temperature equipment (e.g., steam pipes or flues).

T. Secure conduit with conduit clamps fastened to the structure and spaced according to code requirements. Conduit and pull boxes may not be hung on flexible duct strap or tie rods. Conduits may not be run on or attached to ductwork.

U. The Contractor shall terminate all control and/or interlock wiring, and shall maintain updated (as-built) wiring diagrams with terminations identified at the job site.

V. Flexible metal conduits and liquid-tight, flexible metal conduits shall not exceed 1 m (3 ft) in length and shall be supported at each end. Flexible metal conduit less than ½-inch electrical trade size shall not be used. In areas exposed to moisture, liquid-tight, flexible metal conduits shall be used.

W. Conduit must be adequately supported, properly reamed at both ends, and left clean and free of obstructions. Conduit sections shall be joined with couplings (according to code). Terminations must be made with fittings at boxes, and ends not terminating in boxes shall have bushings installed.

3.06 COMMUNICATION WIRING

A. The Contractor shall adhere to the items listed in the "Wiring" article in Part 3 of the specification.

B. All cabling shall be installed in a neat and workmanlike manner. Follow manufacturer's installation recommendations for all communication cabling.

C. Do not install communication wiring in raceway and enclosures containing Class 1 or other Class 2 wiring.

D. Maximum pulling, tension, and bend radius for cable installation, as specified by the cable manufacturer, shall not be exceeded during installation.

E. Contractor shall verify the integrity of the entire network following the cable installation. Use appropriate test measures for each particular cable.

F. When a cable enters or exits a building, a lightning arrestor must be installed between the lines and ground. The lighting arrestor shall be installed according to the manufacturer's instructions.

G. All runs of communication wiring shall be unspliced length when that length is commercially available.

H. All communication wiring shall be labeled to indicate origination and destination data.

I. Grounding of coaxial cable shall be in accordance with NEC regulations article on "Communications Circuits, Cable, and Protector Grounding."

3.07 PROGRAMMING

A. Point Naming: System point names shall be modular in design, allowing easy operator interface without the use of a written point index. Point Naming standard shall be agreed upon between Owner and BAS Contractor. Refer to Submittals section in the General Section.

B. Software Programming

1. Provide programming for the existing system and adhere to the sequences of operation provided. The Contractor also shall provide all other system programming necessary for the operation of the system, but not specified in this document. Imbed into the control program sufficient comment statements to clearly describe each section of the program. The comment statements shall reflect the language used in the sequences of operation and be of different font and color in text editor. Use the appropriate technique based on one of the following programming types:

a. Text-Based
1) Must provide actions for all possible situations
2) Must be modular and structured
3) Must be commented
4) Must provide line by line programing and compilation wizar d to allow for ease of editing

C. Operator Interface

1. Standard Graphics: Provide graphics for all mechanical systems and floor plans related to this project. Point information on the graphic displays shall dynamically update. Show on each graphic all input and output points for the system. Also show relevant calculated points, such as set points.
2. The Contractor shall provide all the labor necessary to install, initialize, start-up, and troubleshoot, update all existing operator interface software and its functions as described in this section. This includes any operating system software, the operator interface database, and any third-party software installation and integration required for successful operation of the operator interface.

3.08 TRAINING

A. Provide application engineer to instruct owner in operation of systems and equipment.

B. Provide system operator's training to include (but not limited to) such items as the following: modification of data displays, alarm and status descriptors, requesting data, and execution of commands and request of logs.

C. Provide training above as required, up to 4 hours on-site, for (4) four people, as part of this contract.

D. Provide each trainee one full size updated set of control drawings for reference during training period.

3.09 FIELD QUALITY CONTROL AND TESTING

A. Calibrate instrumentation and controls and verify the specified accuracy using calibrated test equipment. Adjust controls and equipment to maintain conditions indicated, to perform functions indicated, and to operate in the sequence specified. Furnish personnel, equipment, instrumentation, and supplies necessary to perform calibration and site testing. Ensure that tests are performed by competent employees of the DDC system installer or the DDC system manufacturer regularly employed in the testing and calibration of DDC systems. Calibrate field equipment and verify equipment and system operation before placing the system on-line. Field testing may be witnessed by the Owner or Owner's representative and shall include the following:

1. Calibration Accuracy and Operation of Inputs Test: Check for proper calibration and operation of each input instrument. For each sensor (temperature), record the reading at the sensor, and using a traceable test equipment, and record the reading at the digital controller. Document each reading for the test report.
2. Digital Controller Start-up and Memory Test: Demonstrate that programming is not lost after a power failure, and digital controllers automatically resume proper control after a power failure.
3. Surge Protection: Show that surge protection has been installed on incoming power to the digital controllers and on communication lines.
4. Application Software Operation Test: Test compliance of the application for:

    a. Ability to communicate with the digital controllers, uploading and downloading of programs.
    b. Reporting of alarm conditions: Cause alarm conditions for each alarm, and ensure that workstation receives alarms.
    c. Reporting trend and status reports: Demonstrate ability of software to receive and save trend and status reports.
    d. Execution of Sequence of Operation: Furnish graphic trends to show the sequence of operation is executed in correct order. Demonstrate the control system performs the correct sequence of control after a loss of power.

B. Document all tests with detailed results. Provide statement that all corrective action taken. Include test report in Operation and Maintenance Manuals.

END OF SECTION

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SECTION 23 23 00
REFRIGERANT PIPING

1.00 GENERAL

1.01 RELATED SECTIONS

A. The General Conditions of the Contract, Supplementary Conditions, and General Requirements are a part of and apply to this section. Consult them for additional conditions and requirements pertaining to this section.

B. Refrigeration piping and fittings.

1.02 SUBMITTALS

A. Comply with Section 01 33 00.

B. Product data.

1.03 QUALITY ASSURANCE

A. Refrigeration contractor shall be currently engaged in this type of work and shall maintain a service department which provides service on a 24-hour per day basis. The service department shall be an integral part of the Contractor's organization.

2.00 PRODUCTS

2.01 PIPE AND FITTINGS

A. Refrigeration Piping: Type L copper tubing, refrigeration grade, color-coded, marked ACR. Fittings for flare joints shall be standard SAE forged brass with short shank. Fittings for braze joints shall be long radius wrought copper or forged brass sweat fittings.

B. Condensate Drain Piping: Type L copper with wrought copper sweat fittings.

C. Solder: 95 percent tin/5 percent antimony.

2.02 FLEXIBLE HANGERS AND SUPPORTS

A. Two inches and smaller: Standard swivel loop hanger

1. Michigan 100 or equal.

B. 2-1/2 inches and larger: Standard clevis hanger

1. Michigan 401 or equal.

C. Thermal Hanger Shields: 360 degree insert of high density, 100 PSI, waterproofed calcium silicate encased in a 360 degree galvanized sheet metal shield with vapor barrier jacket. Calcium silicate shall be color coded indicating non-asbestos bearing composition.

D. Acceptable Manufacturers

1. Hangers and Supports

a. B-line
b. Elcen
c. Fee and Mason
d. Grinnell
e. Mason Industries, Inc.
f. Super Strut, Inc.
g. Unistrut
h. Nibco
i. Powerstrut
j. Sammys

2. Thermal Hanger Shields

a. Pipe Shields, Inc.
k. Insulshield
l. Uni-Grip
m. Value Engineered Products, Inc.
n. Mechanical Pipe Shield

2.03 FLEXIBLE CONNECTORS

A. Close pitch corrugated bronze hose with single layer of exterior braiding at least 9 inches long.

B. Bronze fittings.

2.04 REFRIGERATION STOP VALVES

A. Compatible with the refrigerant used and system working pressures.

B. 5/8-Inch and Smaller: All brass, globe or angle type. Hand wheel operated, renewable diaphragm, back seating, packless type; or wrench operated packed type.

C. 3/4-Inch and Larger: Brass or bronze globe or angle type. Wrench operated with ground finish stems, back seated with seal caps. Packed especially for fluorocarbon refrigeration service.

2.05 CHECK VALVES

A. Steel or brass body, lift or swing type, compatible with the application.

2.06 SOLENOID VALVES

A. Bronze, brass, or steel body with threaded or flared ends. Packless type with stainless steel trim rated for continuous duty service. Direct or pilot operated with manual lift stem, compatible with the refrigerant.

B. Safe working pressure of 400 PSI and a maximum operating pressure differential of at least 200 PSI at 85 percent voltage. Capacity and pressure drop shall be compatible with the application.

C. Solenoid coil shall be replaceable type with moisture-proof insulation and be UL-listed.

2.07 EXPANSION VALVES

A. Thermostatic type, diaphragm or bellows operated with an adjustable external super-heat adjustment factory set at 10ºF. Power element, valve size, and pressure rating shall be as recommended by the manufacturer for the application. Compatible with the refrigerant.

2.08 FILTER DRYERS

A. Dryers shall conform to ARI Standard 710. Cores shall be of suitable desiccant that will not plug, cake, dust, channel or break down, and shall remove water, acid, and foreign matter from the refrigerant.

B. Construction shall prevent desiccant from passing into the refrigeration lines.

C. Minimum bursting pressure shall be 1500 PSI.

D. 1/2-Inch and Larger: Full flow, replaceable core type.

E. Smaller than 1/2-Inch: Sealed type.

2.09 STRAINERS

A. Brass or cast-iron body, Y or angle pattern, cleanable type with minimum 60 mesh non-corrodible screen, with an area to provide net free area not less than 10 times the pipe diameter.

B. Pressure ratings shall be compatible with the application.

C. Strainers may be an integral part of the expansion valves.

2.10 SIGHT GLASSES

A. Double ported moisture indicating type with removable moisture indicating element. Moisture indicator shall have reversible color indicator with easily distinguishable color change.

B. Provide protective cover for each sight glass.

2.11 CHARGING VALVES

A. General purpose type with brass body, flared or solder ends, and removable valve core.

B. Quick coupling connection at valve inlet.

3.00 EXECUTION

3.01 REFRIGERANT PIPE

A. All piping shall be installed square to building lines, either vertical or horizontal, and parallel to walls.

B. All piping shall be adequately supported. Provide rubber grommets at all supports to prevent tube to support contact. Supports shall be either hangers or trapeze as specified elsewhere herein.

C. All piping shall be kept clean and dry with factory installed caps in place until time of installation. Extreme care shall be exercised to keep the entire system clean and dry during the installation.

D. All piping shall be straight and free of kinks, ripples, or restrictions of any kind.

E. Bending of pipe will not be permitted. All fittings required shall be of the long radius pattern, except when used for oil traps.

F. All horizontal suction lines shall be pitched 1 inch in 15 feet toward the compressor. Oil traps, consisting of short radius pattern fittings, shall be installed at the base of all vertical suction lines.

G. Tubing shall be cut square and burrs shall be removed. Both inside of fittings and outside of tubing shall be well cleaned with abrasive material before brazing. Care shall be taken to prevent annealing of fittings and hard drawn tubing when making connections.

H. Brazed joints shall be made with silver solder and a flux as recommended by the solder manufacturer. Piping shall be continuously purged with dry nitrogen during the brazing operation. Surplus brazing material shall be removed at all joints in lines not insulated.

I. Valves in gas lines shall be installed with stems horizontal. Stop valves shall be installed on each side of each piece of equipment, such as compressors, evaporators, receivers, and other similar items and at any other points indicated or required for maintenance, isolation, charging, or sectionalizing purposes.

J. Piping shall be sized and installed in accordance with the ASHRAE Handbook.

K. Joints shall be brazed, except that joints on 5/8-inch and smaller lines may be flared.

L. Use flexible connectors only at or near compressors where it is not physically possible to absorb vibration within piping configuration.

M. Provide filter dryer in each liquid line to each evaporator. Pipe in a three-valve bypass arrangement.

3.02 REFRIGERANT PIPE TESTING

A. Remove any controls or relief valves which could be damaged by test pressures. Valve off compressor and open liquid shut-off valve and solenoid valve.

B. Pressurize the system with oil pumped dry nitrogen to 150 PSIG or the pressure required by local codes. Close the liquid line shutoff valve and continue to pressurize the high side of the system to 300 PSIG or the pressure required by local codes.

C. All joints shall be tapped sharply with a rubber mallet. Bubble test all joints with soap solution. Bleed off nitrogen and repair leaks.

D. After the system is assumed to be free of leaks, charge enough refrigerant into the low side of the system with liquid line valve open to raise system pressure to five PSIG. Pressurize the system as specified in Paragraph B above. Recheck the entire system for leaks with a halide torch. If any leaks are discovered, the gas in the system must be removed in accordance with EPA guidelines using a reclaim system, the leaks repaired, and the system charged again as described above and retested.

E. Once the system is found to be tight and free from leaks, it shall be allowed to stand for 24 hours with the pressure on. If after the 24-hour period there is no change in gauge reading with proper compensation allowed for the prevailing ambient temperature, the system can be considered tight.

F. When testing has been completed, the gas in the system must be removed in accordance with EPA guidelines using a reclaim system. Reconnect all controls and valves that were disconnected prior to the testing.

3.03 REFRIGERANT SYSTEM EVACUATION

A. The compressor shall not be used for evacuating the system. A vacuum pump capable of pulling a vacuum of at least one mm Hg absolute shall be used. Vacuum pump should be connected to the back seat port of the compressor suction valve and the liquid line charging valve.

B. A reliable vacuum gauge, such as the Zimmerli gauge, should be connected to the back seat port of the compressor discharge valve.

C. Leave the compressor suction and discharge valves closed. Open all stop valves, including solenoid valves.

D. Operate the pump until a vacuum of 2.5 mm Hg absolute is indicated on the Zimmerli gauge. After the system has been evacuated to 2.5 mm Hg, break the vacuum with oil pumped dry nitrogen.

E. Open the compressor suction and discharge service valves and re-evacuate the system to 2.5 mm Hg absolute. After the 2.5 mm Hg absolute reading has been reached, close the vacuum pump suction valve and stop the pump. Allow the system to stand under a vacuum a minimum of 12 hours. If no noticeable rise in pressure has taken place after 12 hours, the system may be charged.

3.04 REFRIGERANT CHARGING

A. The entire refrigeration system, including the compressor, condenser, evaporator, and controls, must be operational and functioning properly prior to charging the system with refrigerant.

B. A drum of refrigerant for which the system is designed should be connected to the liquid charging valve through a dehydrator. The charging line should be purged and the refrigerant drum inverted so that only liquid refrigerant will be charged.

C. Both suction and discharge valve should be opened slightly off the back seat so that the gauges will function. The liquid line shut off valve on the receiver or condenser should be closed. The condenser should be placed in operation. The liquid solenoid valve must be open.

D. The liquid charging valve should be opened and liquid refrigerant admitted to the system. After a short interval, the compressor should be allowed to run, but it is imperative that the gauges at the compressor be watched carefully and the compressor not allowed to run into a vacuum.

E. Charging should be continued until the estimated requirement of the system is approached. When the estimated amount of refrigerant is approached, the liquid charging valve should be closed, the liquid line shutoff valve opened, and the flow of refrigerant watched through the refrigerant sightglass. If bubbles appear in the flow, additional refrigerant will be required. When the flow of liquid through the sightglass is solid, the liquid charging valve and drum valve should be closed. The charging line should not be disconnected.

F. Adjust refrigerant charge as necessary after the system has been in operation and the system has settled out. System will be considered properly charged when head pressure is normal and there is no indication of flash gas in the liquid line.

G. Leave the refrigerant drum and charging line connected until the 72 hour test run has been completed. When the charging line is being removed, the charging valve must be tightly closed. The charging connection should be protected with a seal cap.

END OF SECTION

SECTION 23 30 00
HVAC AIR DISTRIBUTION

1.00 GENERAL

1.01 RELATED SECTIONS

A. The General Conditions of the Contract, Supplementary Conditions, and General Requirements are a part of and apply to this section. Consult them for additional conditions and requirements pertaining to this section.

1.02 SUBMITTALS

A. Comply with Section 01 33 00.

2.00 PRODUCTS

2.01 SHEET METAL DUCTWORK

A. Sheet metal used for duct and plenum construction shall be galvanized steel, unless otherwise specified. Galvanized steel shall be of lock forming quality with a zinc coating of 1.25 ounces per square foot on each side.

B. Ducts and plenums shall be constructed in accordance with the applicable SMACNA duct manuals. Gauge of metal, type of joint, and reinforcing shall be in accordance with SMACNA standards.

C. Duct construction and installation shall be in accordance with the provisions of the Uniform Mechanical Code.

D. Factory-made air ducts shall be either Class 0 or Class 1.

E. All rigid round and oval single-wall, spiral pipe and fittings shall be manufactured by a company whose primary business is the manufacture of spiral pipe and who has been in business for at least 10 years. All spiral pipe and fittings shall be manufactured by the same manufacturer.

F. Round duct, fittings, and couplings shall be fabricated of prime G90 galvanized steel.

G. Aluminum duct shall be fabricated of commercial designation 3003, temper H14, sheet aluminum.

H. Stainless steel duct shall be fabricated of 316 stainless with welded joints.

2.02 FLEXIBLE DUCT AND FITTINGS

A. Flexible duct shall conform to Class I requirements of NFPA Bulletin No. 90A, with a flame spread rating of 25 or less and a smoke developed rating not higher than 50.

B. Ducts shall be either corrugated aluminum or fabric supported by helically wound steel wire or flat steel strips. Ducts shall have a minimum working pressure of 6 inches WG positive pressure, 2 inches WG negative pressure, and 2500 FPM velocity.

C. All flexible ducts shall be insulated, unless otherwise indicated. Insulation shall be minimum one-inch thick fiberglass with K-value of 0.23 at 75ºF.

2.03 SEALANTS

A. Duct sealer shall be a metal-to-metal air pressure sealant which is flexible and self-curing, water based, and non-toxic.

B. Sealant shall be fire resistive when dry in accordance with NFPA 90.

C. Sealant shall be approved for its pressure class and shall be outdoor-rated when used as such.

D. Acceptable Manufacturers

1. Hardcast, Inc.
2. United McGill
3. Chicago Mastic Corporation
4. Benjamin Foster

2.04 ELBOWS AND TURNING VANES

A. All fittings shall use radius elbows. Turning vanes shall be used only in situations where radius elbows will not fit and must be approved by the Engineer prior to installation.

B. Turning vanes shall be single-walled and formed to assure that any joint on one blade is equidistant from the same point on an adjacent blade. Double-walled turning vanes shall be used only where shown on the drawings or where required for strength of vanes. Construction of all turning vanes shall conform to SMACNA standards.

C. Acceptable Manufacturers

1. Tuttle & Bailey
2. Barber-Colman

2.05 GRILLES, REGISTERS, AND DIFFUSERS

A. Provide frames and mounting hardware appropriate to the installation.

B. Grilles, registers, and diffusers shall have either brushed aluminum finish or baked off-white finish, unless otherwise indicated. Coordinate special colors with General Contractor.

C. Diffusers, grilles, and air terminals shall be selected so as not to exceed the NC curve rating listed for the various areas, taking into account a room attenuation not exceeding 5 dB for small room and 10 dB for large rooms, and the decibel correction due to multiple room outlets. Equipment furnished shall be rated in accordance with the sound power tests measured in accordance with the ASHRAE Standards 36B-63. Air performance tests shall be conducted in accordance with the ADC Equipment Test

Code 1062 RI and ratings approved by the Air Diffusion Council. Maximum noise levels for equipment selection shall be as follows:

Area	NC Curve
IDF Rooms	35
BDF Room	35
Private Offices	35
General Offices	35
Lobbies and Corridors	45

D. Acceptable Manufacturers

1. Titus
2. Nailor
3. Carnes
4. Tuttle & Bailey
5. Anemostat
6. Krueger
7. Metal Aire

2.06 FLEXIBLE CONNECTIONS

A. Not Exposed to Weather: Ventglas

B. Acceptable Manufacturers

1. Ventfabrics, Inc.

2.07 AIR FILTER GAUGES

A. 4-3/4 inches outside diameter, diaphragm actuated, direct reading dial type. Black figures on white background.

B. Standard accessories for mounting gauge and connecting across each filter bank. Vent valves.

C. Appropriate ranges of 0-1.0 inch WG, 2 percent accuracy.

D. Dwyer, Series 2000 magnehelic.

E. Acceptable Manufacturers

1. Dwyer
2. Ashcroft

3.00 EXECUTION

3.01 DUCT FABRICATION AND INSTALLATION

A. Exercise the utmost care to obtain a smooth surface inside of all ductwork, absolutely free from small fins, imperfect joints or other obstructions which cause noise and increase friction. Internal ends of slip joints shall be made in the direction of air flow. Ducts shall be securely attached to the building construction in an approved manner.

B. All ducts and plenums shall be constructed in accordance with the applicable SMACNA duct manuals including gauge of metal, type of joint, and reinforcing.

C. All ductwork shall be fabricated and installed so that no undue vibration or noise results. All joints shall be airtight with additional taping and caulking provided, if necessary.

D. Hang ducts with strap iron attached to bottom of ducts spaced not over 5 feet center-to-center and according to the SMACNA Manual.

E. Curved elbows shall have a center line radius equal to 1-1/2 times the duct width. Square elbows shall have turning vanes where indicated. Job fabricated turning vanes will not be accepted without prior approval. Elbows with square throat and radius heel are not acceptable.

F. Provide dampers as necessary for proper adjustment and control of air distribution. All dampers shall have rigid bearings and locking quadrants which allow no rattling. All damper rods shall be marked to indicate the relative position of the damper blade with respect to the rod.

G. Provide 1-inch angle collars for all exposed ducts passing through walls, ceilings, or floors. Anchor collars in position after installation is complete.

H. Provide flexible connections at inlet and discharge connections of fans and air-handling equipment to prevent mechanical noises from being transmitted to connecting ductwork.

I. At all places where inside of duct (or other surfaces) will be visible through return air grilles, louvers, registers, or diffusers, paint normally visible inside portion of duct (or other surfaces) with flat black paint.

J. Install hinged access panels on ductwork and housing to provide access to all parts of every automatic damper, fire damper, turning vanes, and all other items requiring maintenance or inspection.

K. Transitions in ductwork for changing shapes and sizes shall be made with angles not exceeding 15 degrees per side wherever possible. Indicate any deviation from this on shop drawings or obtain approval from Engineer.

L. Where horizontal ducts pass through walls and vertical ducts pass through floors, opening shall be tightly sealed to provide a tight seal between duct and opening.

M. Maintain fire ratings where ducts penetrate fire rated surfaces and assemblies. Sealants shall be UL-listed.

N. Ensure that work of other trades do not penetrate ducts. Piping, conduits and similar items shall not pass through ducts.

3.02 SEALING OF DUCTS

A. General

1. All ducts which shall be sealed with sealant.
2. Metal surfaces to be joined shall be clean, dry, and grease free.
3. On all ductwork, apply a heavy brush coat finish of sealant to the exterior metal surface duct joint or seam covering heads of lock joint screws. Ensure that all voids are completely filled to provide a continuous air pressure sealant.
4. Where ducts are subject to excessive vibration or mechanical abuse, the exterior joint finish shall consist of a heavy coat of brush applied sealant reinforced with 2-inch wide glass fabric. Press the reinforcing fabric into the wet sealant and cover with a second coat of brush applied sealant.

3.03 AIR FILTER GAUGES

A. Provide magnehelics for each air filter bank.

B. Provide an engraved nameplate on each magnehelic indicating the pressure at which filters should be changed.

3.04 ACCESS DOORS

A. Provide access panels for inspection, maintenance, and cleaning of all automatic dampers, fire and smoke dampers, filters, upstream of duct turning vanes, before and after all coils, and at other locations where equipment will require service.

END OF SECTION

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SECTION 23 81 00
DECENTRALIZED UNITARY HVAC EQUIPMENT

1.00 GENERAL

1.01 RELATED SECTIONS

A. The General Conditions of the Contract, Supplementary Conditions, and General Requirements are a part of and apply to this section. Consult them for additional conditions and requirements pertaining to this section.

1.02 SUBMITTALS

A. Comply with Section 01 33 00.

1.03 QUALITY ASSURANCE

A. The units shall be listed by Electrical Laboratories (ETL) and bear the ETL label.

B. All wiring shall be in accordance with the National Electrical Code (NEC).

C. The units shall be manufactured in a facility registered to ISO 9001 and ISO14001 which is a set of standards applying to environmental protection set by the International Standard Organization (ISO).

1.04 DELIVERY, STORAGE AND HANDLING

A. Unit shall be stored and handled according to the manufacturer's recommendation.

1.05 WARRANTY

A. The units shall be covered by the manufacturer's warranty for a period of one (1) year from date of installation acceptance by the Owner.

2.00 PRODUCTS

2.01 PACKAGE AIR CONDITIONING UNIT

A. Cabinet and frame construction

1. The frame shall be constructed of heliarc-welded tubular steel. The exterior panels shall be insulated with a minimum 1-inch, 1.5 pounds, density fiber insulation. The main front panel shall have captive 1/4 turn fasteners.

B. Filter chamber

1. The filter chambers shall be an integral part of the system located within the cabinet serviceable from either end of the unit. The filters shall be rated not less than 30% efficiency (based on ASHRAE 52-76).

C. Fan Section

1. The fan shall be the centrifugal type, double width double inlet, and shall be statically and dynamically balanced as a complete assembly to a maximum vibration level of two mils in any plant. The shaft shall be heavy duty steel with self-aligning ball bearings with a minimum life span of 100,000 hours.

D. Standard Control Processor

1. The control system shall be microprocessor based. The system shall be provided with two 0.43-inch high, seven segment LED numerical displays to allow observation of room temperature and humidity and each settable function. Temperature set point 65º - 85ºF. Temperature sensitivity 1º - 5ºF. Humidity set point 40% - 60% RH. Humidity Sensitivity 1% - 10% RH.
2. Normal operating modes (cooling, dehumidification) shall be indicated by colored LEDs on the unit-mounted display panel.
3. The control system shall monitor unit operation and activate an audible and visual alarm in the event of the following factory preset alarm conditions: High temperature,low temperature, high humidity, low humidity, restricted air filters, and loss of air.

E. Acceptable Manufacturers

1. Liebert
2. Bard

2.02 SPLIT SYSTEM OUTDOOR UNIT

A. General

1. The outdoor units shall be equipped with multiple circuit boards that interface to the controls system and shall perform all functions necessary for operation. The outdoor unit shall be completely factory assembled, piped and wired. Each unit shall be run tested at the factory.
2. The sum of connected capacity of all indoor units shall range from 50% to 130% of outdoor rated capacity.
3. Outdoor unit shall have a sound rating no higher than 52 dB(A).
4. Both refrigerant lines from the outdoor unit to indoor units shall be individually insulated.
5. The outdoor unit shall have an accumulator with refrigerant level sensors and controls.
6. The outdoor unit shall have a high pressure safety switch, low pressure safety switch and over-current protection and DC bus protection.
7. The outdoor unit shall have the ability to operate with a maximum height difference of 98 feet and have a total refrigerant tubing length of 393 feet. The greatest length is not to exceed 262 feet between the outdoor unit and the indoor units, and shall not require line size changes or traps.
8. The outdoor unit shall have rated performance for heat operation at 10°F ambient temperature without additional low ambient controls.

9. The outdoor unit shall be capable of cooling operation down to 23°F outdoor ambient without additional low ambient controls.
10. The outdoor unit shall have a high efficiency oil separator, plus additional logic controls, to ensure adequate oil volume in the compressor is maintained.

B. Unit Cabinet

1. The casing shall be fabricated of galvanized steel, bonderized and finished with a powder-coated baked enamel.

C. Fan

1. The unit shall be furnished with two direct drive, variable speed motors.
2. The fans will be forward curved type blades for quiet operation.
3. The fan motor shall have inherent protection, have permanently lubricated bearings, and be completely variable speed.
4. The fan motor shall be mounted for quiet operation.
5. The fan shall be provided with a raised guard to prevent contact with moving parts.
6. The outdoor unit shall have horizontal discharge airflow.

D. Refrigerant

1. R410A refrigerant shall be required for outdoor unit systems.

E. Coil

1. The outdoor coil shall be of nonferrous construction with lanced or corrugated fins on copper tubing.
2. The coil fins will have a factory applied corrosion resistant blue-fin finish.
3. The coil shall be protected with an integral metal guard.
4. Refrigerant flow from the outdoor unit shall be controlled by means of an inverter driven compressor.

F. Compressor

1. The compressor shall be a single high performance, inverter driven, modulating capacity scroll compressor.
2. The outdoor unit compressor shall have an inverter to modulate capacity. The capacity shall be completely variable down to 16% of rated capacity.
3. The compressor shall be equipped with an internal thermal overload.
4. The compressor shall be mounted to avoid the transmission of vibration.

G. Electrical

1. The outdoor unit electrical power shall be 208/230 volts, 1-phase, 60 hertz.
2. The unit shall be capable of satisfactory operation within voltage limitations of 187-228 volts (208V/60Hz) or 207-253 volts (230V/60Hz).
3. The outdoor unit shall be controlled by integral microprocessors.

4. The control circuit between the indoor units and the outdoor unit shall be 24VDC completed using a 2-conductor, twisted pair, non-polar shielded cable to provide total integration of the system.

H. Acceptable Manufacturers

1. Mitsubishi
2. Daikin
3. Sanyo

2.03 SPLIT SYSTEM (WALL-MOUNTED) INDOOR UNIT

A. General: The indoor unit shall be wall-mounted with a slim silhouette and shall have a modulating linear expansion device.

B. Indoor Unit: The indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, an auto restart function, and a test run switch. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory.

C. Unit Cabinet:

1. The casing shall have a white finish.
2. Multi directional drain and refrigerant piping offering four (4) directions for refrigerant piping and two (2) directions for draining shall be standard.
3. There shall be a separate back plate which secures the unit firmly to the wall.

D. Fan

1. The indoor fan shall be an assembly with one or two line-flow fan(s) direct driven by a single motor.
2. The indoor fan shall be statically and dynamically balanced to run on a motor with permanently lubricated bearings.
3. A manual adjustable guide vane shall be provided with the ability to change the airflow from side to side (left to right).
4. A motorized air sweep louver shall provide an automatic change in airflow by directing the air up and down to provide uniform air distribution.

E. Filter

1. Return air shall be filtered by means of an easily removable, washable filter.

F. Coil

1. The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing.
2. The tubing shall have inner grooves for high efficiency heat exchange.
3. All tube joints shall be brazed with phos-copper or silver alloy.
4. The coils shall be pressure tested at the factory.

5. A condensate pan and drain shall be provided under the coil.
6. Both refrigerant lines to the indoor units shall be insulated.

G. Electrical

1. The unit electrical power shall be 208/230 volts, 1-phase, 60 hertz.
2. The system shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz) or 207-253 volts (230V/60Hz).

H. Controls

1. Provide each indoor unit with a remote controller. The remote controller shall be approximately 5” x 5” in size and white in color, with a light green LCD display. The PAR-21MAA shall support a selection from multiple languages (Spanish, German, Japanese, Chinese, English, Russian, Italian, or French) for display information. The remote controller supports temperature display selection of Fahrenheit or Celsius. The remote controller shall control the following grouped operations: On/Off, operation mode (cool, heat, auto, dry, and fan), temperature set point, fan speed setting, and airflow direction setting. A remote controller shall support timer settings of on/off/temperature up to 8 times in a day in 1-minute increments. A remote controller shall support an auto off timer. The remote controller shall be able to limit the set temperature range from the remote controller.

I. Acceptable Manufacturers

1. Mitsubishi
2. Daikin
3. Sanyo

3.00 EXECUTION

3.01 INSTALLATION OF AIR CONDITIONING UNITS

A. General

1. Install air conditioning units in accordance with manufacturer's installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances. Provide built-in condensate pump, connection, and accessories as shown on drawing details.

B. Electrical Wiring

1. Install and connect electrical devices furnished by manufacturer, but not specified, to be factory-mounted. Furnish copy of manufacturer's electrical connection diagram submittal to Electrical Contractor.

C. Field quality control.

3.02 CONDENSER INSTALLATION

A. Install unit plumb and level, firmly anchored in location indicated.

B. Install per manufacturer's installation.

END OF SECTION

SECTION 26 05 19
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Building wires and cables rated 600 V and less.
2. Connectors, splices, and terminations rated 600 V and less.

B. Related Requirements:

1. Section 271500 "Communications Horizontal Cabling" for cabling used for voice and data circuits.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

A. Copper Conductors: Comply with NEMA WC 70/ICEA S-95-658.

B. Conductor Insulation: Comply with NEMA WC 70/ICEA S-95-658 for Type THHN-THWN.

C. Multiconductor Cable: Comply with NEMA WC 70/ICEA S-95-658 for metal-clad cable, Type MC with ground wire.

2.2 CONNECTORS AND SPLICES

A. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

2.3 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type THHN-THWN, single conductors in raceway.

B. Exposed Feeders: Type THHN-THWN, single conductors in raceway.

C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN-THWN, single conductors in raceway.

D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.

E. Feeders Installed below Raised Flooring: Type THHN-THWN, single conductors in raceway.

F. Exposed Branch Circuits, Including in Crawlspaces: Type THHN-THWN, single conductors in raceway.

G. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway.

H. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.

I. Branch Circuits Installed below Raised Flooring: Type THHN-THWN, single conductors in raceway.

J. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.

C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

3.4 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches (300 mm) of slack.

3.5 IDENTIFICATION

A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."

B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.7 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 078413 "Penetration Firestopping."

3.8 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. After installing conductors and cables and before electrical circuitry has been energized, test conductors feeding the following critical equipment and services for compliance with requirements.

   a. Uninterruptible power supplies.

   b. Equipment cabinets.

2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

3. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each splice in conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner. Correct deficiencies determined during the scan.

   a. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each splice 11 months after date of Substantial Completion.
   b. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
   c. Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

B. Test and Inspection Reports: Prepare a written report to record the following:

1. Procedures used.
2. Results that comply with requirements.

3. Results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

C. Cables will be considered defective if they do not pass tests and inspections.

END OF SECTION 260519

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SECTION 26 05 26
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Grounding systems and equipment.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.4 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. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:

1. Solid Conductors: ASTM B 3.
2. Stranded Conductors: ASTM B 8.
3. Tinned Conductors: ASTM B 33.
4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch (6 mm) in diameter.
5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.

7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.

2.2 CONNECTORS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, pressure type with at least two bolts.

1. Pipe Connectors: Clamp type, sized for pipe.

C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.3 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel; 3/4 inch by 10 feet (19 mm by 3 m) in diameter.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for No. 10 AWG and smaller, and stranded conductors for No. 8 AWG and larger unless otherwise indicated.

B. Underground Grounding Conductors: Install bare copper conductor, No. 2/0 AWG minimum. Bury at least 24 inches (600 mm) below grade.

C. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.

D. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
3. Connections to Ground Rods at Test Wells: Bolted connectors.
4. Connections to Structural Steel: Welded connectors.

3.2 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:

1. Feeders and branch circuits.
2. Lighting circuits.
3. Receptacle circuits.
4. Single-phase motor and appliance branch circuits.
5. Three-phase motor and appliance branch circuits.
6. Flexible raceway runs.
7. Armored and metal-clad cable runs.
8. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.
9. Computer and Rack-Mounted Electronic Equipment Circuits: Install insulated equipment grounding conductor in branch-circuit runs from equipment-area power panels and power-distribution units.

B. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

C. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

D. Signal and Communication Equipment: In addition to grounding and bonding required by NFPA 70, provide a separate grounding system complying with requirements in TIA/ATIS J-STD-607-A.

1. For telephone, alarm, voice and data, and other communication equipment, 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.
2. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a grounding bus.
3. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

3.3 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Ground Rods: Drive rods until tops are 2 inches (50 mm) below finished floor or final grade unless otherwise indicated.

1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
2. For grounding electrode system, 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, and connect to the service grounding electrode conductor.

C. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Section 260543 "Underground Ducts and Raceways for Electrical Systems," and shall be at least 12 inches (300 mm) deep, with cover.

1. Test Wells: Install at least one test well for each service unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.

D. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

E. Grounding and Bonding for Piping:

1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

F. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.

3.4 LABELING

A. Comply with requirements in Section 260553 "Identification for Electrical Systems" for instruction signs. The label or its text shall be green.

B. Install labels at the telecommunications bonding conductor and grounding equalizer and at the grounding electrode conductor where exposed.

1. Label Text: "If this connector or cable is loose or if it must be removed for any reason, notify the facility manager."

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections and prepare test reports:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
3. 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. Make tests at ground rods before any conductors are connected.

B. Report measured ground resistances that exceed the following values:

1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.
2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.
3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
4. Power Distribution Units or Panelboards Serving Electronic Equipment: 3 ohm(s).

C. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526

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SECTION 26 05 29
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Hangers and supports for electrical equipment and systems.
2. Construction requirements for concrete bases.

1.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.3 ACTION SUBMITTALS

A. Product Data: For steel slotted support systems.

B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:

1. Trapeze hangers. Include Product Data for components.
2. Steel slotted channel systems. Include Product Data for components.
3. Equipment supports.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.5 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Allied Tube & Conduit.
b. Cooper B-Line, Inc.; a division of Cooper Industries.
c. ERICO International Corporation.
d. GS Metals Corp.
e. Thomas & Betts Corporation.
f. Unistrut; Tyco International, Ltd.
g. Wesanco, Inc.

2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
3. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
4. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
5. Channel Dimensions: Selected for applicable load criteria.

B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

C. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

   a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

      1) Hilti Inc.
      2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
      3) MKT Fastening, LLC.
      4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.

2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.

   a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

      1) Cooper B-Line, Inc.; a division of Cooper Industries.
      2) Empire Tool and Manufacturing Co., Inc.
      3) Hilti Inc.
      4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
      5) MKT Fastening, LLC.

3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
6. Toggle Bolts: All-steel springhead type.
7. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Section 055000 "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as scheduled in NECA 1, where its Table 1 lists maximum spacings less than stated in NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with two-bolt conduit clamps.

D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch (38-mm) and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.
3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. To Existing Concrete: Expansion anchor fasteners.
5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4

inches (100 mm) thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches (100 mm) thick.

6. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts.
7. To Light Steel: Sheet metal screws.
8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Section 055000 "Metal Fabrications" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

A. Construct concrete bases of dimensions indicated but not less than 4 inches (100 mm) larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

B. Use 3000-psi (20.7-MPa, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Section 033000 "Cast-in-Place Concrete." Anchor equipment to concrete base.

1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor bolts to elevations required for proper attachment to supported equipment.
3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).

B. Touchup: Comply with requirements in Section 099123 "Interior Painting" for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 260529

SECTION 26 05 33
RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal conduits, tubing, and fittings.
2. Nonmetal conduits, tubing, and fittings.
3. Metal wireways and auxiliary gutters.
4. Nonmetal wireways and auxiliary gutters.
5. Surface raceways.
6. Boxes, enclosures, and cabinets.
7. Handholes and boxes for exterior underground cabling.

B. Related Requirements:

1. Section 260543 "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.
2. Section 270528 "Pathways for Communications Systems" for conduits, wireways, surface pathways, innerduct, boxes, faceplate adapters, enclosures, cabinets, and handholes serving communications systems.
3. Section 280528 "Pathways for Electronic Safety and Security" for conduits, surface pathways, innerduct, boxes, and faceplate adapters serving electronic safety and security.

1.2 ACTION SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:

1. Structural members in paths of conduit groups with common supports.
2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.

B. Seismic Qualification Certificates: For enclosures, cabinets, and conduit racks and their mounting provisions, including those for internal components, from manufacturer.

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

A. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. GRC: Comply with ANSI C80.1 and UL 6.

C. IMC: Comply with ANSI C80.6 and UL 1242.

D. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.

1. Comply with NEMA RN 1.
2. Coating Thickness: 0.040 inch (1 mm), minimum.

E. EMT: Comply with ANSI C80.3 and UL 797.

F. FMC: Comply with UL 1; zinc-coated steel.

G. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

H. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.
2. Fittings for EMT:

   a. Material: Steel.
   b. Type: compression.

3. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
4. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.

I. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS, TUBING, AND FITTINGS

A. Listing and Labeling: Nonmetallic conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.

C. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. Solvent cements and adhesive primers shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

A. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1, Type 3R, Type 4, Type 12, unless otherwise indicated, and sized according to NFPA 70.

1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

2.4 SURFACE RACEWAYS

A. Listing and Labeling: Surface raceways and tele-power poles shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL 5.

2.5 BOXES, ENCLOSURES, AND CABINETS

A. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

B. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

C. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.

D. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.

E. Metal Floor Boxes:

1. Material: Cast metal.
2. Type: Fully adjustable.
3. Shape: Rectangular.
4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

F. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb (23 kg). Outlet boxes designed for attachment of luminaires weighing more than 50 lb (23 kg) shall be listed and marked for the maximum allowable weight.

G. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

H. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, galvanized, cast iron with gasketed cover.

I. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

J. Device Box Dimensions: 4 inches square by 2-1/8 inches deep (100 mm square by 60 mm deep) or 4 inches by 2-1/8 inches by 2-1/8 inches deep (100 mm by 60 mm by 60 mm deep) as required by the application.

K. Gangable boxes are allowed.

L. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1, Type 3R, Type 4, Type 12 as required by the application with continuous-hinge cover with flush latch unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
2. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

M. Cabinets:

1. NEMA 250, Type 1, Type 3R, Type 12, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.

6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.6 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. General Requirements for Handholes and Boxes:

1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.

1. Standard: Comply with SCTE 77.
2. Configuration: Designed for flush burial with closed bottom unless otherwise indicated.
3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
5. Cover Legend: Molded lettering, "ELECTRIC." .
6. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed Conduit: GRC**.**
2. Concealed Conduit, Aboveground: EMT.
3. Underground Conduit: RNC, Type EPC-80-PVC, concrete encased.
4. Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Indoors: Apply raceway products as specified below unless otherwise indicated.

1. Exposed, Not Subject to Physical Damage: EMT.
2. Exposed, Not Subject to Severe Physical Damage: EMT.
3. Exposed and Subject to Severe Physical Damage: GRC. Raceway locations include the following:

   a. Loading dock.

b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
c. Mechanical rooms.
d. Gymnasiums.

4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
6. Damp or Wet Locations: GRC.
7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.

C. Minimum Raceway Size: 1/2-inch (16-mm) trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
3. EMT: Use compression, steel fittings. Comply with NEMA FB 2.10.
4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

E. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

F. Install surface raceways only where indicated on Drawings.

G. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F (49 deg C)

3.2 INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

B. 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.

C. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.

D. Arrange stub-ups so curved portions of bends are not visible above finished slab.

E. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches (300 mm) of changes in direction.

F. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

G. Support conduit within 12 inches (300 mm) of enclosures to which attached.

H. Raceways Embedded in Slabs:

1. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot (3-m) intervals.
2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
3. Arrange raceways to keep a minimum 2 inches (50 mm) of concrete cover in all directions.
4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
5. Change from ENT to GRC or IMC before rising above floor.

I. Stub-ups to Above Recessed Ceilings:

1. Use EMT, IMC, or RMC for raceways.
2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

J. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

K. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.

L. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.

M. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch (35-mm) trade size and insulated throat metal bushings on 1-1/2-inch (41-mm) trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

N. Install pull wires in empty raceways. Use polypropylene 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 pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

O. Surface Raceways:

1. Install surface raceway with a minimum 2-inch (50-mm) radius control at bend points.
2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches (1200 mm) and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.

P. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces.

Q. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where an underground service raceway enters a building or structure.
3. Where otherwise required by NFPA 70.

R. Expansion-Joint Fittings:

1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F (17 deg C) and that has straight-run length that exceeds 25 feet (7.6 m).
2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:

   a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F (70 deg C) temperature change.
   b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F (86 deg C) temperature change.
   c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F (70 deg C) temperature change.
   d. Attics: 135 deg F (75 deg C) temperature change.

3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per degree F (0.06 mm per meter of length of straight run per degree C) of temperature change for PVC conduits.
4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific

location at time of installation. Install conduit supports to allow for expansion movement.

S. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches (1830 mm) of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations subject to severe physical damage.
2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.

T. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.

U. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between the box and cover plate or the supported equipment and box.

V. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

W. Locate boxes so that cover or plate will not span different building finishes.

X. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

Y. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

Z. Set metal floor boxes level and flush with finished floor surface.

AA. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section 312000 "Earth Moving" for pipe less than 6 inches (150 mm) in nominal diameter.
2. Install backfill as specified in Section 312000 "Earth Moving."
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength.

After placing controlled backfill to within 12 inches (300 mm) of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 312000 "Earth Moving."

4. Install manufactured duct elbows for stub-up at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.

    a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete for a minimum of 12 inches (300 mm) on each side of the coupling.
    b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.

6. Underground Warning Tape: Comply with requirements in Section 260553 "Identification for Electrical Systems."

3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch (12.5-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch (25 mm) above finished grade.

D. Install handholes with bottom below grade.

E. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.6 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.7 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260533

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SECTION 26 05 53
IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Identification for raceways.
2. Identification of power and control cables.
3. Identification for conductors.
4. Underground-line warning tape.
5. Warning labels and signs.
6. Instruction signs.
7. Equipment identification labels.
8. Miscellaneous identification products.

1.2 ACTION SUBMITTALS

A. Product Data: For each electrical identification product indicated.

1.3 QUALITY ASSURANCE

A. Comply with ANSI A13.1.

B. Comply with NFPA 70.

C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

D. Comply with ANSI Z535.4 for safety signs and labels.

E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

PART 2 - PRODUCTS

2.1 POWER RACEWAY IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.

B. Colors for Raceways Carrying Circuits at 600 V or Less:

1. Black letters on an orange field.
2. Legend: Indicate voltage and system or service type.

C. Self-Adhesive Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

D. Snap-Around Labels for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

E. Snap-Around, Color-Coding Bands for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches (50 mm) long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

F. Write-On Tags: Polyester tag, 0.010 inch (0.25 mm) thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.

1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
2. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.2 ARMORED AND METAL-CLAD CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

B. Colors for Raceways Carrying Circuits at 600 V and Less:

1. Black letters on an orange field.
2. Legend: Indicate voltage and system or service type.

C. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

D. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; 2 inches (50 mm) wide; compounded for outdoor use.

2.3 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

C. Write-On Tags: Polyester tag, 0.010 inch (0.25 mm) thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.

1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
2. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

D. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

E. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches (50 mm) long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

2.4 CONDUCTOR IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide.

B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

C. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

D. Write-On Tags: Polyester tag, 0.010 inch (0.25 mm) thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.

1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
2. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.5 FLOOR MARKING TAPE

A. 2-inch- (50-mm-) wide, 5-mil (0.125-mm) pressure-sensitive vinyl tape, with black and white stripes and clear vinyl overlay.

2.6 UNDERGROUND-LINE WARNING TAPE

A. Tape:

1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical utility lines.
2. Printing on tape shall be permanent and shall not be damaged by burial operations.
3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.

B. Color and Printing:

1. Comply with ANSI Z535.1 through ANSI Z535.5.
2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE.

C. Tag: Type I:

1. Pigmented polyolefin, bright-colored, compounded for direct-burial service.
2. Thickness: 4 mils (0.1 mm).
3. Weight: 18.5 lb/1000 sq. ft. (9.0 kg/100 sq. m).
4. 3-Inch (75-mm) Tensile According to ASTM D 882: 30 lbf (133.4 N), and 2500 psi (17.2 MPa).

D. Tag: Type ID:

1. Detectable three-layer laminate, consisting of a printed pigmented polyolefin film, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core, bright-colored, compounded for direct-burial service.
2. Overall Thickness: 5 mils (0.125 mm).
3. Foil Core Thickness: 0.35 mil (0.00889 mm).
4. Weight: 28 lb/1000 sq. ft. (13.7 kg/100 sq. m).
5. 3-Inch (75-mm) Tensile According to ASTM D 882: 70 lbf (311.3 N), and 4600 psi (31.7 MPa).

2.7 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.

C. Baked-Enamel Warning Signs:

1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.

2. 1/4-inch (6.4-mm) grommets in corners for mounting.
3. Nominal size, 7 by 10 inches (180 by 250 mm).

D. Metal-Backed, Butyrate Warning Signs:

1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch (1-mm) galvanized-steel backing; and with colors, legend, and size required for application.
2. 1/4-inch (6.4-mm) grommets in corners for mounting.
3. Nominal size, 10 by 14 inches (250 by 360 mm).

E. Warning label and sign shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 48 INCHES (1,219 MM)."

2.8 INSTRUCTION SIGNS

A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch (1.6 mm) thick for signs up to 20 sq. inches (129 sq. cm) and 1/8 inch (3.2 mm) thick for larger sizes.

1. Engraved legend with black letters on white face.
2. Punched or drilled for mechanical fasteners.
3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

B. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm).

C. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm). Overlay shall provide a weatherproof and UV-resistant seal for label.

2.9 EQUIPMENT IDENTIFICATION LABELS

A. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm). Overlay shall provide a weatherproof and UV-resistant seal for label.

B. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be 3/8 inch (10 mm).

C. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch (25 mm).

2.10 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

B. Apply identification devices to surfaces that require finish after completing finish work.

C. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

D. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

E. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.

F. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches (150 to 200 mm) below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches (400 mm) overall.

G. Painted Identification: Comply with requirements in painting Sections for surface preparation and paint application.

3.2 IDENTIFICATION SCHEDULE

A. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30 A, and 120 V to ground: Install labels at 10-foot (3-m) maximum intervals.

B. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:

1. Emergency Power.
2. Power.
3. UPS.

C. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.

1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service feeder and branch-circuit conductors. Where differences exist, use the color-coding system described in Chapter 10 of the City of San Antonio Amendments to the National Electrical Code.

a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.
b. Colors for 208/120-V Circuits:

1) Phase A: Black.
2) Phase B: Red.
3) Phase C: Blue.

c. Colors for 480/277-V Circuits:

1) Phase A: Brown.
2) Phase B: Orange.
3) Phase C: Yellow.

d. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

D. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.

E. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source.

F. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.

G. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.

1. Limit use of underground-line warning tape to direct-buried cables.
2. Install underground-line warning tape for both direct-buried cables and cables in raceway.

H. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

I. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels.

1. Comply with 29 CFR 1910.145.
2. Identify system voltage with black letters on an orange background.
3. Apply to exterior of door, cover, or other access.
4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:

   a. Power transfer switches.
   b. Controls with external control power connections.

J. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.

K. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch- (10-mm-) high letters for emergency instructions at equipment used for power transfer, or load shedding.

L. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

1. Labeling Instructions:

   a. Indoor Equipment: Self-adhesive, engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high label; where two lines of text are required, use labels 2 inches (50 mm) high.
   b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
   c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.

d. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.

END OF SECTION 260553

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SECTION 26 22 00
LOW-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following types of dry-type transformers rated 600 V and less, with capacities up to 1000 kVA:

1. Distribution transformers.

1.2 ACTION SUBMITTALS

A. Product Data: For each product indicated.

B. Shop Drawings: Indicate dimensions and weights.

1. Wiring Diagrams: Power, signal, and control wiring.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control test reports.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

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. Comply with IEEE C57.12.91, "Test Code for Dry-Type Distribution and Power Transformers."

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. ACME Electric Corporation; Power Distribution Products Division.
2. Challenger Electrical Equipment Corp.; a division of Eaton Corp.
3. Eaton Electrical Inc.; Cutler-Hammer Products.
4. General Electric Company.
5. Siemens Energy & Automation, Inc.
6. Sola/Hevi-Duty.
7. Square D; Schneider Electric.

2.2 GENERAL TRANSFORMER REQUIREMENTS

A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.

B. Cores: Grain-oriented, non-aging silicon steel.

C. Coils: Continuous windings without splices except for taps.

1. Internal Coil Connections: Brazed or pressure type.
2. Coil Material: Copper.

2.3 DISTRIBUTION TRANSFORMERS

A. Comply with NEMA ST 20, and list and label as complying with UL 1561.

B. Cores: One leg per phase.

C. Enclosure: Ventilated, NEMA 250, Type 2.

1. Core and coil shall be encapsulated within resin compound, sealing out moisture and air.

D. Transformer Enclosure Finish: Comply with NEMA 250.

1. Finish Color: ANSI 61 gray.

E. Taps for Transformers Smaller Than 3 kVA: None.

F. Taps for Transformers 7.5 to 24 kVA: One 5 percent tap above and one 5 percent tap below normal full capacity.

G. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and two 2.5 percent taps below normal full capacity.

H. Insulation Class: 220 deg C, UL-component-recognized insulation system with a maximum of **115** deg C rise above 40 deg C ambient temperature.

I. Energy Efficiency for Transformers Rated 15 kVA and Larger:

1. Complying with NEMA PREMIUM EFFICIENCY, Class 1 efficiency levels.
2. Tested according to 10 CFR Part 431 “Test Procedures for Distribution Transformers”

J. K-Factor Rating: Transformers indicated to be K-factor rated shall comply with UL 1561 requirements for nonsinusoidal load current-handling capability to the degree defined by designated K-factor.

1. Unit shall not overheat when carrying full-load current with harmonic distortion corresponding to designated K-factor.
2. Indicate value of K-factor on transformer nameplate.

K. Electrostatic Shielding: Each winding shall have an independent, single, full-width copper electrostatic shield arranged to minimize interwinding capacitance.

L. Wall Brackets: Manufacturer's standard brackets.

2.4 IDENTIFICATION DEVICES

A. Nameplates: Engraved, laminated-plastic or metal nameplate. Nameplates are specified in Section 260553 "Identification for Electrical Systems."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install wall-mounting transformers level and plumb with wall brackets fabricated by transformer manufacturer.

1. Brace wall-mounting transformers as specified in Section 260548 "Vibration and Seismic Controls for Electrical Systems."

B. Construct concrete bases and anchor floor-mounting transformers according to manufacturer's written instructions and requirements in Section 260529 "Hangers and Supports for Electrical Systems."

3.2 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Infrared Scanning: Two months after Substantial Completion, perform an infrared scan of transformer connections.

   a. Use an infrared-scanning device designed to measure temperature or detect significant deviations from normal values. Provide documentation of device calibration.
   b. Perform 2 follow-up infrared scans of transformers, one at 4 months and the other at 11 months after Substantial Completion.
   c. Prepare a certified report identifying transformer checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken, and scanning observations after remedial action.

3.3 ADJUSTING

A. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 10 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.

B. Connect buck-boost transformers to provide nameplate voltage of equipment being served, plus or minus 5 percent, at secondary terminals.

C. Output Settings Report: Prepare a written report recording output voltages and tap settings.

END OF SECTION 262200

SECTION 26 24 16
PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes distribution panelboards and lighting and appliance branch-circuit panelboards.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types and details for types other than NEMA 250, Type 1.
3. Detail bus configuration, current, and voltage ratings.
4. Short-circuit current rating of panelboards and overcurrent protective devices.
5. Include evidence of NRTL listing for series rating of installed devices.
6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
7. Include wiring diagrams for power, signal, and control wiring.
8. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Panelboard schedules for installation in panelboards.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.5 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. Comply with NEMA PB 1.

C. Comply with NFPA 70.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Section 260548 "Vibration and Seismic Controls for Electrical Systems."

B. Enclosures: Flush- and surface-mounted cabinets.

1. Rated for environmental conditions at installed location.

a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
b. Outdoor Locations: NEMA 250, Type 3R.

2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
4. Directory Card: Inside panelboard door, mounted in transparent card holder.

C. Incoming Mains Location: Top and bottom.

D. Phase, Neutral, and Ground Buses: Hard-drawn copper, 98 percent conductivity.

E. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Hard-drawn copper, 98 percent conductivity.
2. Main and Neutral Lugs: Mechanical type.
3. Ground Lugs and Bus Configured Terminators: Mechanical type.
4. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.

F. Service Equipment Label: NRTL labeled for use as service equipment for panelboards with one or more main service disconnecting and overcurrent protective devices.

G. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

H. Panelboard Short-Circuit Current Rating: Rated for series-connected system with integral or remote upstream overcurrent protective devices and labeled by an NRTL. Include size and type of allowable upstream and branch devices, and listed and labeled for series-connected short-circuit rating by an NRTL.

I. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.2 DISTRIBUTION PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

B. Panelboards: NEMA PB 1, power and feeder distribution type.

C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

D. Mains: Circuit breaker.

E. Branch Overcurrent Protective Devices: For Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.

F. Branch Overcurrent Protective Devices: 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.

G. Branch Overcurrent Protective Devices: Fused switches.

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

C. Mains: Circuit breaker.

D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

F. Column-Type Panelboards: Narrow gutter extension, with cover, to overhead junction box equipped with ground and neutral terminal buses.

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, 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. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and 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.

4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
5. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
6. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
7. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
8. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:

a. Standard frame sizes, trip ratings, and number of poles.
b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
e. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.
f. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

C. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.

1. Fuses, and Spare-Fuse Cabinet: Comply with requirements specified in Section 262813 "Fuses."

2.5 ACCESSORY COMPONENTS AND FEATURES

A. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Receive, inspect, handle, store and install panelboards and accessories according to NECA 407.

B. Mount top of trim 90 inches (2286 mm) above finished floor unless otherwise indicated.

C. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

D. Install overcurrent protective devices and controllers not already factory installed.

1. Set field-adjustable, circuit-breaker trip ranges.

E. Install filler plates in unused spaces.

F. Stub four 1-inch (27-GRC) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future.

G. Arrange conductors in gutters into groups and bundle and wrap with wire ties.

H. Comply with NECA 1.

3.2 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Section 260553 "Identification for Electrical Systems."

B. Create a directory to indicate installed circuit loads and incorporating Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Acceptance Testing Preparation:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

C. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. 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.

D. Panelboards will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

END OF SECTION 262416

SECTION 26 27 26
WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Receptacles, receptacles with integral GFCI, and associated device plates.
2. Weather-resistant receptacles.
3. Snap switches and wall-box dimmers.
4. Solid-state fan speed controls.
5. Wall-switch and exterior occupancy sensors.
6. Communications outlets.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Receptacles for Owner-Furnished Equipment: Match plug configurations.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:

1. Cooper Wiring Devices; Division of Cooper Industries, Inc. (Cooper).
2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
3. Leviton Mfg. Company Inc. (Leviton).
4. Pass & Seymour/Legrand (Pass & Seymour).

B. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 GENERAL WIRING-DEVICE REQUIREMENTS

A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

C. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:

1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
2. Devices shall comply with the requirements in this Section.

2.3 STRAIGHT-BLADE RECEPTACLES

A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Cooper; 5351 (single), CR5362 (duplex).
b. Hubbell; HBL5351 (single), HBL5352 (duplex).
c. Leviton; 5891 (single), 5352 (duplex).
d. Pass & Seymour; 5361 (single), 5362 (duplex).

2.4 TWIST-LOCK RECEPTACLES

A. Receptacles, twist-lock style, 125 V and 250 V, 20 A, 30 A, and 50 A. Comply with NEMA WD 1, NEMA WD 6 Configuration L5-20R, L5-30R, L6-30R, UL 498, and FS W-C-596.

2.5 GFCI RECEPTACLES

A. General Description:

1. Straight blade, feed-through type.
2. Comply with NEMA WD 1, NEMA WD 6, UL 498, UL 943 Class A, and FS W-C-596.
3. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.

B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Cooper; VGF20.
b. Hubbell; GFR5352L.
c. Pass & Seymour; 2095.
d. Leviton; 7590.

2.6 TOGGLE SWITCHES

A. Comply with NEMA WD 1, UL 20, and FS W-S-896.

B. Switches, 120/277 V, 20 A:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

1) Single Pole:

2) Cooper; AH1221.
3) Hubbell; HBL1221.
4) Leviton; 1221-2.
5) Pass & Seymour; CSB20AC1.

6) Two Pole:

7) Cooper; AH1222.
8) Hubbell; HBL1222.
9) Leviton; 1222-2.

10) Pass & Seymour; CSB20AC2.

11) Three Way:

12) Cooper; AH1223.
13) Hubbell; HBL1223.
14) Leviton; 1223-2.
15) Pass & Seymour; CSB20AC3.

16) Four Way:

17) Cooper; AH1224.
18) Hubbell; HBL1224.
19) Leviton; 1224-2.
20) Pass & Seymour; CSB20AC4.

C. Pilot-Light Switches, 20 A:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Cooper; AH1221PL for 120 and 277 V.
b. Hubbell; HBL1201PL for 120 and 277 V.
c. Leviton; 1221-LH1.
d. Pass & Seymour; PS20AC1RPL for 120 V, PS20AC1RPL7 for 277 V.

2. Description: Single pole, with neon-lighted handle, illuminated when switch is "off."

2.7 WALL PLATES

A. Single and combination types shall match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: 0.035-inch- (1-mm-) thick, satin-finished, Type 302 stainless steel.
3. Material for Unfinished Spaces: Galvanized steel.

2.8 FINISHES

A. Device Color:

1. Wiring Devices Connected to Normal Power System: White unless otherwise indicated or required by NFPA 70 or device listing.
2. Wiring Devices Connected to Emergency Power System: Red
3. TVSS Devices: Blue.

B. Wall Plate Color: For plastic covers, match device color.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.

B. Coordination with Other Trades:

1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:

   a. Cut back and pigtail, or replace all damaged conductors.
   b. Straighten conductors that remain and remove corrosion and foreign matter.
   c. Pigtailing existing conductors is permitted, provided the outlet box is large enough.

D. Device Installation:

1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.

4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the right.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

H. Adjust locations of service poles to suit arrangement of partitions and furnishings.

3.2 GFCI RECEPTACLES

A. Install non-feed-through-type GFCI receptacles where protection of downstream receptacles is not required.

3.3 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Test Instruments: Use instruments that comply with UL 1436.
2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.

B. Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.
2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.

4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.
6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

C. Wiring device will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION 262726

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SECTION 26 28 16
ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fusible switches.
2. Nonfusible switches.
3. Receptacle switches.
4. Shunt trip switches.
5. Molded-case circuit breakers (MCCBs).
6. Enclosures.

1.2 DEFINITIONS

A. NC: Normally closed.

B. NO: Normally open.

C. SPDT: Single pole, double throw.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated.

B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: For power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.6 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. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 FUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

B. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Type HD, Heavy Duty, Double Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

D. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
4. Lugs: Suitable for number, size, and conductor material.
5. Service-Rated Switches: Labeled for use as service equipment.

2.2 NONFUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

B. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Type HD, Heavy Duty, Double Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

D. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Lugs: Suitable for number, size, and conductor material.

2.3 SHUNT TRIP SWITCHES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Cooper Bussmann, Inc.
2. Ferraz Shawmut, Inc.
3. Littelfuse, Inc.

B. General Requirements: Comply with UL 50, and UL 98, with 200-kA interrupting and short-circuit current rating when fitted with Class J fuses.

C. Switches: Three-pole, horsepower rated, with integral shunt trip mechanism and Class J fuse block; lockable handle with capability to accept three padlocks; interlocked with cover in closed position.

D. Control Circuit: 120-V ac; obtained from integral control power transformer, with primary and secondary fuses**,** with a control power source of enough capacity to operate shunt trip, connected pilot, and indicating and control devices.

E. Accessories:

1. Oiltight key switch for key-to-test function.
2. Oiltight ON pilot light.
3. Isolated neutral lug.
4. Mechanically interlocked auxiliary contacts that change state when switch is opened and closed.

5. Form C alarm contacts that change state when switch is tripped.

2.4 MOLDED-CASE CIRCUIT BREAKERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.

C. 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.

D. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:

1. Instantaneous trip.
2. Long- and short-time pickup levels.
3. Long- and short-time time adjustments.
4. Ground-fault pickup level, time delay, and I^2t response.

E. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.

F. Features and Accessories:

1. Standard frame sizes, trip ratings, and number of poles.
2. Lugs: Suitable for number, size, trip ratings, and conductor material.
3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
4. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
5. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
6. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
7. Alarm Switch: One NO contact that operates only when circuit breaker has tripped.

2.5 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
2. Outdoor Locations: NEMA 250, Type 3R.
3. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

B. Comply with mounting and anchoring requirements specified in Section 260548 "Vibration and Seismic Controls for Electrical Systems."

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

D. Install fuses in fusible devices.

E. Comply with NECA 1.

3.2 IDENTIFICATION

A. Comply with requirements in Section 260553 "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Acceptance Testing Preparation:

1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

C. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. 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.

D. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

END OF SECTION 262816

SECTION 26 32 13
ENGINE GENERATORS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes packaged engine-generator sets for emergency power supply with the following features:

1. Diesel engine.
2. Unit-mounted cooling system.
3. Unit-mounted control and monitoring.
4. Unit mounted 24-hour fuel supply
5. Outdoor enclosure.

B. See Section 263600 "Transfer Switches" for transfer switches including sensors and relays to initiate automatic-starting and -stopping signals for engine-generator sets.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of packaged engine generator and accessory indicated.

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.

1.3 INFORMATIONAL SUBMITTALS

A. Source quality-control test reports.

B. Field quality-control test reports.

C. Warranty: Special warranty specified in this Section.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 200 miles (321 km) of Project site, a service center capable of providing training, parts, and emergency maintenance repairs.

C. 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.

D. Comply with ASME B15.1.

E. Comply with NFPA 37.

F. Comply with NFPA 70.

G. Comply with NFPA 99.

H. Comply with NFPA 110 requirements for Level 1 emergency power supply system.

I. Comply with UL 2200.

J. Engine Exhaust Emissions: Comply with applicable Federal, state and local government requirements.

K. Noise Emission: Comply with applicable state and local government requirements for maximum noise level at adjacent property boundaries due to sound emitted by generator set including engine, engine exhaust, engine cooling-air intake and discharge, and other components of installation.

1.6 PROJECT CONDITIONS

A. Environmental Conditions: Engine-generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:

1. Ambient Temperature: 5 to 40 deg C.
2. Relative Humidity: 0 to 95 percent.
3. Altitude: Sea level to 1000 feet (300) m.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of packaged engine generators and associated auxiliary components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 5 years from date of Substantial Completion.

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. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

1. Caterpillar; Engine Div.
2. Generac Power Systems, Inc.
3. Kohler Co.; Generator Division.
4. Onan/Cummins Power Generation; Industrial Business Group.
5. Spectrum Detroit Diesel.

2.2 ENGINE-GENERATOR SET

A. Factory-assembled and -tested, engine-generator set.

B. Mounting Frame: Maintain alignment of mounted components without depending on concrete foundation; and have lifting attachments.

C. Capacities and Characteristics:

1. Power Output Ratings: Nominal ratings as indicated, with capacity as required to operate as a unit as evidenced by records of prototype testing.
2. Output Connections: Three-phase, four wire.
3. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of component.

D. Generator-Set Performance:

1. Steady-State Voltage Operational Bandwidth: 3 percent of rated output voltage from no load to full load.
2. Transient Voltage Performance: Not more than 20 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within three seconds.
3. Steady-State Frequency Operational Bandwidth: 0.5 percent of rated frequency from no load to full load.
4. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
5. Transient Frequency Performance: Less than 5 percent variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within five seconds.

6. Output Waveform: At no load, harmonic content measured line to line or line to neutral shall not exceed 5 percent total and 3 percent for single harmonics. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
7. Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at system output terminals, system shall supply a minimum of 250 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to generator system components.
8. Start Time: Comply with NFPA 110, Type 10, system requirements.

2.3 ENGINE

A. Fuel: Fuel oil, Grade DF-2.

B. Rated Engine Speed: 1800 rpm.

C. Maximum Piston Speed for Four-Cycle Engines: 2250 fpm (11.4 m/s).

D. Lubrication System: The following items are mounted on engine or skid:

1. Filter and Strainer: Rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow.
2. Thermostatic Control Valve: Control flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and is designed to be fail-safe.
3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.

E. Engine Fuel System:

1. Main Fuel Pump: Mounted on engine. Pump ensures adequate primary fuel flow under starting and load conditions.
2. Relief-Bypass Valve: Automatically regulates pressure in fuel line and returns excess fuel to source.
3. Dual Natural Gas with LP-Gas Backup (Vapor-Withdrawal) System:

   a. Carburetor.
   b. Secondary Gas Regulators: One for each fuel type.
   c. Fuel-Shutoff Solenoid Valves: One for each fuel source.
   d. Flexible Fuel Connectors: One for each fuel source.

F. Coolant Jacket Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with NFPA 110 requirements for Level 1 equipment for heater capacity.

G. Governor: Adjustable isochronous, with speed sensing.

H. Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine-generator-set mounting frame and integral engine-driven coolant pump.

1. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
2. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.

I. Muffler/Silencer: Critical type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.

1. Minimum sound attenuation of 25 dB at 500 Hz.
2. Sound level measured at a distance of 10 feet (3 m) from exhaust discharge after installation is complete shall be 85 dBA or less.

J. Air-Intake Filter: Heavy-duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.

K. Starting System: 24-V electric, with negative ground.

1. Components: Sized so they will not be damaged during a full engine-cranking cycle with ambient temperature at maximum specified in Part 1 "Project Conditions" Article.
2. Cranking Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.
3. Cranking Cycle: As required by NFPA 110 for system level specified.
4. Battery: Adequate capacity within ambient temperature range specified in Part 1 "Project Conditions" Article to provide specified cranking cycle at least twice without recharging.
5. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and 35-A minimum continuous rating.

   a. Battery Charger: Current-limiting, automatic-equalizing and float-charging type. Unit shall comply with UL 1236.

2.4 FUEL OIL STORAGE

A. Comply with NFPA 30.

B. Base-Mounted Fuel Oil Tank: Factory installed and piped, complying with UL 142 fuel oil tank. Features include the following:

1. Tank level indicator.
2. Capacity: Fuel for eight hours' continuous operation at 100 percent rated power output.
3. Vandal-resistant fill cap.
4. Containment Provisions: Comply with requirements of authorities having jurisdiction.

2.5 CONTROL AND MONITORING

A. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of generator set. When mode-selector switch is switched to the on position, generator set starts. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms.

B. Manual Starting System Sequence of Operation: Switching on-off switch on the generator control panel to the on position starts generator set. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms.

C. Configuration: Operating and safety indications, protective devices, basic system controls, and engine gages shall be grouped in a common control and monitoring panel mounted on the generator set. Mounting method shall isolate the control panel from generator-set vibration.

D. Indicating and Protective Devices and Controls: As required by NFPA 110 for Level [**1**] [**2**] system, and the following:

1. AC voltmeter.
2. AC ammeter.
3. AC frequency meter.
4. DC voltmeter (alternator battery charging).
5. Engine-coolant temperature gage.
6. Engine lubricating-oil pressure gage.
7. Running-time meter.
8. Ammeter-voltmeter, phase-selector switch(es).
9. Generator-voltage adjusting rheostat.
10. Fuel tank derangement alarm.
11. Fuel tank high-level shutdown of fuel supply alarm.
12. Generator overload.

E. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator, unless otherwise indicated.

F. Common Remote Audible Alarm: Comply with NFPA 110 requirements for Level 1 systems. Include necessary contacts and terminals in control and monitoring panel.

1. Overcrank shutdown.
2. Coolant low-temperature alarm.
3. Control switch not in auto position.
4. Battery-charger malfunction alarm.
5. Battery low-voltage alarm.

G. Remote Alarm Annunciator: Comply with NFPA 99. An LED labeled with proper alarm conditions shall identify each alarm event and a common audible signal shall sound for each alarm condition. Silencing switch in face of panel shall silence signal without altering visual indication. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset. Cabinet and faceplate are surface- or flush-mounting type to suit mounting conditions indicated.

2.6 GENERATOR OVERCURRENT AND FAULT PROTECTION

A. Generator Circuit Breaker: Molded-case, thermal-magnetic type; 100 percent rated; complying with NEMA AB 1 and UL 489.

1. Tripping Characteristic: Designed specifically for generator protection.
2. Trip Rating: Matched to generator rating.
3. Shunt Trip: Connected to trip breaker when generator set is shut down by other protective devices.
4. Mounting: Adjacent to or integrated with control and monitoring panel.

B. Ground-Fault Indication: Comply with NFPA 70, "Emergency System" signals for ground-fault. Integrate ground-fault alarm indication with other generator-set alarm indications.

2.7 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

A. Comply with NEMA MG 1.

B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.

C. Electrical Insulation: Class H or Class F.

D. Stator-Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required.

E. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.

F. Enclosure: Dripproof.

G. Instrument Transformers: Mounted within generator enclosure.

H. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified.

1. Adjusting rheostat on control and monitoring panel shall provide plus or minus 5 percent adjustment of output-voltage operating band.

I. Strip Heater: Thermostatically controlled unit arranged to maintain stator windings above dew point.

J. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.

K. Subtransient Reactance: 12 percent, maximum.

2.8 OUTDOOR GENERATOR-SET ENCLOSURE

A. Description: Vandal-resistant, weatherproof steel housing, wind resistant up to 100 mph (160 km/h). Multiple panels shall be lockable and provide adequate access to components requiring maintenance. Panels shall be removable by one person without tools. Instruments and control shall be mounted within enclosure.

B. Engine Cooling Airflow through Enclosure: Maintain temperature rise of system components within required limits when unit operates at 110 percent of rated load for 2 hours with ambient temperature at top of range specified in system service conditions.

1. Louvers: Fixed-engine, cooling-air inlet and discharge. Storm-proof and drainable louvers prevent entry of rain and snow.
2. Automatic Dampers: At engine cooling-air inlet and discharge. Dampers shall be closed to reduce enclosure heat loss in cold weather when unit is not operating.

C. Interior Lights with Switch: Factory-wired, vaporproof-type fixtures within housing; arranged to illuminate controls and accessible interior. Arrange for external electrical connection.

1. AC lighting system and connection point for operation when remote source is available.
2. DC lighting system for operation when remote source and generator are both unavailable.

D. Convenience Outlets: Factory wired, GFCI. Arrange for external electrical connection.

2.9 VIBRATION ISOLATION DEVICES

A. Elastomeric Isolator Pads: Oil- and water-resistant elastomer or natural rubber, arranged in single or multiple layers, molded with a nonslip pattern and galvanized-steel baseplates of sufficient stiffness for uniform loading over pad area, and factory cut to sizes that match requirements of supported equipment.

1. Material: Bridge-bearing neoprene, complying with AASHTO M 251.
2. Durometer Rating: 60.
3. Number of Layers: .

B. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic restraint.

1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to wind loads or if weight is removed; factory-drilled baseplate bonded to 1/4-inch- (6-mm-) thick, elastomeric isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
2. Outside Spring Diameter: Not less than 80 percent of compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.10 FINISHES

A. Indoor and Outdoor Enclosures and Components: Manufacturer's standard finish over corrosion-resistant pretreatment and compatible primer.

2.11 SOURCE QUALITY CONTROL

A. Prototype Testing: Factory test engine-generator set using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.

1. Tests: Comply with NFPA 110, Level 1 Energy Converters and with IEEE 115.
2. Report factory test results within 10 days of completion of test.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with packaged engine-generator manufacturers' written installation and alignment instructions and with NFPA 110.

B. Install packaged engine generator to provide access, without removing connections or accessories, for periodic maintenance.

C. Install packaged engine generator with restrained spring isolators having a minimum deflection of 1 inch (25 mm) on 4-inch- (100-mm-) high concrete base. Secure sets to anchor bolts installed in concrete bases. Concrete base construction is specified in Section 260548 "Vibration and Seismic Controls for Electrical Systems."

D. Install Schedule 40, black steel piping with welded joints and connect to engine muffler. Install thimble at wall. Piping shall be same diameter as muffler outlet. Flexible connectors and steel piping materials and installation requirements are specified in Section 232113 "Hydronic Piping."

1. Install condensate drain piping to muffler drain outlet full size of drain connection with a shutoff valve, stainless-steel flexible connector, and Schedule 40, black steel pipe with welded joints. Flexible connectors and piping materials and installation requirements are specified in Section 232113 "Hydronic Piping."

E. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.

F. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping and specialties.

G. Connect fuel, cooling-system, and exhaust-system piping adjacent to packaged engine generator to allow service and maintenance.

H. Connect engine exhaust pipe to engine with flexible connector.

I. Connect fuel piping to engines with a gate valve and union and flexible connector.

J. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

K. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

L. Identify system components according to Section 230553 "Identification for HVAC Piping and Equipment" and Section 260553 "Identification for Electrical Systems."

3.2 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

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.

B. Tests and Inspections:

1. Perform tests recommended by manufacturer and each electrical test and visual and mechanical inspection (except those indicated to be optional) for "AC Generators and for Emergency Systems" specified in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. NFPA 110 Acceptance Tests: Perform tests required by NFPA 110 that are additional to those specified here including, but not limited to, single-step full-load pickup test.
3. Battery Tests: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.

a. Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.
b. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.
c. Verify acceptance of charge for each element of the battery after discharge.
d. Verify that measurements are within manufacturer's specifications.

4. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.
5. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine-generator system before and during system operation. Check for air, exhaust, and fluid leaks.
6. Exhaust-System Back-Pressure Test: Use a manometer with a scale exceeding 40-inch wg (120 kPa). Connect to exhaust line close to engine exhaust manifold. Verify that back pressure at full-rated load is within manufacturer's written allowable limits for the engine.
7. Exhaust Emissions Test: Comply with applicable government test criteria.
8. Voltage and Frequency Transient Stability Tests: Use recording oscilloscope to measure voltage and frequency transients for 50 and 100 percent step-load increases and decreases, and verify that performance is as specified.
9. Harmonic-Content Tests: Measure harmonic content of output voltage under 25 percent and at 100 percent of rated linear load. Verify that harmonic content is within specified limits.
10. Noise Level Tests: Measure A-weighted level of noise emanating from generator-set installation, including engine exhaust and cooling-air intake and discharge, at four locations on the property line, and compare measured levels with required values.

C. Coordinate tests with tests for transfer switches and run them concurrently.

D. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

E. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

F. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

G. Remove and replace malfunctioning units and retest as specified above.

H. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.

I. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations.

Attach a label or tag to each tested component indicating satisfactory completion of tests.

3.3 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators. Refer to Section 017900 "Demonstration and Training."

END OF SECTION 263213

SECTION 26 33 53
STATIC UNINTERRUPTIBLE POWER SUPPLY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Three-phase, on-line, double-conversion, static-type, UPS units with the following features:

   a. Surge suppression.
   b. Rectifier-charger.
   c. Inverter.
   d. Static bypass transfer switch.
   e. Battery and battery disconnect device.
   f. Battery monitoring.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include data on features, components, ratings, and performance.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, components, and location and identification of each field connection. Show access, workspace, and clearance requirements; details of control panels; and battery arrangement. Include wiring diagrams.

1.3 INFORMATIONAL SUBMITTALS

A. Factory Test Reports: Comply with specified requirements.

B. Field quality-control reports.

C. Warranties.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.5 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. UL Compliance: Listed and labeled under UL 1778 by an NRTL.

C. NFPA Compliance: Mark UPS components as suitable for installation in computer rooms according to NFPA 75.

1.6 WARRANTY

A. Special Battery Warranties: Specified form in which manufacturer and Installer agree to repair or replace UPS system storage batteries that fail in materials or workmanship within specified warranty period.

1. Warranted Cycle Life for Valve-Regulated, Lead-Calcium Batteries: Equal to or greater than that represented in manufacturer's published table, including figures corresponding to the following, based on annual average battery temperature of 77 deg F (25 deg C):

Discharge Rate	Discharge Duration	Discharge End Voltage	Cycle Life
8 hours	8 hours	1.67	6 cycles
30 minutes	30 minutes	1.67	20 cycles
15 minutes	45 seconds	1.67	120 cycles

2. Warranted Cycle Life for Premium Valve-Regulated, Lead-calcium Batteries: Equal to or greater than that represented in manufacturer's published table, including figures corresponding to the following, based on annual average battery temperature of 77 deg F (25 deg C):

Discharge Rate	Discharge Duration	Discharge End Voltage	Cycle Life
8 hours	8 hours	1.67	40 cycles
30 minutes	30 minutes	1.67	125 cycles
15 minutes	1.5 minutes	1.67	750 cycles

B. Special UPS Warranties: Specified form in which manufacturer and Installer agree to repair or replace components that fail in materials or workmanship within special warranty period.

1. Special Warranty Period: Three years

PART 2 - PRODUCTS

2.1 OPERATIONAL REQUIREMENTS

A. Automatic operation includes the following:

1. Normal Conditions: Load is supplied with power flowing from the normal power input terminals, through the rectifier-charger and inverter, with the battery connected in parallel with the rectifier-charger output.
2. Abnormal Supply Conditions: If normal supply deviates from specified and adjustable voltage, voltage waveform, or frequency limits, the battery supplies energy to maintain constant, regulated inverter power output to the load without switching or disturbance.
3. If normal power fails, energy supplied by the battery through the inverter continues supply-regulated power to the load without switching or disturbance.
4. When power is restored at the normal supply terminals of the system, controls automatically synchronize the inverter with the external source before transferring the load. The rectifier-charger then supplies power to the load through the inverter and simultaneously recharges the battery.
5. If the battery becomes discharged and normal supply is available, the rectifier-charger charges the battery. On reaching full charge, the rectifier-charger automatically shifts to float-charge mode.
6. If any element of the UPS system fails and power is available at the normal supply terminals of the system, the static bypass transfer switch switches the load to the normal ac supply circuit without disturbance or interruption.
7. If a fault occurs in the system supplied by the UPS, and current flows in excess of the overload rating of the UPS system, the static bypass transfer switch operates to bypass the fault current to the normal ac supply circuit for fault clearing.
8. When the fault has cleared, the static bypass transfer switch returns the load to the UPS system.
9. If the battery is disconnected, the UPS continues to supply power to the load with no degradation of its regulation of voltage and frequency of the output bus.

B. Manual operation includes the following:

1. Turning the inverter off causes the static bypass transfer switch to transfer the load directly to the normal ac supply circuit without disturbance or interruption.
2. Turning the inverter on causes the static bypass transfer switch to transfer the load to the inverter.

C. Maintenance Bypass/Isolation Switch Operation: Switch is interlocked so it cannot be operated unless the static bypass transfer switch is in the bypass mode. Device provides manual selection among the three conditions in subparagraphs below without interrupting supply to the load during switching:

1. Full Isolation: Load is supplied, bypassing the UPS. Normal UPS ac input circuit, static bypass transfer switch, and UPS load terminals are completely disconnected from external circuits.
2. Maintenance Bypass: Load is supplied, bypassing the UPS. UPS ac supply terminals are energized to permit operational checking, but system load terminals are isolated from the load.
3. Normal: Normal UPS ac supply terminals are energized and the load is supplied through either the static bypass transfer switch and the UPS rectifier-charger and inverter, or the battery and the inverter.

D. Environmental Conditions: The UPS shall be capable of operating continuously in the following environmental conditions without mechanical or electrical damage or degradation of operating capability, except battery performance.

1. Ambient Temperature for Electronic Components: 32 to 104 deg F (0 to 40 deg C).
2. Ambient Temperature for Battery: 41 to 95 deg F (5 to 35 deg C).
3. Relative Humidity: 0 to 95 percent, noncondensing.
4. Altitude: Sea level to 1000 feet (1220 m).

2.2 PERFORMANCE REQUIREMENTS

A. The UPS shall perform as specified in this article while supplying rated full-load current, composed of any combination of linear and nonlinear load, up to 100 percent nonlinear load with a load crest factor of 3.0, under the following conditions or combinations of the following conditions:

1. Inverter is switched to battery source.
2. Steady-state ac input voltage deviates up to plus or minus 10 percent from nominal voltage.
3. Steady-state input frequency deviates up to plus or minus 5 percent from nominal frequency.
4. THD of input voltage is 15 percent or more with a minimum crest factor of 3.0, and the largest single harmonic component is a minimum of 5 percent of the fundamental value.
5. Load is 50 percent unbalanced continuously.

B. Minimum Duration of Supply: If battery is sole energy source supplying rated full UPS load current at 80 percent power factor, duration of supply is 30 minutes.

C. Input Voltage Tolerance: System steady-state and transient output performance remains within specified tolerances when steady-state ac input voltage varies plus 10, minus 15 percent from nominal voltage.

D. Overall UPS Efficiency: Equal to or greater than 90 percent at 100 percent load, 95 percent at 75 percent load, and 95 percent at 50 percent load.

E. Maximum Acoustical Noise: 75 db, "A" weighting, emanating from any UPS component under any condition of normal operation, measured 3 from nearest surface of component enclosure.

F. Maximum Energizing Inrush Current: Eight times the full-load current.

G. Maximum AC Output-Voltage Regulation for Loads up to 50 Percent Unbalanced: Plus or minus 2 percent over the full range of battery voltage.

H. Output Frequency: 60 Hz, plus or minus 0.5 percent over the full range of input voltage, load, and battery voltage.

I. Limitation of harmonic distortion of input current to the UPS shall be as follows:

1. Description: Either a tuned harmonic filter or an arrangement of rectifier-charger circuits shall limit THD to 5 percent, maximum, at rated full UPS load current, for power sources with X/R ratio between 2 and 30.
2. Description: THD is limited to a maximum of 32 percent, at rated full UPS load current, for power sources with X/R ratio between 2 and 30.

J. Maximum Harmonic Content of Output-Voltage Waveform: 5 percent rms total and 3 percent rms for any single harmonic, for rated full load with THD up to 50 percent, with a load crest factor of 3.0.

K. Minimum Overload Capacity of UPS at Rated Voltage: 125 percent of rated full load for 10 minutes, and 150 percent for 30 seconds in all operating modes.

L. Maximum Output-Voltage Transient Excursions from Rated Value: For the following instantaneous load changes, stated as percentages of rated full UPS load, voltage shall remain within stated percentages of rated value and recover to, and remain within, plus or minus 2 percent of that value within 100 ms:

1. 50 Percent: Plus or minus 5 percent.
2. 100 Percent: Plus or minus 5 percent.
3. Loss of AC Input Power: Plus or minus 1 percent.
4. Restoration of AC Input Power: Plus or minus 1 percent.

M. Input Power Factor: A minimum of 0.70 lagging when supply voltage and current are at nominal rated values and the UPS is supplying rated full-load current.

N. EMI Emissions: Comply with FCC Rules and Regulations and with 47 CFR 15 for Class A equipment.

2.3 UPS SYSTEMS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Liebert Corporation; a division of Emerson.

2. Toshiba Corporation; Industrial Systems.
3. APC, division of Schneider Electric.

B. Electronic Equipment: Solid-state devices using hermetically sealed, semiconductor elements. Devices include rectifier-charger, inverter, static bypass transfer switch, and system controls.

C. Enclosures: Comply with NEMA 250, Type 1, unless otherwise indicated.

D. Control Assemblies: Mount on modular plug-ins, readily accessible for maintenance.

E. Surge Suppression: Protect internal UPS components from surges that enter at each ac power input connection including main disconnect switch, static bypass transfer switch. Protect rectifier-charger, inverter, controls, and output components.

1. Use factory-installed surge suppressors tested according to IEEE C62.41.1 and IEEE C62.41.2, Category C.
2. Additional Surge Protection: Protect internal UPS components from low-frequency, high-energy voltage surges described in IEEE C62.41.1 and IEEE C62.41.2. Design the circuits connecting with external power sources and select circuit elements, conductors, conventional surge suppressors, and rectifier components and controls so input assemblies will have adequate mechanical strength and thermal and current-carrying capacity to withstand stresses imposed by 40-Hz, 180 percent voltage surges described in IEEE C62.41.1 and IEEE C62.41.2.

2.4 RECTIFIER-CHARGER

A. Capacity: Adequate to supply the inverter during rated full output load conditions and simultaneously recharge the battery from fully discharged condition to 95 percent of full charge within 10 times the rated discharge time for duration of supply under battery power at full load.

B. Output Ripple: Limited by output filtration to less than 0.5 percent of rated current, peak to peak.

C. Control Circuits: Immune to frequency variations within rated frequency ranges of normal and emergency power sources.

D. Battery Float-Charging Conditions: Comply with battery manufacturer's written instructions for battery terminal voltage and charging current required for maximum battery life.

2.5 INVERTER

A. Description: Pulse-width modulated, with sinusoidal output.

2.6 STATIC BYPASS TRANSFER SWITCH

A. Description: Solid-state switching device providing uninterrupted transfer. A contactor or electrically operated circuit breaker automatically provides electrical isolation for the switch.

B. Switch Rating: Continuous duty at the rated full UPS load current, minimum.

2.7 BATTERY

A. Description: Valve-regulated, recombinant, lead-calcium units, factory assembled in an isolated compartment of UPS cabinet, complete with battery disconnect switch.

1. Arrange for drawout removal of battery assembly from cabinet for testing and inspecting.

2 The UPS battery shall be of modular construction made up of Owner-replaceable, hot swappable, fused, battery modules. Each battery module shall be monitored to determine the highest battery unit temperature for use by the UPS battery diagnostic, and temperature compensated charger circuitry.

3 Removal of a battery from the array shall not compromise the continued operation of the system using the remaining batteries.

B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. C&D Technologies, Inc.; Standby Power Division.
2. Eaton Corporation; Powerware Division.
3. EnerSys.
4. Panasonic Corporation of North America; Panasonic Industrial Company.
5. APC, division of Schneider Electric.

2.8 CONTROLS AND INDICATIONS

A. Description: Group displays, indications, and basic system controls on a common control panel on front of UPS enclosure.

B. Minimum displays, indicating devices, and controls include those in lists below. Provide sensors, transducers, terminals, relays, and wiring required to support listed items. Alarms include audible signals and visual displays.

C. Indications: Plain-language messages on a digital LCD or LED.

1. Quantitative indications shall include the following:

a. Input voltage, each phase, line to line.
b. Input current, each phase, line to line.
c. Bypass input voltage, each phase, line to line.
d. Bypass input frequency.
e. System output voltage, each phase, line to line.
f. System output current, each phase.
g. System output frequency.
h. DC bus voltage.
i. Battery current and direction (charge/discharge).
j. Elapsed time discharging battery.

2. Basic status condition indications shall include the following:

a. Normal operation.
b. Load-on bypass.
c. Load-on battery.
d. Inverter off.
e. Alarm condition.

3. Alarm indications shall include the following:

a. Bypass ac input overvoltage or undervoltage.
b. Bypass ac input overfrequency or underfrequency.
c. Bypass ac input and inverter out of synchronization.
d. Bypass ac input wrong-phase rotation.
e. Bypass ac input single-phase condition.
f. Bypass ac input filter fuse blown.
g. Internal frequency standard in use.
h. Battery system alarm.
i. Control power failure.
j. Fan failure.
k. UPS overload.
l. Battery-charging control faulty.
m. Input overvoltage or undervoltage.
n. Input transformer overtemperature.
o. Input circuit breaker tripped.
p. Input wrong-phase rotation.
q. Input single-phase condition.
r. Approaching end of battery operation.
s. Battery undervoltage shutdown.
t. Maximum battery voltage.
u. Inverter fuse blown.
v. Inverter transformer overtemperature.
w. Inverter overtemperature.
x. Static bypass transfer switch overtemperature.
y. Inverter power supply fault.
z. Inverter transistors out of saturation.
aa. Identification of faulty inverter section/leg.
bb. Inverter output overvoltage or undervoltage.

cc. UPS overload shutdown.
dd. Inverter current sensor fault.
ee. Inverter output contactor open.
ff. Inverter current limit.

4. Controls shall include the following:

a. Inverter on-off.
b. UPS start.
c. Battery test.
d. Alarm silence/reset.
e. Output-voltage adjustment.

D. Dry-form "C" contacts shall be available for remote indication of the following conditions:

1. UPS on battery.
2. UPS on-line.
3. UPS load-on bypass.
4. UPS in alarm condition.
5. UPS off (maintenance bypass closed).

E. Emergency Power Off Switch: Capable of local operation and operation by means of activation by external dry contacts.

2.9 MONITORING BY REMOTE STATUS AND ALARM PANEL

A. Description: Labeled LEDs on panel faceplate indicate five basic status conditions. Audible signal indicates alarm conditions. Silencing switch in face of panel silences signal without altering visual indication.

1. Cabinet and Faceplate: Surface or flush mounted to suit mounting conditions indicated.

2.10 BASIC BATTERY MONITORING

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Albercorp.
2. BTECH, Inc.
3. Eaton Corporation; Powerware Division.
4. APC, division of Schneider Electric.

B. Battery Ground-Fault Detector: Initiates alarm when resistance to ground of positive or negative bus of battery is less than 5000 ohms.

C. Battery compartment smoke/high-temperature detector initiates an alarm when smoke or a temperature greater than 75 deg C occurs within the compartment.

D. Annunciation of Alarms: At UPS control panel.

2.11 BATTERY-CYCLE WARRANTY MONITORING

A. Description: Electronic device, acceptable to battery manufacturer as a basis for warranty action, for monitoring of charge-discharge cycle history of batteries covered by cycle-life warranties.

B. Performance: Automatically measures and records each discharge event, classifies it according to duration category, and totals discharges according to warranty criteria, displaying remaining warranted battery life on front panel display.

C. Additional monitoring functions and features shall include the following:

1. Measuring and Recording: Total voltage at battery terminals; initiates alarm for excursions outside the proper float-voltage level.
2. Monitors: Ambient temperature at battery; initiates alarm if temperature deviates from normally acceptable range.
3. Keypad on Device Front Panel: Provides access to monitored data using front panel display.
4. Alarm Contacts: Arranged to initiate remote alarm for battery discharge events, abnormal temperature, abnormal battery voltage or temperature.
5. Memory: Stores recorded data in nonvolatile electronic memory.
6. RS-232 Port: Permits downloading of data to a portable PC.
7. Modem: Makes measurements and recorded data accessible to a remote PC via telephone line. Computer is not specified in this Section.

2.12 SOURCE QUALITY CONTROL

A. Factory test complete UPS system before shipment. Use simulated battery testing. Include the following:

1. Test and demonstration of all functions, controls, indicators, sensors, and protective devices.
2. Full-load test.
3. Transient-load response test.
4. Overload test.
5. Power failure test.

B. Report test results.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Equipment Mounting: Install UPS on concrete base. Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete."

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
4. Install anchor bolts to elevations required for proper attachment to supported equipment.

B. Maintain minimum clearances and workspace at equipment according to manufacturer's written instructions and NFPA 70.

C. Connections: Interconnect system components. Make connections to supply and load circuits according to manufacturer's wiring diagrams unless otherwise indicated.

D. Grounding Separately Derived Systems: If not part of a listed power supply for a data-processing room, comply with NFPA 70 requirements for connecting to grounding electrodes and for bonding to metallic piping near isolation transformer.

E. Identify components and wiring according to Section 260553 "Identification for Electrical Systems."

F. Equalize charging of battery cells according to manufacturer's written instructions. Record individual-cell voltages.

3.2 FIELD QUALITY CONTROL

A. 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.

B. Tests and Inspections:

1. Comply with manufacturer's written instructions.
2. Inspect interiors of enclosures, including the following:

   a. Integrity of mechanical and electrical connections.
   b. Component type and labeling verification.

c. Ratings of installed components.

3. Inspect batteries and chargers according to requirements in NETA Acceptance Testing Specifications.
4. Test manual and automatic operational features and system protective and alarm functions.
5. Test communication of status and alarms to remote monitoring equipment.

C. The UPS system will be considered defective if it does not pass tests and inspections.

D. Record of Tests and Inspections: Maintain and submit documentation of tests and inspections, including references to manufacturers' written instructions and other test and inspection criteria. Include results of tests, inspections, and retests.

E. Prepare test and inspection reports.

3.3 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain the UPS.

END OF SECTION 263353

SECTION 26 36 00
TRANSFER SWITCHES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes automatic transfer switches rated 600 V and less.

1.2 ACTION SUBMITTALS

A. Product Data: Include rated capacities, weights, operating characteristics, furnished specialties, and accessories.

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.

1.3 INFORMATIONAL SUBMITTALS

a. Dimensioned Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
b. Detailed description of equipment anchorage devices on which the certification is based.

B. Field quality-control test reports.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

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. Comply with NEMA ICS 1.

C. Comply with NFPA 70.

D. Comply with NFPA 99.

E. Comply with NFPA 110.

F. Comply with UL 1008 unless requirements of these Specifications are stricter.

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:

a. Caterpillar; Engine Div.
b. Emerson; ASCO Power Technologies, LP.
c. Generac Power Systems, Inc.
d. GE Zenith Controls.
e. Kohler Power Systems; Generator Division.
f. Onan/Cummins Power Generation; Industrial Business Group.
g. Russelectric, Inc.
h. Spectrum Detroit Diesel.

2.2 GENERAL TRANSFER-SWITCH PRODUCT REQUIREMENTS

A. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer, including tungsten filament lamp loads not exceeding 30 percent of switch ampere rating, unless otherwise indicated.

B. Tested Fault-Current Closing and Withstand Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.

a. Where transfer switch includes internal fault-current protection, rating of switch and trip unit combination shall exceed indicated fault-current value at installation location.

C. Solid-State Controls: Repetitive accuracy of all settings shall be plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C.

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: Accomplish by a nonfused, momentarily energized solenoid or electric-motor-operated mechanism, mechanically and electrically interlocked in both directions.

F. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.

a. Limitation: Switches using molded-case switches or circuit breakers or insulated-case circuit-breaker components are not acceptable.
b. Switch Action: Double throw; mechanically held in both directions.
c. Contacts: Silver composition or silver alloy for load-current switching. Conventional automatic transfer-switch units, rated 225 A and higher, shall have separate arcing contacts.

G. Neutral Switching. Where four-pole switches are indicated, provide neutral pole switched simultaneously with phase poles.

H. Neutral Terminal: Solid and fully rated, unless otherwise indicated.

I. Oversize Neutral: Ampacity and switch rating of neutral path through units indicated for oversize neutral shall be double the nominal rating of circuit in which switch is installed.

J. Battery Charger: For generator starting batteries.

a. Float type rated 10 A.
b. Ammeter to display charging current.
c. Fused ac inputs and dc outputs.

K. Enclosures: General-purpose NEMA 250, Type 3R, complying with NEMA ICS 6 and UL 508, unless otherwise indicated.

2.3 AUTOMATIC TRANSFER SWITCHES

A. Comply with Level 1 equipment according to NFPA 110.

B. Switching Arrangement: Double-throw type, incapable of pauses or intermediate position stops during normal functioning, unless otherwise indicated.

C. Signal-Before-Transfer Contacts: A set of normally open/normally closed dry contacts operates in advance of retransfer to normal source. Interval is adjustable from 1 to 30 seconds.

D. Transfer Switches Based on Molded-Case-Switch Components: Comply with NEMA AB 1, UL 489, and UL 869A.

E. In-Phase Monitor: Factory-wired, internal relay controls transfer so it occurs only when the two sources are synchronized in phase.

F. Motor Disconnect and Timing Relay: Controls designate starters so they disconnect motors before transfer and reconnect them selectively at an adjustable time interval

after transfer. Time delay for reconnecting individual motor loads is adjustable between 1 and 60 seconds, and settings are as indicated.

G. Programmed Neutral Switch Position: Switch operator has a programmed neutral position arranged to provide a midpoint between the two working switch positions, with an intentional, time-controlled pause at midpoint during transfer.

H. Automatic Transfer-Switch Features:

a. Undervoltage Sensing for Each Phase of Normal Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100 percent of nominal, and dropout voltage is adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.
b. Adjustable Time Delay: For override of normal-source voltage sensing to delay transfer and engine start signals. Adjustable from zero to six seconds, and factory set for one second.
c. Voltage/Frequency Lockout Relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.
d. Time Delay for Retransfer to Normal Source: Adjustable from 0 to 30 minutes, and factory set for 10 minutes to automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.
e. Test Switch: Simulate normal-source failure.
f. Switch-Position Pilot Lights: Indicate source to which load is connected.
g. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and emergency-source sensing circuits.

    a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
    b. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."

h. Unassigned Auxiliary Contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.
i. Transfer Override Switch: Overrides automatic retransfer control so automatic transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.
j. Engine Starting Contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V dc minimum.
k. Engine Shutdown Contacts: Instantaneous; shall initiate shutdown sequence at remote engine-generator controls after retransfer of load to normal source.
l. Engine Shutdown Contacts: Time delay adjustable from zero to five minutes, and factory set for five minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.
m. Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine generator and transfers load to it from normal source for a preset time,

then retransfers and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods are adjustable from 10 to 30 minutes. Factory settings are for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser features include the following:

a. Exerciser Transfer Selector Switch: Permits selection of exercise with and without load transfer.
b. Push-button programming control with digital display of settings.
c. Integral battery operation of time switch when normal control power is not available.

2.4 SOURCE QUALITY CONTROL

A. Factory test and inspect components, assembled switches, and associated equipment. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.

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 Section 260548 "Vibration and Seismic Controls for Electrical Systems."

B. Floor-Mounting Switch: Anchor to floor by bolting.

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 Section 260529 "Hangers and Supports for Electrical Systems."

C. Identify components according to Section 260553 "Identification for Electrical Systems."

D. Set field-adjustable intervals and delays, relays, and engine exerciser clock.

3.2 CONNECTIONS

A. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

B. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

B. Perform tests and inspections and prepare test reports.

a. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installation, including connections, and to assist in testing.
b. After installing equipment and after electrical circuitry has been energized, test for compliance with requirements.
c. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
d. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.

a. Check for electrical continuity of circuits and for short circuits.
b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
c. Verify that manual transfer warnings are properly placed.
d. Perform manual transfer operation.

e. After energizing circuits, demonstrate interlocking sequence and operational function for each switch at least three times.

a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.
b. Simulate loss of phase-to-ground voltage for each phase of normal source.
c. Verify time-delay settings.
d. Verify pickup and dropout voltages by data readout or inspection of control settings.
e. Perform contact-resistance test across main contacts and correct values exceeding 500 microhms and values for 1 pole deviating by more than 50 percent from other poles.
f. 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.

f. Ground-Fault Tests: Coordinate with testing of ground-fault protective devices for power delivery from both sources.

a. Verify grounding connections and locations and ratings of sensors.

C. Coordinate tests with tests of generator and run them concurrently.

D. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.

E. Remove and replace malfunctioning units and retest as specified above.

F. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switch. Remove all access panels so joints and connections are accessible to portable scanner.

a. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of Substantial Completion.
b. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
c. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment as specified below. Refer to Section 017900 "Demonstration and Training."

B. Coordinate this training with that for generator equipment.

END OF SECTION 263600

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SECTION 26 51 00
INTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior lighting fixtures, lamps, and ballasts.
2. Emergency lighting units.
3. Exit signs.
4. Lighting fixture supports.
5. Retrofit kits for fluorescent lighting fixtures.

B. Related Sections:
1. Section 262726 "Wiring Devices" for manual wall-box dimmers for incandescent lamps.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, and finishes.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.4 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. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, product(s) indicated on Drawings.

2.2 GENERAL REQUIREMENTS FOR LIGHTING FIXTURES AND COMPONENTS

A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.

B. Fluorescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable.

C. HID Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5B.

D. Metal Parts: Free of burrs and sharp corners and edges.

E. Sheet Metal Components: Steel unless otherwise indicated. Form and support to prevent warping and sagging.

F. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

G. Diffusers and Globes:

1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

a. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless otherwise indicated.
b. UV stabilized.

2. Glass: Annealed crystal glass unless otherwise indicated.

2.3 BALLASTS FOR LINEAR FLUORESCENT LAMPS

A. General Requirements for Electronic Ballasts:

1. Comply with UL 935 and with ANSI C82.11.
2. Designed for type and quantity of lamps served.

3. Ballasts shall be designed for full light output unless another BF, dimmer, or bi-level control is indicated.
4. Sound Rating: Class A See Evaluations for discussion on harmonic considerations.
5. Total Harmonic Distortion Rating: Less than 10 percent.
6. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
7. Operating Frequency: 42 kHz or higher.
8. Lamp Current Crest Factor: 1.7 or less.
9. BF: 0.88 or higher.
10. Power Factor: 0.98 or higher.

B. Luminaires controlled by occupancy sensors shall have programmed-start ballasts.

C. Single Ballasts for Multiple Lighting Fixtures: Factory wired with ballast arrangements and bundled extension wiring to suit final installation conditions without modification or rewiring in the field.

2.4 EMERGENCY FLUORESCENT POWER UNIT

A. Internal Type: Self-contained, modular, battery-inverter unit, factory mounted within lighting fixture body and compatible with ballast. Comply with UL 924.

1. Emergency Connection: Operate one fluorescent lamp continuously at an output of 1100 lumens each. Connect unswitched circuit to battery-inverter unit and switched circuit to fixture ballast.
2. Nightlight Connection: Operate one fluorescent lamp continuously.
3. Test Push Button and Indicator Light: Visible and accessible without opening fixture or entering ceiling space.

   a. Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
   b. Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

4. Battery: Sealed, maintenance-free, nickel-cadmium type.
5. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.
6. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.
7. Interference: Comply with 47 CFR 18, Ch. 1, Subpart C, for limitations on electromagnetic and radio-frequency interference for nonconsumer equipment.
8. Protection: Class P thermal cutout.

2.5 FLUORESCENT LAMPS

A. T8 rapid-start lamps, rated 32 W maximum, nominal length of 48 inches (1220 mm), 2800 initial lumens (minimum), CRI 75 (minimum), color temperature 3500 K, and average rated life 20,000 hours unless otherwise indicated.

B. T8 rapid-start lamps, rated 32 W maximum, nominal length of 22 inches (560 mm), U-shaped, 2800 initial lumens (minimum), CRI 75 (minimum), color temperature 3500 K, and average rated life 20,000 hours unless otherwise indicated.

2.6 LIGHTING FIXTURE SUPPORT COMPONENTS

A. Comply with Section 260529 "Hangers and Supports for Electrical Systems" for channel- and angle-iron supports and nonmetallic channel and angle supports.

B. Twin-Stem Hangers: Two, 1/2-inch (13-mm) steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.

C. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage (2.68 mm).

D. Rod Hangers: 3/16-inch (5-mm) minimum diameter, cadmium-plated, threaded steel rod.

E. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Lighting fixtures: Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.

B. Comply with NFPA 70 for minimum fixture supports.

C. Suspended Lighting Fixture Support:

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. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.

D. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.2 FIELD QUALITY CONTROL

A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.

B. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

END OF SECTION 265100

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SECTION 27 05 00

COMMON WORK RESULTS FOR COMMUNICATIONS

1.00 GENERAL

1.01 DESCRIPTION

A. A Structured Cabling System (SCS) will be implemented at San Antonio International Airport (SAIA) that consists of a passive infrastructure. This infrastructure will provide the backbone and interconnections to various computer and telephone systems throughout the airport. Installation of the infrastructure devices should follow an industry recognized standards-based approach. An approved common wiring scheme for all organizations within a facility is critical to support services and equipment from multiple vendors. In addition, standards will define cabling types and their maximum distances, communications room design aspects, work area and component recommendations, and the means of connecting to various application systems.

B. ANSI/TIA/EIA 568B and the BICSI Telecommunications Distribution Design Manual (TDDM) have been established as the standard for this cabling infrastructure installation. All cabling infrastructure shall be installed to the requirements set forth in the reference documents listed within.

1.02 RELATED SECTIONS

A. Section 27 05 26 Grounding and Bonding for Communications Systems

B. Section 27 05 33 Conduits and Back Boxes for Communications Systems

C. Section 27 05 36 Cable Trays for Communications Systems

D. Section 27 05 43 Underground Ducts and Raceways for Communications Systems

E. Section 27 05 53 Identification for Communications Systems

F. Section 27 08 00 Commissioning of Communications Systems

G. Section 27 11 00 Communications Equipment Room Fittings

H. Section 27 13 13 Communications Copper Backbone Cabling

I. Section 27 13 23 Communications Optical Fiber Backbone Cabling

J. Section 27 15 00 Communications Horizontal Cabling

1.03 REFERENCES

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

B. Specific reference in specifications to codes, rules, regulations, standards, manufacturer's instructions, or requirements of regulatory agencies shall mean the latest printed edition of each in effect at the date of contract.

C. Conflicts

1. Between referenced requirements: Comply with the one establishing the more stringent requirements.

2. Between referenced requirements and contract documents: Comply with the one establishing the more stringent requirements.

D. Telecommunications Industry Association /Electronic Industries Association (TIA/EIA) 568B-Commercial Building Telecommunications Wiring Standards.

E. TIA/EIA-569A – Commercial Building Standard for Telecommunications Pathways and Spaces.

F. ANSI/TIA/EIA 606 – Administration Standard for the Telecommunications Infrastructure of Commercial Buildings.

G. ANSI/TIA/EIA 607 – Commercial Building Grounding and Bonding Requirements.

H. ANSI/TIA/EIA 758 – Customer-Owned Outside Plant Telecommunications Cabling Standard.

I. TIA/EIA-TSB-67 - Transmission Performance Specifications for Field Testing of Unshielded Twisted Pair Cabling Systems.

J. TIA/EIA-TSB-72 – Centralized Optical Fiber Cabling Guidelines.

K. TIA/EIA PN – 3398 Cabling practices for Open Offices.

L. TIA/EIA TSB-75 – Additional Horizontal Cabling Practices for Open Offices.

M. COSA ITSD Communication Cabling Standards Version 1.0

1.04 ABBREVIATIONS

A. BDF – Building Distribution Frame

B. BICSI – Building Industry Consulting Services International

C. COSA – City of San Antonio

D. IDF – Intermediate Distribution Frame

E. ITSD Information Technology Services Department

F. SAIA – San Antonio International Airport

G. SCS – Structured Cabling System

2.00 PRODUCTS

2.01 MANUFACTURERS

A. The Structured Cabling System (SCS) to be installed at the San Antonio International Airport is required to be a complete end to end (channel) solution. As such, a single entity will be responsible for certifying and warranting all components of the system including backbone cabling, horizontal cabling, and all termination devices. The manufacturers listed below have been identified as acceptable for providing the end-to-end solution:

1. Systimax by CommScope
2. Belden
3. Panduit

B. This list is provided as an aid in the selection process and is not meant to preclude other manufacturers that may be qualified to provide communications components. Other manufacturers may be proposed but shall require project engineer's approval.

C. The Contractor shall supply materials as described and shown. The Contractor shall supply all cabling (including patch cords), connectors, adapters, and terminations necessary to interconnect all system equipment including equipment located in the Communications Rooms (BDFs/IDFs), and as shown on drawings.

D. Substitutions for any product identified in the design drawings or specifications must be submitted to SAIA for approval as part of the product submittal process.

3.00 EXECUTION

3.01 GENERAL

A. Verify conduit, raceways, boxes, cable trays, handholds and manholes to be utilized have been properly installed in accordance with BICSI and ANSI/TIA/EIA standards and recommendations.

B. Verify each Communications Room (BDF/IDF) has properly installed plywood backboards for mounting telecommunications equipment.

1. Each wall of the IDF shall be covered with rigidly fixed ¾ inch void free A-C plywood, 8 feet high, capable of supporting attached equipment.
2. Plywood shall be covered with a minimum of two coats of fire retardant white paint.

C. Verify conduit is minimum 1 -inch diameter.

D. Verify telecommunications grounding system is properly installed and tested in accordance with BICSI and ANSI/TIA/EIA standards and recommendations

E. Verify liquid-carrying pipes are not installed in or above voice and data system Equipment Rooms. If liquid-carrying pipes are identified, do not proceed with installation without written approval from the SAIA.

F. Verify support devices are properly installed

G. Verify all electrical circuits used for the connection of technology equipment are dedicated single phase 120 volt 20 amp circuit. These outlets should be served from dedicated panels within the communications room. A minimum of two electrical outlets are required in each Telecommunications Room. All of these outlets should be on an emergency backup power system to provide continuous uninterrupted power to the equipment.

H. All 120-volt circuits should be clearly marked and dedicated for technology.

I. All Telecommunications Rooms, BDF, IDFs should not be adjacent to any space that contains sources of Electromagnetic Interference (EMI). Transformers shall not be placed in any Telecommunications Room and should be located at least 4 feet from any communications cable or termination equipment.

J. All protected telecommunication terminations require bonding, grounding and a Telecommunications Grounding Busbar (TGB).

K. Flooring in Telecommunications Rooms shall be anti-static.

L. Telecommunications Rooms will have open ceilings at a minimum height of 8' 6" with all exposed concrete to avoid dust.

M. If any of the above items are verified to be non-compliant with the requirements stated in this Specification, or with BICSI and ANSI/TIA/EIA standards and recommendations cease all work and notify the SAIA immediately.

N. Contractor shall be required to coordinate with other disciplines and install all necessary equipment to support the installation of supporting systems including but not limited to; access control, fire monitoring, and HVAC control systems as shown on the project plans for all disciplines.

3.02 INSTALLATION

A. Install all components in accordance with BISCI recommended practices, ANSI/TIA/EIA standards, and SAIA guidelines and standards.

B. Coordinate all work with the SAIA, COSA ITSD and the approved project schedule.

3.03 PROJECT CLOSEOUT

A. Prior to project closeout, all components shall be tested and accepted by SAIA, and all required as-built documentation shall be submitted.

B. Project closeout shall require the following:

C. All cable test records submitted and accepted by SAIA

D. Field inspections performed by the SAIA to ensure all components have been installed correctly. This shall require written acceptance by SAIA field inspector(s).

E. All project punch list items have been completed

F. As-built cable records, drawings, and cable management information has been submitted and accepted by the SAIA.

END OF SECTION 27 05 00

SECTION 27 05 26

GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

1.00 GENERAL

1.01 DESCRIPTION

A. This section includes the specification for grounding and bonding of telecommunications equipment as specified and as shown on the contract drawings.

B. Related Documents: Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to the work this section.

1.02 RELATED SECTIONS

A. Section 27 05 00 Common Work Results for Communications and sections referenced therein

1.03 REFERENCES

A. Conflicts:

1. Between referenced requirements: Comply with the one establishing the more stringent requirements.
2. Between referenced requirements and contract documents: Comply with the one establishing the more stringent requirements.

B. American Society for Testing and Materials (ASTM):

1. B3 Soft or Annealed Copper Wires
2. B8 Concentric-Lay-Stranded Copper Conductors, Hard, Medium Hard, Soft
3. B33 Tinned Soft or Annealed Copper Wire for Electrical Purposes

C. Institute of Electrical and Electronics Engineers (IEEE):

1. 142-82 Recommended Practice for Grounding of Industrial and Commercial Power Systems
2. 383-2.5 IEEE Standard for Type Test of Class IE Electric Cables, Field Splices, and Connections for Nuclear Power Generating Stations
3. 1100-1992 Recommended Practice for Powering and Grounding Sensitive Electronic Equipment in Industrial and Commercial Power Systems

D. Underwriters' Laboratories (UL):

1. 83 Thermoplastic Insulated Wire and Cables
2. 96 Lightning Protection Components
3. 96A System Installation
4. 467 Grounding and Bonding Equipment

E. National Fire Protection Association (NFPA):

1. 780 Lightning Protection Code
2. 70 National Electrical Code (NEC)
3. NEC Article No. 250 - Grounding

F. Telecommunications Industry Association/Electronic Industries Association (TIA/EIA):

1. ANSI/TIA.EIA-607 Commercial Building Grounding and Bonding Requirements for Telecommunications

G. Building Industry Consulting Services International (BICSI):

1. Telecommunications Distribution Methods Manual

H. Local, County, State and Federal regulations and codes in effect as of date of purchase shall be complied with

I. Equipment of foreign manufacture must meet U.S. codes and standards. It shall be indicated in the proposal the components which may be of foreign manufacture, if any, and the country of origin

1.04 DESIGN REQUIREMENTS

A. Design communications grounding system following ANSI/TIA/EIA-607, “Commercial Building Grounding and Bonding Requirements for Telecommunications”, and the BICSI Telecommunications Distribution Methods Manual

1.05 SUBMITTALS

A. Submit all required documents in accordance with Section 01 33 00 Submittal Procedures

B. Product Data:

1. Manufacturer’s catalog data and applicable special fabrication and installation details
2. Installation, terminating and splicing procedures
3. Instructions for handling and storage
4. Dimensions and weights

C. Submit all required documents in accordance with Specification 17030 Administrative Requirements

1.06 QUALITY ASSURANCE

A. Follow Section 01 40 00 Quality Control Services

B. Furnish products of latest proven design, new and in current production. Do not use obsolete components or out-of-production products

C. Tests for Insulated Cable: Pass vertical tray flame test following IEEE 383-2.5

1.07 SHIPPING AND HANDLING

A. Equipment shall be delivered in original packages with labels intact and identification clearly marked. Equipment and components shall be protected from the weather, humidity, temperature variations, dirt, dust, or other containments. Equipment damaged prior to system acceptance shall be replaced at no cost to the Owner

B. Ship on manufacturer's standard reel sizes of one continuous length. Where cut lengths are specified, mark reel quantity accordingly

C. Protect wire wood lagging or suitable barrier across the traverse of reels. Provide heat-shrink self-sealing end caps on cable

2.00 PRODUCTS

2.01 MANUFACTURERS

A. Cable Manufacturers

1. Anixter
2. Cablec
3. Okonite

B. Ground Rod and Connector Manufacturers

1. Blackburn
2. Copperweld
3. Thomas & Betts

C. Exothermic Connector Manufacturers

1. Burndy (Therm-O-Weld)
2. Erico (Cadweld)

D. Grounding Connectors

1. Burndy O.Z. Gedney
2. Thomas & Betts

E. The list above is provided as a supplement and is not intended to exclude other manufacturers which meet or exceed the requirements listed herein

2.02 MATERIALS

A. Grounding Conductors: Bare or insulated (green in color) copper AWG wire following ASTM-B3, ASTM-B8 and ASTM-B33, of following sizes:

1. A minimum of 6 AWG, stranded copper conductor should be used for communications

B. Grounding Connectors: It is recommended that connectors should be one of the following:

1. Tin-plated copper
2. Copper

3. Copper alloy

C. Ground Rods: A minimum of 10 feet long, 3/4 inch diameter, copper-clad steel

D. Where single conductor insulated grounding conductors are required, furnish insulation, green in color (or tape marking), rated for 600 volts

E. Telecommunications Main Grounding Busbar (TMGB):

1. The TMGB shall be a predrilled copper busbar with standard NEMA bolt hole sizing and spacing for the type of connectors to be used

2. The TMGB shall be sized for the immediate requirements and allow for growth

3. The minimum dimensions are 6 mm thick x 100 mm wide, with variable length

4. The busbar should be electrotin plated for reduced contact resistance

F. Telecommunications Grounding Busbar (TGB):

1. The TGB shall be a predrilled copper busbar with standard NEMA bolt hole sizing and spacing for the type of connectors to be used

2. The TGB shall be sized for the immediate requirements and allow for 100% growth

3. The minimum dimensions are 6 mm thick x 50 mm wide, with variable length

4. The busbar should be electrotin plated for reduced contact resistance

3.00 EXECUTION

3.01 PREPARATION

A. Complete site preparation and soil compaction before trenching and driving ground rods for underground grid

B. Verify exact location of stub-up points for grounding of equipment, fences and building or steel structures

C. Copper and copper alloy connections should be cleaned prior to connection

D. In new construction, the electrical contractor must provide accessible means to a direct electrical service ground, which is one of the best points for grounding communications systems. NEC Section 250-71(b) requires an intersystem bonding connection accessible at the electrical service equipment, such as:

1. Approved external connection on the power service panel. The NEC allows direct connection to a provided 6 AWG copper conductor

2. Exposed metallic service raceway (using an approved bonding connector)

3. Grounding electrode conductor

3.02 INSTALLATION

A. Install work following drawings, manufacturer's instructions and approved submittal data

B. Bonding conductors shall be routed with minimum bends or changes in direction and should be made directly to the points being bonded

C. Bonding connections should be made by using:

1. Bolt connectors, clamps, or lugs. Use listed hardware that has been laboratory tested to eliminate most field problems

2. Exothermic welding (see NEC Section 250-81) within the ground electrode system, for parts of a grounding system that are subject to corrosion or that must carry high currents reliably, or for locations that require minimum maintenance

D. Install main ground loop minimum 1-1/2 feet below ground surface

E. Drive rods vertically, leaving top 18 inches exposed above finished grade. Exothermic-weld below-grade grounding connections, except at ground rods. Install additional ground rods as required to pass resistance test

F. Make rods vertically, leaving top 18 inches exposed above finished grade. Exothermic-weld below-grade grounding connections, except at ground rods. Install additional ground rods as required to pass resistance test.

G. Make above-grade grounding connections with mechanical connectors or thermal connections.

1. Ground small groups of isolated equipment with No. 2 AWG minimum insulated conductor connected to the main loop

H. Telecommunications Raceway and Support Systems Grounding:

1. Bond and ground raceway, cable rack or tray and conduit together and permanently ground to the equipment grounding busbar. Connection to conduit may be with grounding bushing or ground clamp

2. Connect ladder-type cable tray to grounding electrode system. Telecommunications cable tray that is located in the same room as the TMGB shall be connected to the TMGB

3. Bond and ground raceway at low voltage motor control centers or other low voltage control equipment, except conduit which is effectively grounded to sheet metal enclosure by bonding bushing or hubs need not be otherwise bonded

4. Where a grounding conductor is run in or on a cable tray, bond grounding conductors to each section of cable tray with a cable tray ground clamp

5. Where only grounding conductor is installed in a metal conduit, bond both ends of conduit to grounding conductors

6. Provide flexible "jumpers" around raceway expansion joints and across cable tray joints parted to allow for expansion and hinged cable tray connections. Provide copper bonding straps for steel conduit

I. Telecommunications Grounding and Bonding Infrastructure:

1. Install the TMGB in the Building Distribution Frame (BDF) as close to the panelboard as possible. The TMGB should also be located so that the

bonding conductor is as short and straight as possible. Maintain clearances required by applicable electrical codes

2. If a panelboard is not installed in the BDF, locate the TMGB near the backbone cabling and terminations.

3. The TMGB shall be insulated from its support with a recommended separation of 2 inches

4. Connect the TMGB to the main electrical service ground for the building and telecommunications primary protectors

5. The minimum Telecommunications Bonding Backbone (TBB) conductor size shall be No. 6 AWG. The TBB originates at the TMGB and extends throughout the building using the telecommunications backbone pathways, and connects to the TGB(s) in all telecommunication closets and equipment rooms

6. Install the TGBs in the telecommunications closets and equipment rooms as close to the panel board as possible. The TGB should also be located so that the bonding conductor is as short and straight as possible. Maintain clearances required by applicable electrical codes. The TGB shall be insulated from its support with a recommended separation of 2 inches

7. Properly bond and ground all communications cabinets, equipment racks, raceway, cable rack or tray, and conduit together and permanently ground to the TGB

J. Telecommunications Cable Armor and Shield:

1. Terminate and ground shield of shielded control cable at one end only, preferably at the control panel end for instrument and communication cable and at the supply end for electronic power cables. Maintain shield continuity by jumpering the ground shield across connection point where it is broken at junction boxes, or other splice points. Insulate these points from ground

2. Connect ground wire in power cable assemblies at each terminal point to a ground bus, if available, or to the equipment enclosure. Do not extend these ground wires through "doughnut" CTs used for ground fault relaying, but do extend ground leads from stress cones. Ground power cable armor and shield at each terminal point

3. Bond and ground exposed cable shields and metallic sheaths according to the manufacturer's guidelines. They should also be grounded as close as possible to the point of entrance

3.03 IDENTIFICATION

A. Grounding system components shall be labeled twelve (12) inches from each end of the Telecommunications Bonding Conductor (TBC) and every ten (10) feet where exposed

B. Label all equipment grounding conductors to indicate the rack and panel being grounded and the ground bar to which the TBC is connected

C. All TBC's in the building, including, but not limited to, those connecting building steel, grounding electrodes, water pipes, radio towers, and telecommunications structural components shall be labeled

D. All TGBs shall be labeled according to their location

1. For example, the TGB located in IDF J3150 shall be labeled "TGB-J3150"

3.04 TESTING

A. Test grounding system before grid trenches are backfilled. Test for ground resistance after installation of underground grid and grounding connections

B. Install test wells at locations as required for testing, using a pipe surrounding the rod and connections with a cover placed on top at grade level

C. Test system resistance at each test well using "fall of potential" method: Maximum resistance of 5 ohms

D. Upon completion of the electrical system, including all grounding, the Electrical Contractor shall test the system for stray currents, ground shorts, etc. Approved instruments, apparatus, services, and qualified personnel shall be utilized. If stray currents, shorts, etc., are detected, eliminate or correct as required. The test procedure shall be as follows:

1. Open all main disconnects for the system being tested

2. Disconnect the system neutral from the service entrance or step-down transformer neutral connection

3. Connect a DC ohmmeter across the system neutral and equipment ground

4. An ohmmeter reading in excess of 100 ohms shall indicate that the system neutral and equipment ground are properly isolated

5. An ohmmeter reading less than 100 ohms shall indicate that the system contains ground shorts (stray currents) at some point along the system neutral

6. Grounded neutrals may be identified by disconnecting individual neutral conductors from the system, one at a time, while monitoring the ohmmeter

7. The systems shall be re-tested after correction of all ground shorts is complete.

E. The contractor shall notify the owner prior to testing the grounding system. At the Owner's discretion, the Owner may require that an Owner's Representative be present for a portion of or the entire testing process

F. Within 10 days of completion of testing of the grounding system, all test documentation shall be submitted to the SAIA Project Manager for review

END OF SECTION 27 05 26

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SECTION 27 05 33

CONDUITS AND BACK BOXES FOR COMMUNICATIONS SYSTEMS

1.00 GENERAL

1.01 DESCRIPTION

A. This section includes specifications for the installation of conduits and back boxes for communications systems.

B. Related Documents: Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to the work of this section.

1.02 RELATED SECTIONS

A. Section 27 05 00 Common Work Results and all sections referenced therein

1.03 REFERENCES

A. Conflicts:

1. Between referenced requirements: Comply with the one establishing the more stringent requirements.
2. Between referenced requirements and contract documents: Comply with the one establishing the more stringent requirements.

B. Telecommunications Industry Association/Electronic Industries Association (TIA/EIA):

1. 569A Commercial Building Standard for Telecommunications Pathways and Spaces

C. Building Industry Consulting Services International (BICSI):

1. Telecommunications Distribution Methods Manual (TDMM)

D. Federal Supply Service, General Services Administration Q-A-601F

E. ANSI C80.3 – Electrical Metallic Tubing, Zinc Coated.

F. American Society for Testing and Materials (ASTM):

1. ASTM E 84 Test Method for Surface Burning Characteristics of Building Materials.
2. ASTM E 119 Method of Fire Tests of Building Construction and Materials
3. ASTM E 814 Test Method for Fire Tests of Through Penetration Firestops.

G. Underwriters Laboratory, Inc. (UL)

1. UL Building Materials Directory
2. UL Fire Resistance Directory
3. UL 2079 Test.

H. National Electrical Manufacturers Association (NEMA) 250

1.04 SUBMITTALS

A. Submit all required documents in accordance with Section 01 33 00 Submittal Procedures

B. Submit plan and section drawings detailing proposed pathway routing and seismic bracing prior to any installation.

C. Submit catalog cut sheets of pathways and associated hardware prior to any installation.

D. Test Reports: Submit certified test reports indicating compliance with material reference standard indicated for material performance characteristics and physical properties of fire stopping materials

E. Certificates: Submit product certificates, signed by manufacturer certifying materials comply with specified performance characteristics and physical properties of fire stopping materials.

F. Submit certificates stating that the contractor is certified to properly install all firestopping materials.

1.05 QUALITY ASSURANCE

A. Follow Section 01 40 00 Quality Control Services

B. Verify conduit runs do not interfere with existing or new systems within each facility.

C. Follow Appendix B of NEC.

D. Fire stopping: Manufacturer trained and approved installer to perform fire stopping work who has specialized in the installation of work similar to that required for this project.

2.00 PRODUCTS

2.01 GENERAL

A. All conduits shall be UL listed and so labeled.

B. Where conduit and other raceway sizes are not specifically shown on the plans, conduits shall be sized in accordance with the requirements of the BICSI, NEC, and the Texas Building Code,. No conduit shall be less than 1 inch.

C. Raceways installed in stud walls or above suspended ceilings shall be Electrical Metallic Tubing. PVC conduit shall not be used.

2.02 CONDUITS AND ACCESSORIES

A. Electrical metallic tubing (EMT) shall be as manufactured by Allied, Triangle, Republic, or approved equal, in accordance with UL 797 and ANSI C80.3. EMT shall be high-strength, zinc-coated, 1 inch minimum size. EMT shall not be utilized for service entrance conductors. Fittings shall be of same finish and material as tubing. Fittings shall be screw in type or approved equivalent.

B. Expansion Joint Fittings: OZ type AX or Appleton type XJB, watertight, permitting two-way movement up to 4 inches, equipped with bonding jumpers around or through each fitting.

C. Thruwall Sealing Fittings: Type WSK by O-Z Gedney Company.

D. Fire-Seal Fittings: Type CFSI by O-Z Gedney Company.

E. Sealing Material for Sealing Fittings: Chico X Fiberdam, and Chico A sealing compound, or Chico A-P interpak by Crouse-Hinds or Apelco sealing cement and fiber filler by Appleton.

F. Insulated Bushings: Type B or SBT, as applicable, by O-Z Gedney or series B1900, series BU500 or series TC700, as applicable, by Steel City.

G. Pulling in Wire: Provide a 100# nylon pull rope in each empty conduit or innerduct.

H. Thread lubricant/sealant shall be Crouse-Hinds type STL or T & B Kopr-Shield except, when required on joints for heat producing elements such as lighting fixtures, it shall be Crouse-Hinds type HTL.

I. Wireways and wiring troughs shall be code gauge galvanized steel, sized as shown, or as required by the NEC. Covers shall be screwed. Where indicated as raintight, wireways shall be galvanized and shall comply with the NEMA requirements

2.03 TRADITIONAL INNERDUCT

A. Install in accordance with contract drawings.

B. Fiber optic cable shall be installed within innerduct.

C. Shall be available in ½ inch, ¾ inch, 1 inch, 1 ¼ inch, 1 ½ inch, and 2 inch sizes

D. Any innerduct placed in space used as an air return or in any way connected with air handling plenums or building ventilation shall be low-smoke, fire retarding innerduct, and must comply with the National Electrical Code Articles 725, 760, and 800. No cabling or innerduct shall be placed in plenums without written approval from the SAIA Project Manager.

E. Where multiple innerducts are placed in the same raceway, each innerduct shall be a different color.

2.04 FLEXIBLE TEXTILE INNERDUCT

A. Unless otherwise noted on the contract drawings, flexible textile innerduct shall be installed in conduit.

B. Textile innerduct shall be constructed of White Polyester and Nylon resin polymer.

C. Standard Outdoor Textile Innerduct: Micro (33mm), 2-inch, 3-inch and 4-inch single or multi-cell polyester/nylon textile innerduct containing 1250lb polyester flat woven pull tape.

D. Detectable Outdoor Textile Innerduct: Micro (33mm), 2-inch, 3-inch and 4-inch single or multi-cell polyester/nylon textile innerduct containing 1250lb polyester

flat woven pull tape, and a solid copper, polyvinyl color coated conductor (19AWG minimum) for tracing and rated for a minimum of 6 amps and 600 volts. Conductor shall be placed in the sidewall edge fold of the textile sleeve.

E. Indoor Textile Innerduct (Riser-listed): Micro (33mm), 2-inch, 3-inch and 4-inch single or multi-cell nylon textile innerduct containing 1250lb polyester flat woven pull tape which meets UL2024A for flame propagation and smoke density values for general applications.

F. Plenum-Listed Textile Innerduct: Micro (33mm), 2-inch and 3-inch single or multi-cell nylon textile innerduct containing 200lb nylon-resin flat woven pull tape which meets UL2024A for flame propagation and smoke density values for use in air handling spaces.

G. Textile Innerduct Type to Be Used

1. Aboveground, Exterior and Interior Conduit Installations: Outdoor textile innerduct (Standard or Detectable as desired).
2. Interior Exposed Locations
   a. Non-plenum Areas: Indoor textile innerduct
   b. Plenum Areas: Plenum-listed indoor innerduct
3. When installed in 4” conduit, use two 3” 3-Cell packs with an additional pull tape on the outside for future pulls in each conduit.
4. Cable Tray: use standard outdoor or indoor textile innerduct.

2.05 FIRESTOPPING AND MATERIALS

A. All Manufacturers:

1. Johns Manville
2. Hilti
3. Nelson

B. Description

1. Performance requirements: Provide fire stopping systems that are produced and installed to resist spread of fire according to requirement indicated, resist passage of smoke and other gases, and maintain fire resistance rating of assembly.
   a. F-Rated Systems: in accordance with ASTM E 814
   b. T-Rated Systems: in accordance with ASTM E 814
2. Fire stopping flame spread performance requirements: Provide products with flame-spread ratings of less than 25 and smoke development ratings of less than 50 as determined in accordance with ASTM E 84.
3. Fire Stopping UL performance requirements: Provide products with UL ratings specified for assembly indicated as determined in accordance with UL listings.

3.00 EXECUTION

3.01 GENERAL

A. Raceways shall be mechanically and electrically connected to all boxes and fittings and shall be properly grounded.

B. All pathways shall be installed in such a fashion that the installation meets or exceeds all local seismic requirements.

C. The routing and location of all conduits and other raceways shall be coordinated with other trades and with the building construction to avoid conflicts.

D. Where raceways pass through walls, partitions and floors, seal penetrations to provide a neat installation which will maintain the integrity of the waterproofing or fireproofing, as applicable, of the structure. Coordinate installation requirements with roofing installer where conduits pass through the roof.

E. All raceways entering a building from underground shall be sealed to prevent water, moisture, gas, or any other foreign matter from entering the building. Service conduits shall be sealed in accordance with NEC 230-8.

3.02 CONDUIT

A. EMT shall be installed with threaded fittings and couplings. Where conduits terminate in thread less opening, locknuts shall be provided both inside and outside of the box or enclosure and the conduit end shall be fitted with an insulating bushing. Where bonding is required, the end of the conduit shall be equipped with an insulated metallic grounding and bonding bushing.

B. All metallic couplings, connectors and fittings shall be malleable iron or steel and finished with zinc plating or by galvanizing.

C. All conduits shall be plugged after installation to prevent the entrance of construction dirt and debris. Conduits shall be cleaned before wires are pulled.

D. Expansion fittings shall be utilized in all cases where conduits pass through building expansion joints. Fittings shall be of an approved weatherproof telescopic type permitting a movement of up to four inches and shall be provided with approved bonding jumpers around or through the fitting.

E. All conduits shall be properly supported using galvanized malleable iron conduit clamps for individual runs. Multiple runs shall be supported on channel adequately secured to walls or hung from structure above with conduits fastened to channel with clamps designed for the purpose. All pathways shall be installed to meet local seismic requirements.

F. Connection of Conduit to Sheet Metal Boxes and Enclosures:

1. Connection to NEMA 1 type boxes and enclosures: EMT- Install compression box connectors with insulated throats.

2. Connection to NEMA 3R, 4, 4X, and 12 type boxes: Install insulated bushings and sealing locknuts or hubs.

3. When conduits enter floor mounted enclosures from below and there is no sheet metal to which to attach; install grounding bushings on the

conduit. Bond bushings to ground bus using a conductor the same size as required for an equipment grounding conductor sized for the given circuit.

4. Install sealing bushing within all conduits which have entered a building from outside, whether from above or below grade.

G. Verify all pathways are installed in accordance with local Seismic requirements.

3.03 JUNCTIONS BOXES AND PULL BOXES

A. All pull boxes shall be constructed of 14 or 12 gauge galvanized steel with an ANSI 61 grey polyester powder finish inside and out unless otherwise specified.

B. All pull boxes shall have flat, removable covers fastened with plated steel screws with unique keyhole screw slots in the cover to permit removal of the cover without extracting screws.

C. All pull boxes shall provide the appropriate provisioning for grounding.

D. All pull boxes shall be NEMA Type 1 and sized according to the table below unless otherwise specified:

Maximum Trade Size of Conduit (inches)	**Minimum Box Size (inches)**			**For Each Additional Conduit Increase Width (Inches)**
	Width	Length	Depth	
1	4	16	3	2
1.25	6	20	3	3
1.5	8	27	4	4
2	8	36	4	5
2.5	10	42	5	6
3	12	48	5	6
3.5	12	54	6	6
4	15	60	8	8

E. Verify all pull boxes are installed in accordance with local Seismic requirements.

3.04 COMMUNICATIONS CONDUIT INSTALLATION

A. No section of conduit shall be longer than 30m (100 ft) or contain more than two 90 degrees bends between pull points or pull boxes.

B. The inside radius of a bend in a 2 inch or smaller conduit shall be at least 6 times the internal diameter. For all conduit larger than 2 inches the inside radius of a bend in the conduit shall be at least 10 times the internal diameter of the conduit.

C. A fish tape or measured pull cord shall be placed in installed conduit.

D. All communications conduits shall be color coded with orange tape marked “communications” and labeled with the location of the conduits beginning and ending points. Labeling shall occur at the beginning and ending points and every 50 feet where conduit is exposed.

E. Conduit shall be reamed to eliminate sharp edges and terminated with an insulated bushing.

F. Conduit protruding through the floor shall be terminated 4 inches above the floor surface.

G. Pull or splice boxes shall be placed in an exposed manner and location, and readily accessible.

H. A color-coded pull or splice box shall be placed in a conduit run where the length is over 30 m (100 ft), there are more than two 90 degree bends, or there is a reverse bend in the run.

I. All conduit and cabinet entrances shall be sealed with an approved, re-enter able sealant material to prevent ingress of water, dust or other foreign materials.

J. Verify all communications conduits are installed in accordance with local Seismic requirements.

3.05 TEXTILE INNERDUCT INSTALLATION

A. .Provide textile innerduct in conduit and wire ways, and place textile innerduct within and under cable trays using continuous unspliced lengths of textile innerduct between maintenance holes, pull boxes, and/or termination points as indicated on the drawings.

B. Make a 2" incision, approximately 18" from the end of textile innerduct. Pull out and cut off approximately 2 feet of pull-tape. Thus allowing the pull tape ends to retract back into the cells.

C. Using approximately 6 feet of pull tape, tie a non-slip knot to the incision. Then tie 3 to 6 half-hitch knots down to the end of textile innerduct. Apply black vinyl tape over all knots and the end of textile innerduct. Using a Bow Line knot tie a swivel to the end of 3 feet pull tape. For multi-pack installations one swivel is sufficient, but stagger each textile innerduct.

D. Using a Bow Line knot, attach the pull rope located in the rigid conduit to the other end of the swivel. Install textile innerduct – ensuring that no twist is introduced to the innerduct.

E. Provide suitable textile innerduct slack in the maintenance holes, hand holes, pull boxes, and at turns to ensure there is no kinking or binding of the product.

F. Textile Innerduct Mountings, Hangers and Attachments: When exposed indoors or in maintenance holes, hold firmly in place using independent support-

1. Design & install hangers and other similar fittings adequate to support loads and so as to not damage innerduct.

2. Do not fasten textile innerduct to steam, water, or other piping, ductwork, mechanical equipment, electrical equipment, electrical raceways, or wires
3. When appropriate, use the following cable ties to secure textile innerduct through previously created incisions:
    a. Plenum areas: plenum-rated plastic or stainless steel
    b. Non plenum areas: Conventional flame-retardant nylon ties
    c. Underground locations: Conventional plastic cable ties.

G. Maintenance Hole and Hand Hole Installation

1. At locations where textile innerduct will be continuous through a manhole or hand hole, allow sufficient slack so that the innerduct may be secured to the side of the vault maintaining the minimum bend radius.
2. At maintenance holes serving as the junction location, pull the exposed end of the innerduct to the far end of the vault, install termination bag, and secure to the vault.

H. Cable Tray and Runway Installation

1. Cut incisions every 24 inches into the edge of the textile innerduct and cable wrap to one side of vertical ladder rack or horizontal ladder-type cable tray at each incision.

3.06 JUNCTION BOX AND PULL BOX INSTALLATION

A. Pull boxes shall be installed in sections of conduit that 100 feet or more in length, that contain more than two 90 degree bends, or that contain bends that are 180 degrees or more in the aggregate.

B. A pull box shall not be used in lieu of a conduit bend.

C. All pull boxes shall be installed in an easily accessible location with unobstructed entry to the pull box access panel.

D. Pull boxes shall be supported on all four corners in such a manner that the pull box is not supported by the cable running through or conduit attached to the pull box.

E. Verify all pull boxes are installed in accordance with local Seismic requirements.

3.07 FIRESTOPPING MATERIALS INSTALLATION

A. Compliance: Comply with manufacturer's product data, including product technical bulletins, product catalog installation instruction, and product carton instruction for installation.

B. Site Verification of Conditions: Verify substrate conditions are acceptable for product installation in accordance with manufacturer's instructions.

C. Installation: Install fire stopping to comply with performance requirements specified herein.

D. Install fire stopping to comply with listed fire rated assemblies in accordance with ASTM and UL requirements

E. Installer shall be trained and approved by the manufacturer

F. Protection: Protect installed products from damage during construction operations until final completions.

G. Inspection: Code official or building inspectors to review proper installation using manufacturer guidelines.

END OF SECTION 27 05 33

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SECTION 27 05 36

CABLE TRAYS FOR COMMUNICATIONS SYSTEMS

1.00 GENERAL

1.01 DESCRIPTION

A. This section includes specifications for the installation of conduits and back boxes for communications systems.

B. Related Documents: Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to the work of this section.

1.02 RELATED SECTIONS

A. Section 27 05 00 Common Work Results for Communications and all sections referenced therein

1.03 REFERENCES

A. Conflicts:

1. Between referenced requirements: Comply with the one establishing the more stringent requirements.
2. Between referenced requirements and contract documents: Comply with the one establishing the more stringent requirements.

B. Telecommunications Industry Association/Electronic Industries Association (TIA/EIA):

1. 569A Commercial Building Standard for Telecommunications Pathways and Spaces

C. Building Industry Consulting Services International (BICSI):

1. Telecommunications Distribution Methods Manual (TDMM)

D. Federal Supply Service, General Services Administration Q-A-601F

E. ANSI C80.3 – Electrical Metallic Tubing, Zinc Coated.

F. American Society for Testing and Materials (ASTM):

1. ASTM E 84 Test Method for Surface Burning Characteristics of Building Materials.
2. ASTM E 119 Method of Fire Tests of Building Construction and Materials
3. ASTM E 814 Test Method for Fire Tests of Through Penetration Firestops.

G. Underwriters Laboratory, Inc. (UL)

1. UL Building Materials Directory
2. UL Fire Resistance Directory
3. UL 2079 Test.

H. National Electrical Manufacturers Association (NEMA) 250

1.04 SUBMITTALS

A. Submit all required documents in accordance with Section 01 33 00 Submittal Procedures

B. Submit plan and section drawings detailing proposed pathway routing and seismic bracing prior to any installation.

C. Submit catalog cut sheets of pathways and associated hardware prior to any installation.

D. Test Reports: Submit certified test reports indicating compliance with material reference standard indicated for material performance characteristics and physical properties of fire stopping materials

E. Certificates: Submit product certificates, signed by manufacturer certifying materials comply with specified performance characteristics and physical properties of fire stopping materials.

F. Submit certificates stating that the contractor is certified to properly install all firestopping materials.

1.05 QUALITY ASSURANCE

A. Follow Section 01 40 00 Quality Control Services

B. Verify cable tray runs do not interfere with existing or new systems within each facility.

C. Follow Appendix B of NEC.

D. Fire stopping: Manufacturer trained and approved installer to perform fire stopping work who has specialized in the installation of work similar to that required for this project.

2.00 PRODUCTS

2.01 GENERAL

A. All cable tray shall be UL listed and so labeled.

B. Where cable tray and other raceway sizes are not specifically shown on the plans, conduits shall be sized in accordance with the requirements of the BICSI, NEC, and the Texas Building Code, No conduit shall be less than 1 inch.

2.02 CABLE TRAY

A. General

1. Manufacturers:

a. B-Line

b. Cope

c. Chatsworth

d. Hoffman

e. The list above is provided as a supplement and is not intended to exclude other manufacturers which meet or exceed the requirements listed herein

B. Description: Cable Tray/ Ladder Rack

1. Aluminum material, hot dip mill-galvanized to ASTM A-525 standard
2. Hot Dip Galvanized after fabrication to ASTM A-123 standard
3. Include appropriate connectors and mounting brackets to properly mount cable tray
4. Minimum width 12 inches, minimum load depth 4 inches, refer to contract drawings for actual dimensions
5. Minimum rung diameter 1 inch
6. Maximum rung spacing 12 inches
7. UL Classified as an equipment grounding conductor and shall meet NEC Article 318-5.

2.03 FIRESTOPPING AND MATERIALS

A. All Manufacturers:

1. Johns Manville
2. Hilti
3. Nelson

B. Description

1. Performance requirements: Provide fire stopping systems that are produced and installed to resist spread of fire according to requirement indicated, resist passage of smoke and other gases, and maintain fire resistance rating of assembly.
   a. F-Rated Systems: in accordance with ASTM E 814
   b. T-Rated Systems: in accordance with ASTM E 814
2. Fire stopping flame spread performance requirements: Provide products with flame-spread ratings of less than 25 and smoke development ratings of less than 50 as determined in accordance with ASTM E 84.
3. Fire Stopping UL performance requirements: Provide products with UL ratings specified for assembly indicated as determined in accordance with UL listings.

3.00 EXECUTION

3.01 GENERAL

A. Cable trays shall be properly grounded.

B. All cable trays shall be installed in such a fashion that the installation meets or exceeds all local seismic requirements.

C. The routing and location of all cable trays shall be coordinated with other trades and with the building construction to avoid conflicts.

D. Where cable trays pass through walls, partitions and floors, seal penetrations to provide a neat installation which will maintain the integrity of the waterproofing or fireproofing, as applicable, of the structure. Coordinate installation requirements with roofing installer where conduits pass through the roof.

3.02 CABLE TRAY INSTALLATION

A. Cable tray shall be supported as follows:

1. Threaded rod shall be fitted with a 6-inch PVC tube where it resides in cable tray to protect cables.
2. All cable tray horizontal bends, cross fittings, and tees shall have 3-inch diameter holes centered on 6 inch centers. Appropriate grommets shall be used to cover the edge of each hole to protect cables.
3. Verify all cable trays are installed in accordance with local Seismic requirements.

3.03 FIRESTOPPING MATERIALS INSTALLATION

A. Compliance: Comply with manufacturer's product data, including product technical bulletins, product catalog installation instruction, and product carton instruction for installation.

B. Site Verification of Conditions: Verify substrate conditions are acceptable for product installation in accordance with manufacturer's instructions.

C. Installation: Install fire stopping to comply with performance requirements specified herein.

D. Install fire stopping to comply with listed fire rated assemblies in accordance with ASTM and UL requirements

E. Installer shall be trained and approved by the manufacturer

F. Protection: Protect installed products from damage during construction operations until final completions.

G. Inspection: Code official or building inspectors to review proper installation using manufacturer guidelines.

END OF SECTION 27 05 36

SECTION 27 05 43

UNDERGROUND DUCTS AND RACEWAYS FOR COMMUNICATIONS SYSTEMS

1.00 GENERAL

1.01 DESCRIPTION

A. This section includes specifications for the installation of Underground Electrical and Communications duct banks, handholes, manholes, and vaults.

B. Related Documents: Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to the work of this section.

1.02 RELATED SECTIONS

A. Section 27 05 00 Common Work Results for Communications and all sections referenced therein

1.03 REFERENCES

A. Conflicts:

1. Between referenced requirements: Comply with the one establishing the more stringent requirements.

2. Between referenced requirements and contract documents: Comply with the one establishing the more stringent requirements.

B. Building Industry Consulting Services International (BICSI):

1. Telecommunications Distribution Methods Manual

2. Customer Owned Outside Plant Design Manual

C. HS20 (AASHTO) highway Fatigue Loading

D. American National Standards Institute/Telecommunications Industry Association/Electronic Industries Association (ANSI/TIA/EIA):

1. 569 Commercial Building Standard for Telecommunications Pathways and Spaces

2. 758 Customer-Owned Outside Plant Telecommunications Cabling Standard

E. Conflicts:

1. Between referenced requirements: Comply with the one establishing the more stringent requirements.

2. Between reference requirements and contract documents: Comply with the one establishing the more stringent requirements.

1.04 SUBMITTALS

A. Submit all required documents in accordance with Section 01 33 00 Submittal Procedures

B. Submit plan and section drawings detailing proposed communication pathway routing prior to installation. Communication pathway installation plan to include but not limited:

1. Room penetration plan
2. Communication pathway extension plan
3. Conduit chase plan
4. Duct bank pathway

C. Manufacturers' data: To include but not limited to part numbers, data sheets and detailed descriptions, for ALL proposed equipment and material.

D. Submit a schematic with the Manhole (MH)/Handhole (HH) duct bank layout showing the wall to wall, center to center and a MH butterfly detail down to individual innerduct assignments in AutoCAD 2005.

E. Submit plan and section drawings detailing proposed vault specifications.

F. Copy of Building Industry Services International (BICSI) Registered Communication Distribution Designer (RCDD) certificate for Contractor's on-site RCDD supervisor. RCDD to supervise all parts of communications installation at all times.

1.05 QUALITY ASSURANCE

A. Verify duct banks do not interfere with existing or new underground facilities.

B. Follow Appendix B of NEC.

C. Assure that the "as installed" system is correct and complete per construction documents: including engineering drawings, manuals, and operational procedures in such a manner as to support maintenance and future expansion of the system.

D. Contractor Qualifications:

1. The Contractor shall submit references and other related evidence of installation experience for a period of three years prior to the issue date of this Specification.
2. All work shall be supervised on-site by a BICSI RCDD. Must demonstrate knowledge and compliance with all BICSI, TIA/EIA, UL, and NEC standards and codes. Contractor shall submit proof of RCDD designation.

E. SAIA and COSA ITSD retains the right to access and inspect all work during the entire duration of the project and any items that do not adhere to the standards, reference, contract, bid, or project documents will be corrected immediately at the expense of the contractor.

1.06 SHIPPING AND HANDLING

A. Clearly mark containers "For Communication Material Only".

2.00 PRODUCTS

2.01 MANUFACTURERS

A. Conduit Measuring Tape:

1. Neptco
2. Greenlee
3. Garvin Industries

B. Caution Tape:

1. Reef Industries
2. Repnet
3. Panduit

C. Maintenance/Hand Hole Covers

1. Neehan Foundry
2. Dabico Inc.
3. Inland Foundry

2.02 MATERIALS

A. Ducts: Schedule 40 rigid PVC following this section, with non-magnetic universal interlocking type spacers for both horizontal and vertical duct arrangements. Duct bank shall be encased in concrete.

B. Duct Spacers and Hardware: On all conduit arrays the contractor shall furnish and install a conduit spacer system as required to maintain uniform conduit spacing. The system shall consist of plastic spacers that interlock vertically and horizontally. A spacer assembly shall consist of base spacers, intermediate spacers and top spacers to provide a completely enclosed and locked in conduit assembly. Install spacers per manufacturer's instructions and provide at 5 foot intervals.

C. Plastic conduit and fittings shall conform to the requirements of Federal Specification W-C-1094 and shall be rigid PVC Schedule 40, with non-magnetic universal interlocking type spacers for both horizontal and vertical duct arrangements.

D. Hand holes (HH): Will be 4 feet x 4 feet x 4 feet and constructed of 2 inch thick concrete, covered with a 3/8 inch steel plate containing an approved locking device with a 35 pound lift to open and close. An 18-inch concrete apron will be placed around the 3/8- inch steel plate cover at grade level. All HH covers shall include the following:

1. Cover and service lettering shall be abrasion, corrosion, and chemical resistant

   a. All HH covers shall include a HH number, which shall be obtained from the Owner, which will be permanently imprinted on the HH cover

   b. Submit cross reference table with construction HH number and permanent HH number.

c. All HH internal components such as racking and ground strips shall be field installable and shall meet the requirements of ANSI/TIA/EIA, NEC, and Owner requirements.

E. Concrete and Reinforcing Steel for Encasement: Furnish products with strengths as follows:

1. Compressive Strength: 2500 psi at 28 days, class A.

2. Flexural Strength: 500 psi at 28 days.

3. Dye concrete encasement “ORANGE” to identify communications conduit.

2.03 ACCESSORIES

A. Continuous Tape for Underground Conduit: orange warning ribbon, PVC tape (detectable, i.e., containing metallic tracings), minimum 5 mils thick and 3 inches wide, permanently imprinted with "CAUTION--BURIED COMMUNICATIONS LINE BELOW" in black letters, minimum 1-inch high.

3.00 EXECUTION

3.01 PREPARATION

A. Verify materials are on site in proper condition and of sufficient quantity.

B. Verify proper excavation depth; verify width route and support of work. Ducts shall be installed so that the tops of all ducts are at least 48 inches below the finished grade. Verify proper location of hand holes and MH. Communications facilities must be placed in separate MH/HH from electrical facilities.

C. Trenches greater than or equal to 5 feet deep:

1. Shall be shored to prevent cave-in.

2. Shall have 2 feet clearance from the dirt pile.

D. Directional boring is a suitable substitute when trenching is impractical or impossible. Locating existing underground utilities is crucial when directional boring is planned because of the potential for the drilling unit to encounter high voltages. Although directional boring machines are manufactured with electrical strike sensing capabilities which can warn the operator of any contact with a high voltage source, accidents may still occur.

1. Operators of directional boring machines require special protection due to the potential for exposure to high voltage. Therefore, operators must always have a ground mat grid underfoot as insulation protection. In addition, operators must wear insulating boots and gloves, along with hard hats and safety glasses.

E. Minimum electrical/communications underground cable separation:

1. Concrete: 3 inches

2. Masonry: 4 inches

3. Well-tamped earth: 12 inches

F. Before encasement, verify ducts are free of debris and properly installed in support and spacer system, are properly fitted together and hold-down hardware is properly installed.

3.02 INSTALLATION

A. Install all work following drawings, manufacturer's instructions and approved submittal data.

B. Install conduit in excavations following Drawings. If directional boring is utilized, cable or flexible conduits can be attached to the unit and pulled back to the origination point (after the drilling unit reaches its destination).

C. HH will be 64 cubic feet (4 feet x 4 feet x 4 feet) and shall be constructed of two-inch thick concrete covered with 3/8 inch steel plate. The hand hole or MH shall rest on a 4 inch blanket of sand, and 4 inches around the side walls shall be filled with sand

D. Install watertight penetrations through foundation, HH and MH walls. Wherever a hand hole is used to simply pass through, the conduit entrances and exits will be situated at opposite ends of the hand hole instead of 90 degree angles.

E. Assemble duct banks with non-magnetic saddles, spacers and separators. Position separators for 2 inch minimum concrete separation between outer surfaces of adjacent ducts.

1. Make uniform required bends with a minimum of a 24 inch radius for conduits less than 3 inch diameter, and a 48 inch radius for conduits 3 inches and larger.

2. Maintain vertical or horizontal separations of 12 inches of well-packed topsoil from any electrical service conduit run parallel to Communications conduits.

F. Install reinforcing. Install concrete encasement fully surrounding reinforcing steel and ducts.

1. Unless otherwise noted on the drawings, reinforce with No. 5 longitudinal steel bars placed at each corner and along each face at maximum parallel spacing of 12 inches o.c., and No. 5 tie-bars transversely placed at 12 inches o.c. maximum longitudinal. Maintain maximum clearance of 2 inches from bars to edge of forms and ducts.

2. Add colorants at mixing site at the rate of ten pounds per cubic yard.

a. ORANGE: For voice and data cable.

3. Place concrete with minimum 3 inch cover surrounding ducts and reinforcement.

4. Maintain ducts in proper place during concrete placement.

G. Transition from non-metallic to PVC coated metallic conduit where duct banks enter structures or turn upward for continuation above grade.

H. Where ducts enter structures such as HH, MH, pull boxes, or buildings, terminate ducts in proper end bells, insulated L-bushings, Meyers hubs or couplings on steel conduits.

I. Extend below grade conduits to 4 inches above the finished floor inside a building.

J. Tag conduits entering pull boxes with stamped stainless steel tags following cable and conduit schedule.

K. Install detectable marking tape imprinted with "CAUTION – BURIED COMMUNICATIONS LINE BELOW" in black letters, approximately 12 inches below finished grade following line of duct banks. This warning ribbon shall be 36 inches above the duct bank and colored orange.

L. Expansion Fittings:

1. Raceways shall be provided with expansion fitting where necessary to compensate for thermal expansion and contraction.

2. Use expansion-deflection fittings on conduit crossing structural expansion joints and on exposed conduit funs where necessary. Provide bonding jumpers across fittings in metal raceways systems

3.03 BACKFILLING

A. Backfill following Division 2 after concrete cures 24 hours. After concrete encased ducts have been properly installed, and the concrete has had time to set, the trench shall be backfilled in at least two layers with excavated material, not larger than four inches in diameter and thoroughly tamped and compacted to at least the density of the surrounding undisturbed soil. If necessary to obtain the desired compaction, the backfill material shall be moistened or aerated as required. Trenches shall not be excessively wet and shall not contain pools of water during backfill operations. The trench shall be completely backfilled and compacted level with the adjacent surface. Any excess excavated material shall be removed and disposed of off-site at the contractor's expense.

3.04 MAINTENANCE HOLES AND HANDHOLES

A. Installation shall be in accordance with the manufacturer's requirements. Top of MH/HH cover shall be set ¼ inch above finished pavement or one inch above finished grade.

B. MH/HH shall be bedded on four inches of stabilized sand with ¾ inch gradation.

C. Have ducts stubbed into the MH/HH, which shall terminate in end bells cast in concrete flush with the inside walls. Ducts shall enter the MH/HH at the lowest knockout window available.

D. MH shall be fitted on each wall with cable racks and struts. Each rack will be provided with a minimum of four rack type arms. Rack arms will be made of non-flammable polymer.

E. MH shall be provided with a pulling eye on each end and a drainage sump in the bottom.

F. All HH shall be provided by contractor

G. MH/HH will be provided with a ¾ inch by 10-foot copper clad ground rod in each MH. See Section 270526 Grounding and Bonding for Communications Systems for ground rod specification. Do not install the ground rod through the drain sump. Install through a prepared opening and grout fill after installation.

H. All vacant ducts and innerducts will be sealed with SAIA and Industry approved plug.

I. Where more than one innerduct is routed in a conduit, each innerduct shall consist of a different color (ex. Orange, Blue, Black and White).

J. When populating duct bank with innerduct the following apply:

1. Innerduct to be OSP rated
2. 4” duct to be populated with no less than 4-1 inch innerducts

K. All fiber cables must be placed in an innerduct.

L. All copper cables 100 pairs or less will be placed in an innerduct.

M. Pull a 12 inch long mandrel (1/4 inch smaller than duct diameter) through ducts. Pull a rag swab or sponge through to remove debris, until it shows clean.

N. Provide a conduit measuring tape, with a minimum test rating of 1250 pounds of pulling tension in all underground conduits and innerducts. Label each end of the duct bank in every MH to ensure continuity.

O. Install continuous, orange warning ribbon, PVC tape (detectable, i.e., containing metallic tracings), 3 inches wide, permanently imprinted with "CAUTION - BURIED COMMUNICATIONS LINE BELOW" in black letters, approximately 12 inches below finished grade following line of duct banks This warning ribbon shall be 36 inches above the duct bank and colored orange.

END OF SECTION 27 05 43

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SECTION 27 05 53

IDENTIFICATION FOR COMMUNICATIONS SYSTEMS

1.01 GENERAL

1.02 DESCRIPTION

A. This section includes the identification requirements for backbone, riser, and horizontal cabling.

B. Related Documents: Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to the work of this section.

1.03 RELATED SECTIONS

A. Section 27 05 00 Common Work Results for Communications and all sections referenced therein

1.04 REFERENCES

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

B. Specific reference in specifications to codes, rules, regulations, standards, manufacturer's instructions, or requirements of regulatory agencies shall mean the latest printed edition of each in effect at the date of contract unless the document is shown dated.

C. Conflicts:

1. Between referenced requirements: Comply with the one establishing the more stringent requirements.

2. Between referenced requirements and contract documents: Comply with the one establishing the more stringent requirements.

D. Telecommunications Industry Association /Electronic Industries Association (TIA/EIA) 568B-Commercial Building Telecommunications Wiring Standards.

E. TIA/EIA 569A-Commercial Building Standard for Telecommunications Pathways and Spaces.

F. ANSI/TIA/EIA 606- Administration Standard for Telecommunications Infrastructure of Commercial Buildings.

G. ANSI/TIA/EIA 607-Commercial Building Grounding and Bonding Requirements.

H. TIA/EIA TSB-67- Transmission Performance Specifications for Field Testing of Unshielded Twisted Pair Cabling Systems.

I. TIA/EIA TSB-72-Centralized Optical Fiber Cabling Guidelines.

J. TIA/EIA PN-3398 Cabling practices for Open Offices.

K. TIA/EIA TSB-75-Additional Horizontal Cabling Practices for Open Offices.

L. International Standards Organization/International Electromechanical Commission (ISO/IEC) DIS 11801.

M. Underwriters Laboratories (UL®) Cable Certification and Follow Up Program.

N. National Electrical Manufacturers Association (NEMA).

O. American Society for Testing Materials (ASTM).

P. National Electric Code (NEC®).

Q. Institute of Electrical and Electronic Engineers (IEEE).

R. UL Testing Bulletin.

S. American National Standards Institute (ANSI) X3T9.5 Requirements for UTP at 100 Mbps.

T. Building Industry Consulting Services International (BICSI):

1. Telecommunications Distribution Methods Manual (TDMM)
2. Customer-Owned Outside Plant Design Manual

1.05 ABBREVIATIONS

A. AWG - American Wire Gauge

B. Mbps - Megabits Per Second

C. PVC - Polyvinyl Chloride

D. ANSI - American National Standards Institute

E. ASTM - American Society for Testing Materials

F. BICSI - Building Industry Consulting Services International

G. RCDD – Registered Communications Distribution Designer

H. EIA - Electronics Industries Association

I. SCS – Structured Cabling System

J. TIA - Telecommunications Industry Association

K. TSB - Technical Systems Bulletin

L. UL - Underwriter's Laboratories

1.06 SUBMITTALS

A. Submit all required documents in accordance with Section 01 33 00 Submittal Procedures

B. Manufacturer's data for all proposed equipment and materials.

C. List of termination and test equipment to be used for Contractor to perform work.

D. Equipment shall be calibrated with trace ability to National Institute of Standards and Testing (NIST) requirements.

E. Contractor shall include copy of calibration and certification that equipment calibration meets NIST standards and has been calibrated at least once in the previous calendar year.

F. Testing Plan

1. All members of the installation team must be certified by the manufacturer as having completed the necessary training to complete their part of the installation. Resumes of the entire team shall be provided along with documentation of completed training courses.

2. Certified test reports of the Contractor performed tests. Copies of the Contractor performed tests shall be submitted within one week of completion of tests. Test equipment and procedures shall conform to manufactures requirements to obtain warranty. Each set of test results will be reviewed by the Owner's representative for a maximum of two times for completion. In the event that the test results are not acceptable upon the second review, the contractor shall be responsible for any cost incurred to the Owner for further review.

G. The Contractor shall provide a record of the final cable installations in an SAIA approved electronic format (e.g. MS Excel) and import the information into the SAIA cable database. The format for submittal shall be compatible with the iTracs cable management system.

2.00 PRODUCTS

NOT APPLICABLE

3.00 EXECUTION

3.01 GENERAL

A. The following provides a general framework for the labeling scheme as developed in cooperation with SAIA. SAIA reserves the right to modify the labeling scheme as needed during design workshops to meet their requirements.

3.02 LABELING SCHEME

A. The fiber cable labeling scheme shall be as follows:

1. Location Code – Room Type – Room Number – Cabinet Number – Panel Number – Port Number

a. Fiber Strands

1) Up to three characters from 0-288

b. Fiber Type

1) SM – Singlemode

2) MM - Multimode

c. Location Code

1) AV – Aviation

2) T – Terminal

3) A or B – Building

d. Room Type

1) BDF – Building Distribution Frame

2) IDF – Intermediate Distribution Frame

3) Numeric Identifier as provided by the Airport

e. Rack/Cabinet Number

1) Rack/cabinet shall be labeled with numbers (1-99)

2) Rack/Cabinet number shall be numbered beginning with 1

f. Panel Number

1) Panels shall be labeled with numbers (1-99)

2) Panels shall be labeled beginning at the top of the rack/cabinet

g. Port/Pairs Number

1) Port/pairs shall be labeled with numbers (1-144)

2. Fiber Labeling: Fiber terminations shall be labeled top to bottom and left to right.

3. For example: 72SM: AVTABDF.1.1.48 > AVTAIDF3.1.1.24

Is a 72 strand singlemode fiber routed from Terminal A BDF, Cabinet 1, Panel 1 to Terminal A IDF3 Cabinet 1, Panel 1

B. The horizontal cable labeling scheme shall be as follows:

1. Location Code – Room Type – Room Number – Cabinet Number – Panel Number – Port Number

a. Location Code

1) AV – Aviation

2) T – Terminal

3) A or B – Building

b. Room Type

1) BDF – Building Distribution Frame

2) IDF – Intermediate Distribution Frame

3) Numeric Identifier as provided by the Airport

c. Rack/Cabinet Number

1) Rack/cabinet shall be labeled with numbers (1-99)

2) Rack/Cabinet number shall be numbered beginning with 1

d. Panel Number

1) Panels shall be labeled with numbers (1-99)

2) Panels shall be labeled beginning at the top of the rack/cabinet

e. Port/Pairs Number

1) Port/pairs shall be labeled with numbers (1-144)

2. Copper Labeling (Patch Panel): All horizontal cabling shall be terminated on patch panels. Patch panels shall be labeled left to right and top to bottom.

3. For example: AVTABDF.3.3.35

Is a patch cable located in Terminal A BDF, Cabinet 3, Panel 3, Port 35

C. Copper Labeling (110 Blocks): Copper backbone cabling shall be terminated on rack-mounted 110 blocks. Pair counts shall be labeled left to right and top to bottom. For example, on a 100 pr 110 block the first row of the 110 block shall be labeled pairs 1-25, the second row shall be labeled 26-50, third row shall be 51-75, and the fourth row labeled 76-100.

D. The contractor shall be responsible for implementing the above labeling scheme for all cabling within the SAIA SCS.

3.03 LABELING VERIFICATION

A. Cable labeling shall be in accordance with the contract documents.

B. Labeling shall meet the requirements in this document, and the ANSI/TIA/EIA 606, Administration Standard for the Telecommunications Infrastructure of Commercial Buildings, where applicable.

C. Cable labels shall be placed in the following locations: on jack face plates, on cable inside back boxes, junction boxes, access points, and manholes/handholes, on cable above the terminations in the BDF, and IDFs, on patch panels and every 50 feet when not in conduit.

D. Conduits shall be labeled every 50 feet and at the origination and destination using an orange label with black lettering. All labels shall be printed using a laser type printer and in no location shall any labels be handwritten.

E. Fiber Optic Cable Termination Cabinet/Housing Labeling:

1. Fiber optic termination housings shall be labeled using the plastic panel provided by the termination housing manufacturer. The plastic panel shall be overlaid with a one piece, self-adhesive, full size, laser printer generated label sheet adhered to the inside of the door of the enclosure. Contractor shall cut sheet to size. An 8.5 x 11 inch laser printable adhesive backed sheet, part number Avery 5165.

2. The background color of the labeling sheet shall be colored coded. Singlemode labels shall be Yellow in color and Multimode labels shall be

Orange in color. Singlemode housing connector panels shall always be placed first, and to the immediate left hand side of the housing, followed by the Multimode connectors. This sequence shall apply to both Singlemode and Multimode strands in the same cable (Hybrid), or in separate cables. In wall-mounted housings, the Singlemode connectors shall always be placed in the very most top position, followed by the Multimode connectors.

3. Each terminal housing shall contain only one labeling sheet to identify the fiber optic strands. Multiple labels on a single door shall not be used.

4. Labeling font shall be Helvetica, 10 point, Black in color, or approved equivalent.

5. Housing labels shall contain the building (Source) where the fiber optic cable originates, the building (Destination) where the fiber optic strands terminate and the MDF/IDF identification number where the Destination housing is located.

6. Fiber strand numbering shall be consistent with the Consecutive Fiber Numbering (CFN) sequence as identified in TIA/EIA 568-B.1. This fiber strand numbering sequence shall be accomplished at each terminated end of the fiber optic cable. The rolling of fiber optic strands, as identified in TIA/EIA 568-B.1 as Reverse Pair Positioning (RPP) shall not be used.

7. Fiber optic housings containing vertical connector panels shall be labeled as follows.

   a. Fiber strand number 1 (Blue) shall occupy fiber port number 1 in the upper most left position of the first duplex bulkhead connector installed in the connector panel placed in the first slot on the left side of the housing.

   b. Fiber strand number 2 (Orange) shall occupy fiber port number 2 of the same duplex bulkhead connector installed in the connector panel. This number 2 port is to the immediate right of fiber port number 1.

   c. All remaining fiber optic strands shall be number consecutively left to right, top to bottom.

8. Fiber Optic Housings containing horizontal connector panels shall be labeled as follows:

   a. Fiber strand number 1 (Blue) shall occupy fiber port number 1 in the upper most top, left position, of the first duplex bulkhead connector installed in the connector panel placed in the upper most left slot of the housing.

   b. Fiber strand number 2 (Orange) shall occupy fiber port number 2 of the same duplex bulkhead connector installed in the connector panel. This number 2 port is located immediate below fiber port number 1.

   c. All remaining fiber optic strands shall be number consecutively top to bottom, left to right.

F. Fiber Optic Splice Shelf Labeling:

1. Fiber optic splice shelves and drawers shall be labeled sequentially from top to bottom.
2. Identify the fiber splices using a single sheet, adhesive backed, labeling stock printed using a laser printer trimmed to fit the inside door of the splice shelf.
3. Identify in tabular form the splice tray, position number and the fiber strand spliced at that location.
4. Labeling shall consist of the cable number, the fiber optic strand number and the strand type.

G. Fiber Optic Cable Sheath Labeling:

1. Fiber optic cables located inside buildings shall have their sheaths labeled within 12 inches of the fiber termination housing, the point at which the cable enters and/or exits the room, and at one mid-point location when the cable is installed in a cable tray or ladder, as a minimum. Additional sheath labels may be installed at the request of the SAIA Project Manager.
2. The fiber optic cable label shall consist of either a stainless steel or a plastic type tag attached with a steel or plastic tie wrap. Plastic label shall be yellow and black in color, and contain a self-laminating cover for use with pre-printed labels. Both the tag and tie wrap shall be approved for interior and exterior use. White color tie wraps shall be used indoors, and black color tie wraps shall be used outdoors. Riser rated labels and tie wraps shall be used where required.
3. All fiber optic cables shall contain a fiber optic warning tag. All warning tags shall be orange in color and contain large black letters. Tags shall be made from PVC type material and install by snapping over the cable sheath. The fiber optic cable sheath label shall contain the cable type, total strand count of the cable, the origination and destination locations, Rack, Panel and Fiber Count

H. Copper Cable Termination Housing Labeling:

1. Building entrance terminals shall be labeled with the name of the building, the building identification number (as specified by SAIA), the cable pair numbers entering the terminal, and the cable pair number exiting the terminal (if applicable).
2. Terminals shall to be labeled using an electronic label maker and the label shall be placed on the wall above the terminal housing. The terminal housing itself shall not be labeled.
3. Labeling font shall be Helvetica, 10 point, Black in color on a white background or approved equivalent.

I. Copper Cable Sheath Labeling:

1. Copper cables located inside buildings shall have their sheaths labeled within 12 inches of the termination housing, the point at which the cable

enters and/or exits the room, and at one mid-point location when the cable is installed in a cable tray or ladder, as a minimum. Additional sheath labels may be installed at the request of SAIA Project Manager.

2. The copper cable label shall consist of either a stainless steel or a plastic type tag attached with a steel or plastic tie wrap. Plastic label shall be grey in color, and have a write on surface. This tag shall be approved for interior and exterior use. White color tie wraps shall be used indoors, and black color tie wraps shall be used outdoors. Riser rated labels and tie wraps shall be used where required.

3. The copper cable sheath label shall contain the type of cable, cable number, cable pair count and number of dead cable pairs, if applicable.

END OF SECTION 27 05 53

SECTION 27 08 00

COMMISSIONING OF COMMUNICATIONS SYSTEMS

1.00 GENERAL

1.01 DESCRIPTION

A. This section includes the testing requirements for backbone, riser, and horizontal cabling, as well as communications field verification services required to perform the specified testing and inspections. All testing and verification shall be performed by an independent third party employed by SAIA.

1.02 RELATED SECTIONS

A. Section 27 05 00 Common Work Results for Communications and all sections referenced therein

1.03 REFERENCES

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

B. Specific reference in specifications to codes, rules, regulations, standards, manufacturer's instructions, or requirements of regulatory agencies shall mean the latest printed edition of each in effect at the date of contract unless the document is shown dated.

C. Conflicts:

1. Between referenced requirements: Comply with the one establishing the more stringent requirements.

2. Between referenced requirements and contract documents: Comply with the one establishing the more stringent requirements.

D. Telecommunications Industry Association /Electronic Industries Association (TIA/EIA) 568B-Commercial Building Telecommunications Wiring Standards.

E. TIA/EIA 569A-Commercial Building Standard for Telecommunications Pathways and Spaces.

F. ANSI/TIA/EIA 606- Administration Standard for Telecommunications Infrastructure of Commercial Buildings.

G. ANSI/TIA/EIA 607-Commercial Building Grounding and Bonding Requirements.

H. TIA/EIA TSB-67- Transmission Performance Specifications for Field Testing of Unshielded Twisted Pair Cabling Systems.

I. TIA/EIA TSB-72-Centralized Optical Fiber Cabling Guidelines.

J. TIA/EIA PN-3398 Cabling practices for Open Offices.

K. TIA/EIA TSB-75-Additional Horizontal Cabling Practices for Open Offices.

L. International Standards Organization/International Electromechanical Commission (ISO/IEC) DIS 11801.

M. Underwriters Laboratories (UL®) Cable Certification and Follow Up Program.

N. National Electrical Manufacturers Association (NEMA).

O. American Society for Testing Materials (ASTM).

P. National Electric Code (NEC®).

Q. Institute of Electrical and Electronic Engineers (IEEE).

R. UL Testing Bulletin.

S. American National Standards Institute (ANSI) X3T9.5 Requirements for UTP at 100 Mbps.

T. Building Industry Consulting Services International (BICSI):

1. Telecommunications Distribution Methods Manual (TDMM)
2. Customer-Owned Outside Plant Design Manual

1.04 ABBREVIATIONS

A. TBD

1.05 SUBMITTALS

A. Submit all documentation in accordance with Section 01 33 00 Submittal Procedures

B. Manufacturer's data for all proposed equipment and materials.

C. List of termination and test equipment to be used for Contractor to perform work.

D. Equipment shall be calibrated with trace ability to National Institute of Standards and Testing (NIST) requirements.

E. Contractor shall include copy of calibration and certification that equipment calibration meets NIST standards and has been calibrated at least once in the previous calendar year.

F. Testing Plan that has been coordinated with COSA ITSD.

G. All members of the installation team must be certified by the manufacturer as having completed the necessary training to complete their part of the installation. Resumes of the entire team shall be provided along with documentation of completed training courses.

H. Certified test reports of the Contractor performed tests. Copies of the Contractor performed tests shall be submitted within one week of completion of tests. Test equipment and procedures shall conform to manufactures requirements to obtain warranty. Each set of test results will be reviewed by the Owner's representative for a maximum of two times for completion. In the event that the test results are not acceptable upon the second review, the

contractor shall be responsible for any cost incurred to the Owner for further review.

2.00 PRODUCTS

A. NOT APPLICABLE

3.00 EXECUTION

3.01 TESTING AND VERIFICATION

A. General

1. Communications Field verification services shall be required in a timely manner for the purpose of acceptance of the installation.

B. Field Verification Team

1. Must be supervised on-site by a BICSI RCDD. Must demonstrate knowledge and compliance with all BICSI, TIA/EIA, UL, and NEC standards and codes

2. All members of the field verification team must be certified by the manufacturer as having completed the necessary training to complete their part of the field verification. Resumes of the entire team shall be provided along with documentation of completed training courses.

C. Reference Standards

1. Reference Section 27 13 13, Section 27 13 23, and Section 27 15 00 for Telecommunications building wiring specifications

D. Field Verification Reports

1. After each inspection and test, the Contractor shall promptly submit 2 copies of field verification report to the project management team.

a. Each report shall include:

1) Date Issued.

2) Project Title and number.

3) Project Phase of Testing

4) Field Verification Contractor name, address and telephone number.

5) Name of inspector and job number.

6) Date and time of sampling or inspection.

7) Record of temperature and weather conditions.

8) Date of test.

9) Identification of specification section.

10) Location of test in the Project.

11) Cable ID where applicable.

12) Type of inspection or test.

13) Results of tests and compliance with Contract Documents.

b. Interpretation of test results.

E. Contractors Responsibilities

1. Provide incidental labor and facilities to provide access to work to be tested, to facilitate tests and inspections, and for storage of test equipment.

2. Notify the SAIA and COSA ITSD (1) week prior to expected time for operations requiring inspection and testing services.

a. When tests or inspections cannot be performed after such notice, the Contractor shall notify the SAIA.

F. Payment for Testing

1. Retesting:

a. When initial tests indicate non-compliance with the Contract Documents, all subsequent retesting occasioned by the non-compliances shall be performed by the Contractor and the costs thereof will be borne by the Contractor.

2. Contractor's Convenience Testing:

a. Inspecting and testing performed exclusively for the Contractor's convenience shall be the sole responsibility of the Contractor.

G. Code Compliance Testing

1. Inspections and tests required by codes or ordinances, or by a plan approval authority having jurisdiction over the project site, and which are made by a legally constituted authority, shall be the responsibility of and shall be paid for by the Contractor, unless otherwise provided in the Contract Documents.

3.02 ACCEPTABLE ATTENTUATION VALUES

A. The general attenuation equation for any link segment is as follows:

1. Link Attn. = Cable Attn. + Connection Attn. + Splice Attn.

B. Note: A connection is defined as the joint made by mating two fibers terminated with remateable duplex SC connectors or ST connectors

1. 62.5μm Multimode Attenuation Coefficients

a. Cable Attn. = Cable Length (km) × (3.75 dB/km@850nm or 1.5 dB/km@1300nm)

b. Connection Attn. (SC connectors) = .75dB per connector pair

c. Fusion Splice Attn. (= Splices × 0.20 dB

2. 8.μm Single Mode Attenuation Coefficients

a. Cable Attn. = Cable Length (km) × (1.0 dB/km@1310nm or 1.0 dB/km@1550nm)

b. Connection Attn. (SC connectors) = .75dB per connector pair

c. Fusion Splice Attn. = Splices × 0.20 dB

3. Note: If lower maximum attenuation values are specified by the chosen manufacture, then the contractor is responsible for meeting those maximum attenuation values specified by the manufacture.

3.03 TESTING CATEGORY 6

A. The Category 6 cable runs shall be tested for full compliance with TIA/EIA 568-B.1 and B.2-1, Category 6 specifications and construction documents. Testing shall be done with an ANSI/TIA/EIA 568B and TSB-95 UL Certified Level III test set at a minimum. Testing shall be performed as outlined in TSB-67, TSB-95, and ANSI/TIA/EIA 568B specifications and shall include length, wire map, characteristic impedance, attenuation, propagation delay, delay skew, return loss, Near-End Crosstalk (NEXT), Far-End Crosstalk (FEXT), Equal-Level Far-End Crosstalk (ELFEXT), Power Sum Equal-Level Far-End Crosstalk (PSELFEXT), and Attenuation to Crosstalk Ratio (ACR). Both ends shall pass TSB-67, TSB-95, and ANSI/TIA/EIA 568B requirements. Any pairs not meeting the requirements of the standard shall be brought into compliance by the Contractor at no charge to SAIA. Complete end to end test results must be submitted to the SAIA.

B. Electrical Characteristics:

Mutual Capacitance	47.8 nF/m
Characteristic Impedance	(± 3%) of 100 Ohms 1-550 MHz
DC Resistance Max	9.83 Ohms/100m)
Positive ACR	Out to 395 MHz-km

C. All Category 6 cables shall meet or exceed the following:

Freq (MHz)	Attn dB/100 m	NEXT (dB)	PS NEXT (dB)	ELFEXT (dB)	PS ELFEXT	Return Loss
0.772	1.6	76.0	74.0	70.0	67.0	‡
1	1.8	74.3	72.3	67.8	64.8	20
4	3.6	65.3	63.3	55.7	52.7	23
8	5.1	60.8	58.8	49.7	46.7	24.5
10	5.8	59.3	57.3	47.8	44.8	25
16	7.3	56.3	54.3	43.7	40.7	25
20	8.2	54.8	52.8	41.7	38.7	25

25	9.2	53.3	51.3	39.8	36.8	24
31.25	10.4	51.9	49.9	37.9	34.9	24
62.5	15.0	47.4	45.4	31.8	28.8	22
100	19.3	44.3	42.3	27.8	24.8	20
200	28.3	39.8	37.8	21.7	18.7	18
250	32.1	38.3	36.3	19.8	16.8	17
300	35.6	37.2	35.2	18.2	15.2	17
350	38.9	36.2	34.2	16.9	13.9	16
400	42.0	35.3	33.3	15.7	12.7	16
450	45.0	34.5	32.5	14.7	11.7	16
500	47.9	33.8	31.8	13.8	10.8	15
550	50.6	33.2	31.2	12.9	9.9	15

3.04 LARGE CABLE COUNT TEST RESULTS

A. Manufacturer's Testing

1. Copper Cable testing

a. Testing of all copper wiring shall be performed prior to system cutover. 100 percent of the horizontal wiring pairs shall be tested for opens, shorts, polarity reversals, transposition and presence of AC voltage. The Category 3 riser cable runs shall be tested for conformance to the specifications of TIA/EIA 568B Category 3.

b. At a minimum, the Owner or their designated representative shall randomly perform unannounced, on-site reviews during the installation. In addition, this person shall perform a final inspection and a complete review of the test results before the installation is accepted.

c. The multi-pair copper cables shall meet the following specifications:

1) Physical Specification:

Gauge	24 AWG
Pair Size	25 to 1800

2) Electrical Specifications:

(i) The non-shielded, plenum cable shall consist of 24-AWG solid-copper conductors insulated with color-coded PVC. 100 to 400 pair cable shall be conformance tested to meet TIA/EIA 568A for Category 3 cables. The cable shall be UL® and c (UL®) Listed for Fire Safety and ISO 9001 Certified. The non-shielded cable shall be available in 100, 200, 300, and 400 pair. The copper cable shall meet or exceed the following electrical specifications listed below:

Maximum DC Resistance	28.6 Ω/1,000 ft (9.38 Ω/100m)
Maximum DC Resistance Unbalanced	5%
Maximum Capacitance Unbalanced (pair to ground)	1,000 pF/1000 ft. (328 pF/m)
Mutual Capacitance @ 1kHz	16 nF/1000 ft (5.2 nF/100 m), maximum

Attenuation (dB/100 m [328 ft.])

Frequency	Attenuation (Max.)
1.00 MHz	7 dB
4.00 MHz	15 dB
10.00 MHz	26 dB
16.00 MHz	35 dB

Worst Pair Near-End Crosstalk (NEXT) dB/100 m [328 ft]

Frequency	Pair-To-Pair NEXT
1.0 MHz	41 dB
4.0 MHz	32 dB
10.0 MHz	26 dB
16.0 MHz	23 dB

(ii) The non-shielded, nonplenum cable shall consist of 24-AWG solid-copper conductors insulated with color-coded PVC. 25 to 1800 pair cable shall be conformance tested to meet TIA/EIA 568A for Category 3 cables. The cable shall be UL® and c (UL®) Listed for Fire Safety and ISO 9001 Certified. The non-shielded cable shall be available in 25, 50, 75, 100, 200, 300, 600, 900, and 1800 pair. The copper cable shall meet or exceed the following electrical specifications listed below:

Maximum DC Resistance	28.6 Ω/1,000 ft (9.4 Ω/100m)
Maximum DC Resistance Unbalanced	5%
Maximum Capacitance Unbalanced (pair to ground)	1,000 pF/1000 ft. (328 pF/m)
Mutual Capacitance @ 1kHz	18 nF/1000 ft (5.9 nF/100 m), maximum

Attenuation (dB/100 m [328 ft.])

Frequency	Attenuation (Max.)
1.00 MHz	2.3 dB
4.00 MHz	4.9 dB
10.00 MHz	8.5 dB

16.00 MHz	12 dB

Worst Pair Near-End Crosstalk (NEXT) dB/100 m [328 ft]

Frequency	Pair-To-Pair NEXT
1.0 MHz	13.8 dB
4.0 MHz	11.2 dB
10.0 MHz	10.2 dB
16.0 MHz	9.2 dB

3.05 OTDR REQUIREMENTS

A. Optical Fiber Cable Testing w/ OTDR

1. The Contractor shall test all fiber optic cable prior to the installation of the cable; the cable shall be tested on-site while on the reel. The Contractor shall assume all liability for the replacement of the cable should it be found defective at a later date.
2. All fiber testing shall be performed on all fibers in the completed end to end system. Testing shall consist of a bidirectional end to end OTDR trace performed per TIA/EIA 455-61. The system loss measurements and cable length shall be provided at 850 and 1300 nanometers for multimode fibers and 1310 and 1550 for single mode fibers. The OTDR shall be used only to determine the length of the cable and the attenuation of that cable. A power meter shall be used to determine the overall link attenuation, including connectors.
3. Fiber Optic Cables shall have a maximum loss of: (allowable cable loss per km)x(km of fiber in link) = maximum allowable loss
4. Loss numbers for the installed link shall be calculated by taking the sum of the bidirectional measurements and dividing that sum by two. The acquired loss statement shall be for the cable only and shall not include the connectors as part of the calculated loss.
5. Any link not meeting the requirements of the standard shall be brought into compliance by the Contractor, at no charge to the SAIA.
6. Documentation shall be provided in both hard copy and on a CD-ROM to the point of contact.

3.06 LIGHT METER AND SOURCE

A. Optical Fiber Cable Testing w/ Power Meter

1. Multimode Inter-Building and Composite Link Segments shall be tested in one direction at both 850-nm and 1300-nm wavelengths, unless warranty requires bi-directional testing.

2. Singlemode Inter-Building and Composite Link Segments shall be tested in one direction at both 1310-nm and 1550-nm wavelengths, unless warranty requires bi-directional testing.

3. Fiber links shall have a maximum loss of: (allowable cable loss per km)x(km of fiber in link)+(.75dB per connector pair)+(.2dB per fusion splice)=maximum allowable loss.

Note: The minor attenuation differences due to test direction are on par with the accuracy and repeatability of the test method. Therefore, testing in only one direction is warranted, unless warranty requires bi-directional testing.

END OF SECTION 27 08 00

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SECTION 27 11 00

COMMUNICATIONS EQUIPMENT ROOM FITTINGS

1.00 GENERAL

1.01 DESCRIPTION

A. This section includes the specifications for building out of Telecommunications Equipment Rooms (BDF/IDFs) to be used for supporting telecommunications and other special systems.

B. Related Documents: Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to the work this section.

C. Upon completion of the installation, a third party field verification firm will independently verify the installation for compliance to the TIA/EIA-568-B standard and/or additional requirements as stated in this specification. Contractor shall be responsible for fully rectifying all indicated faults by the third party field verification firm in accordance with the approved project schedule.

1.02 RELATED SECTIONS

A. Section 27 05 00 Common Work Results for Communications and all sections referenced therein

1.03 REFERENCES

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

B. Specific reference in specifications to codes, rules, regulations, standards, manufacturer's instructions, or requirements of regulatory agencies shall mean the latest printed edition of each in effect at the date of contract unless the document is shown dated.

C. Conflicts:

1. Between referenced requirements: Comply with the one establishing the more stringent requirements.

2. Between referenced requirements and contract documents: Comply with the one establishing the more stringent requirements.

D. Telecommunications Industry Association /Electronic Industries Association (TIA/EIA) 568B-Commercial Building Telecommunications Wiring Standards.

E. TIA/EIA 569A-Commercial Building Standard for Telecommunications Pathways and Spaces.

F. ANSI/TIA/EIA 606-Administration Standard for Telecommunications Infrastructure of Commercial Buildings.

G. ANSI/TIA/EIA 607-Commercial Building Grounding and Bonding Requirements.

H. Underwriters Laboratories (UL®) Cable Certification and Follow Up Program.

I. National Electrical Manufacturers Association (NEMA).

J. National Electric Code (NEC®).

K. UL Testing Bulletin.

1.04 ABBREVIATIONS

A. TBD

1.05 SUBMITTALS

A. Submit all required documents in accordance with Section 01 33 00 Submittal Procedures

B. Contractor shall submit the proposed layout for each communications room prior to any work being performed.

C. The contractor shall submit as-built drawings that depict the complete layout of each communications room prior to implementation.

D. Record Drawings: Furnish CAD drawings of all installed equipment within each communications room. All CAD work performed as part of the design effort shall be in compliance with the current SAIA CAD standards as well as the U.S. National CAD Standard. This should apply to all CAD layering, symbols, etc.

1.06 QUALITY ASSURANCE

A. Follow Section 01 40 00 Quality Control Services

B. Furnish, erect, install, connect, clean, adjust, test and condition all manufactured articles, materials, and equipment, and place in service in accordance with the manufacturer's directions and recommendations except as otherwise indicated in the contract documents.

2.00 PRODUCTS

2.01 MANUFACTURERS

A. The manufacturers and specific part numbers listed in this section are provided as an aid in the construction process and are not meant to preclude other manufacturers that may be qualified to provide communications components. Other manufacturers with comparable qualifications may be proposed but shall be subject to review as an approved equivalent.

B. Substitutions for any product identified in the design drawings or specifications must follow the substitution process as described in Section 01 23 00 Alternates.

2.02 EQUIPMENT RACK/CABINETS/SHELVES

A. Free Standing Equipment Racks – 19 Inch:

1. The equipment rack(s) shall be able to support and organize electronic equipment, cross-connection and/or termination hardware for fiber optic

cabling, station cabling, riser cabling, or building entrance cabling as may be required by design.

2. Racks shall support conventional 19" equipment mounting width.

3. A 3-foot working clearance shall be maintained in the front and in the back of each equipment rack, and a 3 foot working clearance shall be maintained at both ends of the equipment rack or multiple rack assemblies. This clearance shall be measured from the outermost surface of the equipment and connecting hardware rather than from the equipment rack since some of these devices may extend beyond the equipment rack.

4. Designed for cable and jumper management and include hardware to organize and support cabling and patch cords in the vertical and horizontal planes.

5. Equipped for electrical grounding to meet EIA/TIA 607 Standards.

6. The fastening system for the equipment shall facilitate easy installation with roll-formed threads in the screw holes for greater strength and durability and the mounting screws shall have pilot points.

7. All rack components shall be Flat Black in color. The rack shall be shipped with all necessary hardware to assemble the frame included. It shall be packed in cartons with suitable shipping inserts such that no damage occurs to the rack finish. The finish shall not be scratched, chipped or marred.

8. All equipment racks shall be according to the local seismic ratings and mounted to meet local seismic requirements.

9. Rack Specifications:

   a. Tested in accordance with ICBO AC156 standard for use with up to 900lbs

   b. Conformance to EIA 310-D

   c. Zinc plated mounting rails for ground conductivity

   d. Open top, bottom, and sides to permit cable management options.

B. Free Standing Equipment Cabinet

1. Shall provide standard 19" rack mounting options for equipment.

2. Mounting rails shall be adjustable.

3. Equipment cabinet layouts shall be in accordance with cabinet drawings where provided for this design.

4. Cabinets shall be designed to accommodate server rail kits from Compaq, IBM and Dell.

5. Include smoked Plexiglas removable front & rear locking doors – hinged right side.

6. Push button lift-off locking side panels

7. Perforated top panel for ventilation and fan mounting
8. Open base
9. All equipment cabinet assemblies shall include, but not be limited to an exhaust fan, two six foot/six port 20 amp power strips, grounding bus, and any mounting hardware required to meet the mounting requirements unless otherwise specified in the contract drawings.
10. All equipment cabinets shall be floor mountable by design and permanently fixed to the floor with bolt-down kits, unless otherwise specified in the contract drawings. Manufacturer's procedures for floor mounting shall be followed. Multiple racks and cabinets shall be connected together directly or indirectly via horizontal cable management hardware as indicated by drawings.
11. Equipment cabinets shall be 84"H x 30" W x 36" D unless otherwise specified by construction documents.
12. Equipment cabinets shall be black in color.
13. All equipment cabinets shall be Seismic Zone X rated and mounted to meet Seismic Zone X requirements.

C. Partitioned Equipment Cabinets

1. Fully Welded Construction
2. 19" EIA width
3. Individual sets of adjustable mounting rails per compartment
4. EIA-310-D Standard Universal 5/8 x 5/8 x 1/2 hole spacing
5. M6 Cage-Nut (square) mounting holes
6. Up to three secure equipment compartments
7. Pre-drilled for field compartment changes
8. Secure, isolated data and power cable channels, top or bottom entry
9. Reinforced doors, removable w/ combo locks and security hinges
10. Doors exceed active equipment req. for air-flow, hot/cold aisle ready
11. Locking/removable flush side panels
12. Flush top panels w/ cable knock-outs, removable
13. Open bottom for raised floor access and ventilation
14. Seismic floor mounting plates w/ levelers, casters optional
15. Integrated unistrut for rail free mounting of accessories and power
16. Textured epoxy powder-coat finish
17. UL Listed
18. Each compartment shall be provided with a unique lock that will only open a single compartment. Contractor shall coordinate the

cabinet/compartment key codes with the COSA representative prior to purchase to ensure compliance with the existing City key code standards.

D. High Capacity Floor Mount Frames

1. Designed for high density terminations without congestion.
2. Shall separate horizontal and vertical paths for jumpers
3. Capable of mounting 100pr or 300pr 110 blocks
4. Support termination of up to 9000 copper pair
5. Shall be constructed of 6061-T6 structural grade aluminum uprights
6. Shall include cable runway support, junctioning bolts, and ground bus.
7. Shall be UL listed.

2.03 CABLE MANAGEMENT

A. Vertical Wire Menders:

1. Usable dimensions of 6” x 7’, compatible with Free Standing 19 Inch Rack.
2. Usable dimensions of 4” x 7’, to be installed within equipment racks on the outside of each mounting rail.
3. Provide a given organized path for the routing of patch or cross-connect cables between distribution racks.

B. Horizontal Wire Mender:

1. Provide organized movement for horizontal and vertical routing of patch cables on distribution racks.
2. Size as required by application. Some zero (0) rack unit wire menders shall be required in areas of higher density within the installation.
3. Required between all devices mounted within a rack or cabinet.

C. Horizontal Wire Mender (Patch Cord Organizer):

1. Provide organized movement for horizontal and vertical routing of patch cables on distribution racks.
2. Two (2) rack unit and zero (0) rack unit patch cord organizers, or a combination of both, shall be required in some higher density termination racks.
3. Required between all copper patch panels mounted within a rack or cabinet.

2.04 PATCH PANELS

A. Patch Panels and Associated Components:

1. The termination block on the patch panel shall support the appropriate Category 6 applications, including 100 Base-T, 52/155 Mbps ATM, and

1000 BASE-T Gigabit Ethernet, and facilitate cross connection and inter connection using modular patch cords. All Modular jack panels shall be wired to T568B. The wiring block shall be able to accommodate 24 AWG cable conductors. All modular cross connect panels shall be UL listed.

2. General Performance Specifications:

a. Electrical Requirements:

Freq (MHz)	Insertion Loss (dB)	NEXT (dB)	FEXT (dB)	Return Loss
1	0.10	75.0	75.0	30.0
4	0.10	75.0	71.1	30.0
8	0.10	75.0	65.0	30.0
10	0.10	74.0	63.1	30.0
16	0.10	69.9	59.0	30.0
20	0.10	68.0	57.1	30.0
25	0.10	66.0	55.1	30.0
31.25	0.11	64.1	53.2	30.0
62.5	0.16	58.1	47.2	28.1
100	0.20	54.0	43.1	24.0
200	0.28	48.0	37.1	18.0
250	0.32	46.0	35.1	16.0

3. All patch panels and associated components shall be included in the system and performance warranties.

4. 48 port patch panel shall be used unless otherwise specified within the construction documents.

5. All 48 port patch panels shall be two (2) rack units in height unless otherwise specified.

2.05 OPTICAL FIBER PANELS

A. Fiber Optic Distribution System

1. General Performance Specifications:

a. Fiber Optic Interconnect Units and Distribution Shelves: The enclosure is used in fiber optic interconnection, cross-connection, and splicing applications. The enclosure shall be modular in design and suitable for outside plant (OSP) cables. Fiber optic termination cabinets/terminals shall be rack mounted in either equipment racks or enclosed data cabinets.

b. The distribution shelves shall be rack mounted and fit into a 19” frame arrangement.

c. The distribution shelves shall consist of a modular enclosure with front and rear access and can be fully administered from the front or rear.

d. The distribution shelves shall provide terminating capability of 24, 48, 96, or 144 fibers.

e. 24 port distribution shelves shall be two (2) rack units in height unless otherwise specified.

f. 48 port distribution shelves shall be three (3) rack units in height unless otherwise specified.

g. 96 and 144 port distribution shelves shall be four (4) rack units in height unless otherwise specified.

h. The manufacturer must be ISO 9001 certified.

B. Fiber splicing and closures: All splices shall be fusion, unless approved by SAIA. The fiber splice module shall meet the following specifications:

C. Mechanical:

1. Joins singlemode and multimode fibers
2. Establishes a permanent mechanical splice
3. May be used in outside plant and/or premises applications.
4. Accept 250 and 900 micron fibers
5. Re-enterable, re-arrangeable and reusable
6. Require no polishing
7. Require no adhesives
8. No loose parts
9. One part index matching gel
10. Unlimited shelf life

D. Optical:

1. Splice loss < 0.20 dB
2. Reflection < 50 dB
3. Stable from -40°F to 185°F (-40°C to 85°C)

E. Splice Closure

1. The fiber splice closure shall seal, bond, anchor and protect fiber optic cable splices. The splice closure shall be a stand-alone closure that does not require an outer closure. The splice closure shall provide for a maximum of six (6) cable entries in a butt-end configuration. The splice closure shall be used in aerial, underground and direct buried applications.

2.06 TERMINATION BLOCKS

A. Field-Terminated, 110 Wiring Blocks:

1. 110 blocks shall provide for the termination of horizontal, equipment, or tie cables. This high-density modular design shall be compatible with all

voice and data circuits. The block shall be Underwriter's Laboratories (UL) listed.

2. 110 blocks shall be included in manufactures channel performance requirements and warranty program.

B. General Description

1. The wiring blocks shall be fire retardant, molded plastic consisting of horizontal index strips for terminating 25 pairs of conductors each. These index strips shall be marked with five colors on the high teeth, separating the tip and ring of each pair, to establish pair location. A series of fanning strips shall be located on each side of the block for dressing the cable pairs terminated on the adjacent index strips.

2. The wiring block shall accommodate 22- through 26-AWG conductors and shall be able to mount directly on wall surfaces with backboards or on a 24" free-standing frame.

3. Clear label holders with the appropriate colored inserts shall be provided with the wiring blocks. The insert labels shall contain vertical lines spaced on the basis of circuit size (3-, 4-, or 5-pair) and shall not interfere with running, tracing or removing jumper wire/patch cords.

4. The wiring blocks shall be available in 25, 50, 100, and 300 pair sizes. The 100 and 300 pair wiring blocks shall be available with or without legs. The legs allow the cables to pass behind the wiring block and fan out to each side. The space created by the feet, on each side of the block, allows it to be used as a vertical jumper trough.

5. The 25 and 50 pair sizes are not available with legs and shall be utilized for low pair count and/or depth restrictive situations.

6. The wiring block shall be able to accommodate over 500 repeated insertions without incurring permanent deformation and it shall pass the reliability test of no more than one contact failure in 10,000 connections.

7. The 110 wiring blocks shall meet the following specifications:

a. Physical Specifications:

Height:

25-, 50-Pair – 1.75 in. (4.45 cm)

100-Pair – 3.59 in. (9.12 cm)

300-Pair, 10.79 in. (27.41 cm)

b. Electrical Specifications:

EIA/TIA Category 6

2.07 CABLE TRAY

A. Manufacturers:

1. Chatsworth

B. Description: Cable Tray/Ladder Rack

C. Cable tray shall be used to route bulk telecommunications equipment within the MCR.

D. Cable tray and ladder racking shall be at least 12 inches wide and placed 7 feet above the finished floor to coincide with the top of the equipment racks and cabinets.

E. Cable tray and ladder racking shall provide a proper clearance from HVAC ducting or other obstacles.

F. Cable tray and ladder racking shall provide drop outs where cables exit the tray where necessary to prevent violating the maximum bend radius of the installed cabling.

G. Cable tray and ladder racking must include vertical sections secured to the floor for riser cables entering from floor sleeves and slots, and runway drop-offs for racks installed above equipment racks and cabinets.

H. All cable tray and ladder racking shall be grounded and bonded to the TGB in the communications room.

I. Aluminum material, hot dip mill-galvanized to ASTM A-525 standard

J. Hot Dip Galvanized after fabrication to ASTM A-123 standard

K. Include appropriate connectors and mounting brackets to properly mount cable tray

L. Minimum width 12 inches, minimum load depth 4 inches, refer to contract drawings for actual dimensions Note: there may be more than one size cable tray in the design.

M. Shall be supplied in ten (10) foot lengths.

N. Rung edges shall be turned to eliminate sharp edges

O. Minimum rung diameter - 1 inch

P. Maximum rung spacing - 12 inches

Q. All cable tray and ladder rack shall be installed in such a fashion that the installation meets or exceeds all Seismic Zone X requirements.

R. UL Classified as an equipment grounding conductor and shall meet NEC Article 318-5.

2.08 GROUNDING BARS

A. Telecommunications Main Grounding Busbar (TMGB):

1. Refer to Section 270526 Grounding and Bonding for Communications Systems.

2.09 COPPER PATCH CORDS

A. Patch Cords

1. Copper Patch Cords:

a. Patch cords shall be factory made from the same manufacture as the termination (patch panels and Jack modules) hardware to

insure proper compatibility and highest system performance levels. If substitutions are requested by the consultant/contractor, then demonstrated equivalency shall be provided to SAIA Project Manager prior to installation.

b. Provide Category 6, Modular Patch Cords for each port on the patch panel. All cords shall conform to the requirements of TIA/EIA 568B Commercial Building Telecommunications Cabling Standard, Horizontal Cabling Section, and be part of the UL® LAN Certification and Follow-up Program. Cords shall be equipped with an 8 pin modular connector on each end and shall conform to the length(s) specified on the detailed drawing. All Category 6 cordage shall be round, and consist of 24-AWG copper, stranded conductors, tightly twisted into individual pairs and shall meet or exceed the electrical specifications listed below. Patch cords shall be backward compatible with Category 5/5e systems.

c. Performance Specifications:

Guaranteed Channel Performance Specifications						
Freq	Insertion Loss	NEXT	PS NEXT	ELFEXT	PS ELFEXT	Return Loss
(MHz)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)
1	2.1	65.0	62.0	63.3	60.3	19.0
4	4.0	63.0	60.5	51.2	48.2	19.0
8	5.7	58.2	55.6	45.2	42.2	19.0
10	6.3	56.6	54.0	43.3	40.3	19.0
16	8.0	53.2	50.6	39.2	36.2	18.0
20	9.0	53.2	50.6	39.2	36.2	17.5
25	10.1	50.0	47.3	35.3	32.3	17.0
31.25	11.4	48.4	45.7	33.4	30.4	16.5
62.5	16.5	43.4	40.6	27.3	24.3	14.0
100	21.3	39.9	37.1	23.3	20.3	12.0
200	31.5	34.8	31.9	17.2	14.2	9.0
250	35.9	33.1	30.2	15.3	12.3	8.0

d. UTP Patch cord lengths shall be available in the following lengths:

Length	Location/Application
3 ft	From the patch panel to the electronic equipment located within the equipment rack, cabinet or backboard
5 ft	From the patch panel to the electronic equipment located within the equipment rack, cabinet or backboard
7 ft	From the patch panel to the electronic equipment located within the equipment rack, cabinet or backboard and from the jack to the computer workstation
9 ft	From the Jack to the computer workstation
15 ft	From the Jack to the computer workstation

e. Contractor shall provide the following quantity of patch cords and deliver to the SAIA representative for their use:

1) 1 Meter Length - 100

2) 3 Meter Length – 100

3) 7 Meter Length – 100

2.010 FIBER PATCH CORDS

A. Multimode Fiber Patch Cord:

1. The multimode fiber patch cord shall consist of buffered, graded-index fiber with a 62.5 micron core with 3.0 mm Cordage and a 125 micron cladding. The fiber cladding shall be covered by aramid yarn and a jacket of flame-retardant PVC.

2. The multimode patch cord shall meet or exceed the following requirements:

Parameter	Requirement
Mated Connector Loss	μ = 0.3 dB, σ = 0.2 dB
Operating temperature	-4° to 158° F (-20 to 70° C)
Cable Retention	50 lb. (220 N) minimum
Connection Repeatability	0.20 dB maximum change per 100 reconnects
Operating temperature	-4° to 158° F (-20 to 70° C)

3. UL® listed

4. ISO 9001 Certified Manufacturer

5. Contractor shall provide all patch cords of the appropriate length for the particular application. All slack in the patch cords shall be appropriately dressed using vertical and horizontal patch cord organizers to maintain a neat appearance.

B. Single-mode Fiber Patch Cords:

1. The single-mode fiber patch cord shall consist of a stepped-index 8.3 micron core with 3.0 mm Cordage and a 125 micron cladding. The fiber cladding shall be covered by aramid yarn and a jacket of flame-retardant PVC.

2. The single-mode patch cord shall meet or exceed the following requirements:

Parameter	Requirement
Return Loss	-50 dB maximum
Operating temperature	-4° to 158° F (-20 to 70° C)

Mated connector loss	μ = 0.35 dB, σ = 0.2 dB
Cable Retention	50 lb. (220 N) minimum
Connection Repeatability	0.20 dB maximum change per 200 reconnects

3. UL® listed
4. ISO 9001 Certified Manufacturer
5. Contractor shall provide all patch cords of the appropriate length for the particular application. All slack in the patch cords shall be appropriately dressed using vertical and horizontal patch cord organizers to maintain a neat appearance.
6. In addition to the path cords required and shown on the contract drawings, the Contractor shall provide the following quantity of patch cords and deliver to the SAIA representative for their use:
   a. 1 Meter Length – 25 (SM and MM)
   b. 3 Meter Length – 50 (SM and MM)
   c. 7 Meter Length – 50 (SM and MM)

3.00 EXECUTION

3.01 EXAMINATION AND VERIFICATION

A. Verify the following:

1. Conduits, raceways, cable trays, and boxes are properly installed in accordance with BISCI recommended practices, ANSI/TIA/EIA 569A standards and Seismic Zone X installation requirements.
2. Conduit is minimum 1 -inch diameter.
3. Main grounding system is properly installed and tested per contract documents and industry standards.
4. The MCR is equipped with a smoke detection system that is fully integrated with the existing building fire detection system.
5. Ceiling protrusions have been placed to assure a minimum clear height of 8 feet 6 inches to provide space over the equipment frames for cables and suspended racks.
6. The doors are a minimum of 3 feet wide by 7 feet, 5 inches tall. The doors shall be keyed separately from other facility keys and controlled by the airport's access control system. Doors shall open outward, where not restricted by code, and be lockable. Access shall allow for future equipment changes. Door shall be fire rated for a minimum of one hour, or more as required by local code requirements.
7. The floor shall be sealed concrete to minimize dust and static electricity. Carpet is strictly prohibited.

8. Floor loading capacity in the communications rooms are designed for a minimum distributed load rating of 100 lbf/ft² and a minimum concentrated load rating of at least 2000 lbf.

9. There is a continuous and dedicated environmental control (24 hours per day, 365 days per year).

10. The air handling system for equipment rooms is capable of providing positive air flow and cooling even during times when the main building systems are shut down. This may require separate air handlers and/or small stand-alone cooling systems that are thermostatically controlled in this space.

11. Heating, ventilation, and air conditioning sensors and control equipment are located in the communications room.

12. The room temperature is between 64°F and 75°F, with a relative humidity between 30% and 55%.

13. The communications room is protected from contaminates and pollutants that could affect operation and material integrity of the installed equipment. When contaminates are present in concentrations greater than indicated in ANSI/TIA/EIA 569-A, Table 8.2-2, vapor barriers, positive room pressure or absolute filters shall be provided.

14. Positive air pressure differential is maintained with respect to surrounding areas.

15. Adequate lighting is provided. A minimum of 50 foot-candles when measured three feet above finished floor shall be provided. The light fixtures shall be mounted a minimum of 8 feet, 6 inches above the finished floor. The light switches are located near the entrance of the communications room. Emergency lighting has properly been placed that an absence of light will not hamper emergency exit.

16. The communications room shall be equipped with a minimum of two dedicated 3-wire 120V AC quad electrical outlets on separate branch circuits and 20-ampere rated on each equipment rack/cabinet allocated for active electronics. Outlets are to be located on active equipment racks 24" AFF. Provide duplex 20R spade receptacle unless otherwise specified. Separate duplex 120V AC convenience outlets shall also be installed at 18 inches above the finished floor at 6-foot intervals around perimeter walls. The outlets shall be on non-switched circuits and they shall be identified and labeled. Power for all equipment located within the communications rooms shall be supplied from a panel located within the room. Power for the lighting and the telecommunications equipment shall be provided by separate power panels.

17. The communications room is provided with an electrical ground on a 4-inch or larger busbar as defined by NEC Article 250-71(b). The busbar shall be located near the power panel within the communications room. This grounding bar is connected to a main building ground electrode and the electrical panel within the room, reference ANSI/EIA/TIA-607.

18. All outlets, with the exception of convenience outlets, within communications rooms shall be on emergency power
19. The communications rooms shall be equipped with individual rack mount Uninterruptible Power Supplies capable of supporting the equipment within that rack for a minimum of 10 minutes.
20. All walls are lined with Trade Size 3/4-inch AC-grade plywood, 8 feet high. Plywood will be mounted vertically starting 2 inches above finished floor and shall be securely fastened to the wall-framing members, and painted with two coats of white fire-retardant paint.
21. The MCR shall be on separate fire protection loops, and a “dry” fire protection system such as FM-200 or Inergen shall be used.
22. Access to the communications rooms shall be directly from hallways, not through offices, janitorial or mechanical rooms.
23. The communications rooms shall not be located in any place that may be subject to water or steam infiltration, humidity from nearby water or stream, heat, and any other corrosive atmospheric or environmental conditions.
24. The communications rooms shall not be located near electrical power supply transformers, motors, generators, x-ray equipment, radio transmitters, induction heating devices, and other potential sources of electromagnetic interference.
25. All racks, cabinets, cable tray, ladder rack, conduit, and any other communications equipment are installed with proper seismic requirements to meet local Seismic Zone installation requirements.
26. Rough in to support access control and HVAC monitoring systems has been installed.
27. If any of these items are not provided, contact the SAIA Project Manager immediately.

3.02 INSTALLATION

A. Install work following drawings, manufacturer’s instructions, and approved submittal data.

B. All installation shall be done in conformance with TIA/EIA 568B, BICSI installation guidelines, local seismic requirements, and SAIA standards. Failure to follow the appropriate guidelines will require the Contractor to provide, in a timely fashion, the additional material and labor necessary to properly rectify the situation.

C. The Contractor shall adhere to the installation schedule of the general contractor and should attend all construction meetings scheduled by the general contractor.

D. As a general practice for rack mounted equipment, the contractor shall run power cables, control cables, and high-level cables on the left side of an

equipment rack as viewed from the rear. The contractor shall run other cables on the right side of an equipment rack as viewed from the rear. For equipment mounted in drawers or on slides, provide the interconnecting cables with a service loop of not less than three feet and ensure that the cable is long enough to allow full extension of drawer or slide.

E. All racks and cabinets shall be floor mountable by design and permanently fixed to the floor with bolt-down kits, unless otherwise specified. Manufacturer's procedures for floor mounting shall be followed. Multiple racks and cabinets shall be connected together directly or indirectly via horizontal cable management hardware as indicated by drawings.

F. The termination scheme of cabling (fiber and copper) shall be coordinated according to COSA ITSD standards and approved by the SAIA Project Manager.

G. Plastic cable ties shall not be used at any location within this project. All cables shall be bundled using Velcro wraps of the appropriate length. Velcro ties shall be installed in such a manner that cables may be easily removed or added to the cable bundle.

3.03 CONTRACTOR FIELD QUALITY CONTROL

A. The Contractor shall be responsible for performing field inspections to ensure that all communications are installed in accordance with the contract drawings, specifications, and SAIA requirements prior to the performance of field inspections by SAIA.

B. Should there be any discrepancies or a question of intent, refer the matter to SAIA for a decision before ordering any equipment, materials or before starting any related work.

C. COSA ITSD and/or their designated representative shall perform field inspections and note all discrepancies that must be corrected prior to system acceptance.

END OF SECTION 27 11 00

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SECTION 27 13 13

COMMUNICATIONS COPPER BACKBONE CABLING

1.01 GENERAL

1.02 DESCRIPTION

A. This section includes the requirements for furnishing and installing copper backbone cabling as specified and shown on the contract drawings.

B. Related Documents: Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to the work this section.

1.03 RELATED SECTIONS

A. Section 27 05 00 Common Work Results for Communications and all sections referenced therein

1.04 REFERENCES

A. The publications list below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

B. Specific reference in specifications to codes, rules, regulations, standards, manufacturer's instructions, or requirements of regulatory agencies shall mean the latest printed edition of each in effect at the date of contract unless the document is shown dated.

C. Conflicts:

1. Between referenced requirements: Comply with the one establishing the more stringent requirements.

2. Between referenced requirements and contract documents: Comply with the one establishing the more stringent requirements.

D. References:

1. ANSI/TIA/EIA-568-C – Commercial Building Telecommunications Cabling Standard

2. ANSI/TIA/EIA-569-B – Commercial Building Standard for Telecommunications Pathways and Spaces

3. ANSI/TIA/EIA-758-A – Customer Owned Outside Plant Telecommunications Cabling Standard

4. ANSI/TIA/ EIA-568-C.2-1 – Additional Transmission Performance Guidelines for 4-Pair 100Ω Category 6 Cabling

5. TIA/EIA PN-3398 (Cabling practices for Open Offices)

6. Underwriters Laboratories (UL®) Cable Certification and Follow-up Program
7. National Electrical Manufacturers Association (NEMA)
8. American Society for Testing Materials (ASTM)
9. National Electric Code (NEC®)
10. Institute of Electrical and Electronic Engineers (IEEE)
11. UL Testing Bulletin
12. American National Standards Institute (ANSI) X3T9.5 Requirements for UTP at 100 Mbps

1.05 ABBREVIATIONS

A. AWG – American Wire Gauge
B. Mbps – Megabits Per Second
C. PVC – Polyvinyl Chloride
D. ANSI – American National Standards Institute
E. ASTM – American Society for Testing Materials
F. BICSI – Building Industry Consulting Services International
G. EIA –Electronics Industries Association
H. IEEE – Institute of Electrical and Electronic Engineers
I. ISO – International Organization for Standardization
J. NEC – National Electrical Code
K. NEMA – National Electrical Manufacturing Association
L. RCDD – Registered Communications Distribution Designer
M. TIA – Telecommunications Industry Association
N. UL – Underwriter's Laboratories
O. NEXT – Near End Crosstalk
P. FEXT – Far End Crosstalk
Q. ELFEXT – Equal Level Far End Crosstalk
R. PSELFEXT – Power Sum Equal Level Far End Crosstalk

1.06 SUBMITTALS

A. Submit all required documents in accordance with Section 01 33 00 Submittal Procedures
B. Submit the following for copper backbone cabling system:
   1. Manufacturer's Data for all proposed equipment
C. Provide a list of termination and test equipment to be used for CONTRACTOR to perform work.

1. Equipment shall be calibrated with trace ability to National Institute of Standards and Testing (NIST) requirements.
2. Contractor shall include copy of calibration and certification that equipment calibration meets NIST standards and has been calibrated at least once in the previous calendar year.

D. Provide shop drawings indicating the intended cable layout and pulling plan prior to beginning cable pulling.

1. Contractor shall provide general procedures for the installation process.
2. Contractor shall identify pulling point locations.
3. Contractor shall identify pulling tensions and bend radii.

E. Provide calculations and recorded values for actual cable run pulling tensions and recordings of their actual values.

F. Provide cable inventory data for all fiber and copper cabling and termination equipment. Submit data electronically on CD-ROM in an SAIA approved format. Data to be provided includes:

1. Manufacturer's Name
2. Manufacturer's Part Numbers and Com Code Numbers

G. Cable Numbers utilizing the San Antonio International Airport cable numbering standard. (Refer to Section 270533 Identification for Communications Systems).

H. Submit As-builts (Record Drawings): Furnish As-built CAD drawings of completed work including cable numbers. A full size hard copy and electronic copy on CD-ROM shall be furnished to the SAIA Project Manager. Follow format and labeling conventions as specified in Section 270533 Identification for Communications Systems.

1.07 CONTRACTOR'S DUTIES

A. Contractor shall install copper backbone cabling in order to provide a fully operational, tested, certified and warranted cabling system.

B. Contractor shall provide all calculations and analysis to support design and engineering decisions as specified in the Submittals section.

C. Contractor shall comply with all codes, ordinances, regulations, and other legal requirements of public authorities, which bear on performance of Work.

D. Contractor shall have the chosen manufacture provide written guidelines for what constitutes warranty liability issues regarding moves, adds, and changes to the cable plant performed by SAIA personnel.

1.08 QUALITY ASSURANCE

A. Refer to Section 01 40 00 Quality Control Services for installer quality assurance requirements.

B. Materials shall be rated for continuous operation under the ambient environmental temperature, humidity, and vibration conditions encountered at the installed location. The materials shall meet the following requirements:

1. Interior Controlled Environment: 64 to 75 degrees F dry bulb and 30 to 55 percent relative humidity, non-condensing
2. Interior Uncontrolled Environment: 0 to 130 degrees F dry bulb and 10 to 95 percent relative humidity, non-condensing.
3. Exterior Environments: Minus 30 degrees to 130 degrees F dry bulb, and 10 to 100 percent relative humidity, condensing.
4. Hazardous Environment: All system components located in areas where fire or explosion hazards may exist because of flammable gas or vapors, flammable liquids, combustible dust, or ignitable fibers or flyings, shall be rated and installed according to Chapter 5 of the NFPA 70 and as shown.

C. Standard products: Equipment and materials shall be standard products of a manufacturer regularly engaged in the manufacture of telecommunications cabling products and shall be the manufacturer's latest standard design in satisfactory use for at least one (1) year prior to bid opening.

1. Items of the same classification shall be identical. This requirement includes cable, equipment, modules, assemblies, parts, and components.

1.09 DELIVERY

A. Materials shall be delivered in original packages with labels intact and identification clearly marked. Materials damaged prior to final installation acceptance shall be replaced at no cost to SAIA.

1.010 WARRANTY

A. The warranty on all materials, services, and adherence of the cabling system to this specification shall be for a period of not less than twenty (20) years.

1. If items supplied as part of this project have longer warranties, the Contractor shall supply longer warranty.

B. The warranty shall certify that the cabling system shall support and conform to ANSI/TIA/EIA specifications covering any current or future application, which supports transmission over a properly constructed horizontal cabling system premises network.

C. The warranty shall cover the replacement or repair of defective product(s) and labor for the replacement or repair of such defective product(s).

2.00 PRODUCTS

2.01 GENERAL

A. Manufacturers

1. CommScope
2. Belden
3. Panduit

B. The list above is provided as a supplement and is not intended to exclude other manufacturers which meet or exceed the requirements listed herein.

C. The Contractor shall supply materials as described and shown.

D. The Contractor shall supply all cabling necessary to interconnect all system equipment including equipment located in the Telecommunications Rooms.

2.02 COPPER CABLE GENERAL REQUIREMENTS

A. Manufacturer Qualifications

1. ISO 9001 Certified and included in the Underwriters Laboratories LAN Certification and Follow-up Program.

B. All copper cable shall utilize the appropriate sheath for the particular application. This shall be in accordance with ANSI/EIA/TIA-568-B standards. Any cable placed in space used as an air return or in any way connected with air handling plenums or building ventilation shall be low-smoke, fire retarding cable, and must comply with the National Electrical Code Articles 725, 760, and 800. No cabling shall be placed in plenums without written approval from SAIA.

C. Preparation for delivery: The copper cable shall be shipped on reels in lengths as specified with a minimum overage of ten (10) percent.

1. The cable shall be wound on the reel so that unwinding can be done without kinking the cable.

2. Two (2) meters of cable at both ends of the cable shall be accessible for testing.

3. Marking: Each reel shall have a permanent label attached showing length, cable identification number, cable size, cable type, and date of manufacture. Labels shall be water-resistant and the writing on the labels shall be indelible.

D. Storage: The cable shall have a minimum storage temperature range of minus 40 degrees Celsius to plus 70 degrees Celsius.

2.03 COPPER RISER CABLE

A. Multi-pair Riser Cable shall be used for all riser cabling unless specified otherwise.

B. Shielded or unshielded 24 AWG multi-pair copper cables shall be used as the vertical riser cables. The riser cable shall support voice, data, and building service applications. The bending radius and pulling strength requirements of all backbone cables shall be observed and documented during handling and installation. The multi-pair copper cables shall be plenum rated unless placed in conduit or specified otherwise.

C. The shielded non-plenum cable shall consist of solid-copper conductors insulated with expanded polyethylene covered by a PVC skin, be conformance tested to meet EIA/TIA 568B for Category 3 cables, be UL® and c(UL®) Listed as CMR. The core shall be overlaid with a corrugated aluminum sheath, which is adhesively bonded to an outer jacket of PVC plastic to form an ALVYN sheath. The copper riser cable shall meet or exceed the following electrical specifications listed below.

D. The shielded cable shall meet or exceed the following electrical requirements:

Average DC Resistance	26.5Ω/1,000 ft (8.7Ω/100m), maximum
Average DC Resistance Unbalance	1.7%, maximum

Mutual Capacitance @ 1kHz	16 nF/1000 ft (5.25 nF/100 m), maximum
Capacitance Unbalance (pair to ground)	201pF/1,000 ft (65.94 pF/100m) maximum

Attenuation (dB/100 m [328 ft.]:

Frequency	Attenuation (Max.)
1.00 MHz	2.3 dB
4.00 MHz	4.9 dB
10.00 MHz	8.5 dB
16.00 MHz	12 dB

Worst Pair Near-End Crosstalk (NEXT) dB/100 m [328 ft]:

Frequency	Pair-To-Pair NEXT (Max.)
1.0 MHz	13.8 dB
4.0 MHz	11.2 dB
10.0 MHz	10.2 dB
16.0 MHz	9.2 dB

The PVC sheath shall have improved frictional properties, allowing it to be pulled through conduit without the use of lubricants.

The cable shall be available in 25, 50, 100, 150, 200, and 300 pair counts.

E. The non-shielded non-plenum cable shall consist of 24-AWG solid-copper conductors insulated with color coded PVC, 25 pair cable shall be UL® Verified to EIA/TIA 568B for Category 3, 25 to 100 pair shall be conformance tested to meet EIA/TIA 568B for Category 3 cables. The non-shielded cable shall be available in 25, 50, 75,100, 200, and 300 pair. The copper cable shall meet or exceed the following electrical specifications listed below:

Maximum DC Resistance	28.6 Ω/1,000 ft (9.4 Ω/100m)
Maximum DC Resistance Unbalanced	5%
Maximum Capacitance Unbalanced (pair to ground)	1,000 pF/1000 ft. (328 pF/m)
Mutual Capacitance @ 1kHz	18 nF/1000 ft (5.9 nF/100 m), maximum

Attenuation (dB/100 m [328 ft.]):

Frequency	Attenuation (Max.)
1.00 MHz	2.3 dB
4.00 MHz	4.9 dB
10.00 MHz	8.5 dB
16.00 MHz	12 dB

Worst Pair Near-End Crosstalk (NEXT) dB/100 m [328 ft]:

Frequency	Pair-To-Pair NEXT (Max.)
1.0 MHz	13.8 dB
4.0 MHz	11.2 dB
10.0 MHz	10.2 dB
16.0 MHz	9.2 dB

F. 25 to 300 pair cable shall be conformance tested to meet ANSI/TIA/EIA-568-B requirements for Category 3 cables.

3.00 EXECUTION

3.01 EXAMINATION AND VERIFICATION

A. Verify conduits, raceways, and boxes are properly installed following BICSI recommended practices and ANSI/TIA/EIA 569A standards.

B. Verify conduit is minimum 1 -inch diameter.

C. Verify main telecommunications grounding system is properly installed and tested following Section 270526 Grounding and Bonding for Communications Systems.

3.02 INSTALLATION

A. Install work following drawings, manufacturer's instructions, and approved submittal data. The number of cables per run, outlet configuration, and other pertinent data shall be included on the drawings.

B. All installation shall be done in conformance with ANSI/TIA/EIA 568B and BICSI installation guidelines. The Contractor shall ensure that the maximum pulling tensions of the specified distribution cables are not exceeded and cable bends maintain the proper radius during the placement of the facilities. Failure to follow the appropriate guidelines shall require the Contractor to provide, in a timely fashion, the additional material and labor necessary to properly rectify the situation. This shall also apply to any and all damages sustained to the cables by the Contractor during the implementation.

C. Riser and tie cables shall be extended between communications rooms utilizing the interfloor conduit sleeves.

D. All components of the cabling system shall be installed in a neat and professional manner. Wiring color codes shall be strictly observed and terminations shall be uniform throughout the installation. All cables shall be neatly dressed at the termination points. Final installation shall be subject to SAIA Project Manager approval. The cabling installation shall meet all applicable national and local codes pertaining to low voltage cable system installations.

E. The Contractor shall adhere to the installation schedule approved by SAIA and shall coordinate all construction meetings as agreed with SAIA.

F. The Contractor shall provide service loops (slack) for cables terminating in the main equipment room or the telecommunications rooms. A six (6) foot service loop shall be provided above the access ceiling or cable trays unless specified otherwise.

G. The installation shall include coordination, testing, and problem resolution with the system vendors.

H. Upon completion of the installation, the Contractor shall prepare as-built documentation of the entire backbone cable installation as part of the structured cabling system (SCS). This documentation should include:

1. Drawings
2. Documentation
3. This data shall be submitted prior to the use of any system components. System acceptance will not be provided without complete as-built documentation.

I. Plastic cable ties shall not be used at any location within this project. All cables shall be bundled using Velcro wraps of the appropriate length. Velcro ties shall be installed in such a manner that cables may be easily removed or added to the cable bundle.

3.03 BACKBONE CABLE SCHEDULE

A. Refer to the Construction Drawings

END OF SECTION 27 13 13

SECTION 27 13 23

COMMUNICATIONS OPTICAL FIBER BACKBONE CABLING

1.00 GENERAL

1.01 DESCRIPTION

A. This section includes the requirements for furnishing and installing optical fiber backbone cabling as specified and shown on the contract drawings.

B. Related Documents: Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to the work this section.

1.02 RELATED SECTIONS

A. Section 27 05 00 Common Work Results for Communications and all sections referenced therein

1.03 REFERENCES

A. The publications list below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

B. Specific reference in specifications to codes, rules, regulations, standards, manufacturer's instructions, or requirements of regulatory agencies shall mean the latest printed edition of each in effect at the date of contract unless the document is shown dated.

C. Conflicts:

1. Between referenced requirements: Comply with the one establishing the more stringent requirements.
2. Between referenced requirements and contract documents: Comply with the one establishing the more stringent requirements.

D. References:

1. ANSI/TIA/EIA-568-C – Commercial Building Telecommunications Cabling Standard
2. ANSI/TIA/EIA-569-B – Commercial Building Standard for Telecommunications Pathways and Spaces
3. ANSI/TIA/EIA-758-A – Customer Owned Outside Plant Telecommunications Cabling Standard
4. ANSI/TIA/ EIA-568-B.2-1 – Additional Transmission Performance Guidelines for 4-Pair 100Ω Category 6 Cabling
5. TIA/EIA PN-3398 (Cabling practices for Open Offices)
6. Underwriters Laboratories (UL®) Cable Certification and Follow-up Program

7. National Electrical Manufacturers Association (NEMA)
8. American Society for Testing Materials (ASTM)
9. National Electric Code (NEC®)
10. Institute of Electrical and Electronic Engineers (IEEE)
11. UL Testing Bulletin
12. American National Standards Institute (ANSI) X3T9.5 Requirements for UTP at 100 Mbps

1.04 ABBREVIATIONS

A. AWG – American Wire Gauge
B. Mbps – Megabits Per Second
C. PVC – Polyvinyl Chloride
D. ANSI – American National Standards Institute
E. ASTM – American Society for Testing Materials
F. BICSI – Building Industry Consulting Services International
G. EIA –Electronics Industries Association
H. IEEE – Institute of Electrical and Electronic Engineers
I. ISO – International Organization for Standardization
J. NEC – National Electrical Code
K. NEMA – National Electrical Manufacturing Association
L. RCDD – Registered Communications Distribution Designer
M. TIA – Telecommunications Industry Association
N. UL – Underwriter's Laboratories

1.05 SUBMITTALS

A. Submit all documentation in accordance with the approved project schedule and Section 01 33 00.
B. Submit the following for fiber backbone cabling system:
   1. Manufacturer's Data for all proposed equipment
C. Provide shop drawings indicating the intended cable layout and pulling plan prior to beginning cable pulling.
   1. Contractor shall provide general procedures for the installation process.
   2. Contractor shall identify pulling point locations.
   3. Contractor shall identify pulling tensions and bend radii.
D. Provide calculations and recorded values for actual cable run pulling tensions and recordings of their actual values.

E. Provide cable inventory data for all fiber and copper cabling and termination equipment. Submit data electronically on CD-ROM in an SAIA approved format. Data to be provided includes:

1. Manufacturer's Name
2. Manufacturer's Part Numbers and Comm Code Numbers

F. Cable Numbers utilizing the SAIA cable numbering standard. (Refer to Section 27 05 33 Identification for Communications Systems).

G. Submit As-builts (Record Drawings): Furnish As-built CAD drawings of completed work including cable numbers. A full size hard copy and electronic copy on CD-ROM shall be furnished to the SAIA's Project Manager. Follow format and labeling conventions as specified in Section 270533 Identification for Communications Systems.

H. Submit Test Plan – Contractor shall develop a fiber optic testing plan for each fiber backbone cable listing preparation requirements, each step required for testing, expected results and acceptable values, applicable standards and specifications cross referenced to specification sections, maximum loss values for all calculations, SAIA cable ID, suspension and resumption criteria, and pass/fail criteria. Contractor shall obtain approval of the testing plan from the Construction Administration Manager prior to the performance of any testing.

1.06 CONTRACTOR'S DUTIES

A. Contractor shall install fiber backbone cabling in order to provide a fully operational, tested, certified and warranted cabling system.

B. Contractor shall provide all calculations and analysis to support design and engineering decisions as specified in the Submittals section.

C. Contractor shall comply with all codes, ordinances, regulations, and other legal requirements of public authorities, which bear on performance of Work.

D. Contractor shall have the chosen manufacturer provide written guidelines for what constitutes warranty liability issues regarding moves, adds, and changes to the cable plant performed by SAIA personnel.

1.07 QUALITY ASSURANCE

A. Follow Section 01 40 00 Quality Control Services

B. Installers shall be trained and certified by the manufacturer for the installation of the proposed cabling.

C. Materials shall be rated for continuous operation under the ambient environmental temperature, humidity, and vibration conditions encountered at the installed location. The materials shall meet the following requirements:

1. Interior Controlled Environment: 64 to 75 degrees F dry bulb and 30 to 55 percent relative humidity, non-condensing
2. Interior Uncontrolled Environment: 0 to 130 degrees F dry bulb and 10 to 95 percent relative humidity, non-condensing.
3. Exterior Environments: Minus 30 degrees to 130 degrees F dry bulb, and 10 to 100 percent relative humidity, condensing.

4. Hazardous Environment: All system components located in areas where fire or explosion hazards may exist because of flammable gas or vapors, flammable liquids, combustible dust, or ignitable fibers or flyings, shall be rated and installed according to Chapter 5 of the NFPA 70 and as shown.

D. Standard products: Equipment and materials shall be standard products of a manufacturer regularly engaged in the manufacture of telecommunications cabling products and shall be the manufacturer's latest standard design in satisfactory use for at least one (1) year prior to bid opening.

1. Items of the same classification shall be identical. This requirement includes cable, equipment, modules, assemblies, parts, and components.

1.08 DELIVERY

A. Materials shall be delivered in original packages with labels intact and identification clearly marked. Materials damaged prior to final installation acceptance shall be replaced at no cost to SAIA.

1.09 WARRANTY

A. The warranty on all materials, services, and adherence of the cabling system to this specification shall be for a period of not less than twenty (20) years.

1. If items supplied as part of this project have longer warranties, the Contractor shall supply longer warranty.

B. The warranty shall certify that the cabling system shall support and conform to ANSI/TIA/EIA specifications covering any current or future application, which supports transmission over a properly constructed cabling system.

C. The warranty shall cover the replacement or repair of defective product(s) and labor for the replacement or repair of such defective product(s).

2.00 PRODUCTS

2.01 GENERAL

A. Manufacturers

1. AMP
2. Belden
3. Comm Scope
4. Corning
5. Siemons

B. The list above is provided as a supplement and is not intended to exclude other manufacturers which meet or exceed the requirements listed herein.

C. The Contractor shall supply materials as described and shown.

D. The Contractor shall supply all cabling necessary to interconnect all system equipment including equipment located in the Telecommunications Rooms.

2.02 OPTICAL FIBER GENERAL REQUIREMENTS

A. Fiber optic cable shall be certified to meet all parts of EIA-455 and comply with the NEC.

1. Cable installed in plenums or air-handling spaces shall meet UL 910 and shall be marked OFNP in accordance with the NEC.

2. Riser cable shall meet UL 1666 and be marked OFNR in accordance with the NEC.

3. Fiber optic patch cords shall be of the manufactured duplex type, and from the same manufacture as the termination hardware and cable to insure compatibility and performance. Field fabricated patch cords shall not be allowed.

4. Proper bend radius shall be maintained throughout the entire run of cabling and at all termination locations.

B. All fiber optic cable shall utilize the appropriate sheath for the particular application. This shall be in accordance with ANSI/EIA/TIA standards. Any cable placed in space used as an air return or in any way connected with air handling plenums or building ventilation shall be low-smoke, fire retarding cable, and must comply with the National Electrical Code Articles 725, 760, and 800. No cabling shall be placed in plenums without written approval from the Owner's Project Manager.

C. Building Cables: Building cables shall meet the following requirements:

1. Non-plenum Rated – Non-plenum, riser rated cable consisting of multiple fibers, shall have a Polyvinyl Chloride (PVC) outer jacket. The cable should have a non-filled ribbon structure with a nonmetallic crossply PVC core tube. The cable shall be UL listed and meet the NEC requirements for OFNR.

2. Plenum Rated - Plenum rated cable consisting of multiple fibers shall have a Plenum PVC outer jacket. Each group of fibers shall have a color-coded Low Smoke PVC buffer. The buffered fibers are organized in subunits of fibers, reinforced with aramid yarn for extra strength and surrounded with a color-coded Low Smoke tube. The cable and each subunit shall be UL listed and meet the NEC requirements for OFNP.

D. Optical fiber conductors shall follow standard color code schemes. Fiber numbers and binders shall correspond to the color codes as follows:

Fiber/Binder No.	Color	Fiber/Binder No.	Color
1	Blue	7	Red
2	Orange	8	Black
3	Green	9	Yellow
4	Brown	10	Violet
5	Slate	11	Rose
6	White	12	Aqua

E. Preparation for delivery: The fiber optic cable shall be shipped on reels in lengths as specified with a minimum overage of ten (10) percent.

1. The cable shall be wound on the reel so that unwinding can be done without kinking the cable.
2. Two (2) meters of cable at both ends of the cable shall be accessible for testing.
3. Marking: Each reel shall have a permanent label attached showing length, cable identification number, cable size, cable type, attenuation, bandwidth, and date of manufacture. Labels shall be water resistant and the writing on the labels shall be indelible.

F. Unless otherwise specified, all fiber optic cables shall be installed in inner duct throughout the entire length of the cable run.

G. All fiber shall be terminated using factory fan out kits with pre-connectorized terminations. No field installed connectors shall be used.

2.03 MULTIMODE FIBER OPTIC CABLE SPECIFICATIONS

A. Multi-mode fibers must comply with TIA/EIA 492 and IEC 60793. Fibers shall have dual wavelength capability; transmitting at 850 and 1300nm ranges and shall be rated for use as riser cabling. The coating shall be mechanically strippable. The sheath color for multimode riser rated and multimode plenum rated indoor cabling shall be orange in color.

B. The cable shall meet or exceed the following requirements:

Parameter	Requirement
Core Diameter	62.5 (+/-) 2.5 µm
Core Non-Circularity	<5%
Core/Cladding Concentricity Error	<1.5 µm
Numerical Aperture	0.200 ± 0.015
Cladding diameter	125.0 (+/-) 1.0 µm
Cladding Non-Circularity	<5%
Coating	245 µm ± 10 µm
Buffering Diameter	900 mm ± 50 mm
Cable Minimum Bending Radius During Installation: After Installation:	 20 times cable diameter 10 times cable diameter
Operating Temp. Range	0°C to 50°C
Storage Temp. Range	-60°C to 85°C
Maximum Fiber Loss	3.0 dB/km at 850 NM 1.0 dB/km at 1300 NM
Minimum Bandwidth	850nm: 700 MHz/km 1300nm: 500 MHz/km
Gigabit Ethernet Distance Guarantee	1km
Attenuation Uniformity	There shall be no point discontinuities greater than 0.2 dB at either 850 nm or 1300 nm
Attenuation Macro bend	The attenuation due to 100 turns of fiber

	around a 75(+-) 2mm diameter mandrel shall not exceed 0.5 dB @ 850nm and 1300nm

C. UL® listed

D. ISO 9001 Certified Manufacturer

2.04 SINGLE-MODE FIBER OPTIC CABLE SPECIFICATIONS

A. Single mode fibers must comply with TIA/EIA 492, ANSI/ICEA S-83-596, and ANSI/ICEA S-83-640. Fiber must comply with TIA/EIA 455 and IEC 793 test methods for required attributes. Fibers shall have dual wavelength capability; transmitting at 1310 and 1550 nm ranges and shall be rated for use as riser cabling. The coating shall be mechanically strippable. The sheath color for all single mode riser and single mode plenum rated cables shall be yellow in color.

B. The cable shall meet or exceed the following requirements:

Parameter	Requirement
Core Diameter	8.3 μm
Cladding Diameter	125.0 ± 1.0 μm
Cladding Non-Circularity	≤ 0.5 %
Core/Cladding Concentricity	≤ 0.5 μm
Coating Diameter	245 μm ± 10 μm
Mode Field Diameter	8.8 ± 0.5 μm @1310 nm
Minimum Proof Strength	100,000 psi
Cable Minimum Bending Radius During Installation: After Installation:	 20 times cable diameter 10 times cable diameter
Operating Temp. Range	-20°C to 70°C
Storage Temp. Range	-40°C to 70°C
Maximum Fiber Loss Depressed Clad	0.4 dB/km at 1310 NM 0.3 dB/km at 1550 NM
Gigabit Ethernet Distance Guarantee	5000 meters @ 1310 nm and 1550nm
Maximum Dispersion	2.8 ps/nm-km 1285 to 1330 nm
Fiber Macrobend (100 turns @ 75 mm diameter)	≥0.05 dB @ 1310 nm ≥0.10 dB @ 1550 nm

C. UL® listed

D. ISO 9001 Certified Manufacturer

2.05 FIBER SPLICE MODULES

A. Fiber splicing and closures: All splices shall be fusion unless specifically approved by the SAIA Project Manager. The fiber splice module shall meet the following specifications:

1. Mechanical

a. Joins single mode and multimode fibers

b. Establishes a permanent mechanical splice

c. May be used in outside plant and/or premises applications.

d. Accept 250 and 900 micron fibers

e. Re-enterable, re-arrangable, and reusable

f. Require no polishing

g. Require no adhesives

h. No loose parts

i. One part index matching gel

j. Unlimited shelf life

2. Optical

a. Splice loss < 0.20 dB

b. Reflection < 50 dB

c. Stable from -40°F to 185°F (-40°C to 85°C)

2.06 FIBER PATCH CORDS

A. Multimode Fiber Patch Cords

1. Multimode fiber patch cords shall be terminated with LC connectors.

2. The multimode fiber patch cord shall consist of buffered, graded-index fiber with a 62.5 micron core with 3.0 mm Cordage and a 125 micron cladding. The fiber cladding shall be covered by aramid yarn and a jacket of flame-retardant PVC.

3. The multimode patch cord shall meet or exceed the following requirements:

Mated Connector Loss	μ = 0.3 dB, σ = 0.2 dB
Operating temperature	-40 to 70° C
Cable Retention	20 lb. minimum
Connection Repeatability	0.20 dB maximum change per 100 reconnects
Return Loss Minimum	-20dB

4. Contractor shall provide all patch cords required to perform the patching as designated on the contract drawings and specifications. All slack in the patch cords shall be appropriately dressed using vertical and horizontal

patch cord organizers to maintain a neat appearance. In addition, the Contractor shall provide the following quantities of patch cords to the Owner:

a. 100 – 1 Meter patch cords with factory LC connectors

b. 100 – 3 Meter patch cords with factory LC connectors

c. 100 – 7 meter patch cords with factory LC connectors

B. Single-mode Fiber Patch Cords

1. Single-mode fiber patch cords shall be terminated with LC connectors.

2. The single-mode fiber patch cord shall consist of a stepped-index 8.3 micron core with 3.0 mm Cordage and a 125 micron cladding. The fiber cladding shall be covered by aramid yarn and a jacket of flame-retardant PVC.

3. The single-mode patch cord shall meet or exceed the following requirements:

Return Loss	-50 dB maximum
Operating temperature	-40 to 70° C
Mated connector loss	μ = 0.35 dB, σ = 0.2 dB
Cable Retention	20 lb. minimum
Connection Repeatability	0.20 dB maximum change per 200 reconnects

4. Contractor shall provide all patch cords required to perform the patching as designated on the contract drawings and specifications. All slack in the patch cords shall be appropriately dressed using vertical and horizontal patch cord organizers to maintain a neat appearance. In addition, the Contractor shall provide the following quantities of patch cords to the Owner:

a. 100 – 1 Meter patch cords with factory LC connectors

b. 100 – 3 Meter patch cords with factory LC connectors

c. 100 – 7 meter patch cords with factory LC connectors

2.07 FIBER OPTIC PATCH PANELS:

A. The Multimode connector panel must be preloaded with Duplex LC connectors. The color of the connector shall be beige.

B. The Single-mode connector panel must be preloaded with Duplex LC connectors. The color of connector shall be blue.

C. The fiber distribution cabinets must be configured with jumper troughs to aid in jumper management.

D. Fiber distribution cabinets must rack-mounted in either aluminum equipment racks or enclosed data cabinets and shall include radiused patch cord management.

3.00 EXECUTION

3.01 EXAMINATION AND VERIFICATION

A. Verify conduits, raceways, and boxes are properly installed following BICSI recommended practices and ANSI/TIA/EIA 569A standards.

B. Verify conduit is minimum 1 -inch diameter.

C. Verify main telecommunications grounding system is properly installed and tested following Section 27 05 26 Grounding and Bonding for Communications Systems.

3.02 INSTALLATION

A. Install work following drawings, manufacturer's instructions, and approved submittal data. The number of cables per run, outlet configuration, and other pertinent data shall be included on the drawings.

B. All installation shall be done in conformance with ANSI/TIA/EIA and BICSI installation guidelines. The Contractor shall ensure that the maximum pulling tensions of the specified distribution cables are not exceeded and cable bends maintain the proper radius during the placement of the facilities. Failure to follow the appropriate guidelines shall require the Contractor to provide, in a timely fashion, the additional material and labor necessary to properly rectify the situation. This shall also apply to any and all damages sustained to the cables by the Contractor during the implementation.

C. All fibers shall be run in inner duct and terminated in the communications rooms with LC type connectors in wall, or rack mounted Fiber Optic Distribution Shelves equipped with sufficient panels, couplers and jumper storage shelves to terminate and secure all fibers.

D. Riser and tie cables shall be extended between communications rooms utilizing the interfloor conduit sleeves.

E. All components of the cabling system shall be installed in a neat and professional manner. Wiring color codes shall be strictly observed and terminations shall be uniform throughout the installation. All cables shall be neatly dressed at the termination points. Final installation shall be subject to SAIA Project Manager approval. The cabling installation shall meet all applicable national and local codes pertaining to low voltage cable system installations.

F. The Contractor shall adhere to the installation schedule approved by SAIA and shall coordinate all construction meetings as agreed with SAIA.

G. The Contractor shall provide service loops (slack) for cables terminating in the main equipment room or the telecommunications rooms. A six (6) foot service loop shall be provided above the access ceiling or cable trays unless specified otherwise.

H. The installation shall include coordination, testing, and problem resolution with the system vendors.

I. Upon completion of the installation, the Contractor shall prepare as-built documentation of the entire backbone cable installation as part of the structured cabling system (SCS). This documentation should include:

1. Drawings
2. Documentation
3. This data shall be submitted prior to the use of any system components. System acceptance will not be provided without complete as-built documentation.

J. Plastic cable ties shall not be used at any location within this project. All cables shall be bundled using Velcro wraps of the appropriate length. Velcro ties shall be installed in such a manner that cables may be easily removed or added to the cable bundle.

3.03 BACKBONE CABLE SCHEDULE

A. Refer to Construction Drawings

END OF SECTION 27 13 23

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SECTION 27 15 00

COMMUNICATIONS HORIZONTAL CABLING

1.00 GENERAL

1.01 DESCRIPTION

A. This section will include all the specifications for the installation of the horizontal cabling component of the Structured Cabling System (SCS) for the purpose of supporting voice, data and video communications.

B. Related Documents: Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to the work this section.

1.02 RELATED SECTIONS

A. Section 27 05 00 Common Work Results for Communications and all sections referenced therein

1.03 REFERENCES

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

B. Specific reference in specifications to codes, rules, regulations, standards, manufacturer's instructions, or requirements of regulatory agencies shall mean the latest printed edition of each in effect at the date of contract unless the document is shown dated.

C. Conflicts:

1. Between referenced requirements: Comply with the one establishing the more stringent requirements.

2. Between referenced requirements and contract documents: Comply with the one establishing the more stringent requirements.

D. Telecommunications Industry Association /Electronic Industries Association (TIA/EIA) 568B-Commercial Building Telecommunications Wiring Standards.

E. TIA/EIA 569A-Commercial Building Standard for Telecommunications Pathways and Spaces.

F. ANSI/TIA/EIA 606-Administration Standard for Telecommunications Infrastructure of Commercial Buildings.

G. ANSI/TIA/EIA 607-Commercial Building Grounding and Bonding Requirements.

H. TIA/EIA TSB-67-Transmission Performance Specifications for Field Testing of Unshielded Twisted Pair Cabling Systems.

I. TIA/EIA TSB-72-Centralized Optical Fiber Cabling Guidelines.

J. TIA/EIA TSB-75-Additional Horizontal Cabling Practices for Open Offices.

K. ANSI/TIA/EIA 568-B.2-1-Additional Transmission Performance Guidelines for 4-Pair 100Ω Category 6 Cabling.

L. TIA/EIA PN-3398 (Cabling practices for Open Offices).

M. International Standards Organization/International Electromechanical Commission (ISO/IEC) DIS 11801.

N. Underwriters Laboratories (UL®) Cable Certification and Follow Up Program.

O. National Electrical Manufacturers Association (NEMA).

P. American Society for Testing Materials (ASTM).

Q. National Electric Code (NEC®).

R. Institute of Electrical and Electronic Engineers (IEEE).

S. UL Testing Bulletin.

T. American National Standards Institute (ANSI) X3T9.5 Requirements for UTP at 100 Mbps.

1.04 ABBREVIATIONS

A. AWG – American Wire Gauge

B. Mbps – Megabits Per Second

C. PVC – Polyvinyl Chloride

D. ANSI – American National Standards Institute

E. ASTM – American Society for Testing Materials

F. BICSI – Building Industry Consulting Services International

G. EIA –Electronics Industries Association

H. IEEE – Institute of Electrical and Electronic Engineers

I. ISO – International Organization for Standardization

J. NEC – National Electrical Code

K. NEMA – National Electrical Manufacturing Association

L. RCDD – Registered Communications Distribution Designer

M. TIA – Telecommunications Industry Association

N. TSB – Technical Systems Bulletin

O. UL – Underwriter's Laboratories

P. NEXT – Near End Crosstalk

Q. FEXT – Far End Crosstalk

R. ELFEXT – Equal Level Far End Crosstalk

S. PSELFEXT – Power Sum Equal Level Far End Crosstalk

1.05 SUBMITTALS

A. Submit all required documents in accordance with Section 01 33 00 Submittal Procedures

B. Submit the following for the horizontal cabling system:

1. Manufacturer's data for all proposed equipment.

C. List of termination and test equipment to be used for Contractor to perform work.

1. Equipment shall be calibrated with trace ability to National Institute of Standards and Testing (NIST) requirements.

2. Contractor shall include copy of calibration and certification that equipment calibration meets NIST standards and has been calibrated at least once in the previous calendar year.

D. Shop drawings indicating the intended cable layout and pulling plan prior to beginning cable pulling.

1. Contractor shall provide general procedures for the installation process.

2. Contractor shall identify pulling point locations.

3. Contractor shall identify pulling tensions and bend radii.

E. Calculations and recorded values for actual cable run pulling tensions and recordings of their actual values.

F. Cable inventory data for all horizontal cabling and termination equipment. Submit data electronically on data diskettes and CD-ROM in an SAIA approved format. Data to be provided includes:

1. Manufacturer's Name

2. Manufacturer's Part Numbers and Com Code Numbers

3. Cable Numbers utilizing the SAIA cable numbering standard. (Refer to Section 270553 Identification for Communications Systems).

G. As-Built (Record Drawings): Furnish as-built CAD drawings of completed work including cable numbers. A full size hard copy and electronic copy on CD-ROM shall be furnished to the SAIA Project Manager. Follow format and labeling conventions as specified in Section 270533 Identification for Communications Systems.

1.06 CONTRACTOR'S DUTIES

A. Contractor shall install all cabling required to provide a fully operational, tested, certified and warranted cabling system.

B. Contractor shall provide all calculations and analysis to support design and engineering decisions as specified in the Submittals section.

C. Contractor shall provide and pay for all labor, materials, and equipment. Pay all required sales, gross receipts, and other taxes.

D. Contractor shall secure and pay for plan check fees, permits, fees, and licenses necessary for the execution of Work as applicable for the project.

E. Contractor shall give required notices.

F. Contractor shall comply with all codes, ordinances, regulations, and other legal requirements of public authorities, which bear on performance of Work

G. Contractor shall provide SAIA personnel with adequate training in the processes involved with moves, adds, and changes to the cable plant.

H. Contractor shall have the chosen manufacture provide written guidelines for what constitutes warranty liability issues regarding moves, adds, and changes to the cable plant performed by SAIA personnel.

1.07 QUALITY ASSURANCE

A. It shall be the responsibility of the Contractor to provide all cable path engineering for the horizontal installation. It shall be the responsibility of the contractor to certify the design of the SCS according to the electrical specifications which are supplied in this document. Additional engineering, diagrams, records, and project management shall be provided by the contractor as stated in other specifications. Diagrams and records should also be coordinated to avoid duplication of efforts and consolidate documentation.

B. Refer to Specification 01 40 00 Quality Control Services for installer quality assurance requirements.

C. Hardware manufacturer's experience: All components shall be produced by manufacturers who have been regularly engaged in the production of telecommunications cabling components of the types to be installed in this project for a minimum period of five years.

1.08 DELIVERY

A. Equipment shall be delivered in original packages with labels intact and identification clearly marked. Equipment and components shall be protected from the weather, humidity, temperature variations, dirt, dust, or other containments. Equipment damaged prior to system acceptance shall be replaced at no cost to SAIA.

1.09 WARRANTY

A. A minimum twenty (20) year Extended Product Warranty and System Assurance Warranty for this wiring system shall be provided. If items supplied as part of this project have longer warranties, the Contractor shall supply longer warranty.

1. Extended Product Warranty: The Extended Product Warranty shall ensure against product defects, that all approved cabling components exceed the specifications of TIA/EIA 568B and ISO/IEC IS 11801, exceed the requirements of TIA/EIA TSB 67, TIA/EIA TSB 95, and ISO/IEC IS 11801 for cabling links/channels, that the installation shall exceed the loss and bandwidth requirements of TIA/EIA TSB 67, TIA/EIA TSB 95, and ISO/IEC IS 11801 for fiber links/channels, for a twenty (20) year period. The warranty shall apply to all passive SCS components.

a. If items supplied as part of this project have longer warranties, contractor shall supply longer warranty.

2. System Assurance: The System Assurance shall cover the failure of the wiring system to support the application which it was designed to support, as well as additional application(s) introduced in the future by recognized standards or user forums that use the TIA/EIA 568B or ISO/IEC IS 11801 component and link/channel specifications for cabling, for a twenty (20) year period.

3. Extended Product Warranty: The Extended Product Warranty and the System Assurance shall cover the replacement or repair of defective product(s) and labor for the replacement or repair of such defective product(s).

4. System Certification: Upon successful completion of the installation and subsequent inspection, the customer shall be provided with a numbered certificate, from the manufacturing company, registering the installation.

2.00 PRODUCTS

2.01 GENERAL

A. Manufacturers

1. AMP
2. Belden
3. Comm Scope
4. Corning
5. Siemons

B. The list above is provided as a supplement and is not intended to exclude other manufacturers which meet or exceed the requirements listed herein.

C. The Contractor shall supply materials as described and shown.

D. The Contractor shall supply all cabling necessary to interconnect all system equipment including equipment located in the Telecommunications Rooms.

2.02 MATERIAL DESIGN AND PERFORMANCE STANDARDS

A. Applications standards supported should include, but not be limited to, IEEE802.3, 10Base5, 10BaseT, 10BaseTX, IEEE802.5, 4 Mbps, 16 Mbps (328 ft [100m]) and TP-PMD. In addition, high-end applications such as 1 Gbps Ethernet applications shall be supported.

B. Copper Cable Standards:

1. All cable shall utilize the appropriate sheath for the particular application. This shall be in accordance with ANSI/EIA/TIA-568-B (or latest approved version) standards. Any cable placed in space used as an air return or in any way connected with air handling plenums or building ventilation shall be low-smoke, fire retarding cable, and must comply with the National Electrical Code Articles 725, 760, and 800. No cabling shall be placed in plenums without written approval from the SAIA Project Manager.

C. Horizontal Cable:

1. General Performance Specifications: The minimum requirements for all 4 pair, Unshielded Twisted Pair (UTP), Category 6 (or latest approved standard) cables shall conform to TIA/EIA 568B Commercial Building Telecommunications Cabling Standard, Horizontal Cable Section, and be part of the UL® LAN Certification and Follow-up Program. Cables shall be marked as UL verified with a minimum of a Category 6 (or latest approved standard) rating. Application standards supported should include, but not limited to, IEEE 802.3, 10Base5, 10BaseT, IEEE 802.5, 4 Mbps, 16 Mbps (328 ft [100m], 104 Workstations) and TP-PMD. In addition, these cables shall be capable of supporting high-end applications such as 1000 BASE-T Gigabit Ethernet.

2. Plenum, Category 6, Unshielded Twisted Pair (UTP) cable shall be composed of 24 AWG bare solid-copper conductors, insulated with TEFLON. The insulated conductors are twisted into pairs and sheathed with a low smoke PVC jacket. Cable shall be UL rated CMP. All 4-pair UTP cable shall be plenum rated unless specified otherwise.

3. Horizontal Category 6 data cabling shall be blue in color and have the following minimum electrical characteristics:

Freq (MHz)	Insertion Loss (dB)	NEXT (dB)	PS NEXT (dB)	ELFEXT (dB)	PS ELFEXT (dB)	Return Loss (dB)
0.772	1.8	76.0	74.0	70.0	67.0	‡
1	2.0	74.3	72.3	67.8	64.8	20
4	3.8	65.3	63.3	55.8	52.8	23
8	5.3	60.8	58.8	49.7	46.7	24.5
10	6.0	59.3	57.3	47.8	44.8	25
16	7.6	56.2	54.2	43.7	40.7	25
20	8.5	54.8	52.8	41.8	38.8	25
25	9.5	53.3	51.3	39.8	36.8	24.3
31.25	10.7	51.9	49.9	37.9	34.9	23.6
62.5	15.4	47.4	45.4	31.9	28.9	21.5
100	19.8	44.3	42.3	27.8	24.8	20.1
200	29	39.8	37.8	21.8	18.8	18
250	32.8	38.3	36.3	19.8	16.8	18

2.03 COMPONENTS

A. Outlets:

1. General Performance Specifications: Unless otherwise noted on the floor plans or within this document, all outlets shall be 8-position/8-conductor, insulation displacement modular outlets that conform to TIA/EIA 568B Commercial Building Telecommunications Cabling Standard, Horizontal Cable Section, and be part of the UL® LAN Certification and Follow-up

Program, and shall meet or exceed the following electrical and mechanical specifications:

a. Category 6 minimum requirements and support 1 Gbps Ethernet

b. T568B eight-position jack pin/pair assignments

c. Insulation resistance: 500 MW minimum

d. Dielectric withstand voltage 1,000 VAC RMS, 60 Hz minimum, contact-to-contact and 1,500 VAC RMS, 60 Hz minimum from any contact to exposed conductive surface.

e. Contact resistance: 20 MW maximum

f. Current rating: 1.5 A at 68° F (20°C) per IEC Publication 512-3, Test 5b

g. Installations will utilize orange jacks. Faceplates/Dust Cover/Blanks shall be white in color.

B. Patch Cords:

1. Copper Patch Cords

a. Provide Category 6, factory made, Modular Patch Cords for each port on the patch panel. All cords shall conform to the requirements of TIA/EIA 568B Commercial Building Telecommunications Cabling Standard, Horizontal Cabling Section, and be part of the UL® LAN Certification and Follow-up Program. Cords shall be equipped with an 8 pin modular connector on each end and shall conform to the length(s) specified on the detailed drawing. All patch cords shall be factory made and be part of the overall cabling system warranty.

b. All Category 6 cordage shall be round, and consist of 24-AWG copper, stranded conductors, tightly twisted into individual pairs and shall meet or exceed the electrical specifications listed below.

c. General Performance Specifications:

DC Resistance per lead	9.4Ω/100m (328 ft), maximum
DC resistance unbalance	5%, Maximum
Mutual Capacitance	6.6 nF/100m (328 ft), maximum
Characteristic Impedance	100Ω ± 15% from 1 to 100 MHz

d. All station cabling patch cords shall be color-coded to differentiate between different systems. Data cabling shall be blue, voice cabling shall be white, paging system cabling shall be lilac, and security cabling shall be red. Provide Category 6, Patch Cords for each work area jack. The Category 6 Channel, which includes patch cords and horizontal cabling, shall meet the following minimum electrical requirements:

Guaranteed Channel Performance Specifications

Freq	Insertion Loss	NEXT	PS NEXT	ELFEXT	PS ELFEXT	Return Loss
(MHz)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)
1	2.1	65.0	62.0	63.3	60.3	19.0
4	4.0	63.0	60.5	51.2	48.2	19.0
8	5.7	58.2	55.6	45.2	42.2	19.0
10	6.3	56.6	54.0	43.3	40.3	19.0
16	8.0	53.2	50.6	39.2	36.2	18.0
20	9.0	53.2	50.6	39.2	36.2	17.5
25	10.1	50.0	47.3	35.3	32.3	17.0
31.25	11.4	48.4	45.7	33.4	30.4	16.5
62.5	16.5	43.4	40.6	27.3	24.3	14.0
100	21.3	39.9	37.1	23.3	20.3	12.0
200	31.5	34.8	31.9	17.2	14.2	9.0
250	35.9	33.1	30.2	15.3	12.3	8.0

e. UTP Patch cord lengths will be deployed as follows:

Length	Location/Application
3 ft	From the patch panel to the electronic equipment located within the equipment rack, cabinet or backboard
5 ft	From the patch panel to the electronic equipment located within the equipment rack, cabinet or backboard
7 ft	From the patch panel to the electronic equipment located within the equipment rack, cabinet or backboard and from the jack to the computer workstation

f. Contractor shall provide the following quantity of patch cords and deliver to the SAIA representative for their use:

1) 1 Meter Length - 100

2) 3 Meter Length – 100

3) 7 Meter Length – 100

3.00 EXECUTION

3.01 EXAMINATION AND VERIFICATION

A. Verify conduits, raceways, boxes, cable tray, handholds and manholes are properly installed following BICSI recommended practices and ANSI/TIA/EIA 569A standards.

B. Verify backboards are properly installed in all communications rooms.

C. Verify conduit is minimum 1-inch diameter.

D. Verify main grounding system is properly installed and tested following Section 270526 Grounding and Bonding for Communications Systems and per communications drawings.

E. Verify liquid-carrying pipes are not installed in or above voice and data system equipment rooms. This includes fire protection sprinkler systems. Do not proceed with installation in affected areas until removed, or approval is given from the SAIA Project Manager.

F. Patch cords shall be warranted under the same channel and performance warranty as the overall structured cabling system. .

G. Verify that the maximum total length of horizontal cable from the IDF to the individual Jacks shall not exceed 295 feet (90 meters).

3.02 INSTALLATION

A. Install work following drawings, horizontal cable schedules, manufacturer's instructions and approved submittal data. The number of cables per run, outlet configuration and other pertinent data shall be included on the drawings.

B. All installation shall be done in conformance with TIA/EIA 568B, BICSI standards and manufacturer's installation guidelines. The Contractor shall ensure that the maximum pulling tensions of the specified distribution cables are not exceeded and cable bends maintain the proper radius during the placement of the facilities. Failure to follow the appropriate guidelines will require the Contractor to provide in a timely fashion the additional material and labor necessary to properly rectify the situation. This shall also apply to any and all damages sustained to the cables by the Contractor during the implementation.

C. The SCS installation shall meet all applicable national and local codes pertaining to low voltage cable system installations.

D. The Contractor shall adhere to the installation schedule of the general contractor and should attend all construction meetings scheduled by the general contractor.

E. The Contractor shall provide service loops (slack) for all horizontal cables. A 6 foot service loop shall be provided above the access ceiling or in cable trays unless specified otherwise. An additional 6 foot service loop shall also be provided above the finished ceiling (or below the floor) in all work areas. This will allow for future changes or expansion without having to install new cables.

F. The installation shall include coordination, testing and problem resolution with the system vendors.

G. The Contractor shall supply horizontal cables to connect each jack to the nearest communications room.

H. Unless otherwise noted on the floor plans or within this document, the type of horizontal cables used for each work location shall be 4-pair unshielded twisted pair (UTP).

I. The 4-pair UTP cables shall be run using a star topology format from the communications rooms on each floor to every work area information outlet. All cable routes shall be approved by SAIA prior to installation of the cabling.

J. The Contractor shall observe the bending radius and pulling strength requirements of the 4-pair UTP cable during handling and installation.

K. Each run of cable between the termination block and the information outlet shall be continuous without any joints or splices.

L. The Contractor shall conceal horizontal distribution wiring internally within the walls. If obstructions exist, the Contractor shall secure approval by the SAIA Project Manager prior to the use of an alternate method.

M. Conduit runs installed by the contractor shall not exceed 100 feet or contain more than two 90 degree bends without utilizing appropriately sized pull boxes.

N. At any point where station cables and tie cables installed within ceiling spaces must cross electrical circuits, communications cabling shall be routed at right angles to the electrical power circuits.

O. There shall be single gang boxes located in each work location.

P. Each work area outlet shall have a four, six, or eight jack faceplate over a single gang box, terminating the appropriate amount of Category 6 cables from the telecommunications closet. These cables shall terminate in Category 6 jacks, numbered with the labeling scheme identified in the contract drawings.

Q. Plastic cable ties shall not be used at any location within this project. All cables shall be bundled using Velcro wraps of the appropriate length. Velcro ties shall be installed in such a manner that cables may be easily removed or added to the cable bundle.

3.03 CABLE INSTALLATION

A. General

1. Any cable placed in space used as an air return or in any way connected with air-handling plenums or building ventilation shall be low-smoke, fire retarding cable, and must comply with the NEC 725, 760, and 800. No cabling shall be placed in plenums without written approval from SAIA.

2. All station cables shall be Category 6 plenum 4-pair unshielded twisted pair (UTP) copper cable. No substitutions will be accepted.

3. All cables shall be installed per EIA/TIA 568B building standards to designated stations. All cables shall be terminated on Category 6 patch panels within the ICRs and on Category 6 rated 8 position modular jacks at the station end.

4. All cabling will be UL Listed Type CMP or OFNP if it is placed in air-handling plenums without conduit. The cable sheath will be marked with the UL listing. No cabling shall be placed in plenums without written approval from SAIA.

5. Horizontal UTP and fiber optic cables will not be spliced, nor will these cables contain manufacture splices.

6. Contractor shall observe the bending radius and pulling strength requirements of the cabling during handling and installation.

7. Contractor shall monitor pull tension continuously during installation and shall not exceed manufacturer's recommended pull tension.

8. A cable lubricant specifically manufactured for cable pulling lubrication purposes and compatible with the cable sheathing material may be used on cables pulled in conduits or ducts to meet pull tension requirements.

9. Petroleum grease shall not be used as a cable lubricant.

10. All vertical cables shall be affixed to a permanent structure at each floor in accordance with industry standards to avoid cable pull back.

11. All conduit and cabinet entrances shall be sealed with an approved, re-enterable sealant material to prevent ingress of water, dust, or other foreign materials.

12. The Contractor shall conceal all horizontal distribution wiring within conduit in the walls. If it becomes necessary to use an alternative method, the Contractor shall obtain approval from the SAIA Project Manager prior to the use of the alternate method.

13. Install work following drawings, horizontal cable schedules, manufacturer's instructions, and approved submittal data. The number of cables per run, outlet configuration, and other pertinent data shall be included on the drawings.

14. The installation shall meet all applicable national and local codes pertaining to low voltage cable system installations.

B. The installation shall include coordination, testing, and problem resolution with the system vendors.

C. Upon completion of the installation, the Contractor shall prepare as-built documentation of the entire horizontal cable installation as part of the structured cabling system (SCS). This documentation shall be in a format that can be input into the iTracs cable management system and should include:

1. Drawings

a. All drawings shall be provided on CD-ROM in a form compatible with AutoCAD 2010. A complete set of project plans will be

provided to the Contractor on disk. The Contractor shall modify the drawings by placing the cable information on a separate layer. All of the requested drawings shall be placed on these plans so that all cable routes are to scale and provide accurate information for use in the future when changes are made and the exact location of cables are required to avoid service interruptions.

b. A complete diagram of all terminations in the Telecommunications Rooms.

c. A complete diagram of all copper and fiber cable.

d. Floor plans showing exact cable routings.

e. A complete diagram of all cable tray, conduits, and conduit sleeves and their associated fill ratios.

2. Documentation

a. All cable inventory data documentation shall be submitted in an SAIA approved format, so that data can be incorporated into cable management system databases. This shall include, but is not limited to, cable termination details, cable labeling information, and routing information.

b. Complete cross connect documentation is required.

c. Complete test results for all installed cables per manufactures testing procedures.

3. This data shall be submitted prior to the use of any system components. System acceptance will not be provided without complete as-built documentation.

D. Copper Cabling Installation (Horizontal Cabling)

1. The 4-pair UTP cables shall be run using a star topology format from the IDF to every individual Station Outlet. All cable routes shall use a pre-approved route.

2. Horizontal cables will not be connected directly to telecommunications equipment. Suitable connecting hardware (i.e. patch panels and punch-down blocks) and factory-manufactured patch cords must be used to make the connection.

3. Patch cords shall be manufactured by the same manufacture as the data patch panels and information modules, meet or exceed Category 6 requirements and specific performance requirements.

4. The length of each individual run of horizontal copper cable from the IDF shall not exceed 295 ft (90 m) including service loops. The length of the cable described is from the IDF to the outlet.

5. Contractor shall observe and document the bending radius and pulling tension requirements of the 4-pair UTP cable during handling and installation.

6. Each run of cable between the termination block and the Station Outlet shall be continuous without any joints or splices.

7. The Contractor shall conceal all horizontal distribution wiring within conduit in the walls. If it becomes necessary to use an alternative method, the Contractor shall obtain approval from the SAIA Project Manager prior to the use of the alternate method.

8. In suspended ceiling where cable trays or conduit are not available, the contractor shall bundle station wiring with velcro cable ties at appropriate distances. The cable bundling shall be supported via "J" hooks attached to the existing building structure and framework using its own mounting equipment, (i.e. grid wire or threaded rod) at proper angles to the cable tray. Plenum rated cable and accessories shall be used in all appropriate areas.

9. No wiring shall be placed in space used as air return, or in any way connected with air handling plenums, or building ventilation unless approval is given from the SAIA Project Manager.

10. Testing Requirements shall be completed by third party in accordance with Section 27 08 00 Commissioning of Communications Systems.

3.04 CONTRACTOR'S FIELD QUALITY CONTROL

A. Testing as specified in Specification 27 08 00, Commissioning of Communications Systems

3.05 HORIZONTAL CABLE SCHEDULE

A. Refer to Construction Drawings

END OF SECTION 27 15 00

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SECTION 31 63 29
DRILLED CONCRETE PIERS & SHAFTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Dry-installed drilled piers.

B. Related Sections:
   1. Division 01 Section "Construction Progress Documentation" for recording preexisting conditions and drilled-pier progress.
   2. Division 01 Section "Temporary Facilities and Controls."
   3. Division 31 Section "Site Clearing" for preparation of subgrade for drilled-pier operations including removal of vegetation, topsoil, debris, obstructions, and deleterious materials from ground surface.

1.3 UNIT PRICES

A. Unit prices are included in Division 01 Section "Unit Prices."

B. Drilled Piers: Actual net volume of drilled piers in place and approved. Actual length, shaft diameter, and bell diameter if applicable, may vary, to coincide with elevations where satisfactory bearing strata are encountered. These dimensions may also vary with actual bearing value of bearing strata determined by an independent testing and inspecting agency. Adjustments will be made on net variation of total quantities, based on design dimensions for shafts and bells.
   1. Base bids on indicated number of drilled piers and, for each pier, the design length from top elevation to bottom of shaft, and the diameter of shaft.
   2. Unit prices include labor, materials, tools, equipment, and incidentals required for excavation, trimming, shoring, casings, dewatering, reinforcement, concrete fill, testing and inspecting, and other items for complete drilled-pier installation.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Design Mixtures: For each concrete mixture. See Section 03 30 00.

C. Shop Drawings: For concrete reinforcement detailing fabricating, bending, supporting, and placing.

D. Qualification Data: For qualified Installer land surveyor, and testing agency.

E. Material Certificates: For the following, from manufacturer:
   1. Cementitious materials.
   2. Admixtures.
   3. Steel reinforcement and accessories.

F. Field quality-control reports.

G. Other Informational Submittals:
   1. Record drawings.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer that has specialized in drilled-pier work.

B. Testing Agency Qualifications: Qualified according to ASTM C 1077, ASTM D 3740, and ASTM E 329 for testing indicated.

C. Drilled-Pier Standard: Comply with ACI 336.1 unless modified in this Section.
   1. Install reinforcement, fill with concrete, remove temporary casings, and terminate trial drilled pier 24 inches below subgrade and leave in place.
   2. Install permanent casings, excavate bell, excavate rock socket, and place slurry, as required for permanent drilled piers.
   3. If Construction Administration Manager determines that trial drilled pier does not comply with requirements, excavate for and cast another until it is accepted.

D. Preinstallation Conference: Conduct conference at Project site.
   1. Review methods and procedures related to drilled piers including, but not limited to, the following:
      a. Review geotechnical report.

b. Discuss existing utilities and subsurface conditions.
c. Review coordination with temporary controls and protections.

1.6 PROJECT CONDITIONS

A. Existing Utilities: Locate existing underground utilities before excavating drilled piers. If utilities are to remain in place, provide protection from damage during drilled-pier operations.
   1. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, adapt drilling procedure if necessary to prevent damage to utilities. Cooperate with Owner and utility companies in keeping services and facilities in operation without interruption. Repair damaged utilities to satisfaction of utility owner.

B. Interruption of Existing Utilities: Do not interrupt any utility to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility according to requirements indicated:

   1. Notify Owner no fewer than two days in advance of proposed interruption of utility.
   2. Do not proceed with interruption of utility without Owner's written permission.

C. Project-Site Information: A geotechnical report has been prepared for this Project and is available for information only. The opinions expressed in this report are those of geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by geotechnical engineer. Owner will not be responsible for interpretations or conclusions drawn from this data.
   1. Make additional test borings and conduct other exploratory operations necessary for drilled piers.
   2. The geotechnical report is referenced elsewhere in the Project Manual.

D. Survey Work: Engage a qualified land surveyor or professional engineer to perform surveys, layouts, and measurements for drilled piers. Before excavating, lay out each drilled pier to lines and levels required. Record actual measurements of each drilled pier's location, shaft diameter, bottom and top elevations, deviations from specified tolerances, and other specified data.
   1. Record and maintain information pertinent to each drilled pier and cooperate with Owner's testing and inspecting agency to provide data for required reports.

PART 2 - PRODUCTS

2.1 STEEL REINFORCEMENT – See Section 03 30 00

2.2 CONCRETE MATERIALS – See Section 03 30 00

2.3 STEEL CASINGS

A. Steel Pipe Casings: ASTM A 283/A 283M, Grade C, or ASTM A 36/A 36M, carbon-steel plate, with joints full-penetration welded according to AWS D1.1/D1.1M.

2.4 CONCRETE MIXTURES – See Section 03 30 00

2.5 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.6 CONCRETE MIXING – See Section 03 30 00

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, vibration, and other hazards created by drilled-pier operations.

3.2 EXCAVATION

A. Unclassified Excavation: Excavate to bearing elevations regardless of character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions.
   1. Obstructions: Unclassified excavation may include removal of unanticipated boulders, concrete, masonry, or other subsurface obstructions. No changes in the Contract Sum or the Contract Time will be authorized for removal of obstructions.

B. Prevent surface water from entering excavated shafts. Conduct water to site drainage facilities.

C. Excavate shafts for drilled piers to indicated elevations. Remove loose material from bottom of excavation.
   1. Excavate bottom of drilled piers to level plane within 1:12 tolerance.
   2. Remove water from excavated shafts before concreting.
   3. Cut series of grooves about perimeter of shaft to height from bottom of shaft, vertical spacing, and dimensions indicated.

D. Notify and allow testing and inspecting agency to test and inspect bottom of excavation. If unsuitable bearing stratum is encountered, make adjustments to drilled piers as determined by Construction Administration Manager.
   1. Do not excavate shafts deeper than elevations indicated unless approved by Construction Administration Manager.
   2. Payment for additional authorized excavation will be according to Contract provisions for changes in the Work.

E. Excavate shafts for closely spaced drilled piers and for drilled piers occurring in fragile or sand strata only after adjacent drilled piers are filled with concrete and allowed to set.

F. Temporary Casings: Install watertight steel casings of sufficient length and thickness to prevent water seepage into shaft; to withstand compressive, displacement, and withdrawal stresses; and to maintain stability of shaft walls.
   1. Remove temporary casings, maintained in plumb position, during concrete placement and before initial set of concrete.

G. Tolerances: Construct drilled piers to remain within ACI 336.1 tolerances.
   1. If location or out-of-plumb tolerances are exceeded, provide corrective construction. Submit design and construction proposals to Construction Administration Manager for review before proceeding.

3.3 STEEL REINFORCEMENT

A. Comply with recommendations in CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy bond with concrete.

C. Fabricate and install reinforcing cages symmetrically about axis of shafts in a single unit.

D. Accurately position, support, and secure reinforcement against displacement during concreting. Maintain minimum cover over reinforcement.

E. Use templates to set anchor bolts, leveling plates, and other accessories furnished in work of other Sections. Provide blocking and holding devices to maintain required position during final concrete placement.

F. Protect exposed ends of extended reinforcement, dowels, or anchor bolts from mechanical damage and exposure to weather.

3.4 CONCRETE PLACEMENT

A. Place concrete in continuous operation and without segregation immediately after inspection and approval of shaft by Owner's independent testing and inspecting agency.
   1. Construct a construction joint if concrete placement is delayed more than one hour. Level top surface of concrete and insert joint dowel bars. Before placing remainder of concrete, clean surface laitance, roughen, and slush concrete with commercial bonding agent or with sand-cement grout mixed at ratio of 1:1.

B. Dry Method: Place concrete to fall vertically down the center of drilled pier without striking sides of shaft or steel reinforcement.
   1. Where concrete cannot be directed down shaft without striking reinforcement, place concrete with chutes, tremies, or pumps.
   2. Vibrate top 60 inches of concrete.

C. Coordinate withdrawal of temporary casings with concrete placement to maintain at least a 60-inch head of concrete above bottom of casing.
   1. Vibrate top 60 inches of concrete after withdrawal of temporary casing.

D. Screed concrete at cutoff elevation level and apply scoured, rough finish. Where cutoff elevation is above the ground elevation, form top section above grade and extend shaft to required elevation.

E. Protect concrete work, according to ACI 301, from frost, freezing, or low temperatures that could cause physical damage or reduced strength.
   1. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
   2. Do not use calcium chloride, salt, or other mineral-containing antifreeze agents or chemical accelerators.

F. If hot-weather conditions exist that would seriously impair quality and strength of concrete, place concrete according to ACI 301 to maintain delivered temperature of concrete at no more than 90 deg F.
   1. Place concrete immediately on delivery. Keep exposed concrete surfaces and formed shaft extensions moist by fog sprays, wet burlap, or other effective means for a minimum of seven days.

3.5 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:

1. Drilled piers.
2. Excavation.
3. Concrete.
4. Steel reinforcement welding.

B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

C. Drilled-Pier Tests and Inspections: For each drilled pier, before concrete placement.
   1. Soil Testing: Bottom elevations, bearing capacities, and lengths of drilled piers indicated have been estimated from available soil data. Actual elevations and drilled-pier lengths and bearing capacities will be determined by testing and inspecting agency. Final evaluations and approval of data will be determined by Construction Administration Manager.
      a. Bearing Stratum Tests: Testing agency will take undisturbed hardpan core samples from drilled-pier bottoms and test each sample for compression, moisture content, and density, and will report results and evaluations.

D. Concrete Tests and Inspections: ASTM C 172 except modified for slump to comply with ASTM C 94/C 94M.
   1. Slump: ASTM C 143/C 143M; one test at point of placement for each compressive-strength test but no fewer than one test for each concrete load.
   2. Concrete Temperature: ASTM C 1064/C 1064M; 1 test hourly when air temperature is 40 deg F and below and 80 deg F and above, and 1 test for each set of compressive-strength specimens.
   3. Compression Test Specimens: ASTM C 31/C 31M; one set of four standard cylinders for each compressive-strength test unless otherwise indicated. Mold and store cylinders for laboratory-cured test specimens unless field-cured test specimens are required.
   4. Compressive-Strength Tests: ASTM C 39; one set for each drilled pier but not more than one set for each truck load. One specimen will be tested at 7 days, 2 specimens will be tested at 28 days, and 1 specimen will be retained in reserve for later testing if required.
   5. If frequency of testing will provide fewer than five strength tests for a given class of concrete, testing will be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
   6. If strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
   7. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
   8. Report test results in writing to Construction Administration Manager, concrete manufacturer, and Contractor within 48 hours of testing. List Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials,

compressive breaking strength, and type of break for both 7- and 28-day tests in reports of compressive-strength tests.

9. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Construction Administration Manager but will not be used as sole basis for approval or rejection of concrete.
10. Additional Tests: Testing and inspecting agency will make additional tests of concrete if test results indicate that slump, compressive strengths, or other requirements have not been met, as directed by Construction Administration Manager.
    a. Continuous coring of drilled piers may be required, at Contractor's expense, if temporary casings have not been withdrawn within specified time limits or if observations of placement operations indicate deficient concrete quality, presence of voids, segregation, or other possible defects.
11. Perform additional testing and inspecting, at Contractor's expense, to determine compliance of replaced or additional work with specified requirements.
12. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

E. An excavation, concrete, or a drilled pier will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports for each drilled pier as follows:
1. Actual top and bottom elevations.
2. Actual drilled-pier diameter at top, bottom, and bell.
3. Top of marl elevation.
4. Description of soil materials.
5. Description, location, and dimensions of obstructions.
6. Final top centerline location and deviations from requirements.
7. Variation of shaft from plumb.
8. Shaft excavating method.
9. Design and tested bearing capacity of bottom.
10. Depth of penetration into bearing stratum.
11. Levelness of bottom and adequacy of cleanout.
12. Ground-water conditions and water-infiltration rate, depth, and pumping.
13. Description, purpose, length, wall thickness, diameter, tip, and top and bottom elevations of temporary or permanent casings. Include anchorage and sealing methods used and condition and weather tightness of splices if any.
14. Description of soil or water movement, sidewall stability, loss of ground, and means of control.
15. Date and time of starting and completing excavation.
16. Inspection report.
17. Condition of reinforcing steel and splices.
18. Position of reinforcing steel.
19. Concrete placing method, including elevation of consolidation and delays.
20. Elevation of concrete during removal of casings.
21. Locations of construction joints.
22. Concrete volume.
23. Concrete testing results.

24. Remarks, unusual conditions encountered, and deviations from requirements.

3.6 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property.

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DIVISION I
EARTHWORK

Item: 100 Mobilization

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ITEM 100
MOBILIZATION

This item shall govern the mobilization of personnel, equipment and supplies at the project site in preparation for beginning work on other contract items. Mobilization shall include, but is not limited to, the movement of equipment, personnel, material, supplies, etc. to the project site and the establishment of office and other facilities necessary prior to beginning the work.

MEASUREMENT: Measurement of the Item, "Mobilization" as specified herein will be by the "Lump Sum", as the work progresses. Measurement of the item "Insurance and Bond" will be by lump sum not to exceed 3% of the total contract amount.

PAYMENTS: Partial payments of the "Lump Sum" bid for mobilization will be as follows: (The adjusted contract amount for construction items as used below is defined as the total contract amount less the lump sum bid for Mobilization.)

1) When 1% of the adjusted contract amount for construction items is earned, 50% of the mobilization lump sum bid or 5% of the total contract amount, whichever is less, will be paid.

2) When 5% of the adjusted contract amount for construction items is earned, 75% of the mobilization lump sum bid or 10% of the total contract amount, whichever is less, will be deducted from the above amount.

3) When 10% of the adjusted contract amount for construction items is earned, 90% of the mobilization lump sum bid or 15% of the total contract amount, whichever is less, will be paid. Previous payments under this item will be deducted from the above amount.

Upon completion of all work under this contract, payment for the remainder of the lump sum bid for "Mobilization" will be made. Insurance and Bond will be payed as a lump sum on the initial request for payment.

BID ITEMS:

Item	100	Mobilization - Lump Sum.
Item	100.1	Insurance and Bond - Lump Sum (3%)

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DIVISION II

BASE & SURFACE COURSES

Item:	200	Flexible Base
	212	Rolling (Heavy Tamping)
	213	Rolling (Pneumatic Tire)
	214	Rolling (Heavy Pneumatic Tire)
	216	Rolling (Proof)

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ITEM 200
FLEXIBLE BASE

This item shall govern for a foundation course for surfacing, pavement, or other base courses composed of crushed stone, and constructed as herein specified in one or more courses in conformity with the typical sections shown on the plans and to the lines and grades as established by the Engineer.

MATERIAL: The material shall be crushed as necessary to meet the requirements hereinafter specified, and shall consist of durable stone crushed and/or screened to the required particle size, with or without other approved fine sized material. The material shall be from approved sources.

Testing of flexible base materials shall be in accordance with the following TXDOT standard laboratory test procedures:

Preparation for Soil
- Constants and Sieve Analysis Tex-101-E
- Liquid Limit Tex-104-E
- Plastic Limit Tex-105-E
- Plasticity Index Tex-106-E
- Linear Shrinkage Tex-107-E
- Sieve Analysis Tex-110-E
- Los Angeles Abrasion ASTM C131 (Grad. A)

Samples for testing the material shall be taken prior to the compaction operations.

The material shall be well graded and when properly tested, shall meet the following requirements:

Retained on 1-3/4 inch sieve	0%
Retained on No. 4 sieve	45 to 75%
Retained on No. 40 sieve	60 to 85%

The material passing the No. 40 sieve shall be known as Soil Binder and shall meet the following requirements:

Liquid Limit shall not exceed 40
Plasticity Index shall not exceed 12

The crushed stone shall have an abrasion of not more than forty (40) when subjected to the Los Angeles Abrasion Test.

CONSTRUCTION METHODS: The flexible base material shall be placed on the approved subgrade in courses not to exceed 6-inches [152 mm] compacted depth. It shall be the responsibility of the Contractor that the required amount of material be delivered and uniformly spread and shaped. All material shall be moved from the place where it is dumped by cutting into windrows. After the material has been cut into windrows, it shall be sprinkled, spread, shaped, and rolled in proper sequence to prevent segregation and as necessary for required compaction.

The surface upon completion shall be smooth and in conformity with typical sections and to the established lines and grades. Any deviation in excess of 1/4-inch [6 mm] in cross section and in length of 16-feet [4.9 m] measured longitudinally shall be corrected. All irregularities, depressions, or weak spots which develop shall be corrected.

Flexible base shall be compacted to an apparent dry density of not less than 95 percent of the maximum dry density as determined in accordance with THD Test Method Tex 113-E. Tests for density will be made within 24 hours after compaction operations are completed. If the material fails to meet the density specified, it shall be reworked as necessary to meet the density required. Just prior to the placing of any succeeding course of flexible base or surfacing on a previously completed course, the density and moisture of the top 3-inches [76 mm] of flexible base shall be checked and if test show the density to be more than 2 percent below the specified minimum or the moisture content to be

more than 3 percent above or below the optimum, the course shall be reworked as necessary to obtain the specified compaction and moisture content.

MEASUREMENT: "Flexible Base" will be measured by the square yard [square meter], complete in place, for the thickness specified on the plans, or by the cubic yard [cubic meter], complete in place as indicated in the proposal.

PAYMENT: This item will be paid for at the contract unit price bid for "Flexible Base" which price shall be full compensation for all work herein specified, including the furnishing, hauling, and placing of all materials, for all water required, and for all equipment, tools, labor, and incidentals necessary to complete the work.

BID ITEMS:

Item 200.1 - 6 inches [152 mm] compacted depth per square yard [square meter].

Item 200.2 - 8 inches [203 mm] compacted depth per square yard [square meter].

Item 200.3 - 10 inches [254 mm] compacted depth per square yard (square meter).

Item 200.4 - 12 inches [305 mm] compacted depth per square yard [square meter].

Item 200.5 - 14 inches [356 mm] compacted depth per square yard [square meter].

Item 200.6 - Flexible Base (complete in place) per cubic yard [cubic meter]

ITEM 212
ROLLING (Heavy Tamping)

This Item shall govern for the compaction of embankment, flexible base or other courses, by the operation of approved tamping rollers as herein specified, and as directed by the Inspector.

COMPACTION EQUIPMENT: The heavy tamping roller shall consist of two or three metal drums, rolls, or shells of 60 inches [1.5 m] minimum diameter. If the two-drum type is furnished, each drum shall be not less than 60 inches [1.5 m] in length. If the three-drum type is furnished, the roller shall consist of two forward drums and one rear drum, the drums are to be arranged so that the rear drum will compact the space between the two forward drums, and rollers of this type shall have an overall width of not less than 10 feet [3 m].

The drums shall be unit-mounted in a rigid frame in such manner that each drum may oscillate independently of the other.

Each drum shall be surmounted by metal studs with tamping feet projecting not less than 7 inches [178 mm] from the surface and shall be so spaced as to result in one tamping foot for each 0.65 to 0.70 square foot [0.06 to 0.7 square meter] of drum area. The area of each tamping foot shall be approximately 7 square inches [4500 square millimeters]. All rollers shall be provided with cleaning teeth so designed and attached as to prevent the accumulation of material between the tamping feet.

The roller shall be so designed that by ballast loading, the load on each tamping foot may be varied up to at least 550 pounds per square inch [3800 kPa] of cross-sectional area. The load per tamping foot will be determined by dividing the total weight of the roller by the number of tamping feet in one row parallel to or approximately parallel to the axis of the roller. The compression to be provided at any time shall be as directed by the Engineer.

One tamping roller, consisting of two drums or three drums, conforming to the above requirements and drawn by an approved type tractor of adequate tractive effort, shall be considered a heavy tamping roller unit.

Where turning is impractical or detrimental to the work, and when specifically directed by the Inspector, the roller shall be capable of being operated in a forward or backward motion.

In lieu of the rolling equipment specified, the Contractor may, upon written permission from the Inspector, operate other compacting equipment that will produce equivalent relative compaction in the same period of time as the specified equipment. If the substituted compaction equipment fails to produce the desired compaction within the same period of time as would be expected of the specified equipment, as determined by the Inspector, its use shall be discontinued and the Contractor will be required to furnish the specified equipment.

CONSTRUCTION METHODS: The embankment layer or the base course shall be sprinkled if directed. Rolling with a tamping roller unit shall start longitudinally at the sides and proceed toward the center, overlapping on successive trips by at least one-half of the width of the tamping roller unit. On superelevated curves, rolling shall begin at the low sides and progress toward the high sides. Alternative trips of the unit shall be slightly different in length. Rolling shall continue until proper compaction is achieved. The tamping roller unit, unless otherwise directed, shall be operated at a speed between 2 and 3 mile per hour [3 km/h to 5 km/h].

Sufficient roller shall be provided to compact the material in a satisfactory manner. When operations are so isolated from one another than one roller unit cannot perform the required compaction satisfactorily, additional roller units shall be provided

MEASUREMENT: Rolling (Heavy Tamping) will not be measured for payment.

PAYMENT: The work prescribed herein will not be paid for directly, but shall be included in the unit price bid for the items of construction in which the operations occur.

ITEM 213
ROLLING (Pneumatic Tire)

This Item shall govern for the compaction of embankment, flexible base, surface treatments, or pavements by the operation of approved pneumatic tire rollers as herein specified and as directed by the Inspector.

EQUIPMENT: (1) General. When used on seal coats, asphaltic surface treatments and bituminous mixture pavements, the roller shall be self-propelled and equipped with smooth tread tires whether "Rolling (Light Pneumatic Tire)" or "Rolling (Medium Pneumatic Tire)". The roller shall be so constructed as to be capable of being operated in both a forward and a reverse direction.

When used on bituminous mixture pavements, the roller shall have suitable provisions for moistening the surface of the tires while operating.

In lieu of the rolling equipment specified, the Contractor may, upon written permission from the Inspector, operate other compacting equipment that will produce equivalent relative compaction in the same period of time as the specified equipment. If the substituted compaction equipment fails to produce the desired compaction within the same period of time as would be expected of the specified equipment, as determined by the Inspector, its use shall be discontinued and the Contractor will be required to furnish the specified equipment.

(2) The light pneumatic tire roller shall consist of not less than nine pneumatic tired wheels, running on axles in such manner that the rear group of tires will cover the entire gap between adjacent tires of the forward group, and mounted in a rigid frame and provided with a loading platform or body suitable for ballast loading. The front axle shall be attached to the frame in such manner that the roller may be turned within a minimum circle. The pneumatic tire roller under working conditions shall have an effective rolling width of approximately 60 inches [1.5 m] and shall be so designed that by ballast load, the total load may be varied uniformly from 9,000 pounds [4 megagrams] to 18,000 pounds [8 megagrams]. The roller shall be equipped with tires that will afford ground contact pressures of 45 pounds per square inch [310 kPa] or more. The operating load and tire air particular tires furnished. The roller under working conditions shall provide a uniform compression under all wheels. Individual tire inflation pressures shall be within plus or minus 5 psi [34 kPa] of each other. The pneumatic tire roller shall be of the self-propelled type.

(3) Medium pneumatic tire roller (Type A). It shall consist of not less than seven pneumatic tired wheels, running on axles in such manner that the rear group of tires will cover the entire gap between adjacent tires of the forward group, and mounted in a rigid frame and provided with a loading platform or body suitable for ballast loading. The front axle shall be attached to the frame in such manner that the roller may be turned within a minimum circle. The pneumatic tire roller under working conditions shall have an effective rolling width of approximately 84 inches (2 130 mm) and shall be so designed that by ballast load, the total load may be varied uniformly from 23,500 pounds (10 660 kg) to 50,000 pounds (22 680 kg). The roller shall be equipped with tires that will afford ground contact pressures to 80 pounds per square inch (552 kPa) or more. The operating load and tire air pressure shall be within the range of the manufacturer's chart. The roller under working conditions shall provide a uniform compression under all wheels. Individual tire inflation pressures shall be within plus or minus 5 psi [34 kPa] of each other. The pneumatic tire roller shall be of the self-propelled type. The power unit shall have adequate tractive effort to properly move the operating roller at variable

uniform speeds up to approximately 5 miles per hour [8 km/h].

(4) Medium pneumatic tire roller (Type B) shall conform to the requirements for Medium Pneumatic Tire Roller, Type A as specified in (3) above except that the roller shall be equipped with tires that will afford ground contact pressures to 90 pounds per square inch [620 kPa] or more.

CONSTRUCTION METHODS: The embankment layer or the base course shall be sprinkled if directed, and rolling with a tamping roller unit shall start longitudinally at the sides and proceed toward the center, overlapping on successive trips by at least one-half of the width of the tamping roller unit. On super elevated curves, rolling shall begin at the low sides and progress toward the high sides. Alternative trips of the unit shall be slightly different in length. Rolling shall continue until proper compaction is achieved. The light pneumatic tire roller shall be operated at a speed between 4 and 12 miles per hour [6 km/h and 19 km/h] for asphalt surfacing work and between 2 and 6 miles per hour [3 km/h and 10 km/h] for all other work. The medium pneumatic tire roller shall be operated at speeds as directed by the Inspector.

Sufficient rollers shall be provided to compact the material in a satisfactory manner. When operations are so isolated from one another than one roller unit cannot perform the required compaction satisfactorily, additional roller units shall be provided.

MEASUREMENT: Rolling (Pneumatic Tire) will not be measured for payment.

PAYMENT: The work prescribed herein will not be paid for directly, but shall be included in the unit price bid for the items of construction in which the operations occur.

ITEM 214
ROLLING
(Heavy Pneumatic Tire)

This Item shall govern for the compaction of embankment subgrade, flexible base, old concrete pavement, (previously broken) or pavements by the operation of approved heavy pneumatic tire rollers as herein specified and as directed by the Inspector.

EQUIPMENT: The heavy pneumatic tire roller shall consist of not less than four pneumatic tire wheels, running on axles carrying not more than two wheels, and mounted in a rigid frame and provided with a loading platform or body suitable for ballast loading. All wheels shall be arranged so that they will carry approximately equal loads when operating on uneven surfaces. The roller under working condition shall have a rolling width of from 8 feet [2.5 m] to 10 feet [3 m], and shall be so designed that, by ballast loading, the gross load may be varied uniformly from 25 tons [23 megagrams] to 50 tons [45 megagrams]. The tires shall be capable of operating under the various loads with variable air pressure up to 150 pounds per square inch [1000 kPa]. The operating load and tire air pressure shall be within the range of the manufacturer's chart. Tires shall be practically full of liquid. (Tires shall be considered as being practically full when liquid will flow from the valve stem of a fully inflated tire with the stem in the uppermost position). The Contractor shall furnish the Inspector charts or tabulations showing the contact areas and contact pressures for the full range of the tire inflation pressures and for the full range of loadings for the particular tires furnished. There shall be a sufficient quantity of ballast available to load the equipment to a maximum gross weight of 50 tons [45 megagrams]. Rubber tired tractive equipment shall be used on base courses and asphalt pavements. Other type tractive equipment may be used on embankment subgrade. The heavy pneumatic tire roller unit shall be capable of turning 180 degrees in the crown width. The heavy pneumatic tire roller shall be the self-propelled type. In lieu of the rolling equipment pecified, the Contractor may, upon written permission from the Inspector, operate other compacting equipment that will produce equivalent relative compaction in the same period of time as the specified equipment. If the substituted compaction equipment fails to produce the desired compaction within the same period of time as would be expected of the specified equipment, as determined by the Inspector, its use shall be discontinued and the Contractor will be required to furnish the specified equipment.

CONSTRUCTION METHODS: The embankment layer or the base course shall be sprinkled if directed. Rolling with a pneumatic tire roller unit shall start longitudinally at the sides and proceed toward the center, overlapping on successive trips by at least one-half of the width of the pneumatic tire roller. On super elevated curves, rolling shall begin at the low sides and progress toward the high sides. Alternative trips of the roller shall be slightly different in length. Rolling shall continue until desired compaction is achieved. The rollers shall be operated at speeds directed by the Inspector which shall be between 2 and 6 miles per hour [3 km/h and 10 km/h]. Sufficient roller shall be provided to compact the material in a satisfactory manner. When operations are so isolated from one another than one roller unit cannot perform the required compaction satisfactorily, additional roller units shall be provided.

MEASUREMENT: Rolling (Heavy Pneumatic Tire) will not be measured for payment.

PAYMENT: The work prescribed herein will not be paid for directly, but shall be included in the unit price bid for the items of construction in which the operations occur.

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ITEM 216
ROLLING
(Proof)

This Item shall govern for furnishing and operating heavy pneumatic tired compaction equipment for locating unstable areas of earthwork or base.

EQUIPMENT: The proof rolling equipment shall consist of not less than four pneumatic tired heels, running on axles carrying not more than two wheels, and mounted in a rigid frame and provided with loading platform or body suitable for ballast loading. All wheels shall be arranged so that they will carry approximately equal loads when operating on uneven surfaces. The proof roller under working conditions shall have a rolling width of from 8 feet [2.5 m] to 10 feet [3 m], and shall be so designed that, by ballast loading, the gross load may be varied uniformly from 25 tons [23 megagrams] to 50 tons [45 megagrams]. The tires shall be capable of operating under the various loads with variable air pressure up to 150 pounds per square inch [1000 kPa]. Tires shall be practically full of liquid. (Tires shall be considered as being practically full when liquid will flow from the valve stem of a fully inflated tire with the stem in the uppermost position). The operating load and tire pressure shall be within the range of the manufacturer's chart. The Contractor shall furnish the Inspector charts 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. The proof roller shall be the self-propelled type. There shall be a sufficient quantity of ballast available to load the equipment to a maximum gross weight of 50 tons [45 megagrams]. Rubber tired tractive equipment shall be used on base courses and asphalt pavements. Other type tractive equipment may be used on embankment subgrade. The heavy pneumatic tire roller unit shall be capable of turning 180 degrees in the crown width or operating in forward and reverse modes. In lieu of the rolling equipment specified, the Contractor may, upon written permission from the Inspector, operate other compacting equipment that will produce equivalent relative compaction in the same period of time as the specified equipment. If the substituted compaction equipment fails to produce the desired compaction within the same period of time as would be expected of the specified equipment, as determined by the Inspector, its use shall be discontinued.

CONSTRUCTION METHODS: This work shall be done only when directed by the Inspector. The subgrade and/or base layer shall be proof rolled to locate unstable areas when directed by the Inspector. Within the ranges previously set forth, the load and tire inflation pressures shall be adjusted as directed by the Inspector. It is proposed to use a contact pressure corresponding as nearly as practical to the maximum supporting value of the earthwork or base. A minimum of two coverages of the proof roller will be required. Each succeeding trip of the proof roller shall be offset by not greater than one tire width. Rollers shall be operated at speeds directed by the Inspector which shall be between 2 and 6 miles per hour [3 km/h and 10 km/h]. Where the operation of the proof roller unit shows area to be unstable or non-uniform, it shall be corrected in accordance with the applicable Item of Work.

MEASUREMENT: Rolling (Proof) will not be measured for payment.

PAYMENT: The work prescribed herein will not be paid for directly, but shall be included in the unit price bid for the items of construction in which the operations occur.

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DIVISION III

CONCRETE AND CONCRETE STRUCTURES

Item: 300 Concrete (Natural Aggregate)

301 Reinforcing Steel

302 Metal for Structures

305 Membrane Curing

306 Structural Excavation

307 Concrete Structures

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ITEM 300
CONCRETE (NATURAL AGGREGATE)

This item shall govern for the material used; for storing and handling of materials; and for the proportioning, mixing and transportation of concrete for all concrete construction.

This specification does not cover the placement, consolidation, curing, or protection of the concrete.

MATERIAL: The concrete shall be composed of Portland Cement, mineral filler, if necessary, natural aggregates (fine and coarse), and water, proportioned and mixed as hereinafter provided in these specifications. Concrete shall meet all the requirements as set forth in ASTM C-94.

CLASSIFICATIONS AND PROPORTIONS: The minimum cement content, maximum allowable water content, and maximum slump of the various classes of concrete shall conform to Table 1.

MEASUREMENT: The quantities of concrete of the various classifications which constitute the completed and accepted structure will be measured by the cubic yard [cubic meter] in place. Only accepted work will be included, and the dimensions used will be those shown on the plans or ordered in writing by the Engineer. No deductions in measurement will be made for paneling less than 3 inches [76 mm] in width by 1 inch [25 mm] in depth, for chamfers less than 2 inches [51 mm], for embedded reinforcing steel, or for embedded portions of structural steel members.

PAYMENT: The concrete quantities, measured as provided above, will be paid for at the contract unit prices bid per cubic yard [cubic meter] for the various classifications of concrete shown, which prices shall be full compensation for furnishing, hauling and mixing all concrete materials; placing, curing, and finishing all concrete; all grouting and pointing; furnishing and placing all drains and expansion joints, except as hereinafter provided; furnishing and placing metal flashing strips; and for all forms and falsework, labor, tools, equipment, and incidentals necessary to complete the work. The above provisions for payment shall not be interpreted to provide payment for concrete in railings, piling, concrete culvert pipe, precast prestressed concrete units, or other concrete items for which provision is otherwise made in the contract. The above provisions for payment for drains and expansion joints shall not be interpreted to provide payment for cast iron or structural steel shapes used in drains; for structural steel, cast iron or cast steel bearing plates; or for steel members used in armoring roadway joints. Payment for these materials is provided for in Item No. 302, "Metal for Structures". No direct measurement or payment will be made for Concrete Class "G", but shall be considered subsidiary to the particular items required by the plans and the contract.

BID ITEMS:
ITEM 300.1 - Concrete Class "A" - per cubic yard [cubic meter].

ITEM 300.2 - Concrete Class "B" -per cubic yard [cubic meter].

ITEM 300.3 - Concrete Class "C" -per cubic yard [cubic meter].

ITEM 300.4 - Concrete Class "D" -per cubic yard [cubic meter].

TABLE 1

Class	Minimum compressive strength @ 28 days psi [MPa]	Maximum water-cement ratio	Slump range	Min. – max sacks cement per cubic yard [cubic meter]
A	3,000 [20]	7.0	2 - 5 [50 -125]	5.0
B	2,500 [17]	8.0	2 - 5 [50 - 125]	4.5
C	2,000 [14]	9.0	1 - 4 [25 - 102]	4.0
D	1,000 [6]	11.00	1 - 4 [25 - 102]	2.0
G	(as specified on plans)	5.50	2 - 3 [50 - 80]	6.0 - 8.0

ITEM 301
REINFORCING STEEL

This item shall provide for the furnishing and placing of bar reinforcing steel of the size and quantity designated for use in structures and other concrete items that require reinforcing steel as shown on the plans and in accordance with these specifications.

MATERIALS: Reinforcing steel shall be grade 60 and all bar reinforcement shall be deformed, conforming to the requirements of item 440, "Reinforcing Steel" of the Texas Department of Transportation Standard Specifications. Reinforcing steel bars produced outside of the United States are acceptable if such bar reinforcement conforms to the requirements of the ASTM Specifications for the various designations of bars.

BENDING, TOLERANCES AND STORAGE: Bending, tolerances and storage of reinforcing steel shall conform to articles 440.3, "Bending", 440.4, "Tolerances", and 440.5, "Storage" in Item 440, "Reinforcing Steel" of the Texas Department of Transportation Standard Specifications.

SPLICES: No splicing of bars, except when provided on the plans, will be permitted without approval of the Engineer.

PLACING REINFORCEMENT:
All steel reinforcing shall be accurately placed in the position shown on the plans and firmly held during the placing and setting of concrete. All reinforcement shall be free from dust, rust, mill scale, paint, oil, mortar or foreign material. Bars shall be tied at all intersections, except that where spacing of bars in each direction is less than 12 inches [305 mm], only alternate intersections need be tied. Distances from forms shall be maintained by means of stays, precast blocks, ties, hangers, metal chairs or other approved supports. Blocks for holding reinforcing bars from contact with the forms shall be precast concrete blocks of approved shape and dimensions or other equally suitable-devices. The use of pebbles, pieces of broken stones or brick, metal pipe and wooden blocks shall not be permitted. Reinforcement in any sections shall be placed and then inspected and approved by the Inspector before the placing of concrete begins.

MEASUREMENT:
The measurement of quantities of bar reinforcing furnished and placed, will be based an the calculated weight of the steel actually placed in accordance with the plans and these specifications, with no allowance made for added bar lengths for splices nor for extra steel used when bars larger than those specified are substituted with the permission of the Consulting Engineer. Tie wires and supporting devices will not be included in the calculated weights. The calculated weight of bar reinforcement will be determined using the theoretical bar weight set forth in Table No. 1 with no allowance for overrun or underruns:

PAYMENT:
Reinforcing Steel measured as provided above, will be paid for at the contract unit price bid per pound [kilogram] of "Reinforcing Steel", which price shall be full compensation for furnishing, bending, fabricating, welding and placing reinforcement; for all clips, blocks, metal spacers, ties, wire or other materials used for fastening reinforcement in place, and for all tools, labor, equipment and incidentals necessary to complete the work. Payment for reinforcing in items which specifically include the cost of reinforcement shall be paid for as provided in the specifications for those items.

BID ITEM: Item 301 - Reinforcing Steel - per pound [kilogram].

TABLE 1

Bar size number (mm)	Nominal diameter inches(mm)	Nominal Area square inch (mm^2)	Weight per linear foot (kg/m)
2 (6)	0.250 (6.35)	0.05 (32.26)	0.167 (0.249)
3 (10)	0.375 (9.525)	0.11 (70.97)	0.376 (0.560)
4 (12)	0.500 (12.7)	0.20 (129.03)	0.668 (0.994)
5 (15)	0.625 (15.875)	0.31 (200.00)	1.043 (1.552)
6 (20)	0.750 (19.05)	0.44 (283.87)	1.502 (2.235)
7 (22)	0.875 (22.225)	0.60 (387.10)	2.044 (3.042)
8 (25)	1.000 (25.4)	0.79 (509.68)	2.670 (3.973)
9 (28)	1.128 (28.651)	1.00 (645.16)	3.400 (5.060)
10 (30)	1.270 (32.258)	1.27 (819.35)	4.303 (6.404)
11 (35)	1.410 (35.814)	1.56 (1006.45)	5.313 (7.907)
14 (40)	1.693 (43.00)	2.25 (1451.61)	7.65 (11.384)
18 (55)	2.257 (57.328)	4.00 (2580.64)	13.60 (20.239)

ITEM 302
METAL FOR STRUCTURES

This item shall govern for materials, such as structural steels, alloy steels, rivet steel casting, iron castings, wrought iron, bronze, steel pipe and tubing, aluminum castings and tubing, and other, metals used in structures, except reinforcing steel and metal culvert pipe, and for the fabrication and erection of structural steel and other metals, except reinforcing steel, which are used for steel or steel portions of structures and tubing, aluminum castings and tubing, and other, metals used in structures, except reinforcing steel and metal culvert pipe, and for the fabrication and erection of structural steel and other metals, except reinforcing steel, which are used for steel or steel portions of structure

MATERIALS:
Metal for Structures: Metal for structures shall comply with the requirements as set forth under Item No. 442 "Metal for Structures" of the Texas Department of Transportation Standard Specifications. Paint: Paint shall comply with the requirements as set forth under Item No. 514, "Paint and Painting".

CONSTRUCTION METHODS: Construction of "Metal for Structures" shall comply with the requirements as set forth under Item No. 441, "Steel Structures" of the Texas Department of Transportation Standard Specifications.

MEASUREMENT: Measurement of the quantity of structural metal furnished and placed will be based on the weight of metal in the fabricated structure. The weight of erection bolts, paint, and all boxes, crates, or other containers used for packing, together with sills, blocking and rods used for supporting or protecting members during transportation shall be excluded. When increases in size or weights of members have been made which were not ordered by the Consulting Engineer, but approved by him, the measurement will be made on the sizes or weights shown on the contract plans. In determining the weight of structural metal in steel or concrete structures, such items as castings, bearing plates, anchor bolts, drains, deck plates, armor joints, finger joints, and all other metal for which no separate measurement is specified, will be considered as metal for structures. The weights of rolled shapes and of plates shall be computed on the basis of their nominal weights and dimensions, as shown on the approved shop plans. The weight of castings will be computed from the dimensions shown on the approved shop drawings Shoes will be measured by the weights as shown on the standard shoe details, or as specified for castings above, if weights are not shown. Deductions will be made for all cuts, copes, perforations, and all holes except rivet or bolt holes. The weight of rivet heads will be included for payment. No weight shall be allowed for weld metal. A change in design which either increases or reduces the quantity of metal going into the structure or structures will be measured by the actual computed weights of the metal, and the quantity as shown on the plans and in the contract, will be increased or decreased by the revised weights, as the case may be.

PAYMENT: Structural metal will be paid for at the contract unit price bid per pound [kilogram] for "Metal for Structures", or for such other classifications as shown on the plans and in the proposal. Payment will not be made until shop bills of materials, based on approved shop drawings, indicating total weight of material used have been received and checked by the Consulting Engineer. This price shall be full compensation for furnishing all materials and for all fabrication, shopwork, transportation, erection, paint and painting, galvanizing, and for furnishing all equipment tools, labor, and incidentals necessary to complete the work.

BID ITEM:
Item 302 - Metal for Structures - per pound [kilogram].

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ITEM 305
MEMBRANE CURING

This item shall consist of curing by the impervious membrane method of all curbs, sidewalks, driveways, drive approaches, concrete riprap, concrete structures and other concrete as specified in the various items of these specifications or as indicated in the plans.

MATERIALS:

The membrane curing compound shall comply with the "Standard Specification for Liquid Membrane forming Compounds for Curing Concrete", ASTM C309, Type I clear or translucent without dye, Type 1- D clear or translucent with fugitive dye, or Type 2 white pigmented. The vehicle shall be Class A – no restrictions on vehicle solids material, or Class B - vehicle solids restricted to all resin material. The material shall have a minimum flash point of 80° F [27 °C]. when tested by the "Pensky-Martin Closed Cup Method'. It shall be of such consistency that it can be satisfactorily applied as a fine mist through an atomizing nozzle by means of approved pressure spraying equipment at atmospheric temperatures above 40° F [4 °C]. It shall be of such a nature that it will not produce permanent discoloration of concrete surfaces nor react deleteriously with neither the concrete nor its components. Type I-D compound shall contain a fugitive dye that will be distinctly visible not less than 4 hours nor more than 7 days after application. Type 2 compound shall not settle out excessively or cake in the container and shall be capable of being mixed to a uniform consistency by moderate stirring and shall exhibit a daylight reflectance of not less than 60 percent of that of magnesium oxide. The compound shall produce a firm, continuous, uniform moisture impermeable film free from pinholes and shall adhere satisfactorily to the surfaces of damp concrete. It shall, when applied to the damp concrete surface, at the rate of coverage specified herein, dry to touch in not more than 4 hours and shall not be tacky or track off concrete after 12 hours. It shall adhere in a tenacious film and when sprayed, in a single application at the specified rate, on the vertical face of damp concrete, shall not run off or appreciably sag. The compound shall not disintegrate, check, peel or crack during the required curing period. It shall not peel or pick up under traffic and shall disappear from the surface of the concrete by gradual disintegration. The compound shall be delivered to the job only in the manufacturer's original sealed containers which shall be legibly marked with the name of the manufacturer, the trade name of the compound, the type of compound and class of vehicle, the nominal percentage of non-volatile material, and a batch number or symbol with which test samples may be correlated. The permissible percentage moisture loss (at the rate of coverage specified herein) shall not exceed the following:

24 hrs. after application.....2%
72 hrs. after application.....4%

CONSTRUCTION METHODS:

Just before using the membrane curing compound, it shall be thoroughly agitated in its original container until any settlement has been uniformly redispersed. Redispersion shall be checked with a 1 inch by 1 inch [25 mm x 25 mm] wooden slat or similar device scraped along the interior of the container and then examined for accumulation of settlement and uniformity of dispersion. The compound shall be maintained in a uniform condition, substantially free of settlement, during its use. The compounds shall not be applied to a dry surface and if the surface of the concrete has become dry, it shall be thoroughly moistened by water fogging prior to application of membrane. The membrane curing compound shall be applied after the surface finishing has been completed, and immediately after the free surface moisture has disappeared. The surface shall be sealed with a single coat of the specified type of curing

compound applied uniformly at the rate of coverage recommended by the manufacturer and directed by the Inspector, but not less than one (1) gallon per 180 square feet [1 liter per 5 square meters] of surface area. The curing compound shall not be thinned or diluted in any manner prior to application. The Contractor shall provide satisfactory means and facilities to properly control and check the rate of application of the compound. At locations where the coating shows discontinuities, pinholes, or other defects, or if rain falls on the newly coated surface before the film has dried sufficiently to resist damage, an additional coat of the compound shall be applied immediately at the same rate of coverage specified herein. To insure proper coverage, the Inspector will inspect all treated areas after application of the compound for the period of time designated in the governing specification for curing, either for membrane curing or for other methods. Dry areas are identifiable because of the lighter color of dry concrete as compared to damp concrete. All suspected areas shall be tested by placing a few drops of water on the suspected areas. If the water stands in round beads or small pools which can be blown along the surface of the concrete without wetting the surface, the waterimpervious film is present. If the water wets the surface of the concrete as determined by obvious darkening of the surface or by visible soaking into the surface, no water-impervious film is present. Should the foregoing test indicate that any area during the curing period is not protected by the required waterimpervious film, an additional coat or coats of the compound shall be applied immediately, and the rate of application of the membrane compound shall be increased until area areas are uniformly covered by the required water-impervious film. When temperatures are such as to warrant protection against freezing, curing by this method shall be supplemented with an approved insulating material capable of protecting the concrete for the specified curing period. If at any time, there is reason to believe that the method of curing is unsatisfactory or is detrimental to the work, the Contractor, when notified, shall immediately cease the use of this method and shall change to curing by one of the other methods specified under this contract.

MEASUREMENT:
"Membrane Curing" will not be measured for payment.

PAYMENT:
The work and materials prescribed herein will not be paid for directly, but shall be included in the unit price bid for the items of construction in which these materials are used.

ITEM 306
STRUCTURAL EXCAVATION

Only when indicated on the plan details and bid proposals will this item govern the excavation for the placing of structures, and for the disposal of all material obtained from such excavation, and for backfilling around completed structures to the level of the original ground. The work to be done under this item shall include all necessary pumping or bailing, sheathing, drainage and the removal of all structures or portions thereof, such as wingwalls, culverts, inlets, trees and all other obstructions necessary to the proposed construction.

CLASSIFICATION:
All structural excavation shall be unclassified, and shall include all materials encountered regardless of their nature or the manner in which they are removed, except those covered by other pay items of the contract.

CONSTRUCTION METHODS:
1. Excavation: Excavation shall be done in accordance with the lines and depths indicated on the plans or as established by the Engineer. Limits of excavation for payment shall be to a vertical plane 1 foot [305 mm] outside and parallel to the footing. In instances where the structure is stepped outward near the top, the limits of excavation will be increased accordingly. in all cases where excavation diagrams are shown on the plans, such diagrams shall take precedence over these provisions. Excavated material required to be used for backfilling may be deposited by the Contractor at points convenient for rehandling, provided such deposits do not constitute a hazard and provided all hubs and survey lines are kept free of any obstruction.

2. Backfilling: Structural backfilling shall consist of backfilling for footings, bridge structures, headwalls, wingwalls, retaining walls, transition walls, drop inlets, manholes, and all appurtenant structures. Care shall be taken in the backfilling process so as not to induce any movement in the structure or to induce shear forces greater than those for which the structure is designed. Structural backfilling shall be carried to the top of natural ground, or to the proposed grade shown on the plans, as the case may be, by method (a) (b) or (c) below. Backfill behind walls shall not begin until the concrete has attained a compressive strength of 2,000 p.s.i [15 MPa]. Backfill on top of supporting slabs shall not begin until concrete has attained a compressive strength of 3,000 p.s.i. [20 MPa].

(a) Material for backfill shall be placed in uniform layers not more than 12 inches [305 mm] in depth (loose measurement) and, if dry, it shall be wetted uniformly with a spray nozzle to the moisture content required to obtain the specified density and shall be compacted to the required density by means of a mechanical tamper.

(b). A clean gravel, or gravel approved by the Consulting Engineer, conforming to the requirements of Item No. 410, "Subgrade Filler" may be used for backfill material from the bottom of the trench to the top of the conduit. The gravel shall be placed in the trench and lightly tamped to consolidate and seat the mass against conduit and earthen surfaces. A filter fabric shall be placed between the gravel backfill (initial backfill) and secondary backfill. The filter material shall have an apparent opening size of U.S. Sieve No. 40. Where conditions permit and with approval of the Consulting Engineer, a gravel conforming to Item 200 "Flexible Base" may be used from the top of the filter blanket, to the top of the box culvert. This backfill material shall be placed in uniform layers not more than 12 inches [305 mm] in depth (loose measurement) and shall be compacted to the required density. Each layer of material, if dry, shall be wetted uniformly with a spray nozzle to the moisture content required to obtain the specified density and shall be compacted to the

required density by means of a mechanical tamper.

(c) Controlled low strength material (CLSM). CLSM shall be placed by direct discharge from a mixer truck or other approved method. A minimum of 30 psi [1 MPa]. at 3 days and maximum strength of 800 psi [5 MPa]. at 28 days is required. There is no separate pay item for Controlled Low Strength Material.

ITEM 307
CONCRETE STRUCTURES

This item shall govern for the construction of box culverts, headwalls, wingwalls, bridges, box transitions, approach slabs, retaining walls, inlets, storm sewer structures, sanitary sewer structures and incidental structures. All concrete structures shall be constructed in accordance with specifications herein outlined and in conformity with the required lines, grades, sections and details shown on the plans or as directed by the Engineer.

MATERIALS:
1. Concrete: All concrete shall conform to the provisions of Item No. 300, "Concrete (Class A)" or shall be of class as noted on the plans. 2. Reinforcing Steel: All reinforcing steel shall conform to the provisions of Item No. 301, "Reinforcing Steel". 3. Membrane Curing Compound: All membrane curing compound shall conform to the provisions of item No. 305 "Membrane Curing'. 4. Expansion Joint Materials: All expansion joint materials shall conform to the provisions of item No. 304, "Expansion Joint Materials". 5. Cast Iron Castings: All cast iron castings shall conform to the provisions of Item No. 409, "Cast Iron Castings". 6. Metal for Structures: Metal for structures shall conform to the provisions of Item No. 302, "Metal for Structures".

CONSTRUCTION METHODS:
1. Forms: Forms shall be of wood, metal or other approved materials and shall conform to the following requirements:
a. Wood Forms:

(1) Unexposed concrete surfaces, No. 2 common or better lumber.

(2) Exposed concrete surfaces, dressed and matched boards of uniform thickness and width.

b. Plywood: Commercial standard Douglas Fir, moisture resistant, concrete form plywood, not less than 5 ply and at least 9/16th of an inch [14 mm] in thickness. The face of the plywood shall be free from knot holes and other blemishes.

c. Metal Forms: Metal forms of an approved type that will produce surfaces equal to or better than those specified for wood forms.

Forms may be constructed of any of the above substances or of other material if suited to the intended purpose and when approved by the Inspector. Forms shall be built mortar tight and of sufficient strength to prevent bulging between supports and shall be set and maintained to the line and grade designated until the concrete is sufficiently hardened to permit removal. All details of form construction shall be subject to the approval of the Inspector, and in special cases the approval of the Engineer may be required. Permission to place concrete will not be given by the Inspector until all form work has been placed in accordance with the above requirements. If at any stage of the work, the forms show signs of bulging, sagging or moving, that portion of the concrete causing such condition shall be immediately removed if required by the Inspector and the forms reset and securely braced against further movement. All corners and edges, which will be exposed after construction, shall be chamfered with triangular chamfer strips 3/4 inch [19 mm] measured on the sides.

2. Placing Reinforcement: All steel reinforcement shall be placed in accordance with item No. 301, "Reinforcing Steel".

3. Placing Concrete: The base slabs of inlets, junction boxes, headwalls, culverts and other structures shall be placed and allowed to set before the remainder of the structure is constructed. Suitable provision shall be made

for bonding the sidewalls to the base slab by means of longitudinal keys so constructed as to prevent the percolation of water through the construction joints. Before concrete is placed in the walls, the keyed-edge joints shall be thoroughly cleaned of all shavings, sticks, trash or other extraneous materials. The top slabs of culverts and like structures may be poured monolithic with the walls, provided the walls are poured and allowed to set a minimum of one (1) hour, but no more than two (2) hours shall elapse between the placing of the concrete in the wall and that in the top slab; such interval is to allow for shrinkage of the concrete in the wall. Under adverse weather conditions the minimum time will be increased by the Inspector.

All concrete shall be placed with the aid of mechanical vibrating equipment supplemented inside the forms. Vibrating equipment shall be of the internal type and shall maintain a speed of 6000 impulses per minute, when submerged in concrete. Vibrators shall be adequate in number of units to properly consolidate all concrete. Form or surface vibrators shall not be used. The duration of vibration shall be limited to that required to properly consolidate the concrete without causing objectionable segregation of aggregates. Insertion of vibrators into lower courses that have commenced initial set, or the disturbance or reinforcement in concrete beginning to set shall be avoided.

Concrete shall not be allowed to drop freely more than 5 feet [1.5 m] in unexposed work, nor more than 3 feet [1 m] in exposed work; where greater drops are required, a tremie or other approved means shall be employed. Concrete shall not be placed when the ambient temperature is below 40° F. [4 °C], nor where the concrete is likely to be subject to freezing before final set has occurred. When the air temperature is expected to drop below 40° F. [4 °C] during the first 72 hours of the curing period, polyethylene sheeting or burlap-polyethylene blankets shall be placed in direct contact with the top surface of the concrete. Concrete may be poured in temperatures below 40° F. [4 °C]. when poured in protected areas, or where adequate protection can be provided against freezing, if approved by the Inspector. When concrete is poured in air temperatures above 85° F. [30 °C], an approved retarding agent, meeting the requirements of ASTM C494, Type B, will be required in all concrete used in superstructures and top slabs of culverts unless directed otherwise by the Inspector.

4. Form Removal: Forms shall be removed only with the approval of the Inspector and in a manner to insure complete safety of the structure where the structure as a whole is supported on shoring. Form removal from structures shall not begin until the concrete has attained the following compressive strengths: a. Vertical forms shall not be removed until the concrete has set a minimum of twenty-four (24) hours, or the concrete has attained a minimum compressive strength of 500 p.s.i. [3 MPa] b. When wall and top slabs are poured monolithicly, wall forms shall not be removed until the concrete has attained a minimum compressive strength of 2000 psi [14 MPa] c. Forms for the top slab shall not be removed until the top slab has-attained

a minimum compressive strength of 2000 psi [14 MPa]. 5. Finish: Honeycomb and other minor defects shall be patched with cement mortar composed of one (1) part cement to two (2) parts fine aggregate. All exposed surfaces shall be given one of the following finishes: a. Rough Finish: Concrete for which no other finish is indicated or specified shall have fins and rough edges removed.

b. Smooth Finish: Smooth finish shall be given to the interior of inlets, junction boxes, culverts and other structures. Joint marks, fins and rough edges shall be smoothed off and blemishes removed, leaving finished surfaces smooth and unmarred subject to approval by the Inspector.

c. Floor Finish: Floor finish shall be given to the floors of all inlets, culverts and other structures, and shall be struck off true to the required grade as shown on the drawings and floated to a smooth, even finish by manual or mechanical

methods. No coarse aggregate shall be visible after finishing.

d. Rubbed Finish: All exposed surfaces of retaining walls, wingwalls, headwalls and other structures, after patching and pointing has been completed, and the surface has been wetted, shall be given a first rubbing with a No. 16 Carborundum Stone. After the first rubbing is completed and the ground material has been evenly spread, the material shall be allowed to take a reset. After sufficient aging, the surface shall be wetted and given a finish rubbing with a No. 30 Carborundum Stone, after which the surface shall be neatly striped with a brush and allowed to take a reset. On the inside surfaces of all culvert walls an area from the top slab, on a line 30 degrees from the vertical, to the bottom slab shall be rubbed as specified above. The entire structure shall be left with a clear neat uniform finish, free from form markings and shall be uniform in color.

e. Sidewalk surfaces shall be given a wood float finish, a light broom finish, or may be stripped with a brush as directed by the Inspector or specified in the plans.

f. Roadway slabs shall be given a broom finish after completion of the floating or straight-edging operation, but before the disappearance of the moisture sheen. The grooves of the finish shall be parallel to the centerline of the roadway. The average texture depth of the grooves shall be a minimum of 0.035 inches [1 mm]. The Contractor has the option of substituting the surface finish described in item No. 311 "Special Concrete Surface Finish" on the surface areas listed in the specification.

6. Curing: Immediately after placing or finishing, concrete surfaces not covered by forms shall be protected from loss of surface moisture for not less than four (4) curing days. When forms are left in place they shall be kept sufficiently wet to reduce cracks in the forms and prevent the form joints from opening. if forms are removed before four (4) curing days have transpired, the formed surface shall be protected for the remainder of the four (4)-day curing period. Protection and curing shall be accomplished by one of the following methods and shall be subject to the approval of the Inspector during the entire curing process:

a. Water Curing: Water curing shall be effected by covering exposed surfaces with cotton or burlap mats, previously wetted before applying, and kept thoroughly wet during the entire curing period. The application of the mats shall not mar or disturb surfaces which will be exposed on completion.

b. Membrane-Compound Curing: Membrane compound curing shall conform to the provisions of Item No. 305, 'Membrane Curing".

7. Fine Grading: All fine grading of structure foundations shall provide for seating on firm, clean natural earth foundation except as otherwise provided. Any under-cut foundations, except where authorized, shall be corrected to the satisfaction of the Inspector at the sole expense of the Contractor.

8. Excavation and Backfilling shall conform to Item No. 306, "Structural Excavation".

MEASUREMENT AND PAYMENT: No direct measurement or payment will be made for the work to be done or the equipment to be furnished under this item, but shall be considered subsidiary to the particular items of work for which unit prices are required in the proposal.

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DIVISION IV
STORM SEWERS

Item: 400 Excavation, Trenching and Backfilling

410 Subgrade Filler

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ITEM 400

EXCAVATION, TRENCHING AND BACKFILLING

This item shall govern the excavation, trenching and backfilling for storm drainage pipe, and pipe culverts, unless otherwise noted on the plans, details and the specifications. The work shall include all necessary pumping or bailing, sheeting, drainage and the construction and removal of any required cofferdams. All existing utilities shall be protected from damage during the excavation and backfilling of trenches, and if damaged, shall be replaced or repaired by the Contractor at his expense. Unless otherwise shown on the plans and bid proposal all excavation shall be unclassified, and shall include all materials encountered regardless of their nature or the manner in which they are removed.

EXCAVATION: The Contractor shall perform all excavation of every description and of whatever substances encountered, to the lines and grades shown on the plans or determined by the Engineer. During excavation, material suitable for backfilling shall be stockpiled in an orderly manner a sufficient distance from the banks of the trench to avoid overloading and to prevent slides or cave ins. All excavated materials not required or not suitable for backfill shall be removed and properly disposed of by the Contractor or as directed by the Engineer. Such grading shall be done as may be necessary to prevent surface water from flowing into trenches or other excavations, and any water accumulating therein shall be removed by pumping or by other approved methods. Sheeting and shoring shall be done as may be necessary for the protection of the work, adjoining property, and for the safety of the personnel. Unless otherwise indicated, excavation shall be by open cut except that short sections of a trench may be tunneled, if in the opinion of the Engineer, the pipe or structure can be safely and properly installed or constructed, and backfill can be properly tamped in such tunnel sections.

TRENCHING:

1. Trench walls shall be vertical and the practice of undercutting at the bottom or flaring at the top will not be permitted unless at the Engineer's direction. In special cases where trench flaring is permitted and directed by the Engineer, the trench walls shall remain vertical to a depth of at least 1 foot [305 mm] above the top of the pipe. The bottom of the trench shall be square or slightly curved to the shape of the trenching machine cutters. The bottom of the trenches shall be accurately graded to provide uniform bearing and support for each section of pipe on the undisturbed soil at every point along its entire length, except for the portions of pipe sections where it is necessary to excavate for bells and for the proper sealing of pipe joints. Bell holes and depressions for joints shall be dug after the trench bottom has been graded in order that the pipe may rest upon the prepared bottom for as nearly its full length as practicable. Whenever over-excavation occurs, the under-cut trench shall be restored to grade, to the satisfaction of the Inspector, by replacement of excavated material compacted to the same density as the surrounding natural ground. Whenever wet or otherwise unstable soil that is incapable of properly supporting the structure or pipe, as determined by the Engineer, is encountered in the bottom of the trench, such soil shall be removed to the depth shown on the plans or determined by the Engineer and the trench backfilled to the proper grade with a subgrade filler as specified in Item No. 410, "Gravel Subgrade Filler". The depth of cut indicated on cut sheets, as furnished by the Consultant, is from the off-set or cut hub elevation to the invert of the pipe. The width of the trench shall be at least the outside diameter of the pipe plus 6 inches [152 mm] on each side of the pipe for pipe sizes less than 42 inches [1050 mm] in diameter. The maximum working room for pipe 42 inches [1050 mm] in diameter and under shall not exceed 1/2 of the outside

diameter of the pipe or 12 inches [305 mm] whichever is greater, from the edge of the pipe to the face of the trench walls, or inside face of the shoring protection. For pipe over 42 inches [1050 mm] in diameter the maximum width of the trench shall be such that the working space from the pipe to the trench wall, or shoring protection as the case may be, will be a minimum of 12 inches [305 mm], and a maximum of 24 inches [610 mm]. If allowable trench widths are exceeded through over-shooting of rock, caving of earth trenches or over excavation, the Contractor shall employ corrective measures or alternative designs as determined by the Engineer. It shall be understood that the depth of cut as indicated on the cut sheet may be more or less than the actual excavated depth due to ground conditions existing at the site. For this reason the Consultant shall determine the depth for pay purposes based on the surface elevation prior to the Contractor's operation and the invert of the sewer line. The Consultant's decision shall be final.

2. Where water, silt, muck, trash, debris or rock in ledge, boulder or coarse gravel (particle size larger than 1 3/4 inch [44 mm] is encountered at the bearing level, the Contractor shall, as directed by the Inspector, under-excavate and remove such materials to a depth not less than 4 inches [102 mm] below the bottom of the pipe and replace with a material conforming to the requirements of Item 410, "Gravel Subgrade Filler".

BACKFILLING:

1. General: Excavation shall not be backfilled until the constructed structures or appurtenances as installed conform to the requirements specified. The excavation shall be carefully backfilled with the excavated materials approved for backfilling, consisting of earth, loam, sandy clay, flexible base material, sand and gravel, soft shale or other approved materials, free from large clods of earth or stones. Where pipe is specially coated for protection against corrosion, care shall be taken not to damage the coating. Any excavation improperly backfilled, or where settlement occurs, shall be re-opened to the depth required for proper compaction, then refilled and compacted with the surface restored to the required grade and compaction. The use of sand backfill shall not be allowed. All compaction shall be such that the apparent dry density of each layer shall be not less than ninety percent (90%) of the maximum dry density as determined by tests on samples as outlined in TXDOT Testing Method Tex 113-E, unless otherwise shown on the plans.

2. Storm Drainage Pipe Backfilling: Pipe backfilling to a point 12 inches [305 mm] above the top of the pipe shall be done by either method (a), (b) or (c) below.

Backfilling from a point 12 inches [305 mm] above the top of the pipe to the top of trench or proposed subgrade elevation shall be done by method (d) below.

(a). Material for backfill shall be selected fine compactable soil material. It shall be compacted at near optimum moisture content in layers not to exceed 6 inches [152 mm] in compacted thickness. Each layer shall be compacted to the required density by approved hand or mechanical tamping equipment. Care shall be exercised to thoroughly compact the backfill under the haunches of the pipe and to insure that the backfill soil is in intimate contact with the sides of the pipe. Backfill material shall be kept at the same elevation on both sides of pipe.

(b). A clean gravel or gravel approved by the Engineer, conforming to the requirement of Item No. 410, "Gravel Subgrade Filler" may be used for backfill material. The gravel shall be placed in the trench and lightly tamped to consolidate and seat the mass against the conduit and earthen surfaces. Backfill material shall be kept at the same elevation on both sides of pipe.

(c). Cement Stabilized Backfill shall conform to "Class D" Concrete as defined in Item No. 300 "Concrete" of these specifications. Cement Stabilized Backfill shall be placed within one (1)

hour after mixing and shall be placed and rodded in such a manner as to completely fill the backfill area. Before placing Cement Stabilized Backfill, the trench shall be cleaned of any extraneous material and thoroughly wet. All surplus dirt excavated from the ditch shall be removed from the site.

(d). After the backfill has been completed to a point 12 inches [305 mm] above the top of the pipe by one of the methods outlined above, suitable rolling equipment may be used on these portions which are accessible to such equipment to obtain the compaction effect.
Material for backfill shall be placed in uniform layers no more than 12 inches [305 mm] in depth (loose measurement) and shall be compacted to the density specified herein. Each layer of backfill material, if dry, shall be wetted uniformly prior to placement in the trench to the moisture content required to obtain the specified density, and shall be compacted to the required density by means of rolling equipment or other suitable mechanical method. No rolling equipment shall be used which may damage the pipe.

DISPOSAL OF EXCAVATED MATERIALS:
The excess excavated material, not utilized after all fill requirements have been met, shall become the property of the Contractor and he shall dispose of it by hauling and wasting outside the limits of the right-of-way of this project and of public thoroughfares and water courses, in conformity with pertinent City ordinances and in a manner meeting the approval of the Engineer.

MEASUREMENT: Excavation, Trenching and Backfill will not be measured for payment.

PAYMENT: No direct payment shall be made for excavation, trenching and backfilling for pipe culverts, pipe storm sewers, and all costs in connection therewith shall be included in the applicable contract price for the item to which the work pertains.

Excavation for reinforced concrete box culverts will be measured and paid for at the contract unit price bid per cubic yard [cubic meter] under Item No. 106, "Box Culvert Excavation and Backfill". Subgrade filler will be measured and paid for at the contract unit price as provided for in Item No. 410, “Gravel Subgrade Filler."

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ITEM 410
SUBGRADE FILLER

This item shall consist of furnishing and placing materials for purposes of stabilizing subgrades in trenches or channels or under conduits or poured-in-place box culverts, bedding for pre-cast box culverts or as instructed by the Inspector, where quicksand, muck or other unstable material is encountered and the Inspector deems the measures provided herein warranted.

CLASSES: The subgrade fillers shall be of two classes known as Concrete Subgrade Filler and Gravel Subgrade Filler.

MATERIALS:
1. Concrete: Concrete subgrade filler shall be composed of concrete conforming to the provisions of Item No. 300, "Concrete (Class C)".

2. Gravel: Gravel subgrade filler shall be composed of well graded, crushed stone or gravel, approved by the Engineer, one hundred percent (100%) passing a two inch (2") sieve at least ninety-five percent (95%) passing a one and three quarter inch (1 3/4") sieve and at least ninety percent (90%) retained on a one quarter inch (1/4") sieve. The crushed stone or gravel shall have an abrasion of not more than forty (40) when subjected to the Los Angeles Abrasion Test.

CONSTRUCTION METHODS: Where the soil encountered in the subgrade for a channel bottom, a box culvert, box conduit, storm sewer, or other structure at established footing or pipe bearing grade is a quicksand, muck, or other unstable material, the Inspector may order its removal to any depth deemed necessary and replacement with one of the fillers specified above. Where so ordered by the Inspector, the following procedures shall govern:

1. The concrete subgrade filler will be used to establish a thin working surface on subgrades which are saturated but are regarded as stable, and where otherwise the construction operations would disturb the subgrade surface. In such a case a layer of material to a depth below the established footing or bearing elevation, as directed, shall be removed and replaced with the concrete filler material, the material shall be lightly consolidated by tamping and the surface shall be screeded or struck off and allowed to set to form a subgrade surface of accuracy equivalent to that obtained for normal fine grading of subgrade.

2. Gravel subgrade filler will be used to replace wet subgrade or other unstable materials regarded as unsatisfactory for support of the structure involved. In such cases, subgrade material shall be removed to such depth below the established footing or bearing elevation as may be ordered. The soil removed shall be replaced with gravel or crushed stone as subgrade filler, placed in uniform layers of suitable depth, as directed by the Inspector. Graded subgrade filler also will be used for bedding for precast box culverts and initial backfill material for flexible pipe and in rock construction.

MEASUREMENT: Each class of subgrade filler, in place in accordance with these specifications, complete and accepted, will be measured for payment by the cubic yard [cubic meter] of material in place.

PAYMENT: Payment for the subgrade fillers will be made at the contract unit price bid respectively for "Concrete Subgrade Filler", or for "Gravel Subgrade Filler", as the case may be. Such prices shall include full compensation for removal and disposal of materials below the established subgrade levels and the furnishing and placing of the subgrade filler materials.

BID ITEMS:

Item 410.1: Concrete Subgrade Filler - per cubic yard [cubic meter]

Item 410.2: Gravel Subgrade Filler - per cubic yard [cubic meter

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DIVISION V
INCIDENTAL CONSTRUCTION

Item: 507 Chain Link Wire Fence

509 Metal Beam Guard Rail

520 Hydromulch Seeding

526 Field Office

531 Signs

540 Temporary Erosion, Sedimentation and Water Pollution Prevention & Control

542 Temporary Sediment Control Fence (Silt Fence)

545 Baled Hay for Erosion & Sedimentation Control

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ITEM 507
CHAIN LINK WIRE FENCE

This item shall govern for chain link fabric supported on posts and with bracing and accessories as shown in the plans or as specified herein, erected complete in place as shown in the plans or as directed by the inspector.

MATERIALS:

1. Fabric: Fabric shall consist of steel wires of a gauge as shown on the plans and shall be woven with 2-inch [50 mm] mesh openings such that in a vertical dimension of 23 inches [584 mm] along the diagonals of the openings there shall be at least seven meshes. The top and bottom selvages shall have a twisted and barbed finish, the barbing to be done by cutting the wire at an angle to create sharp points. The wire in the fabric shall have a tensile strength of not less than 75,000 pounds per square inch [517 107 kPa], after galvanizing or aluminum coating is applied. Fabric shall conform to the least requirements of the ASTM A 392, Class 1, or ASTM A 491.

2. Top Rail: Top rails shall be tubular steel of the diameter and weight per linear foot as shown on the plans. Rails shall be galvanized inside and out. Sleeves shall be outside sleeves at all joints, and shall be galvanized.

3. Tension Wire: Tension wire shall be used as indicated on the plans. The gauge shall be as shown on the plans and the wire shall be of coil spring steel of good commercial quality and shall be galvanized.

4. Tie wires: Wire for attaching fabric to tension wire and to top rail shall be not less than No. 12 gauge galvanized wire, or fastenings in accordance with the manufacturer's standard design. Sufficient fastening material shall be furnished to provide for attaching the fabric to the tension wire and to the top rail and posts at spacings shown on the plans.

5. Line Posts: Line posts shall be tubular steel and of a diameter and weight per linear foot [meter] as shown on the plans, and shall be galvanized inside and out. Line posts shall be fitted with galvanized watertight malleable iron caps which permit the top rail to pass through the top cap and which provide a tight fit over the outside of the post.

6. Corner, Tension, Terminal and Gate Posts: Corner, tension, terminal and gate posts shall be of tubular steel of the diameter and weight per linear foot [meter] as indicated on the plans, and shall be galvanized inside and out. Such posts shall be furnished with all accessories, braces and fittings of pressed or rolled steel, forged steel or malleable iron, all galvanized, as required for complete installation, bracing, fastening, supporting, and securing the fence, top rails and tension wire. Posts shall have heavy malleable iron caps, galvanized, for closing the posts to exclude moisture. Caps shall be made to provide a driving fit over the outside of the post.

7. Braces and Cables: Braces or cables shall be installed at all corner, tension, terminal and gate posts and shall be extended to adjacent line posts, in accordance with the plans. Braces and trussing material shall be high carbon steel of good commercial quality and shall meet the dimensions and other requirements on the plans. Brace rods shall be 3/8 inch [10 mm] diameter and be equipped with turnbuckles. Cables shall be 3/8 inch [10 mm] diameter and shall be composed of seven wires. Cables shall be installed as shown on the plans, and shall include the use of 3/8 inch [10 mm], drop-forged eye-and-eye, or eye-and-clevis turnbuckles.

8. Gate frames: Gate frames shall be made of high carbon steel of good commercial quality,

tubular, and shall be galvanized inside and out. Gate frames shall be filled with the same fabric as specified for the fence. All gates shall be equipped with suitable malleable iron or steel latches, stops, center rests and shall have satisfactory provisions for locking by means of padlocks. Gate hinges shall be malleable iron or pressed steel and shall be securely attached to the posts. Hinges shall not twist or turn under the action of the gate, and shall be so arranged that a closed gate cannot be lifted off its hinges. Vehicular gates shall be of the full 180-degree opening swing type and shall be so constructed and supported as to be easily operated by one person. All gates shall be equipped with a positive stop which will prevent the gate from being swung into a street or traffic lane; and all gates shall be furnished with a positive latch to hold the gate in a closed position.

9. All steel pipe, except for thin-wall, high strength pipe, used for top rails, line posts, corner, tension, terminal or gate posts, braces or gate frames shall conform to the requirements of ASTM A 120. Thin-wall, high strength pipe shall be manufactured by cold rolling using steel strip conforming to ASTM A 569.

GALVANIZING AND ALUMINUM COATING: All materials used in "Chain Link Wire Fence" shall be galvanized, except that the fabric may be given an aluminum coating in lieu of galvanizing. Galvanizing shall be by the "hot dipping" process, and the zinc used shall conform to ASTM B6, and shall be of at least equal to the grade designated as "Prime Western". Fabric may be aluminum coating with a minimum weight of coating of 0.40 ounce per square foot [11grams per 0.1 square meters] in accordance with the ASTM A 428, or it may be coated with not less than 1.2 ounces [34 grams] of zinc coating in accordance with ASTM A 90. Fabric shall be hot-dip galvanized after weaving to conform to ASTM A 392, Class 1, or it may be aluminum coated in accordance with ASTM A 428. Posts, braces and gates shall be hot-dip galvanized inside and out in conformance with ASTM A 120 or A 123. All fittings, bolts, and miscellaneous hardware shall be hot-dipped galvanized in conformance with ASTM A 90. All galvanized materials shall satisfy all requirements of the latest ASTM Standard Method of Test for Uniformity of Coating by the Preece Test (Copper Sulphate Dip) for Zinc-coated (Galvanized) iron and Steel Articles. The component parts of the fence will not be tested unless careful visual inspection indicated that the quality or workmanship does not comply with these specifications. If, in the opinion of the Inspector, testing is necessary, specimens for testing shall consist of one square foot [0.1 square meters] of woven fencing selected at any point in width of the fence fabric, exclusive of the twisted or knuckled portions, and shall be taken from the end of the roll. The zinc coating shall be tested by a stripping test in accordance with the latest ASTM Methods of "Test for Weight of Coating on Zinc-Coated (Galvanized) Iron and Steel Articles". Careful visual inspection shall be made to determine the quality of the zinc coating. Excessive roughness, blistering, sal-ammoniac spots, bruises, and flaking, if present to any considerable extent, shall provide a basis for rejection. Thin-wall, high-strength pipe shall be externally hot-dip galvanized with the weight of the zinc coating determined in accordance with ASTM A 90. After galvanization, thin-wall, high-strength pipe shall also be externally chromated by total immersion followed by application of clear polyurethane finish. Internally, thin-wall, high-strength pipe shall have a zinc base coating with thickness of 0.5 mil plus or minus 0.2 mil. The coating shall be 81 percent zinc powder by weight.

AMPLING: The Contractor shall furnish, upon request of the Inspector, samples of each component part of the fence, including fittings. These samples shall be subjected to the galvanizing, weight and, where applicable, strength tests. A sample may be taken from each shipment and all samples shall be furnished the City without cost. If a sample or specimen fails to meet the requirements of this specification, two additional samples or specimens shall be taken from the same

shipment and tested, both samples and specimens so tested shall meet the requirements in every respect, or the lot represented by the samples may be rejected.

CONSTRUCTION METHODS: Chain Link Fence shall be erected at locations shown in the plans or as directed by the Inspector or in accordance with the details shown on the plans. The fence shall be true to line, taut and firmly fastened and shall comply with the best practice for fence construction of this type. Posts shall be set in concrete to the depths indicated in the plans, plumb and permanently positioned and all anchorages firmly set before fabric is placed. Posts shall be set in Class "B" Concrete unless otherwise shown in the plans and concrete and equipment shall be in conformity to the requirements of Item No. 300, "Concrete (Class B)". Concrete footings shall be not less than the size and depth shown in the plans. Concrete shall be placed and tamped into position with care to prevent entrance of soil from the walls of the hole. Earth coming in contact with concrete shall be moistened as directed by the inspector prior to placing concrete. Tension posts shall be placed in long, straight runs of fencing and shall be spaced not more than 330 feet [100 m] apart or no straight run of fencing may be more than 330 feet [100 m] without a tension post. Corner posts shall be placed at each angle point and gate posts as shown shall be placed for each opening. After all posts in a run of fencing have been permanently positioned and anchorages are firmly set, the fabric shall be placed by securing one end and applying sufficient tension to the other to remove all slack before making attachments. Fabric shall be fastened as shown in the plans or as called for herein, and the bottom of the fabric shall be placed a normal distance of 2-inches [50 mm] above the ground line; however, over irregular ground this distance may vary between 1-inch [25 mm] and 6-inches [152 mm] for a distance not to exceed 8-feet [2.4 m]. Any necessary backfilling required to comply with these conditions will be considered as incidental work.

MEASUREMENT: "Chain Link Wire Fence", of the height specified, will be measured by the linear foot [meter] of fence at the bottom of the fabric along the center line of the fence from center to center of end posts, exclusive of gates. "Chain Link Wire Fence" shall include all end posts, angle and corner posts, and tension posts, complete in place with all bracing and accessories.

Gates will be measured per each gate of each type, complete in place with gate posts, all bracing and all accessories.

PAYMENT: "Chain Link Wire Fence" measured as prescribed above, will be paid for at the contract unit price bid per linear foot [meter] for "Chain Link Wire Fence" of the height specified, which price shall be full compensation for furnishing and installing all fencing materials, end posts, angle and corner posts, tension posts, line posts, caps, tension wires, top rail, and connection fittings; digging post holes or setting into retaining wall and structures; furnishing and placing concrete for setting posts; all hauling and hauling charges; and for all manipulation, labor, tools, equipment, and incidentals necessary to complete the work. Gates measured as prescribed above will be paid for at the contract unit price bid for each "Gate, Pedestrian" or "Gate, Vehicular" of each size called for, which price shall be full compensation for furnishing all materials; fabrication, preparation, hauling, handling charges, and erecting; including gate and gate posts, posts caps, braces, miscellaneous fitting and fastenings, latches, hinges, stops and holding devices; and for all manipulation, labor, tools, concrete for setting posts, equipment and incidentals necessary complete installation.

BID ITEM:

Item 507.1 - Chain Link Wire Fence - (4 ft. high) [1.2 m] - per linear foot [meter]

Item 507.2 - Chain Link Wire Fence -(6 ft. high) [1.8 m] - per linear foot [meter]

Item 507.3 - Chain Link Wire Fence - (8 ft. high) [2.4 m] - per linear foot [meter]

Item 507.4 - Gates - Pedestrian each.

Item 507.5 - Gates - Vehicular per opening.

ITEM 509
METAL BEAM GUARD RAIL

This item shall govern for the installation of one line of metal beam rail element supported on timber posts. Metal beam guard rail shall be constructed of materials and workmanship as prescribed by these specifications, at such places as shown on the plans or as designated by the Engineer, and in conformity with the plans and typical details shown.

MATERIALS:

1. Rail Elements: The rail elements shall be of the deep beam type fabricated to develop continuous beam strength and shall consist of metal plate or sheet formed into a beam not less than 12 inches [305 mm] wide and 3 inches [76 mm] deep as shown in the plans. The beam shall be free from warp. When tested with a straight edge or string along either edge of a 12-1/2-foot [3.8 m] sectional length of beam, the maximum deviation of the beam edges from the straight edge shall not exceed 1/2 inch [13 mm] at any point. The steel for the rail elements shall conform to the requirements of AASHTO M-180. The rail shall be of a 10 gauge nominal thickness (0.1345 + 0.008 inch) [3.43 mm ± 0.20 mm] or 12 gauge nominal thickness (0.1046 + 0.008) [2.67 mm ± 0.20 mm] as shown on plans. The rail element shall be galvanized before fabrication. Galvanizing shall be in accordance with the requirements of ASTM A 525. Where painting and/or striping is expressly required on the plans, the rail elements need not be galvanized, but shall be painted in accordance with Item No. 514, "Paint and Painting".

2. Posts: The posts shall be timber and shall be of Southern Yellow Pine. All posts shall be round. End posts shall not be less, in any place, than 8-inches [203 mm] in diameter. Intermediate posts shall not be less, in any place, than 7-inches [178 mm] in diameter. They shall be the length shown on the plans. The bottom shall be sawed off square, and the top may be dome shaped or beveled with 10-15 degree bevel. All posts shall be peeled and trimmed of all knots and knobs and shall be straight and smooth. The posts shall be sound and free from defects such as injurious ring shakes, unsound or loose knots, or other defects which might impair their strength and durability. Sound knots will be permitted provided they are not in clusters and they do not exceed one-third (1/3) of the small diameter or least dimension of the post. Any defect or combination of defects which would be more injurious than the maximum allowable knot will not be permitted. A line drawn from the center of each end of the post shall not fall outside the center of the post at any point more than 1-1/4 inches [32 mm]. All timber posts shall be preservative-treated in accordance with Item 492, "Timber Preservative and Treatment", of the Texas Department of Transportation Standard Specifications.

3. Fittings: Fittings shall consist of bolts, nuts and washers and shall conform to the details as shown on the plans and shall comply with the requirements as specified herein. All bolts and nuts used with painted steel rail shall be made by either the open-hearth or electric-furnace process and shall have proper strength for the purpose intended. They shall be hot-dip galvanized to conform to ASTM A 153. The post connection shall withstand a 5,000 pound pull [22 240 newton] in either direction. Fittings shall conform to ASTM A-307.

CONSTRUCTION METHODS: The posts shall be set plumb, firm, and to the line and grade shown on the plans. Unless the plans call for setting in concrete, the posts shall be backfilled by thoroughly tamping approved material in 4 inch [102 mm] layers. The rail elements shall be erected to produce a smooth, continuous rail paralleling the line and grade of the roadway surface or as shown on the plans. The rail

elements shall be joined end to end by bolts and lapped in the direction of traffic in the lane adjoining the guard rail. When designated on the plans, the rail elements shall be curved before erection. Holes for special details may be field-drilled or punched, when approved by the Engineer. Where damage has occurred during handling and erection, galvanized material shall be repaired by the application of "Galvaloy, AMCO No. 321, or ZRC" in accordance with the manufacturer's recommendations. Where painting is specified, after erection all parts of painted steel rail elements on which the primer coat has been scratched or chipped shall be thoroughly cleaned and spot painted with the paint specified for the first field coat. The spot coat shall be allowed to dry for at least 12 hours, after which the beam and posts shall be painted with the first field coat. After the first field coat has dried for at least 48 hours, the second field coat shall be applied.

MEASUREMENT:
Accepted work as prescribed by this item will be measured by the linear foot of rail, complete in place. Measurement shall be made upon the face of rail, from center to center of end posts or terminal anchor.

PAYMENT:
The work performed as prescribed by this item will be paid for at the contract unit price bid per linear foot [meter], measured as prescribed above, for "Metal Beam Guard Rail", which price shall include the terminal anchor section and be full compensation for furnishing all materials, for all preparation, hauling and erection and painting of same, for setting posts in concrete when specified, and for all labor, tools, equipment and incidentals necessary to complete the work, including excavation, backfilling and disposal of surplus material.

BID ITEM

Item 509:	Metal Beam Guard Rail - per linear foot [meter]

ITEM 520
HYDROMULCHING

This item shall govern for preparing ground, providing for sowing of seeds, mulching with cellulose fiber and other management practices along and across such areas as are designated on the plans and in accordance with these specifications. All areas shall be covered with live grass before acceptance.

MATERIALS:

1. Seeds: All seed must meet the requirements of the Texas Seed Law including the labeling requirements for showing purity, germination, name and type of seed. Seed furnished shall be of the previous season's crop for the date of the project. Each variety of seed shall be furnished and delivered in separate bags or containers. A sample of each variety shall be furnished for analysis and testing when directed by the Engineer. The amount of seed planted per acre shall be of the type specified below and shall equal or exceed the following percentages for purity and germination or an equivalent amount of pure live seed. Common Name: Bermuda and Giant Bermuda grass (hulled) Scientific Name: Cynodon Dactylon Purity: 95%

Germination:

90% Annual Rye grass will be free of Johnson grass, field bind weed, dodder seed, and free of other seed to the limits allowable under the Federal Seed Act and applicable State Seed Laws. Annual Rye grass will be added into slurry between October 1 through March 15. No additional cost will be charged to the City.

2. Wood Cellulose Fiber Mulch: Wood cellulose fiber mulch shall be natural cellulose fiber mulch produced from grinding clean, whole wood chips, or fiber produced from ground newsprint with a labeled ash content not to exceed 7%. The mulch shall be designed for use in conventional mechanical planting, hydraulic planting of seed or hydraulic mulching of grass seed, either alone or with fertilizer and other additives. The mulch shall be such that when applied, the material shall form a strong, moisture-retaining matwithout the need of an asphalt binder. The mulch material will also be dyed with a green color to assist in determining coverage and to provide an immediate pleasing appearance. The wood cellulose fiber is also required to be dispersed rapidly in water to form a homogeneous slurry and remain in such state when agitated in the hydraulic mulching unit with the specified materials.

3. Fertilizers: Fertilizer shall have a chemical analysis of 15-15-15 with micronutrients and shall be water soluble. (The figures in the analysis represent the percent of nitrogen, phosphoric acid and potash nutrients respectively.) Fifty percent or greater of the Nitrogen required shall be in the form of Nitrate Nitrogen (N0 3). The remaining Nitrogen required may be in the form urea Nitrogen (C0(NH2)2). In the event it is necessary to substitute a fertilizer of a different analysis, it shall be a pelleted or granulated fertilizer with a lower concentration, but the total amount of nutrients furnished and applied per acre shall equal or exceed that specified for each nutrient. The fertilizer shall be dry and in good physical condition. Fertilizer that is powdered or caked will be rejected.

4. Tactifier and binder: Natural vegetable gum containing gelling and hardening agents that when mixed with water and properly cured, shall form an insoluble network.

5. Water. Shall be furnished by the contractor and shall be clean and free of substances harmful to the growth of vegetation.

6. Herbicide: Herbicide used shall be an easy to apply, effective in a short term, chemical agent to inhibit or destroy weed growth, while being harmless to seed and grass being implanted.

7. Topsoil: Topsoil shall conform to the provisions of Item 515 "Topsoil".

CONSTRUCTION METHOD:

1. Security of stored hydromulch materials will be the sole responsibility of the Contractor at no additional expense to the City. It is the contractor's responsibility to verify the location of all utility lines, electric cables, sprinkling systems and conduits so that the proper precautions must be taken not to disturb or damage any subsurface improvements. Should obstructions be found, the Contractor will promptly notify the City Inspector. Any damage caused by the contractor shall be repaired by himself at no cost to the City. Any such repairs shall be subject to approval by the Inspector.

2. Preparation of Subsoil: Inspect subsoil for the presence of objectionable materials, such as rocks (2 inches [50 mm] in diameter and larger), concrete waste, building debris, weeds, grass or other material that would be detrimental to the growth of grasses. Protect existing underground improvements from damage. Cultivate to a depth of 3 inches [76 mm] in areas to receive hydromulch. If compaction is due to equipment, traffic or storage, cultivate to a depth of 6 inches, and apply herbicide as directed by manufacturer. Remove any foreign or objectionable materials collected during cultivation. Grade to eliminate rough spots and low areas where ponding may occur. Assure positive drainage away from all buildings. Maintain smooth, uniform grades. Hydromulch area and weed control shall consist of killing all weeds and maintaining a weed-free condition until completion of the project by applying herbicide as directed by the manufacturer.

3. Seeded Lawns: The following construction sequences and procedures shall be observed:

A) The contractor shall notify the Inspector not less than 48 hours in advance of any seeding operation and shall not begin the work until areas prepared or designated for seeding have been approved.

B) Before placement of hydromulch, all areas shall be cultivated to a depth of 3 inches [76 mm] unless otherwise specified or ordered by the City Inspector. Cultivation of the soil may be done by disc, spring tooth harrow, rototiler, or similar equipment. This operation shall be done at right angles to the natural flow of water on the slopes.

C) The area shall then be rolled in two directions; the second shall be done at right angles to the first rolling.

D) Rake the area to make it smooth and level. Add soil where necessary or as directed by the Inspector.

E) The finished grade shall be 1 inch (25 mm) below all curbs, sidewalks, and/or other appurtenances.

F) Apply the fertilizer at the rate and mixture specified. The fertilizer shall be applied by an approved hand or mechanical method.

G) Roll the area in one direction.

H) Slurry to be sprayed evenly in two intersecting directions with a hydraulic seeder.

I) Erect a barrier of stakes and strings, and post warning signs where necessary, or as directed by the Inspector.

J) Apply water as required to keep the mulch damp at all times throughout germination and initial growth period as determined by the Inspector.

K) Upon completion, all excess material shall be removed and disposed of off the project site at contractor's expense.

4. Slurry: The slurry will be mixed and spread uniformly over the area at the following rate: Residential area or commercial area:

Wood Cellulose Fiber Mulch --2000 lb./acre.
Fertilizer -- 400 lb./acre.
Bermuda -- 1.5 lb./1000 sq. ft.
Annual Ryegrass (Oct. through March 15) - 20 lbs. per 1000 sq. ft. Water and binder to be added according to manufacturer's recommendations.

5. Guarantee and Lawn Established Period: The guarantee and lawn established period shall begin immediately after the completion of the planting and shall start with the Provisional Acceptance and end with the Final Acceptance.
A) Provisional Acceptance: Upon completion of hydromulching and written request of Contractor, the Inspector will inspect all the work for Provisional acceptance.

B) Guarantee Period: The guarantee period shall begin upon completion of the provisional acceptance. All plant materials shall be guaranteed by the Contractor for a period of thirty days (30) from the date of provisional acceptance, to be in good, healthy, and nourished condition. The exceptions are damages resulting from neglect by the property owner, abuse or damage by others, or unusual phenomena or incidents which are beyond the Contractor's control. During the lawn establishment period, it shall be the contractor's responsibility to ensure the continuing healthy growth. This care shall include labor, water and material necessary to keep the project in a presentable condition, including but not limit to removal of litter, mowing, trimming, removal of grass clippings, edging, fertilization, insecticide and fungicide applications, weed control, and repair and reseeding any and all damaged areas.

Water application shall be accomplished each week from March through October. An even application of one inch minimum of water shall be required over all lawn areas weekly. The rate and frequency of water application may be changed, as directed by the Inspector, depending on weather, and soil conditions.

C) Replacement: The Contractor shall replace, without cost to the City, and as soon as weather conditions permit, all dead grassed areas not in a vigorous, thriving condition, as determined by the Inspector during and at the end of the guarantee period. Replacements shall be subject to all requirements stated in this specification. The Contractor shall make all necessary repairs to grades, grassed areas, and terrace paving required because of grass replacement at no cost to the City.

D) Final Inspection and Acceptance: At the end of the guarantee period and upon written request of the contractor, the Inspector will inspect all guaranteed work for final acceptance. The written request shall be submitted to the City ten(10) days prior to the anticipated date of inspection. Acceptance of hydromulching lawn as herein specified shall be based on a uniform stand of grass and a uniform grade at the time of final inspection. Area of two square feet or more that are bare or have a poor stand of grass and area not having a uniform grade for any cause before final inspection shall be regraded, rehydromulched and reseeded as specified at the Contractor's expense. Upon completion by the Contractor of all repairs or renewals which may appear at that time to be necessary in the judgment of the City or its authorized representative, the final acceptance of the hydromulching will be issued.

MEASUREMENT: Measurement of acceptable "Hydromulching", complete in place, shall be made by the square yard [square meter] and only for those areas designated on the plans, or for other areas directed by the Inspector. Fertilizers, wood cellulose fibers, seeds, herbicide and water will not be measured for payment.

BID ITEM:

Item 520:	Hydromulching - per square yard [square meter]. (Residential or Commercial)

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ITEM 526
FIELD OFFICE

This item shall govern the erection or furnishing of a building to be used by the inspection force as a Field Office where the contract amount is one million dollars or greater

GENERAL REQUIREMENTS:
The structure to be furnished by the Contractor shall be of the type described in this item or as described in the plans. The building shall be provided immediately after work on the project is begun and shall remain in place until the project is accepted by the City as complete, unless its' earlier removal is authorized by the Engineer. It shall be floored and roofed, weather tight and constructed in a workmanlike manner. All windows shall be screened. This building shall be constructed or furnished near the site of the work, at a location acceptable to the Engineer and shall be an independent unit, detached from any office, storage or warehouse building occupied by the Contractor. The building shall be for the sole use of the inspection force. Should the building be destroyed or damaged in any manner, except through causes due to negligence of the occupying inspecting force, the Contractor shall immediately restore it to its original state. Upon completion of the project, the building will become the property of the Contractor and shall be removed from the project site. The building shall be a minimum of 10 feet [3 m] by 16 feet [4.8 m] by 8 feet [2.5 m] high with not less than three glass windows and one door. A table not less than 3 feet [1 m] wide and 8 feet [2.5 m] long plus two chairs shall be provided. Unless specified otherwise on the plans, the structure for the field office shall be electrically wired with lights, outlets and plugs and have a unit or units for cooling and heating of said structure. A telephone shall be provided for use by the inspection force for local calls. The building shall be serviced with sewer or septic tank with connections and shall contain a restroom with a minimum of a flush toilet and a lavatory. A portable toilet may be furnished and serviced in lieu of a flush toilet. The contractor will be responsible for adequate collection and disposal of trash. A rental building or office, meeting the specified minimum requirements at a suitable location acceptable to the Engineer may be furnished by the Contractor instead of the building prescribed in this item.

MEASUREMENT AND PAYMENT: No measurement or payment will be made under this item. The Field Office is not a pay item and shall remain the property of the contractor after completion of this project.

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ITEM 531
SIGNS

This specification applies to the furnishing of retroreflective and non retro-reflective signs constructed of aluminum substrate to the dimensions specified and the installation of signs of varying sizes and legends as shown on the plans or as specified by the Traffic Design Engineer.

MATERIALS:
Subtrate: This shall be aluminum alloy 5052-H38 and otherwise in conformance with ASTM B-209 and have gold chromate finish. The size, shape and thickness of the sign blanks are as indicated on the standard detail sheet in the plans or as specified by the Design Engineer.

(A) Metal working: The aluminum shall be free of burrs and pits on both sides, including edges and holes, and shall be made ready for applications of the sheeting.

(B) Surface Preparation: The aluminum shall be thoroughly cleaned and degreased with solvent and alkaline emulsions cleaner by immersion, spray, or vapor degreasing and dried prior to application of the gold chromate sheeting coat. The aluminum shall be new and corrosion-free with holes drilled or punched, corners rounded to the radii shown in the standard detail sheet, and all edges smoothed prior to application of sheeting. The heavy or medium chromate coating shall conform in color and corrosion resistance to that imparted by the Alodine 1200F treatment.

(C) Size: The dimensions of substrate applications for regulatory, warning, and guide signs will be as specified by the Design Engineer and as shown on the plans.

BACKGROUND, LEGENDS, SYMBOLS AND COLORS:
These shall be in accordance with the Standard Highway Sign Designs (SHSD) for Texas and with the Texas Manual of Uniform Traffic Control Devices (TMUTCD).
(A) Retroreflective Materials: Retroreflective materials shall comply with "Standard Specifications for construction of Roads and Bridges on Federal Highway Projects", FP-85 and Federal Specifications L-S-300C. The Contractor shall furnish a certification that the materials comply with the requirements of FP-85 and L-S-300C.

(1) Retroreflective Sheeting - Type II (Engineer Grade): The materials as listed in these specifications shall comply with FP-85, Section 718 and L-S-300C. Colors shall be as specified in specifications for Standard Highway Sign Colors (FHWA, HTO- 21).

(2) Retroreflective Sheeting - Type III (High Intensity): The materials as listed in these specifications shall comply with FP-85, Section 718 and L-S-300C. Colors shall be as specified in specifications for Standard Highway Sign Colors (FHWA, HTO- 21).

(B) Non-Retroreflective Sheeting: All letters, numerals, and symbols shall be as prescribed in this specification.

(C) Application Methods: The method of application of sheeting, letters, numbers, and symbols shall be precisely as prescribed in writing by the manufacturer.

(1) Silkscreening -- Letter styles shall conform to specifications for die-cut legend in this specification. Screen processing when used, shall be of careful workmanship with neat, clean lines and corners, performed strictly as prescribed by the manufacturer of the transparent, opaque or screen colors. The inks shall be drawn over the screen with a firm, even pressure. As needed, three to five minutes shall

be allowed for the ink to flow out so that it has a smooth surface.

(2) Direct Application -- The applicator diaphragm shall have at least two pyrometers centrally attached. The applicator shall also have a cycle control unit approved by the sheeting manufacturer.
Temperature control calibration and accuracy monitoring of the approved cycle control unit shall be required each day that the heat and vacuum applicator is operated. Applicator operating temperature shall be calibrated with the specific temperature measuring device each day of operations, and

1. Whenever different substrate materials are being used.

2. Whenever a diaphragm, light bulb, cycle-control unit, or thermocouple is replaced.

3. Whenever different types or different colors of retroreflective sheeting are used.

(3) Legend spacing and Layout -- Spacing and layout for all traffic control signs shall conform to the SHSD.

(a) Tolerance for Horizontal Alignment: Letters, numerals, and symbols shall be horizontally aligned to a tolerance of 1/16 inch [1.5 mm]. Test of each sign board shall be as follows: Place a metal straight edge along the bottom of a series of letters forming each line of the sign. In each line, letters shall not vary more than 1/16 inch [1.5 mm] from that line.

(b) Tolerance for Vertical Alignment: Letters, numerals, and symbols shall be vertically aligned to a tolerance of 1/16 inch [1.5 mm]. The following tests shall be performed on each letter in each line: Place a metal straight edge along the bottom edge of a series of letters forming each line of the sign. Place a square along the straight edge and test the trueness of the vertical faces of individual letters. Letters shall be normal to the square within 1/16 inch [1.5 mm].

SIGN POSTS: Posts shall be "high visibility yellow traffic posts". Outside diameter shall be 2.375 inches [60 mm]; wall thickness shall be .065 inch [1.6 mm]; weight shall be 1.064 pounds per foot [1.58 kg/m]; length shall be 11 or 12 feet [3.4 m - 3.6 m] with 12 holes, 3/8 inch [9 mm] in diameter, drilled to specifications as indicated in the standard details. The post shall be welded steel tubing conforming to ASTM specification A-513 made from hot-dipped galvanized sheet metal conforming to ASTM specification A-525 or the tube may be hot-dipped galvanized sheet metal which is a G-90 commercial weight. The color shall be "High Visibility Traffic Yellow". Yellow coating shall be applied over the galvanized post to a minimum dry thickness average of 2.5 mils.

(A) Flange: When sign post installation is required over building basements, bridges and cavities, a cast iron pipe flange shall be used. The base shall be 8 inches [203 mm] in diameter with six 5/16 inch [7.5 mm] holes drilled equidistant around the circumference, 5/8 inch [15 mm] from the outer edge. The neck of the flange shall be 3 inches [76 mm] in diameter, drilled and threaded to receive a 2 inch [50 mm] diameter galvanized post.

(B) Hardware: All bolts shall be stainless-steel, theft resistant, 5/16 inch x 3 inches [7.9 mm x 76 mm]. Stainless steel banding material, brackets and clips will be used for signs installed on light standards or mast arms.

(C) Construction: Poles shall be anchored in a minimum of one cubic foot [0.03 cubic meters] of class "C" concrete, 18 inches [457 mm] deep, with a 6 inch [152 mm] long, 3/8 inch [9 mm] diameter pin inserted through the pre-drilled hole 3 inches [76 mm] from the bottom of the pole. Where the pole installation requires surface mounting, an 8 inch [203 mm] flange with a 2 inch [50 mm] threaded collar shall be used. The pole shall be galvanized, two inches [50 mm] in diameter and threaded to fit the flange. Sign placement and orientation shall be as specified in the construction plans.

ANTI-VANDALISM AND MAKER'S MARK DECALS: The anti-vandalism decal shall be installed on the back bottom left corner of the sign. Decals will be supplied by the Traffic Operations Section (207-7765). Each sign shall be permanently marked on the lower right corner of the back side with the month and year of installation, and name of manufacturer.

WARRANTY: The Contractor shall warrant the materials and workmanship of each sign in accordance with the maximum limits of material warranties extended by manufacturers of raw materials, subject to the conditions they specify. Type II and III sheetings processed and applied to sign blank materials in accordance with sheeting manufacturer's recommendations, shall perform effectively for the number of years stated in Table I of this specification. The retroreflective sheeting will be considered unsatisfactory if it has deteriorated due to natural causes to the extent that:

(1) the sign is ineffective for its intended purpose when viewed from a moving vehicle under normal day and night driving conditions; or

(2) The coefficient of retro reflection is less than the minimum specified for that sheeting during that period listed in Table I. When sign failure occurs prior to the minimum years indicated and an inspection demonstrates that the failure is caused by materials warranted to contractor to endure at least that long, the sign will be replaced or repaired free of materials charges. When failure occurs and inspection demonstrates that such failure is due to poor workmanship, the sign will be replaced or repaired at Contractor's expense, including shipping charges.

TABLE I
Minimum Coefficient of Retroreflection
Candelas per Foot -Candle per sq. Ft.
(.2° observation angle and -4° entrance angle)

Type II and III Sheetings

Life Span	7 years	10 years
Sheeting Color:		
White	212	200
Yellow	144	136
Green	38	36
Red	38	36
Blue	17	16
Brown	10	9

For screen printed transparent colored areas on white sheeting, the coefficients of retroreflection shall not be less than 70% of the values for the corresponding color in the above table.

CONSTRUCTION METHODS:
If a signalized intersection has either mast arms or span wire on which overhead street name signs and be attached, no ground mounted streets name signs are required at that intersection. Street name signs shall always be supplied and installed at each project intersection whether signs previously existed at the location or not. Overhead street name signs shall be 12 inches [305 mm] high with 6 inch [152 mm] letters and shall be installed on all approaches. Signs shall be bolted or strapped to the mast arm or span wire. Attachments to mast arms shall be by means of a 5/8 inch [15 mm] stainless steel strap and a stainless steel flared strap bracket. At unsignalized intersections, ground-mounted street name signs of 9 inch [229 mm] heights are required. However, if all of the intersecting streets at a given unsignalized intersection, have speed limits less than 35 mph [56 kph], all street name signs at that intersection shall be 6 inches [152 mm] high. Construction shall be high quality with no visible defects in the finished product. Fabrication shall be in accordance with these specifications.

EXISTING SIGNS The removal of existing signs shall be coordinated with the Traffic Division to assure required signage is in place during all construction phases. When existing signs are to

be removed, they will be unbolted from their post by hand and delivered to the Traffic Operations Section (207-7765).

MEASUREMENT AND PAYMENT:
Measurement shall be based on the number of satisfactorily installed signs. The accepted quantities shall be paid at the contract unit price for the sign type applicable in the bid list which shall be full compensation, furnishing of all materials, labor, tools, equipment, and supplies to construct signs of varying sizes and legends as shown on the plans or as specified by the Traffic Design Engineer.

BID ITEMS:
Item 531.01: 12 inch [305 mm] Metro Street Name

Item 531.02: 18 inch [457 mm] Metro Street Name

Item 531.03: R1-1 STOP

Item 531.04: R1-2 YIELD

Item 531.05: R1-4 ALL WAY plate

Item 531.06: R2-1 Speed Limit

Item 531.07: R3-1 No Right Turn

Item 531.08: R3-2 No Left Turn

Item 531.09: R3-3 NO TURNS

Item 531.10: R3-4 No U-Turns

Item 531.11: R3-5 Left or Right Only

Item 531.12: R3-6 Lane-Use Control

Item 531.13: R3-7 LEFT LANE MUST TURN LEFT or RIGHT LANE MUST TURN RIGHT

Item 531.14: R3-8 Lane-Use Control

Item 531.15: R3-8 U-Turn Only

Item 531.16: R3-9 Two Way Left Turn Only

Item 531.17: R4-7 Keep Right

Item 531.18: R5-1 DO NOT ENTER

Item 531.19: R6-1 ONE WAY

Item 531.20: R6-2 ONE WAY

Item 531.21: R7-1 NO PARKING ANYTIME

Item 531.22: R7-18 NO PARKING THIS SIDE THIS BLOCK

Item 531.23: R7-32 LOADING ZONE

Item 531.24: R9-3a Pedestrian Crossing Prohibited

Item 531.25: R10-11 NO TURN ON RED 7-9 AM AND 2-4 PM, SCHOOL DAYS ONLY

Item 531.26: R10-11a NO TURN ON RIGHT

Item 531.27: R10-12 LEFT TURN YIELD ON "Green Ball"

Item 531.28: R10-5 LEFT ON ARROW ONLY

Item 531.29: R10-6 STOP HERE ON RED

Item 531.30: R10-7 DO NOT BLOCK INTERSECTION

Item 531.31: S-25 NO PARKING 7-9 AM AND 2-4 PM SCHOOL DAYS ONLY

Item 531.32: S-26 NO PARKING 7-9 AM AND 2-4 PM STUDENT LOADING, SCHOOL DAYS ONLY

Item 531.33: S-27 NO PARKING 7-9 AM AND 2-4 PM SCHOOL BUS ZONE

Item 531.34: S1-1 Advance School Crossing

Item 531.35: S2-1 School Crossing
Item 531.36: S4-1 School Speed Limit

Item 531.37: W1-1 Turn

Item 531.38: W1-2 Curve

Item 531.39: W1-3 Reverse Turn

Item 531.40: W1-4 Reverse Curve

Item 531.41: W1-5 Winding Road

Item 531.42: W1-6 Large Arrow

Item 531.43: W1-7 Large Arrow

Item 531.44: No sign Assigned to this Item

Item 531.45: W1-8 Chevron Alignment

Item 531.46: W3-3 Signal Ahead

Item 531.47: W4-2 Lane Reduction Transition

Item 531.48: W8-1 BUMP

Item 531.50: W8-2 DIP

Item 531.51: W9-2 Merge

Item 531.52: W10-1 Railroad Advance Warning

Item 531.53: W11a2 Ped Crossing

Item 531.54: W13-1 Advisory Speed

Item 531.55: W14-1 DEAD END

Item 531.56: W14-2 NO OUTLET

Item 531.57: OM-3 Type 3 Object Marker

Item 531.58: OM-4 End of Road Marker

Item 531.59: 9 inch [229 mm] Street Name

Item 531.60: 6 inch [152 mm] Street Name

Item 531.61: Special Sign

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ITEM 540

TEMPORARY EROSION, SEDIMENTATION AND WATER POLLUTION PREVENTION AND CONTROL

This item shall govern the control measures necessary to prevent and control soil erosion, sedimentation and water pollution which may degrade receiving waters including rivers, streams, lakes, reservoirs, tidal water, groundwater and wetlands.

GENERAL: The control measures contained herein shall be installed and maintained throughout the construction contract and coordinated with the permanent or existing temporary pollution control features specified elsewhere on the plans and in the specifications to assure effective and continuous water pollution control throughout the construction and post construction period. These control measures shall not be used as a substitute for the permanent pollution control measures unless otherwise directed by the Engineer in writing. The controls may include sediment control fences, inlet protection, baled hay, rock filter dams, dikes, swales, sediment traps and basins, pipe slope drains, paved flumes, construction exits, temporary seeding, sodding, mulching, soil retention blankets or other structural or non-structural water pollution controls. This item does not apply to commercial operations.

ITEMS OF WORK AND MATERIAL: The items, estimated quantities and locations of the control measures are shown on the plans; however, the Engineer may increase or decrease the quantity of these items as the need arises. The materials will be shown on the plans and in the specifications. The Engineer may allow other materials and work as the need arises and as approved in writing. Pollution control measures may be applicable to contractor operations outside the right of way where such work is necessary as a result of roadway related construction such as construction and haul roads, field offices, equipment and supply areas, and materials sources.

PRECONSTRUCTION SUBMITTALS:

Operations on Right of Way: Prior to the start of construction, the Contractor shall submit to the Engineer, for approval, schedules for accomplishment of the pollution control measures in accordance with the Storm Water Pollution Prevention Plan (SW3P). A plan for the disposal of waste materials generated on the project site must be submitted for approval, also. The Contractor shall submit to the Engineer, for approval, the proposed SW3P for the industrial activities (such as hot mix plants, concrete batch plants, or material handling areas) on the right of way.

Operations off Right of Way: The Contractor shall provide the Engineer, for information purposes only, proposed methods of pollution control for Contractor operations in areas which are outside the right of way (such as construction and haul roads, field offices, equipment and supply areas, and material sources).

Pollution control measures for the Contractor's facilities off the right of way are not covered by the City's Environmental Protection Agency (EPA) NPDES general permit. The Contractor shall obtain his own Notice of Intent for the off-site operations. These pollution controls will not be measured for payment but shall be performed at the Contractor's expense.

CONSTRUCTION REQUIREMENTS: The contractor shall provide control measures to prevent or minimize the impact to receiving waters as required by the plans and/or as directed by the Engineer in writing. Storm water

discharges associated with industrial activities (such as hot mix plants, concrete batch plants or material handling areas) within the right of way must comply with the terms of the EPA'S NPDES general permit. Inactive construction areas are defined as areas in which no construction activity will occur for a period of 30 days or longer. Inactive construction areas which have been disturbed will require stabilization through the use of vegetation, mulch, erosion control matting or structural methods within 7 calendar days from the last construction activity in the area. At all times prior to stabilization, inactive construction areas shall be considered as active, disturbed construction area, contributing to the sediment loading at the site control systems. After stabilization, inactive construction areas will be considered undisturbed areas, eliminating the contribution of sediment to the erosion control devices. The Contractor shall effectively prevent and control erosion and sedimentation on the site at the earliest practicable time as outlined in the approved schedule. Control measures, where applicable, will be implemented prior to the commencement of each construction operation or immediately after the area has been disturbed. The Contractor shall limit the amount of disturbed earth to the area(s) shown on the plans or as directed by the Engineer. The Engineer has the authority to limit the disturbed surface area exposed by construction operations. If, in the opinion of the Engineer, the Contractor is not able to effectively control soil erosion and sedimentation resulting from construction operations, the engineer will limit the amount of disturbed area to that which the Contractor is able to control. Should the control measures fail to function effectively, the Contractor shall act immediately to bring the erosion and sedimentation under control by maintaining existing controls or by providing additional controls as directed by the Engineer. When in the opinion of the Engineer, the site is adequately stabilized, the control measures, excepting mulches and soil retention blankets, will be removed and properly disposed of by the Contractor. Soil retention blankets shall be removed only when, in the opinion of the Engineer, final permanent perennial seeding would be adversely affected by the presence of an existing solid retention blanket. All erosion, sediment and water pollution controls will be maintained in good working order. A rain gauge shall be provided by the Contractor and located at the project site. Within 24 hours of a rainfall event of 0.5 inch [13 mm] or more as measured by the project rain gauge, the Contractor and Inspector will inspect the entire project to determine the condition of the control measures. Sediment will be removed and devices repaired as soon as practicable but no later than 7 days after the surrounding exposed ground has dried sufficiently to prevent further damage from equipment needed for repair of control measures. In the event of continuous rainfall over a 24-hour period, or other circumstances that preclude equipment operation in the area, the Contractor will hand carry and install additional backup devices as determined by the Engineer. The Contractor will remove silt accumulations and deposit the spoils in an area approved by the Engineer as soon as practical. Any corrective action needed for the control measures will be accomplished in the sequence directed by the Engineer; however, areas adjacent to waterbodies shall generally have priority followed by devices protecting storm sewer inlets.

CONTRACTOR RESPONSIBILITIES: The contractor shall also conform to the following practices and controls. All labor, tools, equipment and incidentals to complete the following work will not be paid for directly, but shall be considered as subsidiary work to the various items included in the contract, unless otherwise noted.

1. Disposal areas, stockpiles and haul roads shall be constructed in a manner that will minimize and control the amount of sediment that may enter receiving waters. Disposal areas shall not be located in any wetland, waterbody or streambed. Construction roads may not be located in or across any waterbody or streambed without prior approval of the

Engineer and shall be done in compliance with applicable rules and regulations.

2. Construction operations in rivers, streams, lakes, tidal water wetlands and other waterbodies shall be restricted to those areas where it is necessary to perform the work shown on the plans. Wherever streams are crossed, temporary bridges, timber mats or other structures shall be used.

3. Protected storage for paints, chemicals, solvents, fertilizers and other potentially toxic materials will be provided by the Contractor at a location approved by the Engineer.

4. Construction staging areas and vehicle maintenance areas shall be constructed by the Contractor in a manner to minimize the runoff of pollutants. Those areas located on the right of way must be approved by the Engineer. The Contractor shall prevent pollution of receiving waters with petroleum products or other hazardous or regulated substances. When work areas or material sources are located adjacent to a waterbody, control measures shall be used to keep sediment and other contaminants from entering the adjacent waterbody. Control devices located on the right of way will be measured for payment. Care shall be taken during the construction and removal of control measures to minimize down-gradient sedimentation.

5. All waterways shall be cleared as soon as practicable of temporary embankment, temporary bridges, matting, false work, piling, debris or other obstructions placed during construction operations that are not a part of the finished work.

6. Disturbance of vegetation shall be minimized and limited to only what is shown on the construction plans or as directed by the Engineer in writing.

7. The Contractor shall clean paved surfaces as necessary to remove sediment which has accumulated on the roadway.

PROJECT ACCEPTANCE: The project will not be accepted until the Contractor provides a uniform perennial vegetative cover with a density of 70% of adjacent undisturbed areas, or, if in the opinion of the Engineer, permanent measures (such as rip-rap, gabions, or geotextiles), supplemented by temporary measures (such as mulching with seed, hay bales, sediment control fences, earth dams, etc.) have been employed that will control erosion, sedimentation and water pollution until sufficient vegetative cover can be established.

MEASUREMENT: If the Contractor is required to install temporary erosion, sediment and water pollution control measures due to his negligence, carelessness, lack of maintenance, or failure to install permanent controls as a part of the work as scheduled, and measures are ordered in writing by the Engineer, such work shall not be measured for payment, but shall be performed at the Contractor's expense. When the need for control measures can not be attributed to the contractor's negligence, carelessness, lack of maintenance or failure to install permanent water pollution control measures and these measures are shown on the plans and/or directed by the Engineer, these measures shall be measured and paid for in accordance with applicable contract bid items. In case of failure on the part of the Contractor to prevent and control soil erosion, sedimentation and water pollution which may degrade receiving water, the Engineer reserves the right to employ outside assistance or to use City forces to provide the necessary corrective measures. All costs including engineering costs will be deducted from any moneys due or to become due to the Contractor.

PAYMENT: All labor, tools, equipment and incidentals to complete the work specified under "Contractor Responsibilities" will not be paid for directly, but will be considered subsidiary to the various bid items, unless otherwise noted. Pollution control measures outside the right of way will not be measured for payment but shall be performed at the Contractor's expense. Control measures as shown on the plans will be paid for in accordance with applicable contract bid items.

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ITEM 542
TEMPORARY SEDIMENT CONTROL FENCE (SILT FENCE)

This item shall govern for the materials to be furnished and for the installation, maintenance and removal of temporary sediment control fence of the dimensions shown on the plans. This item will be used temporarily during construction to control erosion and sedimentation.

MATERIALS:

1. Fence Description. The fence shall be a netreinforced fence, using woven geotextile fabric.

2. Fabric. Fabric may be manufactured from polyester, polypropylene or polyamide and shall be resistant to ultraviolet degradation, mildew and rot and shall be suitable for use in a wet soil and stagnant water environment. The edge of woven fabric shall be sealed or selveged to prevent raveling. Fabric shall be at least 36 inches [1 m] wide with 6 to 8 inches [152 mm – 203 mm] inches of the width buried in a trench to prevent undercutting, unless specified otherwise on the plans. The fabric shall exhibit the following physical properties when sampled and tested using the specified methods shown in Table 1.

3. Posts. Posts shall be a minimum of 48 inches [1.2 m] long, essentially straight, and shall be wood or steel, unless otherwise shown on the plans. Soft wood posts shall be at least 3 inches [76 mm] in diameter or nominal 2x4 inches [50 mm x100 mm]. Hardwood posts shall have a minimum cross section of 1.5 x 1.5 inches [38 mm x 38 mm]. Steel posts shall be "T" or "L" shaped with a minimum weight of 1.3 pounds per linear foot [6.3 kg per meter].

4. Net Reinforcement. Net reinforcement shall be galvanized welded wire mesh of a minimum 12.5 gauge wire or equal as approved by the Engineer with a maximum opening size of 2 inches [50 mm] by 4 inches [102 mm] and shall be at least 24 inches [610 mm] wide unless otherwise shown on the plans.

5. Staples. Staples used to secure reinforcement and fabric to wood posts shall have a crown at least 3/4 inch [19 mm] wide and legs 1/2 inch [13 mm] long.

6. Used Materials. Previously-used materials, meeting the above requirements and when approved by the Engineer, may be used.

CONSTRUCTION METHODS. The temporary sediment control fence shall be used during construction near the downstream perimeter of a disturbed area to intercept sediment from sheet flow. The fence may be incorporated into the erosion control measures used to control sediment in areas of higher flow. The fence installation methods shall be as specified below, unless otherwise shown on the plans. The physical alignment and location of the fence shall be as shown on the plans or as directed by the Engineer.

1. Installation of Post. Posts shall be embedded 18 inches [457 mm] deep, or adequately anchored if in rock, with a spacing of 6 to 8 feet [2 m -2.4 m], and installed on a slight angle toward the anticipated run-off source.

2. Fabric Anchoring. Trenches shall be dug along the uphill side of the fence to anchor 6 to 8 inches [152 mm - 203 mm] of fabric. The trench shall have a minimum cross section of 6 x 6 inches [150 mm x 150 mm]. The fabric shall be installed in the trench such that 4 to 6 inches [102 mm - 152 mm] of fabric is against the side of the trench and approximately 2 inches [50 mm] of fabric is across the bottom in the upstream direction. The trench shall then be

backfilled and hand tamped as approved by the Engineer.

3. Fabric Attachment The reinforcement shall be attached to the end posts, if wood, by staples, or if steel, by T-clips or sewn vertical pickets at a minimum of 4 locations. The reinforcement shall be attached to each succeeding post as approved by the Engineer. The ends of successive reinforcement sheets or rolls shall be connected at a fence post at least 6 times with hog rings. The fabric shall be fastened to the top strand of reinforcement by hog rings or cord at a maximum spacing of 15 inches [381 mm].

4. Fabric Splices. Splices shall occur at a fence post and shall have a minimum lap of 6 inches (152 mm) attached in at least six places. Splices in concentrated flow areas will not be permitted.

MAINTENANCE: The temporary sediment control fence shall be maintained in good condition (including staking, anchoring, tension adjustments, etc.) by the Contractor. All necessary work and materials to maintain the integrity of the fence, including keeping fabric free of accumulated silt, debris, etc., shall be provided until earthwork construction and permanent erosion control features are in place and/or the disturbed area has been adequately stabilized as per Item 540 "Temporary Erosion, Sedimentation and Water Pollution Prevention and Control". The areas damaged by the removal process shall be stabilized by the Contractor using appropriate methods as approved by the Engineer. Torn or punctured fabric shall be repaired by the placement of a patch consisting of an additional layer of fabric over the damaged area. The patch shall have a minimum overlap of 18 inches [457 mm] in all directions and be securely attached to the repaired fabric.

When the accumulated sediment deposit reaches a depth of approximately 6 inches [152 mm], it shall be removed and disposed of at approved sites in a manner that will not contribute to additional siltation. If the structure ceases to function as intended, the engineer may direct that the fence or portions thereof be replaced. Such replacement will not be measured for payment.

MEASUREMENT: Measurement shall be made by the linear foot [meter], as measured on the centerline of the fence installed, complete, in place and ready for use including all components necessary for a completed and working installation.

PAYMENT:
The work performed and materials furnished as prescribed by this Item will be paid for at the unit price bid per linear foot [meter] for "Temporary Sediment Control Fence", which price shall be full compensation for furnishing, placing, removing and maintenance of the fence; for all required trenching, fence posts, fabric, backfill and removal of accumulated sediment deposits, as described under "Maintenance" and for all labor, tools, equipment and incidentals necessary to complete the work.

BID ITEM:
Item 542: Temporary Sediment Control Fence (Silt Fence) - per linear foot [meter].

Table 1

Physical Property	Test Method	Min. Req.
(1) TensileStrength, 1b	ASTM D 4632	90 MIN
(2) Elongation @ Yield, %	ASTM D 4632	100 MIN
(3) Trapezoidal Tear, 1b	ASTM D 4533	35 MIN
(4) Apparent Opening Size	ASTM D 4751	50-80
(5) Permittivity, 1/sec	ASTM D 4491	1.0 MIN
(6) Ultraviolet Stability original tensile strength retained after 500 hrs. exposure, %	ASTM D 4355	80 MIN

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ITEM 545

BALED HAY FOR EROSION AND SEDIMENTATION CONTROL

This item shall govern for the installation, maintenance, and removal of baled hay utilized temporarily during construction to control erosion and sedimentation.

MATERIALS: The hay baled shall weigh a minimum of 50 pounds [23 kg], be composed entirely of vegetable matter, and measure at least 30 inches [762 mm] in length. They shall be bound by wire, nylon or polypropylene string.

CONSTRUCTION METHODS: The hay bales shall be installed in accordance with the details and at the locations shown on the plans by embedding in the soil a minimum of 4 inches [102 mm], and where possible, approximately one half the height of the bale, or as directed by the Inspector. Gaps between bales shall be filled with hay.

MAINTENANCE: The baled hay installation shall be maintained in good condition by the Contractor. All necessary work and materials to maintain the integrity of the installation shall be provided until permanent erosion-control features are in place and/or the disturbed area has been adequately stabilized, as per Item 540 "Temporary Erosion, Sedimentation and Water Pollution Prevention and Control". The area beneath the baled hay and area damaged by the removal process shall then be stabilized by the Contractor using appropriate methods as approved by the Inspector. When the accumulated sediment reaches a depth of approximately 6 inches [152 mm], it shall be removed and deposited at approved sites in a manner that will not contribute to additional siltation. If the installation ceases to function as intended due to washouts, etc., the Inspector may direct that the installation or portions thereof be replaced. Such replacement will not be measured for payment.

MEASUREMENT: This item will be measured by the linear foot [meter] of bale, complete in place and ready for use including all components necessary for a complete and working installation.

PAYMENT: The work performed and materials furnished as prescribed by this item will be paid for at the unit price bid for "Baled Hay for Erosion and Sedimentation Control", which price shall be full compensation for furnishing, placing, removing, maintenance of the bales, removing and replacing when necessary; for all required trenching, backfill and removal of accumulated sediment deposits as described under "Maintenance" and for all labor, tools, equipment and incidentals necessary to complete the work. Payment shall also include site stabilization after removal of the hay bales.

BID ITEM:

Item 545: Baled Hay for Erosion and Sedimentation Control - per linear foot [meter].

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