STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH, N.C.

C204203

CONTRACT AND
CONTRACT BONDS

FOR CONTRACT NO. C204203

WBS 15BPR.14 STATE FUNDED

COUNTY OF NEW HANOVER
THIS IS THE ROADWAY & STRUCTURE CONTRACT
ROUTE NUMBER US 74 LENGTH 0.437 MILES
LOCATION BRIDGE NO. 640011 ON US-74 OVER NORTH EAST CAPE FEAR RIVER.

CONTRACTOR PCL CIVIL CONSTRUCTORS INC
ADDRESS 5440 WADE PARK BLVD SUITE 102
RALEIGH, NC 27607

BIDS OPENED FEBRUARY 19, 2019
CONTRACT EXECUTION 3/12/2019

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH, N.C.

PROPOSAL

INCLUDES ADDENDUM No.1 DATED 02-14-2019

DATE AND TIME OF BID OPENING: **FEBRUARY 19, 2019 AT 2:00 PM**

CONTRACT ID	C204203
WBS	15BPR.14

FEDERAL-AID NO.	STATE FUNDED
COUNTY	NEW HANOVER
T.I.P. NO.	
MILES	0.437
ROUTE NO.	US 74
LOCATION	BRIDGE NO. 640011 ON US-74 OVER NORTH EAST CAPE FEAR RIVER.

TYPE OF WORK BRIDGE PRESERVATION.

NOTICE:

ALL BIDDERS SHALL COMPLY WITH ALL APPLICABLE LAWS REGULATING THE PRACTICE OF GENERAL CONTRACTING AS CONTAINED IN CHAPTER 87 OF THE GENERAL STATUTES OF NORTH CAROLINA WHICH REQUIRES THE BIDDER TO BE LICENSED BY THE N.C. LICENSING BOARD FOR CONTRACTORS WHEN BIDDING ON ANY NON-FEDERAL AID PROJECT WHERE THE BID IS $30,000 OR MORE, EXCEPT FOR CERTAIN SPECIALTY WORK AS DETERMINED BY THE LICENSING BOARD. BIDDERS SHALL ALSO COMPLY WITH ALL OTHER APPLICABLE LAWS REGULATING THE PRACTICES OF ELECTRICAL, PLUMBING, HEATING AND AIR CONDITIONING AND REFRIGERATION CONTRACTING AS CONTAINED IN CHAPTER 87 OF THE GENERAL STATUTES OF NORTH CAROLINA. NOTWITHSTANDING THESE LIMITATIONS ON BIDDING, THE BIDDER WHO IS AWARDED ANY FEDERAL - AID FUNDED PROJECT SHALL COMPLY WITH CHAPTER 87 OF THE GENERAL STATUTES OF NORTH CAROLINA FOR LICENSING REQUIREMENTS WITHIN 60 CALENDAR DAYS OF BID OPENING.

BIDS WILL BE RECEIVED AS SHOWN BELOW:

THIS IS A ROADWAY & STRUCTURE PROPOSAL

5% BID BOND OR BID DEPOSIT REQUIRED

_____

PROPOSAL FOR THE CONSTRUCTION OF

CONTRACT No. C204203 IN NEW HANOVER COUNTY, NORTH CAROLINA

Date_____ 20_____

DEPARTMENT OF TRANSPORTATION,

RALEIGH, NORTH CAROLINA

The Bidder has carefully examined the location of the proposed work to be known as Contract No. **C204203** has carefully examined the plans and specifications, which are acknowledged to be part of the proposal, the special provisions, the proposal, the form of contract, and the forms of contract payment bond and contract performance bond; and thoroughly understands the stipulations, requirements and provisions. The undersigned bidder agrees to bound upon his execution of the bid and subsequent award to him by the Board of Transportation in accordance with this proposal to provide the necessary contract payment bond and contract performance bond within fourteen days after the written notice of award is received by him. The undersigned Bidder further agrees to provide all necessary machinery, tools, labor, and other means of construction; and to do all the work and to furnish all materials, except as otherwise noted, necessary to perform and complete the said contract in accordance with *the 2018 Standard Specifications for Roads and Structures* by the dates(s) specified in the Project Special Provisions and in accordance with the requirements of the Engineer, and at the unit or lump sum prices, as the case may be, for the various items given on the sheets contained herein.

The Bidder shall provide and furnish all the materials, machinery, implements, appliances and tools, and perform the work and required labor to construct and complete State Highway Contract No. **C204203** in **New Hanover County**, for the unit or lump sum prices, as the case may be, bid by the Bidder in his bid and according to the proposal, plans, and specifications prepared by said Department, which proposal, plans, and specifications show the details covering this project, and hereby become a part of this contract.

The published volume entitled *North Carolina Department of Transportation, Raleigh, Standard Specifications for Roads and Structures, January 2018* with all amendments and supplements thereto, is by reference incorporated into and made a part of this contract; that, except as herein modified, all the construction and work included in this contract is to be done in accordance with the specifications contained in said volume, and amendments and supplements thereto, under the direction of the Engineer.

If the proposal is accepted and the award is made, the contract is valid only when signed either by the Contract Officer or such other person as may be designated by the Secretary to sign for the Department of Transportation. The conditions and provisions herein cannot be changed except over the signature of the said Contract Officer.

The quantities shown in the itemized proposal for the project are considered to be approximate only and are given as the basis for comparison of bids. The Department of Transportation may increase or decrease the quantity of any item or portion of the work as may be deemed necessary or expedient.

An increase or decrease in the quantity of an item will not be regarded as sufficient ground for an increase or decrease in the unit prices, nor in the time allowed for the completion of the work, except as provided for the contract.

Accompanying this bid is a bid bond secured by a corporate surety, or certified check payable to the order of the Department of Transportation, for five percent of the total bid price, which deposit is to be forfeited as liquidated damages in case this bid is accepted and the Bidder shall fail to provide the required payment and performance bonds with the Department of Transportation, under the condition of this proposal, within 14 calendar days after the written notice of award is received by him, as provided in the *Standard Specifications*; otherwise said deposit will be returned to the Bidder.

NORTH CAROLINA PROFESSIONAL SEAL 022071 ENGINEER RONALD ELTON DAVENPORT, JR.

State Contract Officer

DocuSigned by:

Ronald E. Davenport, Jr.

F81B6038A47A442... 2/14/2019

TABLE OF CONTENTS

COVER SHEET
PROPOSAL SHEET

PROJECT SPECIAL PROVISIONS

CONTRACT TIME AND LIQUIDATED DAMAGES: G-1
INTERMEDIATE CONTRACT TIME NUMBER 1 AND LIQUIDATED DAMAGES: G-1
INTERMEDIATE CONTRACT TIME NUMBER 2 AND LIQUIDATED DAMAGES: G-3
INTERMEDIATE CONTRACT TIME NUMBER 3 AND LIQUIDATED DAMAGES: G-3
MANDATORY PRE-BID CONFERENCE (Prequalifying To Bid): G-3
NO MAJOR CONTRACT ITEMS: G-4
SPECIALTY ITEMS: G-4
SCHEDULE OF ESTIMATED COMPLETION PROGRESS: G-5
MINORITY BUSINESS ENTERPRISE AND WOMEN BUSINESS ENTERPRISE: G-5
CONTRACTOR'S LICENSE REQUIREMENTS: G-20
REMOVABLE PAVEMENT MARKINGS - (Partial Payments for Materials): G-20
ELECTRONIC BIDDING: G-21
TWELVE MONTH GUARANTEE: G-21
OUTSOURCING OUTSIDE THE USA: G-22
NOTES TO CONTRACTOR: G-22

ROADWAY R-1

STANDARD SPECIAL PROVISIONS

AVAILABILITY FUNDS – TERMINATION OF CONTRACTS SSP-1
NCDOT GENERAL SEED SPECIFICATION FOR SEED QUALITY SSP-2
ERRATA SSP-5
PLANT AND PEST QUARANTINES SSP-6
MINIMUM WAGES SSP-7
TITLE VI AND NONDISCRIMINATION SSP-8
ON-THE-JOB TRAINING SSP-16

UNIT PROJECT SPECIAL PROVISIONS

EROSION CONTROL EC-1
STRUCTURE / CULVERTS BP-1

PROPOSAL ITEM SHEET

ITEM SHEET(S) (TAN SHEETS)

PROJECT SPECIAL PROVISIONS

GENERAL

CONTRACT TIME AND LIQUIDATED DAMAGES:

(7-1-95) (Rev. 12-18-07) 108 SP1 G10 A

The date of availability for this contract is **April 1, 2019**.

The completion date for this contract is **November 1, 2020**.

Except where otherwise provided by the contract, observation periods required by the contract will not be a part of the work to be completed by the completion date and/or intermediate contract times stated in the contract. The acceptable completion of the observation periods that extend beyond the final completion date shall be a part of the work covered by the performance and payment bonds.

The liquidated damages for this contract are **Two Thousand Dollars ($ 2,000.00)** per calendar day.

INTERMEDIATE CONTRACT TIME NUMBER 1 AND LIQUIDATED DAMAGES:

(2-20-07) 108 SP1 G14 B

The Contractor shall not narrow or close a lane of traffic on **US-74 & Any Associated Ramps, North 3rd Street, and Martin Luther King Jr. Parkway**, detain and /or alter the traffic flow on or during holiday weekends, special events, or any other time when traffic is unusually heavy, including the following schedules:

HOLIDAY AND HOLIDAY WEEKEND LANE CLOSURE RESTRICTIONS

1. For **unexpected occurrence** that creates unusually high traffic volumes, as directed by the Engineer.

2. For **New Year's Day**, between the hours of **5:00 A.M.** December 31st and **7:00 P.M.** January 2nd. If New Year's Day is on a Friday, Saturday, Sunday or Monday, then until **7:00 P.M.** the following Tuesday.

3. For the **Martin Luther King Jr. Parade**, between the hours of **5:00 A.M.** the **Sunday** before the **Martin Luther King Jr. Parade** and **7:00 P.M.** the following **Tuesday** after the **Martin Luther King Jr. Parade**.

4. For **Easter**, between the hours of **5:00 A.M.** Thursday and **7:00 P.M.** Monday.

5. For **Memorial Day**, between the hours of **5:00 A.M.** Friday and **7:00 P.M** Tuesday.

6. For **Independence Day**, between the hours of **5:00 A.M.** the day before Independence Day and **7:00 P.M.** the day after Independence Day.

If **Independence Day** is on a Friday, Saturday, Sunday or Monday, then between the hours of **5:00 A.M.** the Thursday before Independence Day and **7:00 P.M.** the Tuesday after Independence Day.

7. For the **YMCA Tri-Span Race**, between the hours of **5:00 A.M.** the **Friday** after **Independence Day** and **7:00 P.M.** the following **Sunday** after the **YMCA Tri-Span Race**.

8. For **Labor Day**, between the hours of **5:00 A.M.** Friday and **7:00 P.M.** Tuesday.

9. For the **Ironman Triathlon**, between the hours of **5:00 A.M.** the **Friday** before the **Ironman Triathlon** and **7:00 P.M.** the following **Sunday** after the **Ironman Triathlon**.

10. For the **Battleship Half-Marathon**, between the hours of **5:00 A.M.** the **Saturday** before the **Battleship Half-Marathon** and **7:00 P.M.** the following **Monday** after the **Battleship Half-Marathon**.

11. For **Thanksgiving**, between the hours of **5:00 A.M.** Tuesday and **7:00 P.M.** Monday.

12. For the **City of Wilmington Holiday Parade**, between the hours of **5:00 A.M.** the **Saturday** before the **City of Wilmington Holiday Parade** and **7:00 P.M.** the following **Monday** after the **City of Wilmington Holiday Parade**.

13. For the **Wilmington Historic Half-Marathon**, between the hours of **5:00 A.M.** the **Friday** before the **Wilmington Historic Half-Marathon** and **7:00 P.M.** the following **Sunday** after the **Wilmington Historic Half-Marathon**.

14. For **Christmas**, between the hours of **5:00 A.M.** the Friday before the week of Christmas Day and **7:00 P.M.** the following Tuesday after the week of Christmas Day.

15. For the **Azalea Festival**, between the hours of **5:00 A.M.** the **Tuesday** before the weekend of the **Azalea Festival** and **7:00 P.M.** the following **Monday** after the weekend of the **Azalea Festival**.

Holidays and holiday weekends shall include New Year's, Easter, Memorial Day, Independence Day, Labor Day, Thanksgiving, and Christmas. The Contractor shall schedule his work so that lane closures are not required during these periods, unless otherwise directed by the Engineer.

The time of availability for this intermediate contract work shall be the time the Contractor begins to install all traffic control devices for lane closures according to the time restrictions listed herein.

The completion time for this intermediate contract work shall be the time the Contractor is required to complete the removal of all traffic control devices for lane closures according to the time restrictions stated herein and place traffic in the existing traffic pattern.

The liquidated damages are **Two Thousand Dollars ($ 2.000.00)** per hour.

INTERMEDIATE CONTRACT TIME NUMBER 2 AND LIQUIDATED DAMAGES:
(2-20-07) 108 SP1 G14 D

The Contractor shall complete the required work of installing, maintaining and removing the traffic control devices for road closures and restoring traffic to the existing traffic pattern. The Contractor shall not close **US-74, NC-133, Wrightsville Beach-Burgaw Exit Ramp, and Wilmington Downtown Exit Ramp** during the following time restrictions:

DAY AND TIME RESTRICTIONS

Monday thru Thursday
5:00 A.M. to 9:00 P.M.

And from Friday at 5:00 A.M. to Sunday at 9:00 P.M.

The time of availability for this intermediate contract time will be the time the Contractor begins to install traffic control devices required for road closures according to the time restrictions stated herein.

The completion time for this intermediate contract time will be the time the Contractor is required to complete the removal of traffic control devices required for the road closures according to the time restrictions stated herein and restore traffic to the existing traffic pattern.

The liquidated damages are **Five Hundred Dollars ($ 500.00)** per fifteen **(15)** minute time period.

INTERMEDIATE CONTRACT TIME NUMBER 3 AND LIQUIDATED DAMAGES:
(2-20-07) (Rev. 6-18-13) 108 SP1 G14 F

The Contractor shall complete the work require of **Operation #2, Step #1** as shown on Sheet **TMP-3** and shall place and maintain traffic on same. **The Contractor may close the Isabell Holmes Bridge on two (2) separate weekends to complete this work.**

The time of availability for **each weekend of** this intermediate contract time is the **Friday** at **9:00 P.M.** that the Contractor elects to begin the work.

The completion time for **each weekend of** this intermediate contract time is the following **Monday** at **5:00 A.M.** after the time of availability.

The liquidated damages are **One Thousand Dollars ($ 1,000.00)** per hour.

MANDATORY PRE-BID CONFERENCE (Prequalifying To Bid):
(7-18-06) (Rev. 3-25-13) SPI 1-14

In order for all prospective bidders to have an extensive knowledge of the project, all prospective bidders shall attend a mandatory pre-bid conference on Wednesday, February 6th at 1:00pm at:

NCDOT Division 3 Conference Room
5501 Barbados Blvd.
Castle Hayne, NC 28429
Contact: Kevin Bowen 910-341-2000

The bidders may also attend a voluntary site visit immediately following the pre-bid conference. A van will be provided to shuttle bidders to the site. Other specifics of the site visit will be discussed at the mandatory pre-bid conference. Closed toed shoes and a reflective safety vest will be required of all participants to visit the site.

The pre-bid conference will include a thorough discussion of the plans, contract pay items, special provisions, etc.

Only bidders who have attended and properly registered at the above scheduled pre-bid conference and who have met all other prequalification requirements will be considered prequalified to bid on this project. A bid received from a bidder who has not attended and properly registered at the above scheduled pre-bid conference will not be accepted and considered for award.

Attendance at the pre-bid conference will not meet the requirements of proper registration unless the individual attending has registered at the pre-bid conference in accordance with the following:

(A) The individual has signed his name on the official roster no later than 30 minutes after the above noted time for the beginning of the conference.

(B) The individual has written in the name and address of the company he or she represents.

(C) Only one company has been shown as being represented by the individual attending.

(D) The individual attending is an officer or permanent employee of the company they are representing.

Attendance at any prior pre-bid conference will not meet the requirement of this provision.

NO MAJOR CONTRACT ITEMS:
(2-19-02) (Rev. 8-21-07) 104 SP1 G31

None of the items included in this contract will be major items.

SPECIALTY ITEMS:
(7-1-95)(Rev. 1-17-12) 108-6 SP1 G37

Items listed below will be the specialty items for this contract (see Article 108-6 of the *2018 Standard Specifications*).

Line #	Description
14-17 and 21-22	Long-Life Pavement Markings
18	Removable Tape
23	Permanent Pavement Markers
24	Erosion Control

SCHEDULE OF ESTIMATED COMPLETION PROGRESS:

(7-15-08) (Rev. 6-19-18) 108-2 SP1 G58

The Contractor's attention is directed to the Standard Special Provision entitled *Availability of Funds Termination of Contracts* included elsewhere in this proposal. The Department of Transportation's schedule of estimated completion progress for this project as required by that Standard Special Provision is as follows:

	Fiscal Year	Progress (% of Dollar Value)
2019	(7/01/18 - 6/30/19)	**23**% of Total Amount Bid
2020	(7/01/19 - 6/30/20)	**66**% of Total Amount Bid
2021	(7/01/20 - 6/30/21)	**11**% of Total Amount Bid

The Contractor shall also furnish his own progress schedule in accordance with Article 108-2 of the *2018 Standard Specifications*. Any acceleration of the progress as shown by the Contractor's progress schedule over the progress as shown above shall be subject to the approval of the Engineer.

MINORITY BUSINESS ENTERPRISE AND WOMEN BUSINESS ENTERPRISE:

(10-16-07)(Rev. 2-19-19) 102-15(J) SP1 G66

Description

The purpose of this Special Provision is to carry out the North Carolina Department of Transportation's policy of ensuring nondiscrimination in the award and administration of contracts financed in whole or in part with State funds.

Definitions

Additional MBE/WBE Subcontractors - Any MBE/WBE submitted at the time of bid that will not be used to meet the Combined MBE /WBE Goal. No submittal of a Letter of Intent is required.

Combined MBE/WBE Goal: A portion of the total contract, expressed as a percentage that is to be performed by committed MBE/WBE subcontractors.

Committed MBE/WBE Subcontractor - Any MBE/WBE submitted at the time of bid that is being used to meet the Combined MBE /WBE goal by submission of a Letter of Intent. Or any MBE or WBE used as a replacement for a previously committed MBE or WBE firm.

Contract Goal Requirement - The approved participation at time of award, but not greater than the advertised Combined MBE/WBE contract goal.

Goal Confirmation Letter - Written documentation from the Department to the bidder confirming the Contractor's approved, committed participation along with a listing of the committed MBE and WBE firms.

Manufacturer - A firm that operates or maintains a factory or establishment that produces on the premises, the materials or supplies obtained by the Contractor.

MBE Participation (Anticipated) - A portion of the total contract, expressed as a percentage that is anticipated to be performed by committed MBE subcontractor(s).

Minority Business Enterprise (MBE) - A firm certified as a Disadvantaged Minority-Owned Business Enterprise through the North Carolina Unified Certification Program.

Regular Dealer - A firm that owns, operates, or maintains a store, warehouse, or other establishment in which the materials or supplies required for the performance of the contract are bought, kept in stock, and regularly sold to the public in the usual course of business. A regular dealer engages in, as its principal business and in its own name, the purchase and sale or lease of the products in question. A regular dealer in such bulk items as steel, cement, gravel, stone, and petroleum products need not keep such products in stock, if it owns and operates distribution equipment for the products. Brokers and packagers are not regarded as manufacturers or regular dealers within the meaning of this section.

Replacement / Substitution – A full or partial reduction in the amount of work subcontracted to a committed (or an approved substitute) MBE/WBE firm.

North Carolina Unified Certification Program (NCUCP) - A program that provides comprehensive services and information to applicants for MBE/WBE certification. The MBE/WBE program follows the same regulations as the federal Disadvantaged Business Enterprise (DBE) program in accordance with 49 CFR Part 26.

United States Department of Transportation (USDOT) - Federal agency responsible for issuing regulations (49 CFR Part 26) and official guidance for the DBE program.

WBE Participation (Anticipated) - A portion of the total contract, expressed as a percentage, that is anticipated to be performed by committed WBE subcontractor(s).

Women Business Enterprise (WBE) - A firm certified as a Disadvantaged Women-Owned Business Enterprise through the North Carolina Unified Certification Program.

Forms and Websites Referenced in this Provision

Payment Tracking System - On-line system in which the Contractor enters the payments made to MBE and WBE subcontractors who have performed work on the project. https://apps.dot.state.nc.us/Vendor/PaymentTracking/

DBE-IS *Subcontractor Payment Information* - Form for reporting the payments made to all MBE/WBE firms working on the project. This form is for paper bid projects only. https://connect.ncdot.gov/business/Turnpike/Documents/Form%20DBE-IS%20Subcontractor%20Payment%20Information.pdf

RF-1 *MBE/WBE Replacement Request Form* - Form for replacing a committed MBE or WBE. http://connect.ncdot.gov/projects/construction/Construction%20Forms/DBE%20MBE%20WBE%20Replacement%20Request%20Form.pdf

SAF *Subcontract Approval Form* - Form required for approval to sublet the contract.
http://connect.ncdot.gov/projects/construction/Construction%20Forms/Subcontract%20Approval%20Form%20Rev.%202012.zip

JC-1 *Joint Check Notification Form* - Form and procedures for joint check notification. The form acts as a written joint check agreement among the parties providing full and prompt disclosure of the expected use of joint checks.
http://connect.ncdot.gov/projects/construction/Construction%20Forms/Joint%20Check%20Notification%20Form.pdf

Letter of Intent - Form signed by the Contractor and the MBE/WBE subcontractor, manufacturer or regular dealer that affirms that a portion of said contract is going to be performed by the signed MBE/WBE for the estimated amount (based on quantities and unit prices) listed at the time of bid.
http://connect.ncdot.gov/letting/LetCentral/Letter%20of%20Intent%20to%20Perform%20as%20a%20Subcontractor.pdf

Listing of MBE and WBE Subcontractors Form - Form for entering MBE/WBE subcontractors on a project that will meet the Combined MBE/WBE goal. This form is for paper bids only.
http://connect.ncdot.gov/municipalities/Bid%20Proposals%20for%20LGA%20Content/09%20MBE-WBE%20Subcontractors%20(State).docx

Subcontractor Quote Comparison Sheet - Spreadsheet for showing all subcontractor quotes in the work areas where MBEs and WBEs quoted on the project. This sheet is submitted with good faith effort packages.
http://connect.ncdot.gov/business/SmallBusiness/Documents/DBE%20Subcontractor%20Quote%20Comparison%20Example.xls

Combined MBE/WBE Goal

The Combined MBE/WBE Goal for this project is **0.0 %**

The Combined Goal was established utilizing the following anticipated participation for Minority Business Enterprises and Women Business Enterprises:

(A) Minority Business Enterprises **0.0 %**

(1) *If the anticipated MBE participation is more than zero*, the Contractor shall exercise all necessary and reasonable steps to ensure that MBEs participate in at least the percent of the contract as set forth above.

(2) *If the anticipated MBE participation is zero*, the Contractor shall make an effort to recruit and use MBEs during the performance of the contract. Any MBE participation obtained shall be reported to the Department.

(B) Women Business Enterprises **0.0 %**

(1) *If the anticipated WBE participation is more than zero*, the Contractor shall exercise all necessary and reasonable steps to ensure that WBEs participate in at least the percent of the contract as set forth above.

(2) *If the anticipated WBE participation is zero*, the Contractor shall make an effort to recruit and use WBEs during the performance of the contract. Any WBE participation obtained shall be reported to the Department.

The Bidder is required to submit only participation to meet the Combined MBE/WBE Goal. The Combined Goal may be met by submitting all MBE participation, all WBE participation, or a combination of MBE and WBE participation.

Directory of Transportation Firms (Directory)

Real-time information is available about firms doing business with the Department and firms that are certified through NCUCP in the Directory of Transportation Firms. Only firms identified in the Directory as MBE and WBE certified shall be used to meet the Combined MBE/WBE Goal. The Directory can be found at the following link.
https://www.ebs.nc.gov/VendorDirectory/default.html

The listing of an individual firm in the directory shall not be construed as an endorsement of the firm's capability to perform certain work.

Listing of MBE/WBE Subcontractors

At the time of bid, bidders shall submit <u>all</u> MBE and WBE participation that they anticipate to use during the life of the contract. Only those identified to meet the Combined MBE/WBE Goal will be considered committed, even though the listing shall include both committed MBE/WBE subcontractors and additional MBE/WBE subcontractors. Any additional MBE/WBE subcontractor participation above the goal will follow the banking guidelines found elsewhere in this provision. All other additional MBE/WBE subcontractor participation submitted at the time of bid will be used toward the Department's overall race-neutral goals. Only those firms with current MBE and WBE certification at the time of bid opening will be acceptable for listing in the bidder's submittal of MBE and WBE participation. The Contractor shall indicate the following required information:

(A) Electronic Bids

Bidders shall submit a listing of MBE and WBE participation in the appropriate section of the electronic submittal file.

(1) Submit the names and addresses of MBE and WBE firms identified to participate in the contract. If the bidder uses the updated listing of MBE and WBE firms shown in the electronic submittal file, the bidder may use the dropdown menu to access the name and address of the firms.

(2) Submit the contract line numbers of work to be performed by each MBE and WBE firm. When no figures or firms are entered, the bidder will be considered to have no MBE or WBE participation.

(3) The bidder shall be responsible for ensuring that the MBE and WBE are certified at the time of bid by checking the Directory of Transportation Firms. If the firm is not certified at the time of the bid-letting, that MBE's or WBE's participation will not count towards achieving the Combined MBE/WBE goal.

(B) Paper Bids

(1) *If the Combined MBE/WBE Goal is more than zero,*

(a) Bidders, at the time the bid proposal is submitted, shall submit a listing of MBE/WBE participation, including the names and addresses on *Listing of MBE and WBE Subcontractors* contained elsewhere in the contract documents in order for the bid to be considered responsive. Bidders shall indicate the total dollar value of the MBE and WBE participation for the contract.

(b) If bidders have no MBE or WBE participation, they shall indicate this on the *Listing of MBE and WBE Subcontractors* by entering the word "None" or the number "0." This form shall be completed in its entirety. **Blank forms will not be deemed to represent zero participation.** Bids submitted that do not have MBE and WBE participation indicated on the appropriate form will not be read publicly during the opening of bids. The Department will not consider these bids for award and the proposal will be rejected.

(c) The bidder shall be responsible for ensuring that the MBE/WBE is certified at the time of bid by checking the Directory of Transportation Firms. If the firm is not certified at the time of the bid-letting, that MBE's or WBE's participation will not count towards achieving the Combined MBE/WBE Goal.

(2) *If the Combined MBE/WBE Goal is zero,* entries on the *Listing of MBE and WBE Subcontractors* are not required for the zero goal, however any MBE or WBE participation that is achieved during the project shall be reported in accordance with requirements contained elsewhere in the special provision.

MBE or WBE Prime Contractor

When a certified MBE or WBE firm bids on a contract that contains a Combined MBE/WBE goal, the firm is responsible for meeting the goal or making good faith efforts to meet the goal, just like any other bidder. In most cases, a MBE or WBE bidder on a contract will meet the Combined MBE/WBE Goal by virtue of the work it performs on the contract with its own forces. However, all the work that is performed by the MBE or WBE bidder and any other similarly certified

subcontractors will count toward the goal. The MBE or WBE bidder shall list itself along with any MBE or WBE subcontractors, if any, in order to receive credit toward the goal.

MBE/WBE prime contractors shall also follow Sections A and B listed under *Listing of MBE/WBE Subcontractor* just as a non-MBE/WBE bidder would.

Written Documentation – Letter of Intent

The bidder shall submit written documentation for each MBE/WBE that will be used to meet the Combined MBE/WBE Goal of the contract, indicating the bidder's commitment to use the MBE/WBE in the contract. This documentation shall be submitted on the Department's form titled *Letter of Intent*.

The documentation shall be received in the office of the State Contractor Utilization Engineer or at DBE@ncdot.gov no later than 10:00 a.m. of the sixth calendar day following opening of bids, unless the sixth day falls on an official state holiday. In that situation, it is due in the office of the State Contractor Utilization Engineer no later than 10:00 a.m. on the next official state business day.

If the bidder fails to submit the Letter of Intent from each committed MBE and WBE to be used toward the Combined MBE/WBE Goal, or if the form is incomplete (i.e. both signatures are not present), the MBE/WBE participation will not count toward meeting the Combined MBE/WBE Goal. If the lack of this participation drops the commitment below the Combined MBE/WBE Goal, the Contractor shall submit evidence of good faith efforts for the goal, completed in its entirety, to the State Contractor Utilization Engineer or DBE@ncdot.gov no later than 10:00 a.m. on the eighth calendar day following opening of bids, unless the eighth day falls on an official state holiday. In that situation, it is due in the office of the State Contractor Utilization Engineer no later than 10:00 a.m. on the next official state business day.

Banking MBE/WBE Credit

If the bid of the lowest responsive bidder exceeds $500,000 and if the committed MBE/WBE participation submitted exceeds the algebraic sum of the Combined MBE /WBE Goal by $1,000 or more, the excess will be placed on deposit by the Department for future use by the bidder. Separate accounts will be maintained for MBE and WBE participation and these may accumulate for a period not to exceed 24 months.

When the apparent lowest responsive bidder fails to submit sufficient participation by MBE and WBE firms to meet the advertised goal, as part of the good faith effort, the Department will consider allowing the bidder to withdraw funds to meet the Combined MBE/WBE Goal as long as there are adequate funds available from the bidder's MBE and WBE bank accounts.

Submission of Good Faith Effort

If the bidder fails to meet or exceed the Combined MBE/WBE Goal, the apparent lowest responsive bidder shall submit to the Department documentation of adequate good faith efforts made to reach that specific goal.

A hard copy and an electronic copy of this information shall be received in the office of the State Contractor Utilization Engineer or at DBE@ncdot.gov no later than 10:00 a.m. on the sixth calendar day following opening of bids unless the sixth day falls on an official state holiday. In that situation, it would be due in the office of the State Contractor Utilization Engineer no later than 10:00 a.m. on the next official state business day. If the contractor cannot send the information electronically, then one complete set and 5 copies of this information shall be received under the same time constraints above.

Note: Where the information submitted includes repetitious solicitation letters, it will be acceptable to submit a representative letter along with a distribution list of the firms that were solicited. Documentation of MBE/WBE quotations shall be a part of the good faith effort submittal. This documentation may include written subcontractor quotations, telephone log notations of verbal quotations, or other types of quotation documentation.

Consideration of Good Faith Effort for Projects with a Combined MBE/WBE Goal More Than Zero

Adequate good faith efforts mean that the bidder took all necessary and reasonable steps to achieve the goal which, by their scope, intensity, and appropriateness, could reasonably be expected to obtain sufficient MBE/WBE participation. Adequate good faith efforts also mean that the bidder actively and aggressively sought MBE/WBE participation. Mere *pro forma* efforts are not considered good faith efforts.

The Department will consider the quality, quantity, and intensity of the different kinds of efforts a bidder has made. Listed below are examples of the types of actions a bidder will take in making a good faith effort to meet the goals and are not intended to be exclusive or exhaustive, nor is it intended to be a mandatory checklist.

(A) Soliciting through all reasonable and available means (e.g. attendance at pre-bid meetings, advertising, written notices, use of verifiable electronic means through the use of the NCDOT Directory of Transportation Firms) the interest of all certified MBEs/WBEs that are also prequalified subcontractors. The bidder must solicit this interest within at least 10 days prior to bid opening to allow the MBEs/WBEs to respond to the solicitation. Solicitation shall provide the opportunity to MBEs/WBEs within the Division and surrounding Divisions where the project is located. The bidder must determine with certainty if the MBEs/WBEs are interested by taking appropriate steps to follow up initial solicitations.

(B) Selecting portions of the work to be performed by MBEs/WBEs in order to increase the likelihood that the Combined MBE/WBE Goal will be achieved.

(1) Where appropriate, break out contract work items into economically feasible units to facilitate MBE/WBE participation, even when the prime contractor might otherwise prefer to perform these work items with its own forces.

(2) Negotiate with subcontractors to assume part of the responsibility to meet the advertised goal when the work to be sublet includes potential for MBE/WBE participation (2nd and 3rd tier subcontractors).

(C) Providing interested certified MBEs/WBEs that are also prequalified subcontractors with adequate information about the plans, specifications, and requirements of the contract in a timely manner to assist them in responding to a solicitation.

(D) (1) Negotiating in good faith with interested MBEs/WBEs. It is the bidder's responsibility to make a portion of the work available to MBE/WBE subcontractors and suppliers and to select those portions of the work or material needs consistent with the available MBE/WBE subcontractors and suppliers, so as to facilitate MBE/WBE participation. Evidence of such negotiation includes the names, addresses, and telephone numbers of MBEs/WBEs that were considered; a description of the information provided regarding the plans and specifications for the work selected for subcontracting; and evidence as to why additional agreements could not be reached for MBEs/WBEs to perform the work.

(2) A bidder using good business judgment would consider a number of factors in negotiating with subcontractors, including MBE/WBE subcontractors, and would take a firm's price and capabilities as well as the advertised goal into consideration. However, the fact that there may be some additional costs involved in finding and using MBEs/WBEs is not in itself sufficient reason for a bidder's failure to meet the contract goal, as long as such costs are reasonable. Also, the ability or desire of a prime contractor to perform the work of a contract with its own organization does not relieve the bidder of the responsibility to make good faith efforts. Bidding contractors are not, however, required to accept higher quotes from MBEs/WBEs if the price difference is excessive or unreasonable.

(E) Not rejecting MBEs/WBEs as being unqualified without sound reasons based on a thorough investigation of their capabilities. The bidder's standing within its industry, membership in specific groups, organizations, or associates and political or social affiliations (for example, union vs. non-union employee status) are not legitimate causes for the rejection or non-solicitation of bids in the bidder's efforts to meet the project goal.

(F) Making efforts to assist interested MBEs/WBEs in obtaining bonding, lines of credit, or insurance as required by the recipient or bidder.

(G) Making efforts to assist interested MBEs/WBEs in obtaining necessary equipment, supplies, materials, or related assistance or services.

(H) Effectively using the services of available minority/women community organizations; minority/women contractors' groups; Federal, State, and local minority/women business assistance offices; and other organizations as allowed on a case-by-case basis to provide assistance in the recruitment and placement of MBEs/WBEs. Contact within 7 days from the bid opening the Business Opportunity and Work Force Development Unit at BOWD@ncdot.gov to give notification of the bidder's inability to get MBE or WBE quotes.

(I) Any other evidence that the bidder submits which shows that the bidder has made reasonable good faith efforts to meet the advertised goal.

In addition, the Department may take into account the following:

(1) Whether the bidder's documentation reflects a clear and realistic plan for achieving the Combined MBE/WBE Goal.

(2) The bidders' past performance in meeting the contract goal.

(3) The performance of other bidders in meeting the advertised goal. For example, when the apparent successful bidder fails to meet the goal, but others meet it, you may reasonably raise the question of whether, with additional reasonable efforts the apparent successful bidder could have met the goal. If the apparent successful bidder fails to meet the advertised goal, but meets or exceeds the average MBE and WBE participation obtained by other bidders, the Department may view this, in conjunction with other factors, as evidence of the apparent successful bidder having made a good faith effort.

If the Department does not award the contract to the apparent lowest responsive bidder, the Department reserves the right to award the contract to the next lowest responsive bidder that can satisfy to the Department that the Combined MBE/WBE Goal can be met or that an adequate good faith effort has been made to meet the advertised goal.

Non-Good Faith Appeal

The State Contractual Services Engineer will notify the contractor verbally and in writing of non-good faith. A contractor may appeal a determination of non-good faith made by the Goal Compliance Committee. If a contractor wishes to appeal the determination made by the Committee, they shall provide written notification to the State Contractual Services Engineer or at DBE@ncdot.gov. The appeal shall be made within 2 business days of notification of the determination of non-good faith.

Counting MBE/WBE Participation Toward Meeting the Combined MBE/WBE Goal

(A) Participation

The total dollar value of the participation by a committed MBE/WBE will be counted toward the contract goal requirements. The total dollar value of participation by a committed MBE/WBE will be based upon the value of work actually performed by the MBE/WBE and the actual payments to MBE/WBE firms by the Contractor.

(B) Joint Checks

Prior notification of joint check use shall be required when counting MBE/WBE participation for services or purchases that involves the use of a joint check. Notification shall be through submission of Form JC-1 *(Joint Check Notification Form)* and the use of joint checks shall be in accordance with the Department's Joint Check Procedures.

(C) Subcontracts (Non-Trucking)

A MBE/WBE may enter into subcontracts. Work that a MBE subcontracts to another MBE firm may be counted toward the anticipated MBE participation. The same holds true for work that a WBE subcontracts to another WBE firm. Work that a MBE/WBE subcontracts to a non-MBE/WBE firm does not count toward the contract goal requirement. It should be noted that every effort shall be made by MBE and WBE contractors to subcontract to the same certification (i.e., MBEs to MBEs and WBEs to WBEs), in order to fulfill the MBE or WBE participation breakdown. This, however, may not always be possible due to the limitation of firms in the area. If the MBE or WBE firm shows a good faith effort has been made to reach out to similarly certified firms and there is no interest or availability, and they can get assistance from other certified firms, the Engineer will not hold the prime responsible for meeting the individual MBE or WBE breakdown. If a MBE or WBE contractor or subcontractor subcontracts a significantly greater portion of the work of the contract than would be expected on the basis of standard industry practices, it shall be presumed that the MBE or WBE is not performing a commercially useful function.

(D) Joint Venture

When a MBE or WBE performs as a participant in a joint venture, the Contractor may count toward its contract goal requirement a portion of the total value of participation with the MBE or WBE in the joint venture, that portion of the total dollar value being a distinct clearly defined portion of work that the MBE or WBE performs with its forces.

(E) Suppliers

A contractor may count toward its MBE/ WBE requirement 60 percent of its expenditures for materials and supplies required to complete the contract and obtained from a MBE or WBE regular dealer and 100 percent of such expenditures from a MBE or WBE manufacturer.

(F) Manufacturers and Regular Dealers

A contractor may count toward its MBE/ WBE requirement the following expenditures to MBE/WBE firms that are not manufacturers or regular dealers:

(1) The fees or commissions charged by a MBE/WBE firm for providing a *bona fide* service, such as professional, technical, consultant, or managerial services, or for providing bonds or insurance specifically required for the performance of a DOT-assisted contract, provided the fees or commissions are determined to be reasonable and not excessive as compared with fees and commissions customarily allowed for similar services.

(2) With respect to materials or supplies purchased from a MBE/WBE, which is neither a manufacturer nor a regular dealer, count the entire amount of fees or commissions charged for assistance in the procurement of the materials and supplies, or fees or transportation charges for the delivery of materials or supplies required on a job site (but not the cost of the materials and supplies themselves), provided the fees are

determined to be reasonable and not excessive as compared with fees customarily allowed for similar services.

Commercially Useful Function

(A) MBE/WBE Utilization

The Contractor may count toward its contract goal requirement only expenditures to MBEs and WBEs that perform a commercially useful function in the work of a contract. A MBE/WBE performs a commercially useful function when it is responsible for execution of the work of the contract and is carrying out its responsibilities by actually performing, managing, and supervising the work involved. To perform a commercially useful function, the MBE/WBE shall also be responsible with respect to materials and supplies used on the contract, for negotiating price, determining quality and quantity, ordering the material and installing (where applicable) and paying for the material itself. To determine whether a MBE/WBE is performing a commercially useful function, the Department will evaluate the amount of work subcontracted, industry practices, whether the amount the firm is to be paid under the contract is commensurate with the work it is actually performing and the MBE/WBE credit claimed for its performance of the work, and any other relevant factors. If it is determined that a MBE or WBE is not performing a Commercially Useful Function, the contractor may present evidence to rebut this presumption to the Department.

(B) MBE/WBE Utilization in Trucking

The following factors will be used to determine if a MBE or WBE trucking firm is performing a commercially useful function:

(1) The MBE/WBE shall be responsible for the management and supervision of the entire trucking operation for which it is responsible on a particular contract, and there shall not be a contrived arrangement for the purpose of meeting the Combined MBE/WBE Goal.

(2) The MBE/WBE shall itself own and operate at least one fully licensed, insured, and operational truck used on the contract.

(3) The MBE/WBE receives credit for the total value of the transportation services it provides on the contract using trucks it owns, insures, and operates using drivers it employs.

(4) The MBE may subcontract the work to another MBE firm, including an owner-operator who is certified as a MBE. The same holds true that a WBE may subcontract the work to another WBE firm, including an owner-operator who is certified as a WBE. When this occurs, the MBE or WBE who subcontracts work receives credit for the total value of the transportation services the subcontracted MBE or WBE provides on the contract. It should be noted that every effort shall be made by MBE and WBE contractors to subcontract to the same certification (i.e.,

MBEs to MBEs and WBEs to WBEs), in order to fulfill the participation breakdown. This, however, may not always be possible due to the limitation of firms in the area. If the MBE or WBE firm shows a good faith effort has been made to reach out to similarly certified transportation service providers and there is no interest or availability, and they can get assistance from other certified providers, the Engineer will not hold the prime responsible for meeting the individual MBE or WBE participation breakdown.

(5) The MBE/WBE may also subcontract the work to a non-MBE/WBE firm, including from an owner-operator. The MBE/WBE who subcontracts the work to a non-MBE/WBE is entitled to credit for the total value of transportation services provided by the non-MBE/WBE subcontractor not to exceed the value of transportation services provided by MBE/WBE-owned trucks on the contract. Additional participation by non-MBE/WBE subcontractors receives credit only for the fee or commission it receives as a result of the subcontract arrangement. The value of services performed under subcontract agreements between the MBE/WBE and the Contractor will not count towards the MBE/WBE contract requirement.

(6) A MBE/WBE may lease truck(s) from an established equipment leasing business open to the general public. The lease must indicate that the MBE/WBE has exclusive use of and control over the truck. This requirement does not preclude the leased truck from working for others during the term of the lease with the consent of the MBE/WBE, so long as the lease gives the MBE/WBE absolute priority for use of the leased truck. This type of lease may count toward the MBE/WBE's credit as long as the driver is under the MBE/WBE's payroll.

(7) Subcontracted/leased trucks shall display clearly on the dashboard the name of the MBE/WBE that they are subcontracted/leased to and their own company name if it is not identified on the truck itself. Magnetic door signs are not permitted.

MBE/WBE Replacement

When a Contractor has relied on a commitment to a MBE or WBE subcontractor (or an approved substitute MBE or WBE subcontractor) to meet all or part of a contract goal requirement, the contractor shall not terminate the MBE/WBE subcontractor for convenience. This includes, but is not limited to, instances in which the Contractor seeks to perform the work of the terminated subcontractor with another MBE/WBE subcontractor, a non-MBE/WBE subcontractor, or with the Contractor's own forces or those of an affiliate.

The Contractor must give notice in writing both by certified mail and email to the MBE/WBE subcontractor, with a copy to the Engineer of its intent to request to terminate and/or substitute, and the reason for the request. The Contractor must give the MBE/WBE subcontractor five (5) business days to respond to the Contractor's Notice of Intent to Request Termination and/or Substitution. If the MBE/WBE subcontractor objects to the intended termination/substitution, the MBE/WBE, within five (5) business days must advise the Contractor and the Department of the reasons why the action should not be approved. The five-day notice period shall begin on the next business day after written notice is provided to the MBE/WBE subcontractor.

A committed MBE/WBE subcontractor may only be terminated after receiving the Department's written approval based upon a finding of good cause for the proposed termination and/or substitution. For purposes of this section, good cause shall include the following circumstances:

(a) The listed MBE/WBE subcontractor fails or refuses to execute a written contract;
(b) The listed MBE/WBE subcontractor fails or refuses to perform the work of its subcontract in a way consistent with normal industry standards. Provided, however, that good cause does not exist if the failure or refusal of the MBE/WBE subcontractor to perform its work on the subcontract results from the bad faith or discriminatory action of the prime contractor;
(c) The listed MBE/WBE subcontractor fails or refuses to meet the prime contractor's reasonable, nondiscriminatory bond requirements;
(d) The listed MBE/WBE subcontractor becomes bankrupt, insolvent, or exhibits credit unworthiness;
(e) The listed MBE/WBE subcontractor is ineligible to work on public works projects because of suspension and debarment proceedings pursuant to 2 CFR Parts 180, 215 and 1,200 or applicable state law;
(f) The listed MBE/WBE subcontractor is not a responsible contractor;
(g) The listed MBE/WBE voluntarily withdraws from the project and provides written notice of withdrawal;
(h) The listed MBE/WBE is ineligible to receive MBE/WBE credit for the type of work required;
(i) A MBE/WBE owner dies or becomes disabled with the result that the listed MBE/WBE contractor is unable to complete its work on the contract;
(j) Other documented good cause that compels the termination of the MBE/WBE subcontractor. Provided, that good cause does not exist if the prime contractor seeks to terminate a MBE/WBE it relied upon to obtain the contract so that the prime contractor can self-perform the work for which the MBE/WBE contractor was engaged or so that the prime contractor can substitute another MBE/WBE or non-MBE/WBE contractor after contract award.

The Contractor shall comply with the following for replacement of a committed MBE/WBE:

(A) Performance Related Replacement

When a committed MBE/WBE is terminated for good cause as stated above, an additional MBE/WBE that was submitted at the time of bid may be used to fulfill the MBE/WBE commitment to meet the Combined MBE/WBE Goal. A good faith effort will only be required for removing a committed MBE/WBE if there were no additional MBE/WBEs submitted at the time of bid to cover the same amount of work as the MBE/WBE that was terminated.

If a replacement MBE/WBE is not found that can perform at least the same amount of work as the terminated MBE/WBE, the Contractor shall submit a good faith effort documenting the steps taken. Such documentation shall include, but not be limited to, the following:

(1) Copies of written notification to MBE/WBEs that their interest is solicited in contracting the work defaulted by the previous MBE/WBE or in subcontracting other items of work in the contract.

(2) Efforts to negotiate with MBE/WBEs for specific subbids including, at a minimum:

(a) The names, addresses, and telephone numbers of MBE/WBEs who were contacted.

(b) A description of the information provided to MBE/WBEs regarding the plans and specifications for portions of the work to be performed.

(3) A list of reasons why MBE/WBE quotes were not accepted.

(4) Efforts made to assist the MBE/WBEs contacted, if needed, in obtaining bonding or insurance required by the Contractor.

(B) Decertification Replacement

(1) When a committed MBE/WBE is decertified by the Department after the SAF (*Subcontract Approval Form*) has been received by the Department, the Department will not require the Contractor to solicit replacement MBE/WBE participation equal to the remaining work to be performed by the decertified firm. The participation equal to the remaining work performed by the decertified firm will count toward the contract goal requirement.

(2) When a committed MBE/WBE is decertified prior to the Department receiving the SAF (*Subcontract Approval Form*) for the named MBE/WBE firm, the Contractor shall take all necessary and reasonable steps to replace the MBE/WBE subcontractor with another MBE/WBE subcontractor to perform at least the same amount of work to meet the Combined MBE/WBE goal requirement. If a MBE/WBE firm is not found to do the same amount of work, a good faith effort must be submitted to NCDOT (see A herein for required documentation).

All requests for replacement of a committed MBE/WBE firm shall be submitted to the Engineer for approval on Form RF-1 *(DBE Replacement Request).* If the Contractor fails to follow this procedure, the Contractor may be disqualified from further bidding for a period of up to 6 months.

Changes in the Work

When the Engineer makes changes that result in the reduction or elimination of work to be performed by a committed MBE/WBE, the Contractor will not be required to seek additional participation. When the Engineer makes changes that result in additional work to be performed

by a MBE/WBE based upon the Contractor's commitment, the MBE/WBE shall participate in additional work to the same extent as the MBE/WBE participated in the original contract work.

When the Engineer makes changes that result in extra work, which has more than a minimal impact on the contract amount, the Contractor shall seek additional participation by MBEs/WBEs unless otherwise approved by the Engineer.

When the Engineer makes changes that result in an alteration of plans or details of construction, and a portion or all of the work had been expected to be performed by a committed MBE/WBE, the Contractor shall seek participation by MBEs/WBEs unless otherwise approved by the Engineer.

When the Contractor requests changes in the work that result in the reduction or elimination of work that the Contractor committed to be performed by a MBE/WBE, the Contractor shall seek additional participation by MBEs/WBEs equal to the reduced MBE/WBE participation caused by the changes.

Reports and Documentation

A SAF (*Subcontract Approval Form*) shall be submitted for all work which is to be performed by a MBE/WBE subcontractor. The Department reserves the right to require copies of actual subcontract agreements involving MBE/WBE subcontractors.

When using transportation services to meet the contract commitment, the Contractor shall submit a proposed trucking plan in addition to the SAF. The plan shall be submitted prior to beginning construction on the project. The plan shall include the names of all trucking firms proposed for use, their certification type(s), the number of trucks owned by the firm, as well as the individual truck identification numbers, and the line item(s) being performed.

Within 30 calendar days of entering into an agreement with a MBE/WBE for materials, supplies or services, not otherwise documented by the SAF as specified above, the Contractor shall furnish the Engineer a copy of the agreement. The documentation shall also indicate the percentage (60% or 100%) of expenditures claimed for MBE/WBE credit.

Reporting Minority and Women Business Enterprise Participation

The Contractor shall provide the Engineer with an accounting of payments made to all MBE/WBE firms, including material suppliers and contractors at all levels (prime, subcontractor, or second tier subcontractor). This accounting shall be furnished to the Engineer for any given month by the end of the following month. Failure to submit this information accordingly may result in the following action:

(A) Withholding of money due in the next partial pay estimate; or

(B) Removal of an approved contractor from the prequalified bidders' list or the removal of other entities from the approved subcontractors list.

While each contractor (prime, subcontractor, 2nd tier subcontractor) is responsible for accurate accounting of payments to MBEs/WBEs, it shall be the prime contractor's responsibility to report all monthly and final payment information in the correct reporting manner.

Failure on the part of the Contractor to submit the required information in the time frame specified may result in the disqualification of that contractor and any affiliate companies from further bidding until the required information is submitted.

Failure on the part of any subcontractor to submit the required information in the time frame specified may result in the disqualification of that contractor and any affiliate companies from being approved for work on future DOT projects until the required information is submitted.

Contractors reporting transportation services provided by non-MBE/WBE lessees shall evaluate the value of services provided during the month of the reporting period only.

At any time, the Engineer can request written verification of subcontractor payments.

The Contractor shall report the accounting of payments through the Department's Payment Tracking System.

Failure to Meet Contract Requirements

Failure to meet contract requirements in accordance with Subarticle 102-15(J) of the *2018 Standard Specifications* may be cause to disqualify the Contractor.

CONTRACTOR'S LICENSE REQUIREMENTS:

(7-1-95) 102-14 SP1 G88

If the successful bidder does not hold the proper license to perform any plumbing, heating, air conditioning, or electrical work in this contract, he will be required to sublet such work to a contractor properly licensed in accordance with *Article 2 of Chapter 87 of the General Statutes* (licensing of heating, plumbing, and air conditioning contractors) and *Article 4 of Chapter 87* of the *General Statutes* (licensing of electrical contractors).

REMOVABLE PAVEMENT MARKINGS - (Partial Payments for Materials):

(7-1-95) (Rev. 8-16-11) 1205-10 SP1 G124

When so authorized by the Engineer, partial materials payments will be made up to 95 percent of the delivered cost of pavement marking tape, provided that these materials have been delivered on or in the vicinity of the project, stored in an acceptable manner, not to exceed the shelf life recommended by the manufacturer, and further provided the documents listed in Subarticle 109-5(C) of the *2018 Standard Specifications* have been furnished to the Engineer.

The Contractor shall be responsible for the material and the satisfactory performance of the material when used in the work.

The provisions of Article 109-6 of the *2018 Standard Specifications* will not apply to removable pavement marking materials.

ELECTRONIC BIDDING:

(2-19-19) 101, 102, 103 SP1 G140

Revise the *2018 Standard Specifications* as follows:

Page 1-4, Article 101-3, DEFINITIONS, BID (OR PROPOSAL) *Electronic Bid,* line 1, replace "Bid Express®" with "the approved electronic bidding provider".

Page 1-15, Subarticle 102-8(B), Electronic Bids, lines 39-40, replace "to Bid Express®" with "via the approved electronic bidding provider".

Page 1-15, Subarticle 102-8(B)(1), Electronic Bids, line 41, delete "from Bid Express®"

Page 1-17, Subarticle 102-9(C)(2), Electronic Bids, line 21, replace "Bid Express® miscellaneous folder within the .ebs" with "electronic submittal".

Page 1-29, Subarticle 103-4(C)(2), Electronic Bids, line 32, replace ".ebs miscellaneous data file of Expedite" with "electronic submittal file"

TWELVE MONTH GUARANTEE:

(7-15-03) 108 SP1 G145

(A) The Contractor shall guarantee materials and workmanship against latent and patent defects arising from faulty materials, faulty workmanship or negligence for a period of twelve months following the date of final acceptance of the work for maintenance and shall replace such defective materials and workmanship without cost to the Department. The Contractor will not be responsible for damage due to faulty design, normal wear and tear, for negligence on the part of the Department, and/or for use in excess of the design.

(B) Where items of equipment or material carry a manufacturer's guarantee for any period in excess of twelve months, then the manufacturer's guarantee shall apply for that particular piece of equipment or material. The Department's first remedy shall be through the manufacturer although the Contractor is responsible for invoking the warranted repair work with the manufacturer. The Contractor's responsibility shall be limited to the term of the manufacturer's guarantee. NCDOT would be afforded the same warranty as provided by the Manufacturer.

This guarantee provision shall be invoked only for major components of work in which the Contractor would be wholly responsible for under the terms of the contract. Examples would include pavement structures, bridge components, and sign structures. This provision will not be used as a mechanism to force the Contractor to return to the project to make repairs or perform additional work that the Department would normally compensate the Contractor for. In addition, routine maintenance activities (i.e. mowing grass, debris removal, ruts in earth shoulders,) are not parts of this guarantee.

Appropriate provisions of the payment and/or performance bonds shall cover this guarantee for the project.

To ensure uniform application statewide the Division Engineer will forward details regarding the circumstances surrounding any proposed guarantee repairs to the Chief Engineer for review and approval prior to the work being performed.

OUTSOURCING OUTSIDE THE USA:

(9-21-04) (Rev. 5-16-06) SP1 G150

All work on consultant contracts, services contracts, and construction contracts shall be performed in the United States of America. No work shall be outsourced outside of the United States of America.

Outsourcing for the purpose of this provision is defined as the practice of subcontracting labor, work, services, staffing, or personnel to entities located outside of the United States.

The North Carolina Secretary of Transportation shall approve exceptions to this provision in writing.

NOTES TO CONTRACTOR:

1. Refer to actuators that are to be removed and reconditioned as referenced in Note 2 on Sheet M-11. All 4 actuators may be removed at one time.

2. All existing machinery that is to be removed and replaced with new machinery becomes the property of the Contractor upon removal.

PROJECT SPECIAL PROVISIONS

ROADWAY

BURNING RESTRICTIONS:

(7-1-95) 200, 210, 215 SP2 R05

Open burning is not permitted on any portion of the right-of-way limits established for this project. Do not burn the clearing, grubbing or demolition debris designated for disposal and generated from the project at locations within the project limits, off the project limits or at any waste or borrow sites in this county. Dispose of the clearing, grubbing and demolition debris by means other than burning, according to state or local rules and regulations.

STANDARD SPECIAL PROVISION
AVAILABILITY OF FUNDS – TERMINATION OF CONTRACTS

(5-20-08) Z-2

General Statute 143C-6-11. (h) Highway Appropriation is hereby incorporated verbatim in this contract as follows:

(h) Amounts Encumbered. – Transportation project appropriations may be encumbered in the amount of allotments made to the Department of Transportation by the Director for the estimated payments for transportation project contract work to be performed in the appropriation fiscal year. The allotments shall be multiyear allotments and shall be based on estimated revenues and shall be subject to the maximum contract authority contained in *General Statute 143C-6-11(c)*. Payment for transportation project work performed pursuant to contract in any fiscal year other than the current fiscal year is subject to appropriations by the General Assembly. Transportation project contracts shall contain a schedule of estimated completion progress, and any acceleration of this progress shall be subject to the approval of the Department of Transportation provided funds are available. The State reserves the right to terminate or suspend any transportation project contract, and any transportation project contract shall be so terminated or suspended if funds will not be available for payment of the work to be performed during that fiscal year pursuant to the contract. In the event of termination of any contract, the contractor shall be given a written notice of termination at least 60 days before completion of scheduled work for which funds are available. In the event of termination, the contractor shall be paid for the work already performed in accordance with the contract specifications.

Payment will be made on any contract terminated pursuant to the special provision in accordance with Subarticle 108-13(D) of the *2018 Standard Specifications*.

STANDARD SPECIAL PROVISION
NCDOT GENERAL SEED SPECIFICATION FOR SEED QUALITY

(5-17-11) Z-3

Seed shall be sampled and tested by the North Carolina Department of Agriculture and Consumer Services, Seed Testing Laboratory. When said samples are collected, the vendor shall supply an independent laboratory report for each lot to be tested. Results from seed so sampled shall be final. Seed not meeting the specifications shall be rejected by the Department of Transportation and shall not be delivered to North Carolina Department of Transportation warehouses. If seed has been delivered it shall be available for pickup and replacement at the supplier's expense.

Any re-labeling required by the North Carolina Department of Agriculture and Consumer Services, Seed Testing Laboratory, that would cause the label to reflect as otherwise specified herein shall be rejected by the North Carolina Department of Transportation.

Seed shall be free from seeds of the noxious weeds Johnsongrass, Balloonvine, Jimsonweed, Witchweed, Itchgrass, Serrated Tussock, Showy Crotalaria, Smooth Crotalaria, Sicklepod, Sandbur, Wild Onion, and Wild Garlic. Seed shall not be labeled with the above weed species on the seed analysis label. Tolerances as applied by the Association of Official Seed Analysts will NOT be allowed for the above noxious weeds except for Wild Onion and Wild Garlic.

Tolerances established by the Association of Official Seed Analysts will generally be recognized. However, for the purpose of figuring pure live seed, the found pure seed and found germination percentages as reported by the North Carolina Department of Agriculture and Consumer Services, Seed Testing Laboratory will be used. Allowances, as established by the NCDOT, will be recognized for minimum pure live seed as listed on the following pages.

The specifications for restricted noxious weed seed refers to the number per pound as follows:

Restricted Noxious **Weed**	Limitations per Lb. Of Seed	Restricted Noxious **Weed**	Limitations per Lb. of Seed
Blessed Thistle	4 seeds	Cornflower (Ragged Robin)	27 seeds
Cocklebur	4 seeds	Texas Panicum	27 seeds
Spurred Anoda	4 seeds	Bracted Plantain	54 seeds
Velvetleaf	4 seeds	Buckhorn Plantain	54 seeds
Morning-glory	8 seeds	Broadleaf Dock	54 seeds
Corn Cockle	10 seeds	Curly Dock	54 seeds
Wild Radish	12 seeds	Dodder	54 seeds
Purple Nutsedge	27 seeds	Giant Foxtail	54 seeds
Yellow Nutsedge	27 seeds	Horsenettle	54 seeds
Canada Thistle	27 seeds	Quackgrass	54 seeds
Field Bindweed	27 seeds	Wild Mustard	54 seeds
Hedge Bindweed	27 seeds		

Seed of Pensacola Bahiagrass shall not contain more than 7% inert matter, Kentucky Bluegrass, Centipede and Fine or Hard Fescue shall not contain more than 5% inert matter whereas a maximum of 2% inert matter will be allowed on all other kinds of seed. In addition, all seed shall

not contain more than 2% other crop seed nor more than 1% total weed seed. The germination rate as tested by the North Carolina Department of Agriculture shall not fall below 70%, which includes both dormant and hard seed. Seed shall be labeled with not more than 7%, 5% or 2% inert matter (according to above specifications), 2% other crop seed and 1% total weed seed.

Exceptions may be made for minimum pure live seed allowances when cases of seed variety shortages are verified. Pure live seed percentages will be applied in a verified shortage situation. Those purchase orders of deficient seed lots will be credited with the percentage that the seed is deficient.

FURTHER SPECIFICATIONS FOR EACH SEED GROUP ARE GIVEN BELOW:

Minimum 85% pure live seed; maximum 1% total weed seed; maximum 2% total other crop seed; maximum 144 restricted noxious weed seed per pound. Seed less than 83% pure live seed will not be approved.

Sericea Lespedeza
Oats (seeds)

Minimum 80% pure live seed; maximum 1% total weed seed; maximum 2% total other crop; maximum 144 restricted noxious weed seed per pound. Seed less than 78% pure live seed will not be approved.

Tall Fescue (all approved varieties)
Kobe Lespedeza
Korean Lespedeza
Weeping Lovegrass
Carpetgrass
Bermudagrass
Browntop Millet
German Millet – Strain R
Clover – Red/White/Crimson

Minimum 78% pure live seed; maximum 1% total weed seed; maximum 2% total other crop seed; maximum 144 restricted noxious weed seed per pound. Seed less than 76% pure live seed will not be approved.

Common or Sweet Sundangrass

Minimum 76% pure live seed; maximum 1% total weed seed; maximum 2% total other crop seed; maximum 144 restricted noxious weed seed per pound. Seed less than 74% pure live seed will not be approved.

Rye (grain; all varieties)
Kentucky Bluegrass (all approved varieties)
Hard Fescue (all approved varieties)
Shrub (bicolor) Lespedeza

Minimum 70% pure live seed; maximum 1% total weed seed; maximum 2% total other crop seed; maximum 144 noxious weed seed per pound. Seed less than 70% pure live seed will not be approved.

Centipedegrass
Crownvetch
Pensacola Bahiagrass
Creeping Red Fescue
Japanese Millet
Reed Canary Grass
Zoysia

Minimum 70% pure live seed; maximum 1% total weed seed; maximum 2% total other crop seed; maximum 5% inert matter; maximum 144 restricted noxious weed seed per pound.

Barnyard Grass
Big Bluestem
Little Bluestem
Bristly Locust
Birdsfoot Trefoil
Indiangrass
Orchardgrass
Switchgrass
Yellow Blossom Sweet Clover

STANDARD SPECIAL PROVISION

ERRATA

(10-16-18) (Rev.1-15-19) Z-4

Revise the *2018 Standard Specifications* as follows:

Division 6

Page 6-7, Article 609-1 DESCRIPTION, line 29, replace article number "609-10" with "609-9".

Division 7

Page 7-27, Article 725-1 MEASUREMENT AND PAYMENT, line 4, replace article number "725-1" with "724-4".

Page 7-28, Article 725-1 MEASUREMENT AND PAYMENT, line 10, replace article number "725-1" with "725-3".

Division 10

Page 10-78, Article 1056-4 GEOTEXTILES, TABLE 1056-1, Permittivity, Type 2, replace "Table 6[D]" with "Table 7[D]" and **Permittivity, Type 3[B],** replace "Table 7[D]" with "Table 8[D]".

Page 10-162, Article 1080-50 PAINT FOR VERTICAL MARKERS, line 1, replace article number "1080-50" with "1080-10".

Page 10-162, Article 1080-61 EPOXY RESIN FOR REINFORCING STEEL, line 5, replace article number "1080-61" with "1080-11".

Page 10-162, Article 1080-72 ABRASIVE MATERIALS FOR BLAST CLEANING STEEL, line 22, replace article number "1080-72" with "1080-12".

Page 10-163, Article 1080-83 FIELD PERFORMANCE AND SERVICES, line 25, replace article number "1080-83" with "1080-13".

Division 17

Page 17-15, Article 1715-4 MEASUREMENT AND PAYMENT, lines 42-44, replace the second sentence with the following:

An example is an installation of a single 1.25 inch HDPE conduit would be paid as:

Directional Drill (1)(1.25″) Linear Foot

STANDARD SPECIAL PROVISION

PLANT AND PEST QUARANTINES
(Imported Fire Ant, Gypsy Moth, Witchweed, Emerald Ash Borer, And Other Noxious Weeds)

(3-18-03) (Rev. 12-20-16) Z-04a

Within Quarantined Area

This project may be within a county regulated for plant and/or pests. If the project or any part of the Contractor's operations is located within a quarantined area, thoroughly clean all equipment prior to moving out of the quarantined area. Comply with federal/state regulations by obtaining a certificate or limited permit for any regulated article moving from the quarantined area.

Originating in a Quarantined County

Obtain a certificate or limited permit issued by the N.C. Department of Agriculture/United States Department of Agriculture. Have the certificate or limited permit accompany the article when it arrives at the project site.

Contact

Contact the N.C. Department of Agriculture/United States Department of Agriculture at 1-800-206-9333, 919-707-3730, or *http://www.ncagr.gov/plantindustry/* to determine those specific project sites located in the quarantined area or for any regulated article used on this project originating in a quarantined county.

Regulated Articles Include

1. Soil, sand, gravel, compost, peat, humus, muck, and decomposed manure, separately or with other articles. This includes movement of articles listed above that may be associated with cut/waste, ditch pulling, and shoulder cutting.
2. Plants with roots including grass sod.
3. Plant crowns and roots.
4. Bulbs, corms, rhizomes, and tubers of ornamental plants.
5. Hay, straw, fodder, and plant litter of any kind.
6. Clearing and grubbing debris.
7. Used agricultural cultivating and harvesting equipment.
8. Used earth-moving equipment.
9. Any other products, articles, or means of conveyance, of any character, if determined by an inspector to present a hazard of spreading imported fire ant, gypsy moth, witchweed, emerald ash borer, or other noxious weeds.

STANDARD SPECIAL PROVISION

MINIMUM WAGES

(7-21-09) Z-5

FEDERAL: The Fair Labor Standards Act provides that with certain exceptions every employer shall pay wages at the rate of not less than SEVEN DOLLARS AND TWENTY FIVE CENTS ($7.25) per hour.

STATE: The North Carolina Minimum Wage Act provides that every employer shall pay to each of his employees, wages at a rate of not less than SEVEN DOLLARS AND TWENTY FIVE CENTS ($7.25) per hour.

The minimum wage paid to all skilled labor employed on this contract shall be SEVEN DOLLARS AND TWENTY FIVE CENTS ($7.25) per hour.

The minimum wage paid to all intermediate labor employed on this contract shall be SEVEN DOLLARS AND TWENTY FIVE CENTS ($7.25) per hour.

The minimum wage paid to all unskilled labor on this contract shall be SEVEN DOLLARS AND TWENTY FIVE CENTS ($7.25) per hour.

This determination of the intent of the application of this act to the contract on this project is the responsibility of the Contractor.

The Contractor shall have no claim against the Department of Transportation for any changes in the minimum wage laws, Federal or State. It is the responsibility of the Contractor to keep fully informed of all Federal and State Laws affecting his contract.

STANDARD SPECIAL PROVISION

TITLE VI AND NONDISCRIMINATION:

(6-28-77)(Rev 6/19/2018) Z-6

Revise the *2018 Standard Specifications* as follows:

Replace Article 103-4(B) with the following:

The North Carolina Department of Transportation is committed to carrying out the U.S. Department of Transportation's policy of ensuring nondiscrimination in the award and administration of contracts.

The provisions of this section related to United States Department of Transportation (US DOT) Order 1050.2A, Title 49 Code of Federal Regulations (CFR) part 21, 23 United States Code (U.S.C.) 140 and 23 CFR part 200 (or 49 CFR 303, 49 U.S.C. 5332 or 49 U.S.C. 47123) are applicable to all North Carolina Department of Transportation (NCDOT) contracts and to all related subcontracts, material supply, engineering, architectural and other service contracts, regardless of dollar amount. Any Federal provision that is specifically required not specifically set forth is hereby incorporated by reference.

(1) **Title VI Assurances (USDOT Order 1050.2A, Appendix A)**

During the performance of this contract, the contractor, for itself, its assignees, and successors in interest (hereinafter referred to as the "contractor") agrees as follows:

(a) Compliance with Regulations

The contractor (hereinafter includes consultants) shall comply with the Acts and the Regulations relative to Nondiscrimination in Federally-assisted programs of the U.S. Department of Transportation, Federal Highway Administration (FHWA), as they may be amended from time to time, which are herein incorporated by reference and made a part of this contract.

(b) Nondiscrimination

The contractor, with regard to the work performed by it during the contract, shall not discriminate on the grounds of race, color, or national origin in the selection and retention of subcontractors, including procurements of materials and leases of equipment. The contractor shall not participate directly or indirectly in the discrimination prohibited by the Acts and the Regulations, including employment practices when the contract covers any activity, project, or program set forth in Appendix B of 49 CFR Part 21.

(c) Solicitations for Subcontractors, Including Procurements of Materials and Equipment

In all solicitations, either by competitive bidding, or negotiation made by the contractor for work to be performed under a subcontract, including procurements of materials, or leases of equipment, each potential subcontractor or supplier shall be notified by the contractor of the contractor's obligations under this contract and the Acts and the Regulations relative to Nondiscrimination on the grounds of race, color, or national origin.

(d) Information and Reports

The contractor shall provide all information and reports required by the Acts, the Regulations, and directives issued pursuant thereto and shall permit access to its books, records, accounts, other sources of information, and its facilities as may be determined by the Recipient or the FHWA to be pertinent to ascertain compliance with such Acts,

Regulations, and instructions. Where any information required of a contractor is in the exclusive possession of another who fails or refuses to furnish the information, the contractor shall so certify to the Recipient or the FHWA, as appropriate, and shall set forth what efforts it has made to obtain the information.

(e) Sanctions for Noncompliance:
In the event of a contractor's noncompliance with the Non-discrimination provisions of this contract, the Recipient will impose such contract sanctions as it and/or the FHWA may determine to be appropriate, including, but not limited to:
(i) Withholding payments to the contractor under the contract until the contractor complies; and/or
(ii) Cancelling, terminating, or suspending a contract, in whole or in part.

(f) Incorporation of Provisions
The contractor shall include the provisions of paragraphs (a) through (f) in every subcontract, including procurements of materials and leases of equipment, unless exempt by the Acts, the Regulations and directives issued pursuant thereto. The contractor shall take action with respect to any subcontract or procurement as the Recipient or the FHWA may direct as a means of enforcing such provisions including sanctions for noncompliance. Provided, that if the contractor becomes involved in, or is threatened with litigation by a subcontractor, or supplier because of such direction, the contractor may request the Recipient to enter into any litigation to protect the interests of the Recipient. In addition, the contractor may request the United States to enter into the litigation to protect the interests of the United States.

(2) **Title VI Nondiscrimination Program (23 CFR 200.5(p))**
The North Carolina Department of Transportation (NCDOT) has assured the USDOT that, as a condition to receiving federal financial assistance, NCDOT will comply with Title VI of the Civil Rights Act of 1964 and all requirements imposed by Title 49 CFR part 21 and related nondiscrimination authorities to ensure that no person shall, on the ground of race, color, national origin, limited English proficiency, sex, age, or disability (including religion/creed or income-level, where applicable), be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any programs, activities, or services conducted or funded by NCDOT. Contractors and other organizations under contract or agreement with NCDOT must also comply with Title VI and related authorities, therefore:

(a) During the performance of this contract or agreement, contractors (e.g., subcontractors, consultants, vendors, prime contractors) are responsible for complying with NCDOT's Title VI Program. Contractors are not required to prepare or submit Title VI Programs. To comply with this section, the prime contractor shall:
1. Post NCDOT's Notice of Nondiscrimination and the Contractor's own Equal Employment Opportunity (EEO) Policy in conspicuous locations accessible to all employees, applicants and subcontractors on the jobsite.
2. Physically incorporate the required Title VI clauses into all subcontracts on federally-assisted and state-funded NCDOT projects, and ensure inclusion by subcontractors into all lower-tier subcontracts.
3. Required Solicitation Language. The Contractor shall include the following notification in all solicitations for bids and requests for work or material, regardless of funding source:
"The North Carolina Department of Transportation, in accordance with the provisions of Title VI of the Civil Rights Act of 1964 (78 Stat. 252, 42 US.C. §§

2000d to 2000d-4) and the Regulations, hereby notifies all bidders that it will affirmatively ensure that any contract entered into pursuant to this advertisement, disadvantaged business enterprises will be afforded full and fair opportunity to submit bids in response to this invitation and will not be discriminated against on the grounds of race, color, or national origin in consideration for an award. In accordance with other related nondiscrimination authorities, bidders and contractors will also not be discriminated against on the grounds of sex, age, disability, low-income level, creed/religion, or limited English proficiency in consideration for an award."

4. Physically incorporate the FHWA-1273, in its entirety, into all subcontracts and subsequent lower tier subcontracts on Federal-aid highway construction contracts only.
5. Provide language assistance services (i.e., written translation and oral interpretation), free of charge, to LEP employees and applicants. Contact NCDOT OCR for further assistance, if needed.
6. For assistance with these Title VI requirements, contact the NCDOT Title VI Nondiscrimination Program at 1-800-522-0453.

(b) Subrecipients (e.g. cities, counties, LGAs, planning organizations) may be required to prepare and submit a Title VI Plan to NCDOT, including Title VI Assurances and/or agreements. Subrecipients must also ensure compliance by their contractors and subrecipients with Title VI. (23 CFR 200.9(b)(7))

(c) If reviewed or investigated by NCDOT, the contractor or subrecipient agrees to take affirmative action to correct any deficiencies found within a reasonable time period, not to exceed 90 calendar days, unless additional time is granted by NCDOT. (23 CFR 200.9(b)(15))

(d) The Contractor is responsible for notifying subcontractors of NCDOT's External Discrimination Complaints Process.

1. Applicability
   Title VI and related laws protect participants and beneficiaries (e.g., members of the public and contractors) from discrimination by NCDOT employees, subrecipients and contractors, regardless of funding source.
2. Eligibility
   Any person—or class of persons—who believes he/she has been subjected to discrimination based on race, color, national origin, Limited English Proficiency (LEP), sex, age, or disability (and religion in the context of employment, aviation, or transit) may file a written complaint. The law also prohibits intimidation or retaliation of any sort.
3. Time Limits and Filing Options
   Complaints may be filed by the affected individual(s) or a representative and must be filed no later than 180 calendar days after the following:
   (i) The date of the alleged act of discrimination; or
   (ii) The date when the person(s) became aware of the alleged discrimination; or
   (iii) Where there has been a continuing course of conduct, the date on which that conduct was discontinued or the latest instance of the conduct.

   Title VI and related discrimination complaints may be submitted to the following entities:

- North Carolina Department of Transportation, Office of Civil Rights, Title VI Program, 1511 Mail Service Center, Raleigh, NC 27699-1511; toll free 1-800-522-0453
- Federal Highway Administration, North Carolina Division Office, 310 New Bern Avenue, Suite 410, Raleigh, NC 27601, 919-747-7010
- US Department of Transportation, Departmental Office of Civil Rights, External Civil Rights Programs Division, 1200 New Jersey Avenue, SE, Washington, DC 20590; 202-366-4070

4. Format for Complaints
   Complaints must be in writing and signed by the complainant(s) or a representative, and include the complainant's name, address, and telephone number. Complaints received by fax or e-mail will be acknowledged and processed. Allegations received by telephone will be reduced to writing and provided to the complainant for confirmation or revision before processing. Complaints will be accepted in other languages, including Braille.
5. Discrimination Complaint Form
   Contact NCDOT Civil Rights to receive a full copy of the Discrimination Complaint Form and procedures.
6. Complaint Basis
   Allegations must be based on issues involving race, color, national origin (LEP), sex, age, disability, or religion (in the context of employment, aviation or transit). "Basis" refers to the complainant's membership in a protected group category.

TABLE 103-1
COMPLAINT BASIS

Protected Categories	Definition	Examples	Applicable Nondiscrimination Authorities
Race and Ethnicity	An individual belonging to one of the accepted racial groups; or the perception, based usually on physical characteristics that a person is a member of a racial group	Black/African American, Hispanic/Latino, Asian, American Indian/Alaska Native, Native Hawaiian/Pacific Islander, White	Title VI of the Civil Rights Act of 1964; 49 CFR Part 21; 23 CFR 200; 49 U.S.C. 5332(b); 49 U.S.C. 47123. *(Executive Order 13166)*
Color	Color of skin, including shade of skin within a racial group	Black, White, brown, yellow, etc.	
National Origin *(Limited English Proficiency)*	Place of birth. Citizenship is not a factor. (*Discrimination based on language or a person's accent is also covered)*	Mexican, Cuban, Japanese, Vietnamese, Chinese	
Sex	Gender. The sex of an individual. *Note:* Sex under this program does not include sexual orientation.	Women and Men	1973 Federal-Aid Highway Act; 49 U.S.C. 5332(b); 49 U.S.C. 47123.
Age	Persons of any age	21-year-old person	Age Discrimination Act of 1975 49 U.S.C. 5332(b); 49 U.S.C. 47123.
Disability	Physical or mental impairment, permanent or temporary, or perceived.	Blind, alcoholic, para-amputee, epileptic, diabetic, arthritic	Section 504 of the Rehabilitation Act of 1973; Americans with Disabilities Act of 1990

Religion (in the context of employment) *(Religion/ Creed in all aspects of any aviation or transit-related construction)*	An individual belonging to a religious group; or the perception, based on distinguishable characteristics that a person is a member of a religious group. In practice, actions taken as a result of the moral and ethical beliefs as to what is right and wrong, which are sincerely held with the strength of traditional religious views. ***Note:*** Does not have to be associated with a recognized religious group or church; if an individual sincerely holds to the belief, it is a protected religious practice.	Muslim, Christian, Sikh, Hindu, etc.	Title VII of the Civil Rights Act of 1964; 23 CFR 230; FHWA-1273 Required Contract Provisions. *(49 U.S.C. 5332(b);* *49 U.S.C. 47123)*

(3) **Pertinent Nondiscrimination Authorities**

During the performance of this contract, the contractor, for itself, its assignees, and successors in interest agrees to comply with the following non-discrimination statutes and authorities, including, but not limited to:

(a) Title VI of the Civil Rights Act of 1964 (42 U.S.C. § 2000d et seq., 78 stat. 252), (prohibits discrimination on the basis of race, color, national origin); and 49 CFR Part 21.

(b) The Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, (42 U.S.C. § 4601), (prohibits unfair treatment of persons displaced or whose property has been acquired because of Federal or Federal-aid programs and projects);

(c) Federal-Aid Highway Act of 1973, (23 U.S.C. § 324 et seq.), (prohibits discrimination on the basis of sex);

(d) Section 504 of the Rehabilitation Act of 1973, (29 U.S.C. § 794 et seq.), as amended, (prohibits discrimination on the basis of disability) and 49 CFR Part 27;

(e) The Age Discrimination Act of 1975, as amended, (42 U.S.C. § 6101 et seq.), (prohibits discrimination on the basis of age);

(f) Airport and Airway Improvement Act of 1982, (49 USC § 471, Section 47123), as amended, (prohibits discrimination based on race, creed, color, national origin, or sex);

(g) The Civil Rights Restoration Act of 1987, (PL 100-209), (Broadened the scope, coverage and applicability of Title VI of the Civil Rights Act of 1964, The Age Discrimination Act of 1975 and Section 504 of the Rehabilitation Act of 1973, by expanding the definition of the terms "programs or activities" to include all of the programs or activities of the Federal-aid recipients, sub-recipients and contractors, whether such programs or activities are Federally funded or not);

(h) Titles II and III of the Americans with Disabilities Act, which prohibit discrimination on the basis of disability in the operation of public entities, public and private transportation systems, places of public accommodation, and certain testing entities (42 U.S.C. §§ 12131-12189) as implemented by Department of Transportation regulations at 49 C.F.R. parts 37 and 38;

(i) The Federal Aviation Administration's Nondiscrimination statute (49 U.S.C. § 47123) (prohibits discrimination on the basis of race, color, national origin, and sex);

(j) Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, which ensures Nondiscrimination against minority populations by discouraging programs, policies, and activities with

disproportionately high and adverse human health or environmental effects on minority and low-income populations;

(k) Executive Order 13166, Improving Access to Services for Persons with Limited English Proficiency, and resulting agency guidance, national origin discrimination includes discrimination because of Limited English proficiency (LEP). To ensure compliance with Title VI, you must take reasonable steps to ensure that LEP persons have meaningful access to your programs (70 Fed. Reg. at 74087 to 74100);

(l) Title IX of the Education Amendments of 1972, as amended, which prohibits you from discriminating because of sex in education programs or activities (20 U.S.C. 1681 et seq).

(m) Title VII of the Civil Rights Act of 1964 (42 U.S.C. § 2000e et seq., Pub. L. 88-352), (prohibits employment discrimination on the basis of race, color, religion, sex, or national origin).

(4) **Additional Title VI Assurances**

***The following Title VI Assurances (Appendices B, C and D) shall apply, as applicable*

(a) Clauses for Deeds Transferring United States Property (1050.2A, Appendix B)

The following clauses will be included in deeds effecting or recording the transfer of real property, structures, or improvements thereon, or granting interest therein from the United States pursuant to the provisions of Assurance 4.

NOW, THEREFORE, the U.S. Department of Transportation as authorized by law and upon the condition that the North Carolina Department of Transportation (NCDOT) will accept title to the lands and maintain the project constructed thereon in accordance with the North Carolina General Assembly, the Regulations for the Administration of the Federal-Aid Highway Program, and the policies and procedures prescribed by the Federal Highway Administration of the U.S. Department of Transportation in accordance and in compliance with all requirements imposed by Title 49, Code of Federal Regulations, U.S. Department of Transportation, Subtitle A, Office of the Secretary, Part 21, Nondiscrimination in Federally-assisted programs of the U.S Department of Transportation pertaining to and effectuating the provisions of Title VI of the Civil Rights Act of 1964 (78 Stat. 252; 42 U.S.C. § 2000d to 2000d-4), does hereby remise, release, quitclaim and convey unto the NCDOT all the right, title and interest of the U.S. Department of Transportation in and to said lands described in Exhibit A attached hereto and made a part hereof.

(HABENDUM CLAUSE)

TO HAVE AND TO HOLD said lands and interests therein unto the North Carolina Department of Transportation (NCDOT) and its successors forever, subject, however, to the covenants, conditions, restrictions and reservations herein contained as follows, which will remain in effect for the period during which the real property or structures are used for a purpose for which Federal financial assistance is extended or for another purpose involving the provision of similar services or benefits and will be binding on the NCDOT, its successors and assigns.

The NCDOT, in consideration of the conveyance of said lands and interests in lands, does hereby covenant and agree as a covenant running with the land for itself, its successors and assigns, that (1) no person will on the grounds of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be otherwise subjected to discrimination with regard to any facility located wholly or in part on, over, or under such lands hereby conveyed [,] [and]* (2) that the NCDOT will use the lands and interests in lands and interests in lands so conveyed, in compliance with all requirements imposed by or pursuant to Title 49, Code of Federal Regulations, U.S. Department of Transportation, Subtitle A, Office of the Secretary, Part 21, Non-discrimination in Federally-assisted programs of the U.S. Department of Transportation, Effectuation of Title VI of the Civil Rights Act of 1964, and as said Regulations and Acts may be amended [, and (3) that in the event of breach of any of the above-mentioned nondiscrimination conditions, the Department will have a right to enter or re-enter said lands and facilities on said land, and that above described land and facilities will thereon revert to and vest in and become the absolute property of the U.S. Department of Transportation and its assigns as such interest existed prior to this instruction].*

(*Reverter clause and related language to be used only when it is determined that such a clause is necessary in order to make clear the purpose of Title VI.)

(b) Clauses for Transfer of Real Property Acquired or Improved Under the Activity, Facility, or Program (1050.2A, Appendix C)

The following clauses will be included in deeds, licenses, leases, permits, or similar instruments entered into by the North Carolina Department of Transportation (NCDOT) pursuant to the provisions of Assurance 7(a):

1. The (grantee, lessee, permittee, etc. as appropriate) for himself/herself, his/her heirs, personal representatives, successors in interest, and assigns, as a part of the consideration hereof, does hereby covenant and agree [in the case of deeds and leases add "as a covenant running with the land"] that:
   (i.) In the event facilities are constructed, maintained, or otherwise operated on the property described in this (deed, license, lease, permit, etc.) for a purpose for which a U.S. Department of Transportation activity, facility, or program is extended or for another purpose involving the provision of similar services or benefits, the (grantee, licensee, lessee, permittee, etc.) will maintain and operate such facilities and services in compliance with all requirements imposed by the Acts and Regulations (as may be amended) such that no person on the grounds of race, color, or national origin, will be excluded from participation in, denied the benefits of, or be otherwise subjected to discrimination in the use of said facilities.
2. With respect to licenses, leases, permits, etc., in the event of breach of any of the above Nondiscrimination covenants, the NCDOT will have the right to terminate the (lease, license, permit, etc.) and to enter, re-enter, and repossess said lands and facilities thereon, and hold the same as if the (lease, license, permit, etc.) had never been made or issued. *
3. With respect to a deed, in the event of breach of any of the above Nondiscrimination covenants, the NCDOT will have the right to enter or re-enter the lands and facilities thereon, and the above described lands and facilities will there upon revert to and vest in and become the absolute property of the NCDOT and its assigns. *

(*Reverter clause and related language to be used only when it is determined that such a clause is necessary to make clear the purpose of Title VI.)

(c) Clauses for Construction/Use/Access to Real Property Acquired Under the Activity, Facility or Program (1050.2A, Appendix D)

The following clauses will be included in deeds, licenses, permits, or similar instruments/ agreements entered into by the North Carolina Department of Transportation (NCDOT) pursuant to the provisions of Assurance 7(b):

1. The (grantee, licensee, permittee, etc., as appropriate) for himself/herself, his/her heirs, personal representatives, successors in interest, and assigns, as a part of the consideration hereof, does hereby covenant and agree (in the case of deeds and leases add, "as a covenant running with the land") that (1) no person on the ground of race, color, or national origin, will be excluded from participation in, denied the benefits of, or be otherwise subjected to discrimination in the use of said facilities, (2) that in the construction of any improvements on, over, or under such land, and the furnishing of services thereon, no person on the ground of race, color, or national origin, will be excluded from participation in, denied the benefits of, or otherwise be subjected to discrimination, (3) that the (grantee, licensee, lessee, permittee, etc.) will use the premises in compliance with all other requirements imposed by or pursuant to the Acts and Regulations, as amended, set forth in this Assurance.
2. With respect to (licenses, leases, permits, etc.), in the event of breach of any of the above Non¬ discrimination covenants, the NCDOT will have the right to terminate the (license, permit, etc., as appropriate) and to enter or re-enter and repossess said land and the facilities thereon, and hold the same as if said (license, permit, etc., as appropriate) had never been made or issued. *
3. With respect to deeds, in the event of breach of any of the above Nondiscrimination covenants, the NCDOT will there upon revert to and vest in and become the absolute property of the NCDOT and its assigns. *

(*Reverter clause and related language to be used only when it is determined that such a clause is necessary to make clear the purpose of Title VI.)

STANDARD SPECIAL PROVISION

ON-THE-JOB TRAINING

(10-16-07) (Rev. 4-21-15) Z-10

Description

The North Carolina Department of Transportation will administer a custom version of the Federal On-the-Job Training (OJT) Program, commonly referred to as the Alternate OJT Program. All contractors (existing and newcomers) will be automatically placed in the Alternate Program. Standard OJT requirements typically associated with individual projects will no longer be applied at the project level. Instead, these requirements will be applicable on an annual basis for each contractor administered by the OJT Program Manager.

On the Job Training shall meet the requirements of 23 CFR 230.107 (b), 23 USC – Section 140, this provision and the On-the-Job Training Program Manual.

The Alternate OJT Program will allow a contractor to train employees on Federal, State and privately funded projects located in North Carolina. However, priority shall be given to training employees on NCDOT Federal-Aid funded projects.

Minorities and Women

Developing, training and upgrading of minorities and women toward journeyman level status is a primary objective of this special training provision. Accordingly, the Contractor shall make every effort to enroll minority and women as trainees to the extent that such persons are available within a reasonable area of recruitment. This training commitment is not intended, and shall not be used, to discriminate against any applicant for training, whether a member of a minority group or not.

Assigning Training Goals

The Department, through the OJT Program Manager, will assign training goals for a calendar year based on the contractors' past three years' activity and the contractors' anticipated upcoming year's activity with the Department. At the beginning of each year, all contractors eligible will be contacted by the Department to determine the number of trainees that will be assigned for the upcoming calendar year. At that time the Contractor shall enter into an agreement with the Department to provide a self-imposed on-the-job training program for the calendar year. This agreement will include a specific number of annual training goals agreed to by both parties. The number of training assignments may range from 1 to 15 per contractor per calendar year. The Contractor shall sign an agreement to fulfill their annual goal for the year.\

Training Classifications

The Contractor shall provide on-the-job training aimed at developing full journeyman level workers in the construction craft/operator positions. Preference shall be given to providing training in the following skilled work classifications:

Equipment Operators	Office Engineers
Truck Drivers	Estimators
Carpenters	Iron / Reinforcing Steel Workers
Concrete Finishers	Mechanics
Pipe Layers	Welders

The Department has established common training classifications and their respective training requirements that may be used by the contractors. However, the classifications established are not all-inclusive. Where the training is oriented toward construction applications, training will be allowed in lower-level management positions such as office engineers and estimators. Contractors shall submit new classifications for specific job functions that their employees are performing. The Department will review and recommend for acceptance to FHWA the new classifications proposed by contractors, if applicable. New classifications shall meet the following requirements:

Proposed training classifications are reasonable and realistic based on the job skill classification needs, and

The number of training hours specified in the training classification is consistent with common practices and provides enough time for the trainee to obtain journeyman level status.

The Contractor may allow trainees to be trained by a subcontractor provided that the Contractor retains primary responsibility for meeting the training and this provision is made applicable to the subcontract. However, only the Contractor will receive credit towards the annual goal for the trainee.

Where feasible, 25 percent of apprentices or trainees in each occupation shall be in their first year of apprenticeship or training. The number of trainees shall be distributed among the work classifications on the basis of the contractor's needs and the availability of journeymen in the various classifications within a reasonable area of recruitment.

No employee shall be employed as a trainee in any classification in which they have successfully completed a training course leading to journeyman level status or in which they have been employed as a journeyman.

Records and Reports

The Contractor shall maintain enrollment, monthly and completion reports documenting company compliance under these contract documents. These documents and any other information as requested shall be submitted to the OJT Program Manager.

Upon completion and graduation of the program, the Contractor shall provide each trainee with a certification Certificate showing the type and length of training satisfactorily completed.

Trainee Interviews

All trainees enrolled in the program will receive an initial and Trainee/Post graduate interview conducted by the OJT program staff.

Trainee Wages

Contractors shall compensate trainees on a graduating pay scale based upon a percentage of the prevailing minimum journeyman wages (Davis-Bacon Act). Minimum pay shall be as follows:

60 percent	of the journeyman wage for the first half of the training period
75 percent	of the journeyman wage for the third quarter of the training period
90 percent	of the journeyman wage for the last quarter of the training period

In no instance shall a trainee be paid less than the local minimum wage. The Contractor shall adhere to the minimum hourly wage rate that will satisfy both the NC Department of Labor (NCDOL) and the Department.

Achieving or Failing to Meet Training Goals

The Contractor will be credited for each trainee employed by him on the contract work who is currently enrolled or becomes enrolled in an approved program and who receives training for at least 50 percent of the specific program requirement. Trainees will be allowed to be transferred between projects if required by the Contractor's scheduled workload to meet training goals.

If a contractor fails to attain their training assignments for the calendar year, they may be taken off the NCDOT's Bidders List.

Measurement and Payment

No compensation will be made for providing required training in accordance with these contract documents.

STABILIZATION REQUIREMENTS:

(3-11-16) S-2A

Stabilization for this project shall comply with the time frame guidelines as specified by the NCG-010000 general construction permit effective August 1, 2016 issued by the North Carolina Department of Environmental Quality Division of Water Resources. Temporary or permanent ground cover stabilization shall occur within 7 calendar days from the last land-disturbing activity, with the following exceptions in which temporary or permanent ground cover shall be provided in 14 calendar days from the last land-disturbing activity:

- Slopes between 2:1 and 3:1, with a slope length of 10 ft. or less
- Slopes 3:1 or flatter, with a slope of length of 50 ft. or less
- Slopes 4:1 or flatter

The stabilization timeframe for High Quality Water (HQW) Zones shall be 7 calendar days with no exceptions for slope grades or lengths. High Quality Water Zones (HQW) Zones are defined by North Carolina Administrative Code 15A NCAC 04A.0105 (25). Temporary and permanent ground cover stabilization shall be achieved in accordance with the provisions in this contract and as directed.

SEEDING AND MULCHING: (East Crimp)

The kinds of seed and fertilizer, and the rates of application of seed, fertilizer, and limestone, shall be as stated below. During periods of overlapping dates, the kind of seed to be used shall be determined. All rates are in pounds per acre.

All Roadway Areas

March 1 - August 31		**September 1 - February 28**	
50#	Tall Fescue	50#	Tall Fescue
10#	Centipede	10#	Centipede
25#	Bermudagrass (hulled)	35#	Bermudagrass (unhulled)
500#	Fertilizer	500#	Fertilizer
4000#	Limestone	4000#	Limestone
10#	Millet	25#	Choose ONE of the Following Rye Grain, Wheat FFR 555, or Roane Wheat

Waste and Borrow Locations

March 1 – August 31		**September 1 - February 28**	
75#	Tall Fescue	75#	Tall Fescue
25#	Bermudagrass (hulled)	35#	Bermudagrass (unhulled)
500#	Fertilizer	500#	Fertilizer
4000#	Limestone	4000#	Limestone

Note: 50# of Bahiagrass may be substituted for either Centipede or Bermudagrass only upon Engineer's request.

Approved Tall Fescue Cultivars

06 Dust	Escalade	Justice	Scorpion
2nd Millennium	Essential	Kalahari	Serengeti
3rd Millennium	Evergreen 2		Shelby
Apache III	Falcon IV	Kitty Hawk 2000	Sheridan
Avenger	Falcon NG	Legitimate	Signia
Barlexas	Falcon V	Lexington	Silver Hawk
Barlexas II	Faith	LSD	Sliverstar
Bar Fa	Fat Cat	Magellan	Shenandoah Elite
Barrera	Festnova	Matador	Sidewinder
Barrington	Fidelity	Millennium SRP	Skyline
Barrobusto	Finelawn Elite	Monet	Solara
Barvado	Finelawn Xpress	Mustang 4	Southern Choice II
Biltmore	Finesse II	Ninja 2	Speedway
Bingo	Firebird	Ol' Glory	Spyder LS
Bizem	Firecracker LS	Olympic Gold	Sunset Gold
Blackwatch	Firenza	Padre	Taccoa
Blade Runner II	Five Point	Patagonia	Tanzania
Bonsai	Focus	Pedigree	Trio
Braveheart	Forte	Picasso	Tahoe II
Bravo	Garrison	Piedmont	Talladega
Bullseye	Gazelle II	Plantation	Tarheel
Cannavaro	Gold Medallion	Proseeds 5301	Terrano
Catalyst	Grande 3	Prospect	Titan ltd
Cayenne	Greenbrooks	Pure Gold	Titanium LS
Cessane Rz	Greenkeeper	Quest	Tracer
Chipper	Gremlin	Raptor II	Traverse SRP
Cochise IV	Greystone	Rebel Exeda	Tulsa Time
Constitution	Guardian 21	Rebel Sentry	Turbo
Corgi	Guardian 41	Rebel IV	Turbo RZ
Corona	Hemi	Regiment II	Tuxedo RZ
Coyote	Honky Tonk	Regenerate	Ultimate
Darlington	Hot Rod	Rendition	Venture
Davinci	Hunter	Rhambler 2 SRP	Umbrella
Desire	Inferno	Rembrandt	Van Gogh
Dominion	Innovator	Reunion	Watchdog
Dynamic	Integrity	Riverside	Wolfpack II
Dynasty	Jaguar 3	RNP	Xtremegreen
Endeavor	Jamboree	Rocket	

On cut and fill slopes 2:1 or steeper Centipede shall be applied at the rate of 5 pounds per acre and add 20# of Sericea Lespedeza from January 1 - December 31.

Fertilizer shall be 10-20-20 analysis. A different analysis of fertilizer may be used provided the 1-2-2 ratio is maintained and the rate of application adjusted to provide the same amount of plant food as a 10-20-20 analysis and as directed.

All areas seeded and mulched shall be tacked with asphalt. Crimping of straw in lieu of asphalt tack shall not be allowed on this project.

CRIMPING STRAW MULCH:

Crimping shall be required on this project adjacent to any section of roadway where traffic is to be maintained or allowed during construction. In areas within six feet of the edge of pavement, straw is to be applied and then crimped. After the crimping operation is complete, an additional application of straw shall be applied and immediately tacked with a sufficient amount of undiluted emulsified asphalt.

Straw mulch shall be of sufficient length and quality to withstand the crimping operation.

Crimping equipment including power source shall be subject to the approval of the Engineer providing that maximum spacing of crimper blades shall not exceed 8".

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

Project Special Provisions
Structures
Table of Contents

PROJECT SPECIAL PROVISIONS - STRUCTURE BP-3

VOLUMETRIC MIXER (12-18-12) BP-4
CONCRETE FOR DECK REPAIR (12-18-12) BP-6
SHOTCRETE REPAIRS (12-05-12) BP-8
FALSEWORK AND FORMWORK (04-05-12) BP-13
CRANE SAFETY (08-15-05) BP-20
MAINTENANCE OF WATER TRAFFIC (12-05-12) BP-21
WORK IN, OVER OR ADJACENT TO NAVIGABLE WATERS (12-05-12) BP-22
SECURING OF VESSELS (10-12-01) BP-23
SUBMITTAL OF WORKING DRAWINGS (06-28-17) BP-24
ASBESTOS ASSESSMENT FOR BRIDGE DEMOLITION AND RENOVATION ACTIVITIES (12-30-15) BP-25

ELASTOMERIC CONCRETE FOR PRESERVATION (SPECIAL) BP-28
FOAM JOINT SEALS FOR PRESERVATION (SPECIAL) BP-31
EXPANSION JOINT SEAL REPAIR (SPECIAL) BP-35
CONCRETE REPAIRS (SPECIAL) BP-38
EPOXY RESIN INJECTION (SPECIAL) BP-41
PLATFORM EXTENSIONS (SPECIAL) BP-45
UNDER STRUCTURE WORK PLATFORM (SPECIAL) BP-48
COAST GUARD COORDINATION (SPECIAL) BP-49
REPLACEMENT OF OPEN STEEL GRID DECK (SPECIAL) BP-50
REPLACEMENT OF FILLED GRID DECK (SPECIAL) BP-53
SILANE DECK TREATMENT (SPECIAL) BP-57
PAINTING EXISTING STRUCTURE (SPECIAL) BP-62
REPAIRS TO PRESTRESSED CONCRETE GIRDERS (SPECIAL) BP-77
EPOXY PROTECTIVE COATING (SPECIAL) BP-82
STRUCTURAL STEEL FOR REPAIRS (SPECIAL) BP-83
CLASS II SURFACE PREPARATION (SPECIAL) BP-85
BRIDGE JOINT DEMOLITION (SPECIAL) BP-88
BIRD DETERRENT SCREENING (SPECIAL) BP-89
PLASTIC GLAZING PANELS (SPECIAL) BP-90
EMBEDDED GALVANIC ANODE (SPECIAL) BP-92
THERMAL SPRAYED ANODE (SPECIAL) BP-96

PROJECT SPECIAL PROVISIONS - MECHANICAL BP-105

MECHANICAL OPERATING MACHINERY (SPECIAL) BP-106

PROJECT SPECIAL PROVISIONS – ELECTRICAL BP-138

BRIDGE ELECTRICAL WORK (SPECIAL) BP-139
BRIDGE BACKUP GENERATOR (SPECIAL) BP-167
SUBMARINE CABLES (SPECIAL) BP-173
TRAFFIC GATES (SPECIAL) BP-179
TRAFFIC SIGNALS (SPECIAL) BP-183

PROJECT SPECIAL PROVISIONS - UTILITIES BP-184

BRIDGE TENDER HOUSE SEWER LINE REPLACEMENT (SPECIAL) BP-185

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

ARCHITECTURAL SPECIFICATIONS FOR OPERATOR HOUSE RENOVATIONS..... BP-186

OPERATOR HOUSE RENOVATION (SPECIAL)..... BP-187
SELECTIVE DEMOLITION (SPECIAL) BP-188
ROUGH CARPENTRY (SPECIAL) BP-196
ROOF DECK AND INSULATION (SPECIAL)..... BP-203
MODIFIED BITUMINOUS MEMBRANE ROOFING (SPECIAL) BP-208
JOINT SEALANTS (SPECIAL)..... BP-220
STEEL DOORS AND FRAMES (SPECIAL) BP-233
GLAZED ALUMINUM CURTAIN WALL (SPECIAL)..... BP-245
DOOR HARDWARE (SPECIAL)..... BP-251
GENERAL GLAZING (SPECIAL) BP-266
ACOUSTICAL PANEL CEILINGS (SPECIAL) BP-278
RESILIENT BASE AND ACCESSORIES (SPECIAL)..... BP-287
RESILIENT TILE FLOORING (SPECIAL) BP-291
PAINTING (SPECIAL)..... BP-297
TOILET COMPARTMENTS (SPECIAL) BP-312
TOILET ACCESSORIES (SPECIAL)..... BP-316
ROLLER WINDOW SHADES (SPECIAL) BP-320
COMMON WORK RESULTS FOR PLUMBING (SPECIAL)..... BP-326
EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPES (SPECIAL) BP-334
SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING (SPECIAL) BP-340
ESCUTCHEONS FOR PLUMBING PIPING (SPECIAL)..... BP-345
GENERAL-DUTY VALVES FOR PLUMBING PIPING (SPECIAL)..... BP-347
HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT (SPECIAL) BP-352
IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT (SPECIAL)..... BP-368
PLUMBING PIPING INSULATION (SPECIAL) BP-374
DOMESTIC WATER PIPING (SPECIAL)..... BP-392
DOMESTIC WATER PIPING SPECIALTIES (SPECIAL) BP-403
SANITARY WASTE AND VENT PIPING (SPECIAL) BP-410
SANITARY WASTE PIPING SPECIALTIES (SPECIAL)..... BP-423
STORM DRAINAGE PIPING (SPECIAL) BP-434
STORM DRAINAGE PIPING SPECIALTIES (SPECIAL)..... BP-445
COMMON WORK RESULTS FOR HVAC (SPECIAL)..... BP-450
SLEEVES AND SLEEVE SEALS FOR HVAC PIPING (SPECIAL)..... BP-456
ESCUTCHEONS FOR HVAC PIPING (SPECIAL) BP-461
HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT (SPECIAL) BP-463
VIBRATION CONTROLS FOR HVAC PIPING AND EQUIPMENT (SPECIAL) BP-474
IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT (SPECIAL)..... BP-481
HVAC PIPING INSULATION (SPECIAL) BP-486
REFRIGERANT PIPING (SPECIAL) BP-502
METAL DUCTS (SPECIAL)..... BP-513
DUCT ACCESSORIES (SPECIAL) BP-521
POWER VENTILATORS (SPECIAL) BP-524
SPLIT-SYSTEM AIR-CONDITIONING UNITS (SPECIAL) BP-530
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (SPECIAL) BP-541
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS (SPECIAL) BP-546
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS (SPECIAL)..... BP-552
RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS (SPECIAL) BP-558
IDENTIFICATION FOR ELECTRICAL SYSTEMS (SPECIAL) BP-569
WIRING DEVICES (SPECIAL)..... BP-576
LED INTERIOR LIGHTING (SPECIAL) BP-582
DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM (SPECIAL) BP-591

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
PROJECT NO. 15BPR.14
NEW HANOVER COUNTY
REHABILITATION OF
ISABEL HOLMES BASCULE BRIDGE AND FIXED APPROACH SPANS

PROJECT SPECIAL PROVISIONS - STRUCTURE

- Volumetric Mixer (12-18-12)
- Concrete for Deck Repair (12-18-12)
- Shotcrete Repairs (12-05-12)
- Falsework and Formwork (04-05-12)
- Crane Safety (8-15-05)
- Maintenance of Water Traffic (12-05-12)
- Work in, Over or Adjacent to Navigable Waters (12-05-12)
- Securing of Vessels (10-12-01)
- Submittal of Working Drawings (06-28-17)
- Asbestos Assessment for Bridge Demolition and Renovation Activities (12-30-15)

- Elastomeric Concrete for Preservation (Special)
- Foam Joint Seals for Preservation (Special)
- Expansion Joint Seal Repair (Special)
- Concrete Repairs (Special)
- Epoxy Resin Injection (Special)
- Platform Extensions (Special)
- Under Structure Work Platform (Special)
- Coast Guard Coordination (Special)
- Replacement of Open Steel Grid Deck (Special)
- Replacement of Filled Grid Deck (Special)
- Silane Deck Treatment (Special)
- Painting Existing Structure (Special)
- Repairs to Prestressed Concrete Girders (Special)
- Epoxy Protective Coating (Special)
- Structural Steel for Repairs (Special)
- Class II Surface Preparation (Special)
- Bridge Joint Demolition (Special)
- Bird Deterrent Screening (Special)
- Plastic Glazing Panels (Special)
- Embedded Galvanic Anode (Special)
- Thermal Sprayed Anode (Special)

NORTH CAROLINA PROFESSIONAL SEAL 032967 ENGINEER JASON R. DOUGHTY

1/17/2019

DocuSigned by:
Jason R Doughty
5F73FA2DEA974E8...

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

VOLUMETRIC MIXER (12-18-12)

DESCRIPTION

This provision addresses the requirements for batching deck repair concrete at the point of delivery using a Mobile High Performance Volume Mixer (MHPVM). Work shall be in accordance with the general requirements of Section 1000-12 of the *Standard Specifications* and as amended by these provisions.

MATERIALS

Produce high early strength concrete with MHPVM equipment. Furnish project site storage facilities that will provide protection of materials in accordance with the *Standard Specifications* and all material suppliers' recommendations.

EQUIPMENT

MHPVM devices shall have prominently displayed stamped metal plate(s) from the Volumetric Mixers Manufacturers Bureau stating that the equipment conforms to the requirements of ASTM C685.

Hydraulic cement concrete shall be mixed at the point of delivery by a combination of materials and mixer unit conforming to the following:

1.) The unit shall be equipped with calibrated proportioning devices for each ingredient added to the concrete mix. The unit shall be equipped with a working recording meter that is visible at all times and furnishes a ticket printout with the calibrated measurement of the mix being produced. If at any time the mixer fails to discharge a uniform mix, production of concrete shall be suspended until such time that problems are corrected.

2.) Each unit shall have prominently displayed stamped metal plate(s) attached by the manufacturer on which the following are plainly marked: the gross volume of the transportation unit in terms of mixed concrete, the discharge speed and the mass calibrated constant of the machine in terms of volume.

3.) MHPVMs shall be calibrated by a Department approved testing agency in accordance with the manufacturer's recommendations at an interval of every 6 months or a maximum production of 2500 cubic yards, whichever comes first prior to use on the project. The yield shall be maintained within a tolerance of +/- 1% and verified using a minimum 2 cubic feet container every 500 cubic yards or a minimum of once per week.

4.) The three cubic feet initially discharged from the truck shall be discarded and not used for concrete placement. Acceptance of the concrete shall comply with the Standard Specifications except that the sample secured for acceptance testing will be taken after four cubic feet is discharged from the delivery vehicle. During discharge, the consistency as determined by ASTM C143 on representative samples taken from the mixer discharge at random intervals shall not vary by more than 1 inch. Acceptance tests shall be performed on each load. If test data demonstrates that acceptable consistency of concrete properties is being achieved, the Engineer may reduce testing requirements.

5.) MHPVM equipment shall be operated by a person who is a certified operator by the equipment manufacturer. Any equipment adjustments made during the on-site

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

production of concrete shall be done under the direct on-site supervision of the producer's NCDOT Certified Concrete Batch Technician.

UNIFORMITY AND ACCEPTANCE

The contractor is responsible for providing a Certified Concrete Plant Technician during batching operations, and a Certified Concrete Field Technician during placing operations

MEASUREMENT AND PAYMENT

Volumetric Mixer will be paid for as lump sum and will be full compensation for furnishing the certified MHPVM devices and calibration of the equipment.

Pay Item	Pay Unit
Volumetric Mixer	Lump Sum

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

CONCRETE FOR DECK REPAIR (12-18-12)

DESCRIPTION

This provision addresses the material requirements of high early strength structural concrete to be used for reconstruction of deck slab and, if necessary, bent diaphragms as noted in the plans.

MATERIALS

Furnish Department approved pre-packaged concrete or bulk concrete materials in a mix proportioned to satisfy provisions for Class AA Concrete detailed in Section 1000-4 of the *Standard Specifications* or as otherwise noted in these provisions. Concrete mix shall meet the following requirements:

Physical Property	Threshold Limitation	Test Method
Compressive Strength (at 3 hrs.)	4500 psi (min.)	ASTM C39/C109
Slump	4 in. (min.) 7 in. (max.)	AASHTO T119
Water to Cement Ratio	0.450 (max.)	N/A
Modulus of Elasticity (at 28 days)	5200 ksi (max.)	ASTM C469
Coefficient of Thermal Expansion (at 28 days)	4.5 in./in./^{o}F (min.) 5.5 in./in./^{o}F (max.)	AASHTO T336
Concrete Setting Times Initial Final	 30 min. (max.) 40 min. (max)	ASTM C191

Concrete shall be capable of placement on existing concrete substrate surfaces within the following temperature limitations:

40^0 F (min.)

100^0 F (max.)

Measurement for determination of concrete material compositions shall be in accordance with Section 1000-8 of the *Standard Specifications*.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

Submit pre-packaged concrete mix contents or concrete mix design, including laboratory compressive strength data, for a minimum of six 4-inch by 8-inch cylinders at an age of 3 hours and 1 day to the Engineer for review. Include test results for the slump and air content of the laboratory mix. Perform tests in accordance with AASHTO T119 and T152.

Provide aggregates that are free from ice, frost and frozen particles when introduced into the mixer.

For equipment, proportioning and mixing of concrete compositions, see Section 1000-12 of the *Standard Specification*s and the Special Provision entitled "Volumetric Mixer". Prior to beginning any work, obtain approval for all equipment to be used for joint area preparation, mixing, placing, finishing, and curing the deck repair concrete.

Measurement and Payment

Concrete for Deck Repair will be measured and paid for at the contract unit price bid for the actual cubic feet of concrete incorporated into the completed and accepted structure. This price and payment will be full compensation for furnishing the required amount of material to complete the deck repair.

Pay Item	Pay Unit
Concrete for Deck Repair	Cubic Feet

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

SHOTCRETE REPAIRS (12-5-12)

GENERAL

The work covered by this Special Provision consists of removing deteriorated concrete from the structure in accordance with the limits, depth and details shown on the plans, described herein and as established by the Engineer. This work also includes removing and disposing all loose debris, cleaning and repairing reinforcing steel and applying shotcrete.

The location and extent of repairs shown on the plans are general in nature. The Engineer shall determine the extent of removal in the field based on an evaluation of the condition of the exposed surfaces.

Any portion of the structure that is damaged from construction operations shall be repaired to the Engineer's satisfaction, at no extra cost to the Department.

MATERIAL REQUIREMENTS

Use prepackaged shotcrete conforming to the requirements of ASTM C1480, the applicable sections of the Standard Specifications and the following:

Test Description	Test Method	Age (Days)	Specified Requirements
Silica Fume (%)	ASTM C1240	-	10 (Max.)
Water/Cementitious Materials Ratio	-	-	0.40 (Max.)
Air Content - As Shot (%)	ASTM C231	-	4 ± 1
Slump - As Shot (Range in inches)	ASTM C143	-	2 - 3
Minimum Compressive Strength (psi)	ASTM C39	7 28	3,000 5,000
Minimum Bond Pull-off Strength (psi)	ASTM C1583	28	145
Rapid Chloride Permeability Tests (range in coulombs)	ASTM C1202	-	100 - 1000

Admixtures are not allowed unless approved by the Engineer. Store shotcrete in an environment where temperatures remain above 40°F and less than 95°F

All equipment must operate in accordance with the manufacturer's specifications and material must be placed within the recommended time.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

QUALITY CONTROL

A. Qualification of Shotcrete Contractor

The shotcrete Contractor shall provide proof of experience by submitting a description of jobs similar in size and character that have been completed within the last 5 years. The name, address and telephone number of references for the submitted projects shall also be furnished. Failure to provide appropriate documentation will result in the rejection of the proposed shotcrete contractor.

B. Qualification of Nozzleman

The shotcrete Contractor's nozzleman shall be certified by the American Concrete Institute (ACI). Submit proof of certification to the Engineer prior to beginning repair work. The nozzleman shall maintain certification at all times while work is being performed for the Department. Failure to provide and maintain certification will result in the rejection of the proposed nozzleman.

TEMPORARY WORK PLATFORM

Prior to beginning any repair work, provide details for a sufficiently sized temporary work platform at each repair location. Design steel members to meet the requirements of the American Institute of Steel Construction Manual. Design timber members in accordance with the "National Design Specification for Stress-Grade Lumber and Its Fastenings" of the National Forest Products Association. Submit the platform design and plans for review and approval. The design and plans shall be sealed and signed by a North Carolina registered Professional Engineer. Do not install the platform until the design and plans are approved. Drilling holes in the superstructure for the purpose of attaching the platform is prohibited. Upon completion of work, remove all anchorages in the substructure and repair the substructure at no additional cost to the Department.

SURFACE PREPARATION

Prior to starting the repair operation, delineate all surfaces and areas assumed to be deteriorated by visually examining and sounding the concrete surface with a hammer or other approved method. The Engineer is the sole judge in determining the limits of deterioration.

Prior to removal, introduce a shallow saw cut approximately ½" in depth around the repair area at right angles to the concrete surface. Remove all deteriorated concrete 1 inch below the reinforcing steel with a 17 lb (maximum) pneumatic hammer with points that do not exceed the width of the shank or with hand picks or chisels as directed by the Engineer. Do not cut or remove the existing reinforcing steel. Unless specifically directed by the Engineer, do not remove concrete deeper than 1 inch below the reinforcing steel.

Abrasive blast all exposed concrete surfaces and existing reinforcing steel in repair areas to remove all debris, loose concrete, loose mortar, rust, scale, etc. Use a wire brush to clean all exposed reinforcing steel. After sandblasting examine the reinforcing steel to ensure at

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

least 90% of the original diameter remains. If there is more than 10% reduction in the rebar diameter, splice in and securely tie supplemental reinforcing bars as directed by the Engineer.

Provide welded stainless wire fabric at each repair area larger than one square foot if the depth of the repair exceeds 2 inches from the "As Built" outside face. Provide a minimum 4" x 4" - 12 gage stainless welded wire fabric unless otherwise shown on the plans. Rigidly secure the welded wire fabric to existing steel or to 3/16" diameter stainless hook fasteners adequately spaced to prevent sagging. Encase the welded wire fabric in shotcrete a minimum depth of 1½ inches.

The contractor has the option to use synthetic fiber reinforcement as an alternate to welded wire fabric if attaching welded wire fabric is impractical or if approved by the Engineer. Welded wire fabric and synthetic fiber reinforcement shall not be used in the same repair area.

Thoroughly clean the repair area of all dirt, grease, oil or foreign matter, and remove all loose or weakened material before applying shotcrete. Saturate the repair area with clean water the day before applying shotcrete. Bring the wetted surface to a saturated surface dry (SSD) condition prior to applying shotcrete and maintain this condition until the application begins. Use a blowpipe to facilitate removal of free surface water. Only oil-free compressed air is to be used in the blowpipe.

The time between removal of deteriorated concrete and applying shotcrete shall not exceed 5 days. If the time allowance exceeds 5 days, prepare the surface at the direction of the Engineer before applying shotcrete.

APPLICATION AND SURFACE FINISH

Apply shotcrete only when the surface temperature of the repair area is greater than 40°F and less than 95°F. Do not apply shotcrete to frosted surfaces. Maintain shotcrete at a minimum temperature of 40°F for 3 days after placement.

Apply shotcrete in layers. The properties of the applied shotcrete determine the proper thickness of each layer or lift.

The nozzleman should hold the nozzle 3 to 4 feet from the surface being covered in a position that ensures the shotcrete strikes at right angles to the surface being covered without excessive impact. The nozzleman shall maintain the water amount at a practicable minimum, so the mix properly adheres to the repair area. Water content should not become high enough to cause the mix to sag or fall from vertical or inclined surfaces, or to separate in horizontal layers.

Use shooting wires or guide strips that do not entrap rebound sand. Use guide wires to provide a positive means of checking the total thickness of the shotcrete applied. Remove the guide wires prior to the final finish coat.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

To avoid leaving sand pockets in the shotcrete, blow or rake off sand that rebounds and does not fall clear of the work, or which collects in pockets in the work. Do not reuse rebound material in the work.

If a work stoppage longer than 2 hours takes place on any shotcrete layer prior to the time it has been built up to required thickness, saturate the area with clean water and use a blowpipe as outlined previously, prior to continuing with the remaining shotcrete course. Do not apply shotcrete to a dry surface.

Finish all repaired areas, including chamfered edges, as close as practicable to their original "As Built" dimensions and configuration. Provide a minimum 2" of cover for reinforcing steel exposed during repair. Slightly build up and trim shotcrete to the final surface by cutting with the leading edge of a sharp trowel. Use a rubber float to correct any imperfections. Limit work on the finished surface to correcting imperfections caused by trowel cutting.

Immediately after bringing shotcrete surfaces to final thickness, thoroughly check for sags, bridging, and other deficiencies. Repair any imperfections at the direction of the Engineer.

Prevent finished shotcrete from drying out by maintaining 95% relative humidity at the repair and surrounding areas by fogging, moist curing or other approved means for seven days.

MATERIAL TESTING & ACCEPTANCE

Each day shotcreting takes place, the nozzleman shall shoot one 18" x 18" x 3" test panel in the same position as the repair work that is being done to demonstrate the shotcrete is being applied properly. Store, handle and cure the test panel in the same manner as the repaired substructure.

Approximately 72 hours after completing the final shotcrete placement, thoroughly test the surface with a hammer. At this time, the repair area should have sufficient strength for all sound sections to ring sharply. Remove and replace any unsound portions prior to the final inspection of the work. No additional compensation will be provided for removal and replacement of unsound shotcrete.

After 7 days, core three 3" diameter samples from each test panel and from the repaired structure as directed by the Engineer. Any cores taken from the structure shall penetrate into the existing structure concrete at least 2 inches. Cores shall be inspected for delamination, sand pockets, tested for bond strength and compressive strength. If a core taken from a repaired structure unit indicates unsatisfactory application or performance of the shotcrete, take additional cores from the applicable structure unit(s) for additional evaluation and testing as directed by the Engineer. Any repair work failing to meet the requirements of this provision will be rejected and the Contractor shall implement a remediation plan to correct the deficiency at no additional cost to the Department. No extra payment will be provided for drilling extra cores. Patch all core holes in repaired structure units to the satisfaction of the Engineer. All material testing, core testing and sampling will be done by the Materials and Tests Unit of North Carolina Department of Transportation.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

MEASUREMENT AND PAYMENT

Shotcrete Repairs will be measured and paid for at the contract unit price bid per cubic foot and will be full compensation for removal, containment and disposal off-site of unsound concrete including the cost of materials, labor, tools, equipment and incidentals necessary to complete the repair work. Depth will be measured from the original outside concrete face. The Contractor and Engineer will measure quantities after removal of unsound concrete and before application of repair material. Payment will also include the cost of sandblasting, surface cleaning and preparation, cleaning of reinforcing steel, placement of new steel, cost of temporary work platform, testing for soundness, curing of shotcrete and taking core samples from the test panels and substructure units.

Payment will be made under:

Pay Item	**Pay Unit**
Shotcrete Repairs	Cubic Feet

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

FALSEWORK AND FORMWORK (4-5-12)

1.0 DESCRIPTION

Use this Special Provision as a guide to develop temporary works submittals required by the Standard Specifications or other provisions; no additional submittals are required herein. Such temporary works include, but are not limited to, falsework and formwork.

Falsework is any temporary construction used to support the permanent structure until it becomes self-supporting. Formwork is the temporary structure or mold used to retain plastic or fluid concrete in its designated shape until it hardens. Access scaffolding is a temporary structure that functions as a work platform that supports construction personnel, materials, and tools, but is not intended to support the structure. Scaffolding systems that are used to temporarily support permanent structures (as opposed to functioning as work platforms) are considered to be falsework under the definitions given. Shoring is a component of falsework such as horizontal, vertical, or inclined support members. Where the term "temporary works" is used, it includes all of the temporary facilities used in bridge construction that do not become part of the permanent structure.

Design and construct safe and adequate temporary works that will support all loads imposed and provide the necessary rigidity to achieve the lines and grades shown on the plans in the final structure.

2.0 MATERIALS

Select materials suitable for temporary works; however, select materials that also ensure the safety and quality required by the design assumptions. The Engineer has authority to reject material on the basis of its condition, inappropriate use, safety, or nonconformance with the plans. Clearly identify allowable loads or stresses for all materials or manufactured devices on the plans. Revise the plan and notify the Engineer if any change to materials or material strengths is required.

3.0 DESIGN REQUIREMENTS

A. Working Drawings

Provide working drawings for items as specified in the contract, or as required by the Engineer, with design calculations and supporting data in sufficient detail to permit a structural and safety review of the proposed design of the temporary work.

On the drawings, show all information necessary to allow the design of any component to be checked independently as determined by the Engineer.

When concrete placement is involved, include data such as the drawings of proposed sequence, rate of placement, direction of placement, and location of all construction joints. Submit the number of copies as called for by the contract.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

When required, have the drawings and calculations prepared under the guidance of, and sealed by, a North Carolina Registered Professional Engineer who is knowledgeable in temporary works design.

If requested by the Engineer, submit with the working drawings manufacturer's catalog data listing the weight of all construction equipment that will be supported on the temporary work. Show anticipated total settlements and/or deflections of falsework and forms on the working drawings. Include falsework footing settlements, joint take-up, and deflection of beams or girders.

As an option for the Contractor, overhang falsework hangers may be uniformly spaced, at a maximum of 36 inches, provided the following conditions are met:

Member Type (PCG)	Member Depth, (inches)	Max. Overhang Width, (inches)	Max. Slab Edge Thickness, (inches)	Max. Screed Wheel Weight, (lbs.)	Bracket Min. Vertical Leg Extension, (inches)
II	36	39	14	2000	26
III	45	42	14	2000	35
IV	54	45	14	2000	44
MBT	63	51	12	2000	50
MBT	72	55	12	1700	48

Overhang width is measured from the centerline of the girder to the edge of the deck slab.

For Type II, III & IV prestressed concrete girders (PCG), 45-degree cast-in-place half hangers and rods must have a minimum safe working load of 6,000 lbs.

For MBT prestressed concrete girders, 45-degree angle holes for falsework hanger rods shall be cast through the girder top flange and located, measuring along the top of the member, 1'-2 ½" from the edge of the top flange. Hanger hardware and rods must have a minimum safe working load of 6,000 lbs.

The overhang bracket provided for the diagonal leg shall have a minimum safe working load of 3,750 lbs. The vertical leg of the bracket shall extend to the point that the heel bears on the girder bottom flange, no closer than 4 inches from the bottom of the member. However, for 72-inch members, the heel of the bracket shall bear on the web, near the bottom flange transition.

Provide adequate overhang falsework and determine the appropriate adjustments for deck geometry, equipment, casting procedures and casting conditions.

If the optional overhang falsework spacing is used, indicate this on the falsework submittal and advise the girder producer of the proposed details. Failure to notify the Engineer of hanger type and hanger spacing on prestressed concrete girder casting drawings may delay the approval of those drawings.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

Falsework hangers that support concentrated loads and are installed at the edge of thin top flange concrete girders (such as bulb tee girders) shall be spaced so as not to exceed 75% of the manufacturer's stated safe working load. Use of dual leg hangers (such as Meadow Burke HF-42 and HF-43) are not allowed on concrete girders with thin top flanges. Design the falsework and forms supporting deck slabs and overhangs on girder bridges so that there will be no differential settlement between the girders and the deck forms during placement of deck concrete.

When staged construction of the bridge deck is required, detail falsework and forms for screed and fluid concrete loads to be independent of any previous deck pour components when the mid-span girder deflection due to deck weight is greater than ¾".

Note on the working drawings any anchorages, connectors, inserts, steel sleeves or other such devices used as part of the falsework or formwork that remains in the permanent structure. If the plan notes indicate that the structure contains the necessary corrosion protection required for a Corrosive Site, epoxy coat, galvanize or metalize these devices. Electroplating will not be allowed. Any coating required by the Engineer will be considered incidental to the various pay items requiring temporary works.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

Design falsework and formwork requiring submittals in accordance with the 1995 AASHTO *Guide Design Specifications for Bridge Temporary Works* except as noted herein.

1. Wind Loads

   Table 2.2 of Article 2.2.5.1 is modified to include wind velocities up to 110 mph. In addition, Table 2.2A is included to provide the maximum wind speeds by county in North Carolina.

Table 2.2 - Wind Pressure Values

Height Zone feet above ground	Pressure, lb/ft^2 for Indicated Wind Velocity, mph				
	70	80	90	100	110
0 to 30	15	20	25	30	35
30 to 50	20	25	30	35	40
50 to 100	25	30	35	40	45
over 100	30	35	40	45	50

2. Time of Removal

   The following requirements replace those of Article 3.4.8.2.

   Do not remove forms until the concrete has attained strengths required in Article 420-16 of the Standard Specifications and these Special Provisions.

   Do not remove forms until the concrete has sufficient strength to prevent damage to the surface.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

Table 2.2A - Steady State Maximum Wind Speeds by Counties in North Carolina

COUNTY	25 YR (mph)	COUNTY	25 YR (mph)	COUNTY	25 YR (mph)
Alamance	70	Franklin	70	Pamlico	100
Alexander	70	Gaston	70	Pasquotank	100
Alleghany	70	Gates	90	Pender	100
Anson	70	Graham	80	Perquimans	100
Ashe	70	Granville	70	Person	70
Avery	70	Greene	80	Pitt	90
Beaufort	100	Guilford	70	Polk	80
Bertie	90	Halifax	80	Randolph	70
Bladen	90	Harnett	70	Richmond	70
Brunswick	100	Haywood	80	Robeson	80
Buncombe	80	Henderson	80	Rockingham	70
Burke	70	Hertford	90	Rowan	70
Cabarrus	70	Hoke	70	Rutherford	70
Caldwell	70	Hyde	110	Sampson	90
Camden	100	Iredell	70	Scotland	70
Carteret	110	Jackson	80	Stanley	70
Caswell	70	Johnston	80	Stokes	70
Catawba	70	Jones	100	Surry	70
Cherokee	80	Lee	70	Swain	80
Chatham	70	Lenoir	90	Transylvania	80
Chowan	90	Lincoln	70	Tyrell	100
Clay	80	Macon	80	Union	70
Cleveland	70	Madison	80	Vance	70
Columbus	90	Martin	90	Wake	70
Craven	100	McDowell	70	Warren	70
Cumberland	80	Mecklenburg	70	Washington	100
Currituck	100	Mitchell	70	Watauga	70
Dare	110	Montgomery	70	Wayne	80
Davidson	70	Moore	70	Wilkes	70
Davie	70	Nash	80	Wilson	80
Duplin	90	New Hanover	100	Yadkin	70
Durham	70	Northampton	80	Yancey	70
Edgecombe	80	Onslow	100		
Forsyth	70	Orange	70		

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

B. Review and Approval

The Engineer is responsible for the review and approval of temporary works' drawings.

Submit the working drawings sufficiently in advance of proposed use to allow for their review, revision (if needed), and approval without delay to the work.

The time period for review of the working drawings does not begin until complete drawings and design calculations, when required, are received by the Engineer.

Do not start construction of any temporary work for which working drawings are required until the drawings have been approved. Such approval does not relieve the Contractor of the responsibility for the accuracy and adequacy of the working drawings.

4.0 CONSTRUCTION REQUIREMENTS

All requirements of Section 420 of the Standard Specifications apply.

Construct temporary works in conformance with the approved working drawings. Ensure that the quality of materials and workmanship employed is consistent with that assumed in the design of the temporary works. Do not weld falsework members to any portion of the permanent structure unless approved. Show any welding to the permanent structure on the approved construction drawings.

Provide tell-tales attached to the forms and extending to the ground, or other means, for accurate measurement of falsework settlement. Make sure that the anticipated compressive settlement and/or deflection of falsework does not exceed 1 inch. For cast-in-place concrete structures, make sure that the calculated deflection of falsework flexural members does not exceed 1/240 of their span regardless of whether or not the deflection is compensated by camber strips.

A. Maintenance and Inspection

Inspect and maintain the temporary work in an acceptable condition throughout the period of its use. Certify that the manufactured devices have been maintained in a condition to allow them to safely carry their rated loads. Clearly mark each piece so that its capacity can be readily determined at the job site.

Perform an in-depth inspection of an applicable portion(s) of the temporary works, in the presence of the Engineer, not more than 24 hours prior to the beginning of each concrete placement. Inspect other temporary works at least once a month to ensure that they are functioning properly. Have a North Carolina Registered Professional Engineer inspect the cofferdams, shoring, sheathing, support of excavation structures, and support systems for load tests prior to loading.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

B. Foundations

Determine the safe bearing capacity of the foundation material on which the supports for temporary works rest. If required by the Engineer, conduct load tests to verify proposed bearing capacity values that are marginal or in other high-risk situations.

The use of the foundation support values shown on the contract plans of the permanent structure is permitted if the foundations are on the same level and on the same soil as those of the permanent structure.

Allow for adequate site drainage or soil protection to prevent soil saturation and washout of the soil supporting the temporary works supports.

If piles are used, the estimation of capacities and later confirmation during construction using standard procedures based on the driving characteristics of the pile is permitted. If preferred, use load tests to confirm the estimated capacities; or, if required by the Engineer conduct load tests to verify bearing capacity values that are marginal or in other high risk situations.

The Engineer reviews and approves the proposed pile and soil bearing capacities.

5.0 REMOVAL

Unless otherwise permitted, remove and keep all temporary works upon completion of the work. Do not disturb or otherwise damage the finished work.

Remove temporary works in conformance with the contract documents. Remove them in such a manner as to permit the structure to uniformly and gradually take the stresses due to its own weight.

6.0 METHOD OF MEASUREMENT

Unless otherwise specified, temporary works will not be directly measured.

7.0 BASIS OF PAYMENT

Payment at the contract unit prices for the various pay items requiring temporary works will be full compensation for the above falsework and formwork.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

CRANE SAFETY (8-15-05)

Comply with the manufacturer specifications and limitations applicable to the operation of any and all cranes and derricks. Prime contractors, sub-contractors, and fully operated rental companies shall comply with the current Occupational Safety and Health Administration regulations (OSHA).

Submit all items listed below to the Engineer prior to beginning crane operations involving critical lifts. A critical lift is defined as any lift that exceeds 75 percent of the manufacturer's crane chart capacity for the radius at which the load will be lifted or requires the use of more than one crane. Changes in personnel or equipment must be reported to the Engineer and all applicable items listed below must be updated and submitted prior to continuing with crane operations.

CRANE SAFETY SUBMITTAL LIST

A. **Competent Person:** Provide the name and qualifications of the "Competent Person" responsible for crane safety and lifting operations. The named competent person will have the responsibility and authority to stop any work activity due to safety concerns.

B. **Riggers:** Provide the qualifications and experience of the persons responsible for rigging operations. Qualifications and experience should include, but not be limited to, weight calculations, center of gravity determinations, selection and inspection of sling and rigging equipment, and safe rigging practices.

C. **Crane Inspections:** Inspection records for all cranes shall be current and readily accessible for review upon request.

D. **Certifications:** **By July 1, 2006**, crane operators performing critical lifts shall be certified by NC CCO (National Commission for the Certification of Crane Operators), or satisfactorily complete the Carolinas AGC's Professional Crane Operator's Proficiency Program. Other approved nationally accredited programs will be considered upon request. All crane operators shall also have a current CDL medical card. Submit a list of anticipated critical lifts and corresponding crane operator(s). Include current certification for the type of crane operated (small hydraulic, large hydraulic, small lattice, large lattice) and medical evaluations for each operator.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

MAINTENANCE OF WATER TRAFFIC **(12-5-12)**

The Contractor will be required to maintain water traffic in a manner satisfactory to both the Engineer and the U.S. Coast Guard and in conformance with the conditions of the Bridge Permit issued by the U.S. Coast Guard. The Contractor shall provide and maintain navigational lights in conformance with the requirements of the U.S. Coast Guard on both temporary and permanent work and shall carry on all operations in connection with the construction of the project in such a manner as to avoid damage or delay to water traffic.

No direct payment will be made for work under this section. All costs shall be considered incidental to items for which direct payment is made.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

WORK IN, OVER OR ADJACENT TO NAVIGABLE WATERS **(12-5-12)**

All work in, over, or adjacent to navigable waters shall be in accordance with the special provisions and conditions contained in the permits obtained by the Department from the U.S. Coast Guard, U.S. Army Corps of Engineers, or other authority having jurisdiction. The work shall have no adverse effect on navigation of the waterway including traffic flow, navigational depths, and horizontal and vertical clearances without approval from the authorities granting the permits.

The Contractor shall prepare drawings necessary to obtain any permits which may be required for his operations which are not included in the Department's permit including but not limited to excavation and dumping, constructing wharves, piers, ramps, and other structures connecting to bank or shore, and drawings for constructing falsework, cofferdams, sheeting, temporary bridges, and any other construction within the waterway. Submittals shall show locations of such work with respect to the navigational opening. The Contractor shall coordinate the submittal of drawings with the Engineer.

All construction shall progress and be maintained in a safe and timely manner. Temporary construction facilities shall be removed completely and promptly upon discontinuation of their useful purpose. Navigational lights, signals, or facilities shall be provided and maintained by the Contractor on temporary or permanent construction or vessels until such facilities are no longer needed as determined by the Engineer or permitting agency.

The Contractor shall immediately notify the appropriate authorities and take corrective measures as needed when any situation occurs that imposes a threat to the public. He shall also immediately correct any acts or occurrences that contradict or violate any requirements in the plans, special provisions, or permits when corrective measures can be performed in a safe manner. The Contractor shall notify the appropriate authorities when such corrective measures cannot be performed in a safe manner.

All costs incurred by the Contractor in complying with the above requirements shall be included in the prices bid for the various pay items and no additional payment will be made.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

SECURING OF VESSELS **(10-12-01)**

Secure vessels in accordance with Section 107 of the Standard Specifications and the following provision.

When utilizing barges, tugboats or other vessels, take all necessary precautions to ensure that such vessels are securely anchored or moored when not in active operation. Take all necessary measures to ensure that the vessels are operated in a manner that avoids damage to or unnecessary contact with bridges and other highway structures and attachments. If severe weather conditions are anticipated, or should be anticipated through reasonable monitoring of weather forecasts, take additional measures to protect bridges and other highway structures and attachments from extreme conditions. The Contractor is strictly liable for damages to any bridge or other highway structure or attachment caused by a vessel owned or controlled by the Contractor. The Contractor is also liable to third parties for property damages and loss of revenue caused by vessels under the Contractor's control.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

SUBMITTAL OF WORKING DRAWINGS (6-28-17)

1.0 GENERAL

Submit working drawings in accordance with Article 105-2 of the *Standard Specifications* and this provision. For this provision, "submittals" refers to only those listed in this provision. The list of submittals contained herein does not represent a list of required submittals for the project. Submittals are only necessary for those items as required by the contract. Make submittals that are not specifically noted in this provision directly to the Engineer. Either the Structures Management Unit or the Geotechnical Engineering Unit or both units will jointly review submittals.

If a submittal contains variations from plan details or specifications or significantly affects project cost, field construction or operations, discuss the submittal with and submit all copies to the Engineer. State the reason for the proposed variation in the submittal. To minimize review time, make sure all submittals are complete when initially submitted. Provide a contact name and information with each submittal. Direct any questions regarding submittal requirements to the Engineer, Structures Management Unit contacts or the Geotechnical Engineering Unit contacts noted below.

In order to facilitate in-plant inspection by NCDOT and approval of working drawings, provide the name, address and telephone number of the facility where fabrication will actually be done if different than shown on the title block of the submitted working drawings. This includes, but is not limited to, precast concrete items, prestressed concrete items and fabricated steel or aluminum items.

2.0 ADDRESSES AND CONTACTS

For submittals to the Structures Management Unit, use the following addresses:

Via US mail:

Mr. B. C. Hanks, P. E.
State Structures Engineer
North Carolina Department
of Transportation
Structures Management Unit
1581 Mail Service Center
Raleigh, NC 27699-1581

Attention: Mr. J. L. Bolden, P. E.

Via other delivery service:

Mr. B. C. Hanks, P. E.
State Structures Engineer
North Carolina Department
of Transportation
Structures Management Unit
1000 Birch Ridge Drive
Raleigh, NC 27610

Attention: Mr. J. L. Bolden, P. E.

Submittals may also be made via email.

Send submittals to:

jlbolden@ncdot.gov (James Bolden)

Send an additional e-copy of the submittal to the following address:

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

ASBESTOS ASSESSMENT FOR BRIDGE DEMOLITION AND RENOVATION ACTIVITIES **(12-30-15)**

1.0 INSPECTION FOR ASBESTOS CONTAINING MATERIAL

Prior to conducting bridge demolition or renovation activities, the Contractor shall thoroughly inspect the bridge or affected components for the presence of asbestos containing material (ACM) using a firm prequalified by NCDOT to perform asbestos surveys. The inspection must be performed by a N.C. accredited asbestos inspector with experience inspecting bridges or other industrial structures. The N.C. accredited asbestos inspector must conduct a thorough inspection, identifying all asbestos-containing material as required by the Environmental Protection Agency National Emission Standards for Hazardous Air Pollutants (NESHAP) Code of Federal Regulations (CFR) 40 CFR, Part 61, Subpart M.

The Contractor shall submit an inspection report to the Engineer, which at a minimum must include information required in 40 CFR 763.85 (a)(4) vi)(A)-(E), as well as a project location map, photos of existing structure, the date of inspection and the name, N.C. accreditation number, and signature of the N.C. accredited asbestos inspector who performed the inspection and completed the report. The cover sheet of the report shall include project identification information. Place the following notes on the cover sheet of the report and check the appropriate box:

___ ACM was found
___ ACM was not found

2.0 REMOVAL AND DISPOSAL OF ASBESTOS CONTAINING MATERIAL

If ACM is found, notify the Engineer. Compensation for removal and disposal of ACM is considered extra work in accordance with Article 104-7 of the Standard Specifications.

An Asbestos Removal Permit must be obtained from the Health Hazards Control Unit (HHCU) of the N.C. Department of Health & Human Services, Division of Public Health, if more than 35 cubic feet, 160 square feet, or 260 linear feet of regulated ACM (RACM) is to be removed from a structure and this work must be completed by a contractor prequalified by NCDOT to perform asbestos abatement. RACM is defined in 40 CFR, Part 61, Subpart M. Note: 40 CFR 763.85 (a)(4) vi)(D) defines ACM as surfacing, TSI and Miscellaneous which does not meet the NESHAP RACM.

3.0 DEMOLITION NOTIFICATION

Even if no ACM is found (or if quantities are less than those required for a permit), a Demolition Notification (DHHS-3768) must be submitted to the HHCU. Notifications and Asbestos Permit applications require an original signature and must be submitted to the HHCU 10 working days prior to beginning demolition activities. The 10 working day period starts based on the post-marked date or date of hand delivery. Demolition that does not begin as originally notified requires submission of a separate revision form HHCU

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

3768-R to HHCU. Reference the North Carolina Administrative Code, Chapter 10A, Subchapter 41C, Article .0605 for directives on revision submissions.

Contact Information
Health Hazards Control Unit (HHCU)
N.C. Department of Health and Human Services
1912 Mail Service Center
Raleigh, NC 27699-1912
Telephone: (919) 707-5950
Fax: (919) 870-4808

4.0 SPECIAL CONSIDERATIONS

Buncombe, Forsyth, and Mecklenburg counties also have asbestos permitting and NESHAP requirements must be followed. For projects involving permitted RACM removals, both the applicable county and the state (HHCU) must be notified.

For demolitions with no RACM, only the local environmental agencies must be notified. Contact information is as follows:

Buncombe County
WNC Regional Air Pollution Control Agency
49 Mt. Carmel Road
Asheville, NC 28806
(828) 250-6777

Forsyth County
Environmental Affairs Department
537 N. Spruce Street
Winston-Salem, NC 27101
(336) 703-2440

Mecklenburg County
Land Use and Environmental Services Agency
Mecklenburg Air Quality
700 N. Tryon Street
Charlotte, NC 28202
(704) 336-5430

5.0 ADDITIONAL INFORMATION

Additional information may be found on N.C. asbestos rules, regulations, procedures and N.C. accredited inspectors, as well as associated forms for demolition notifications and asbestos permit applications at the N.C. Asbestos Hazard Management Program website:

www.epi.state.nc.us/epi/asbestos/ahmp.html

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

6.0 BASIS OF PAYMENT

Payment for the work required in this provision will be at the lump sum contract unit price for "Asbestos Assessment". Such payment will be full compensation for all asbestos inspections, reports, permitting and notifications.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

ELASTOMERIC CONCRETE FOR PRESERVATION (SPECIAL)

DESCRIPTION

Elastomeric concrete is a mixture of a two-part polymer consisting of polyurethane and/or epoxy and kiln-dried aggregate. Provide an elastomeric concrete and binder system that is preapproved. Use the concrete in the blocked out areas on both sides of the bridge deck joints as indicated on the plans.

MATERIALS

Provide materials that comply with the following minimum requirements at 14 days (or at the end of the specified curing time).

ELASTOMERIC CONCRETE PROPERTIES	TEST METHOD	MINIMUM REQUIREMENT
Compressive Strength, psi	ASTM D695	2000
5% Deflection Resilience	ASTM D695	95
Splitting Tensile Strength, psi	ASTM D3967	625
Bond Strength to Concrete, psi	ASTM C882 (C882M)	450
Durometer Hardness	ASTM D2240	50

BINDER PROPERTIES (without aggregate)	TEST METHOD	MINIMUM REQUIREMENT
Tensile Strength, psi	ASTM D638	1000
Ultimate Elongation	ASTM D638	150%
Tear Resistance, lb/in	ASTM D624	200

In addition to the requirements above, the elastomeric concrete must be resistant to water, chemical, UV and ozone exposure and withstand temperature extremes. Elastomeric concrete systems requiring preheated aggregates are not allowed.

PREQUALIFICATION

Manufacturers of elastomeric concrete materials shall submit samples (including aggregate, primer and binder materials) and a Type 3 certification in accordance with Article 106-3 of the *Standard Specifications* for prequalification to:

North Carolina Department of Transportation

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

Materials and Tests Unit
1801 Blue Ridge Road
Raleigh, NC 27607

Prequalification will be determined for the system. Individual components will not be evaluated, nor will individual components of previously evaluated systems be deemed prequalified for use.

The submitted binder (a minimum volume of 1 gallon) and corresponding aggregate samples will be evaluated for compliance with the Materials requirements specified above. Systems satisfying all of the Materials requirements will be prequalified for a one (1) year period. Before the end of this period new product samples shall be resubmitted for prequalification evaluation.

If, at any time, any formulation or component modifications are made to a prequalified system that system will no longer be approved for use.

INSTALLATION

The elastomeric concrete shall not be placed until the reinforced concrete deck slab or overlay has cured for seven (7) full days and reached a minimum strength of 3,000 psi.

Provide a manufacturer's representative at the bridge site during the installation of the elastomeric concrete to ensure that all steps being performed comply with all manufacturer installation requirements including, but not limited to: weather conditions (ambient temperature, relative humidity, precipitation, wind, etc.), concrete deck surface preparation, binder and aggregate mixing, primer application, elastomeric concrete placement, curing conditions and minimum curing time before joint exposure to traffic. Do not place elastomeric concrete if the ambient air or surface temperature is below 45°F.

Prepare the concrete surface within 48 hours prior to placing the elastomeric concrete. Before placing the elastomeric concrete, all concrete surfaces shall be thoroughly cleaned and dry. Sandblast the concrete surface in the blockout and clear the surface of all loose debris. Do not place the elastomeric concrete until the surface preparation is completed and approved.

Prepare and apply a primer, as per manufacturer's recommendations, to all concrete faces to be in contact with elastomeric concrete, and to areas specified by the manufacturer.

Prepare, batch, and place the elastomeric concrete in accordance with the manufacturer's instructions. Place the elastomeric concrete in the areas specified on the plans while the primer is still tacky and within two (2) hours after applying the primer. Trowel the elastomeric concrete to a smooth finish.

The joint opening in the elastomeric concrete shall match the formed opening in the concrete deck prior to sawing the joint.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

FIELD SAMPLING

Provide additional production material to allow freshly mixed elastomeric concrete to be sampled for acceptance. A minimum of six (6) 2-inch cube molds and three (3) 3-inch diameter x 6-inch cylinders will be taken by the Department for each day's production. Compression, splitting tensile, and durometer hardness testing will be performed by the Department to determine acceptance. Materials failing to meet the requirements listed above are subject to removal and replacement at no cost to the Department.

BASIS OF PAYMENT

Elastomeric Concrete for Preservation will be measured and paid for at the contract unit price bid per cubic foot and will be full compensation for material, labor, tools, and equipment necessary for satisfactorily installing the elastomeric concrete in place.

Pay Item	Pay Unit
Elastomeric Concrete for Preservation	Cubic Feet

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

FOAM JOINT SEALS FOR PRESERVATION (SPECIAL)

SEALS

Use preformed seals compatible with concrete and resistant to abrasion, oxidation, oils, gasoline, salt, and other materials that are spilled on or applied to the surface. Use a resilient, UV stable, preformed, impermeable, flexible, expansion joint seal. The joint seal shall consist of low-density, closed cell, cross-linked polyethylene non-extrudable foam. The joint seal shall contain no EVA (Ethylene Vinyl Acetate). Cell generation shall be achieved by being physically blown using nitrogen. No chemical blowing agents shall be used in the cell generation process.

Use seals manufactured with grooves ⅛" ± wide by ⅛" ± deep and spaced between ¼" and ½" apart along the bond surface running the length of the joint. Use seals with a depth that meets the manufacturer's recommendation, but is not less than 70% of the uncompressed width. Provide a seal designed so that, when compressed, the center portion of the top does not extend upward above the original height of the seal by more than ¼". Provide a seal that has a working range of 30% tension and 60% compression and meets the requirements given below.

TEST	TEST METHOD	REQUIREMENT
Tensile Strength	ASTM D3575, Suffix T	110 – 130 psi
Compression Set	ASTM D1056 Suffix B, 2 hr recovery	10% - 16%
Water Absorption	ASTM D3575	< 0.03 lb/ft^2
Elongation at Break	ASTM D3575	180% - 210%
Tear Resistance	ASTM D624 (D3575, Suffix G)	14 – 20 pli
Density	ASTM D3575, Suffix W, Method A	1.8 – 2.2 lb/ft^3
Toxicity	ISO-10993.5	Pass (not cytotoxic)

Have the top of the joint seal clearly shop marked. Inspect the joint seals upon receipt to ensure that the marks are clearly visible before installation.

BONDING ADHESIVE

Use a two-component, 100% solid, modified epoxy adhesive supplied by the joint seal manufacturer that meets the requirements given below.

TEST	TEST METHOD	REQUIREMENT
Tensile strength	ASTM D638	3,000 psi (min.)
Compressive strength	ASTM D695	7,000 psi (min.)
Hardness	Shore D Scale	75-85 psi
Water Absorption	ASTM D570	0.25% by weight max.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

Elongation to Break	ASTM D638	5% (max.)
Bond Strength	ASTM C882	2,000 psi (min.)

Use an adhesive that is workable to 40°F. When installing in ambient air or surface temperatures below 40°F or for application on moist, difficult to dry concrete surfaces, use an adhesive specified by the manufacturer of the joint seal.

SAWING THE JOINT

The concrete at the face of the joint (elastomeric concrete, polyester polymer concrete, Portland cement concrete, etc.) shall have sufficient time to cure such that no damage can occur to the concrete prior to sawing to the final width and depth as specified in the plans.

When sawing the joint to receive the foam seal, always use a rigid guide to control the saw in the desired direction. To control the saw and to produce a straight line as indicated on the plans, anchor and positively connect a template or a track to the bridge deck. Do not saw the joint by visual means such as a chalk line. Fill the holes used for holding the template or track to the deck with an approved flowable, non-shrink, non-metallic grout.

Saw cut to the desired width and depth in one (1) or two (2) passes of the saw by placing and spacing two (2) metal blades on the saw shaft to the desired width for the joint opening.

The desired depth is the depth of the seal plus ¼" above the top of the seal plus approximately 1" below the bottom of the seal. An irregular bottom of sawed joint is permitted as indicated on the plans. Grind exposed corners on saw cut edges to a ¼" chamfer.

Saw cut a straight joint, centered over the formed opening and to the desired width specified in the plans. Prevent any chipping or damage to the sawed edges of the joint.

Remove any staining or deposited material resulting from sawing with a wet blade to the satisfaction of the Engineer.

PREPARATION OF SAWED JOINT FOR SEAL INSTALLATION

The elastomeric concrete or polyester polymer concrete at the joint shall cure a minimum of 24 hours prior to seal installation. Portland cement concrete at the joint shall cure following the special provisions.

After sawing the joint, the Engineer will thoroughly inspect the sawed joint opening for spalls, popouts, cracks, etc. All necessary repairs will be made by the Contractor prior to blast cleaning and installing the seal, at no cost to the Department.

Clean the joints by sandblasting with clean dry sand immediately before placing the bonding agent. Sandblast the joint opening to provide a firm, clean joint surface free of curing compound, loose material and any foreign matter. Sandblast the joint opening without causing pitting or uneven surfaces. The aggregate in the joint concrete may be exposed after sandblasting.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

After blasting, either brush the surface with clean brushes made of hair, bristle, or fiber, blow the surface with compressed air, or vacuum the surface until all traces of blast products and abrasives are removed from the surface, pockets, and corners.

If nozzle blasting is used to clean the joint opening, use compressed air that does not contain detrimental amounts of water or oil.

Examine the blast-cleaned surface and remove any traces of oil, grease, or smudge deposited in the cleaning operations.

Bond the seal to the blast-cleaned surface on the same day the surface is blast cleaned.

SEAL INSTALLATION

Install the joint seal according to the manufacturer's procedures and recommendations and as recommended below. Do not install the joint seal if the ambient air or surface temperature is below 45°F. Have a manufacturer's certified trained factory representative present during the installation of the first seal of the project.

Before installing the joint seal, check the uninstalled seal length to ensure the seal is the same length as the deck opening. When the joint seal requires splicing, use the heat welding method by placing the joint material ends against a Teflon heating iron of 425-475°F for 7 - 10 seconds, then pressing the ends together tightly. Do not test the welding until the material has completely cooled.

Begin installation by protecting the top edges of the concrete deck adjacent to the vertical walls of the joint as a means to minimize clean up. Stir each epoxy bonding agent component independently, using separate stirring rods for each component to prevent premature curing of the bonding agent. Pour the two (2) components, at the specified mixing ratio, into a clean mixing bucket. Mix the components with a low speed drill (400 rpm max.) until a uniform gray color is achieved without visible marbling. Apply bonding agent to both sides of the joint concrete, as well as both sides of the joint seal, making certain to fill completely the grooves with epoxy. With gloved hands, compress the joint seal and with the help of a blunt probe, push the seal into the joint opening until the seal is recessed approximately ¼" below the surface. When pushing down on the joint seal, apply pressure only in a downward direction. Do not push the joint seal into the joint opening at an angle that would stretch the material. Seals that are stretched during installation shall be removed and rejected. Once work on placing a seal begins, do not stop until it is completed. Clean the excess epoxy from the top of the joint seal immediately with a trowel. Do not use solvents or any cleaners to remove the excess epoxy from the top of the seal. Remove the protective cover at the joint edges and check for any excess epoxy on the surface. Remove excess epoxy with a trowel, the use of solvents or any cleaners will not be allowed.

The installed system shall be watertight and will be monitored until final inspection and approval.

(A) <u>Watertight Integrity Test</u>

(1) Upon completion of each foam seal expansion joint, perform a water test on the top surface to detect any leakage. Cover the roadway section of the joint from curb to curb, or barrier rail to barrier rail, with water, either ponded or flowing, not less than 1 inch

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

above the roadway surface at all points. Block sidewalk sections and secure an unnozzled water hose delivering approximately 1 gallon of water per minute to the inside face of the bridge railing, trained in a downward position about six (6) inches above the sidewalk, such that there is continuous flow of water across the sidewalk and down the curb face of the joint.

(2) Maintain the ponding or flowing of water on the roadway and continuous flow across sidewalks and curbs for a period of five (5) hours. At the conclusion of the test, the underside of the joint is closely examined for leakage. The foam seal expansion joint is considered watertight if no obvious wetness is visible on the Engineer's finger after touching a number of underdeck areas. Damp concrete that does not impart wetness to the finger is not considered a sign of leakage.

(3) If the joint system leaks, locate the place(s) of leakage and take any repair measures necessary to stop the leakage at no additional cost to the Department. Use repair measures recommended by the manufacturer and approved by the Engineer prior to beginning corrective work.

(4) If measures to eliminate leakage are taken, perform a subsequent water integrity test subject to the same conditions as the original test. Subsequent tests carry the same responsibility as the original test and are performed at no additional cost to the Department.

Do not place pavement markings on top of foam joint seals.

BASIS OF PAYMENT

Foam Joint Seals for Preservation will be measured and paid for at the contract unit price bid per linear foot and will be full compensation for furnishing all material, labor, tools, and equipment necessary for installing these seals in place and accepted.

Pay Item	Pay Unit
Foam Joint Seals for Preservation	Linear Feet

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

EXPANSION JOINT SEAL REPAIR (SPECIAL)

1.0 GENERAL

The work covered by this Special Provision consists of removal of existing continuous premolded neoprene or epdm gland and furnishing and installing a new premolded neoprene or epdm gland as shown on the contract drawings. All materials, labor, equipment and incidentals necessary for the proper replacement of the expansion joint seal gland are included.

2.0 MATERIAL

Provide expansion joint seal gland capable of accommodating a total movement measured parallel to the centerline of the roadway as shown on plans.

Provide an elastomeric component for each expansion joint seal that is a continuous unit for the entire length of the joint. Do not field splice the elastomeric component. Only vulcanized shop splicing of the elastomeric component is permitted. The minimum length of an elastomeric component before shop splicing is 20 feet. However, one piece shorter than 20 feet is permitted. Provide an elastomeric component that is clearly shop marked to indicate the top side and joint location of the elastomeric component. On skewed bridges, or under unsymmetrical conditions, clearly mark the left side of the elastomeric component. Left is defined as being on the left when facing in the direction of increasing station. Inspect the seals upon receipt to ensure that the marks are clearly visible upon installation.

Make sure the convolution of the gland does not project above the top of the hold-down plates when the joint opening is in the most compressed condition. Use either elastic polychloroprene (neoprene) or ethyl propylene diene monomer (EPDM) for the elastomer that meets the following minimum properties:

	ASTM TEST METHOD	REQUIREMENTS
Hardness, Durometer - Shore A	D2240	60 ± 5, Neoprene (upward corrugated shape - fabric reinforced) 75 ± 5, EPDM and Neoprene (upward non-corrugated shape) 80 ± 5, EPDM (upward corrugated shape-fabric reinforced)
Tensile Strength	D412	2000 psi (min.)
Elongation at Break	D412	250% (min.)

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

Width of Gland in Relaxed Condition	N/A	10" ± 0.25"

Thickness of Upturned portion of gland	N/A	0.25" non-corrugated shape, -0.032" to +0.032"
Thickness of Upturned portion of gland	N/A	0.1875" corrugated shape, -0.032" to +0.032"
Thickness of Flat portion of gland	N/A	0.1563", -0.032" to +0.032"

Inspect the condition of the existing hold-down plates for cracks, deformations or other damage that the Engineer might determine necessitates replacement of a hold-down plate. If a hold-down plate replacement is warranted, coordinate with Engineer.

Replace hold-down bolts with new bolts that conform to ASTM F593 alloy 304 stainless steel. Replace washers with new washers that conform to ASTM F844 except they shall be made from allow 304 stainless steel.

3.0 INSTALLATION

See contract plans for installation procedure.

If the Engineer deems any aspects of the expansion joint seals unacceptable, make necessary corrections.

4.0 INSPECTION

Watertight Integrity Test

- Upon completion of an expansion joint seal gland replacement, perform a water test on the top surface to detect any leakage. Cover the roadway section of the joint from curb to curb, or barrier rail to barrier rail, with water, either ponded or flowing, not less than 1 inch above the roadway surface at all points. Block sidewalk sections and secure an unnozzled water hose delivering approximately 1 gallon of water per minute to the inside face of the bridge railing, trained in a downward position about 6 inches above the sidewalks, such that there is continuous flow of water across the sidewalk and down the curb face of the joint.
- Maintain the ponding or flowing of water on the roadway and continuous flow across sidewalks and curbs for a period of 5 hours. At the conclusion of the test, the underside of the joint is closely examined for leakage. The expansion joint seal is considered watertight if no obvious wetness is visible on the Engineer's finger after touching a number of underdeck areas. Damp concrete that does not impart wetness to the finger is not a sign of leakage.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

- If the joint system leaks, locate the place(s) of leakage and take any repair measures necessary to stop the leakage at no additional cost to the Department. Use repair measures recommended by the manufacturer and approved by the Engineer prior to beginning corrective work.
- If measures to eliminate leakage are taken, perform a subsequent water integrity test subject to the same conditions as the original test. Subsequent tests carry the same responsibility as the original test and are performed at no extra cost to the Department.

5.0 BASIS OF PAYMENT

Expansion Joint Seal Repair will be paid at the lump sum contract price and will be full compensation for all work and material specified in this project special provision, contract plans and all incidental items necessary to provide a functioning expansion joint seal.

Payment will be made under:

1.0 PAY ITEM	PAY UNIT
Expansion Joint Seal Repair	Lump Sum

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

CONCRETE REPAIRS (SPECIAL)

DESCRIPTION

Work includes removal of concrete in spalled, delaminated and/or cracked areas of the existing bent caps and bent columns in reasonably close conformity with the lines, depth, and details shown on the plans, described herein and as established by the Engineer. This work also includes straightening, cleaning, and replacement of reinforcing steel, doweling new reinforcing steel, removing all loose materials, removing and disposing of debris, formwork, applying repair material, and protecting adjacent areas of the bridge and environment from material leakage. The repair material shall be one of the materials described in this Special Provision, unless otherwise noted in the plans or special provisions.

The location and extent of repairs shown on the plans described herein are general in nature. The Engineer shall determine the extent of removal in the field based on an evaluation of the condition of the exposed surfaces. The Contractor shall coordinate removal operations with the Engineer. No more than 30% of a round or square column or 30% of the bearing area under a beam shall be removed without a temporary support system and approval from the Engineer.

Repair, to the Engineer's satisfaction, any portion of the structure that is damaged from construction operations. No extra payment is provided for these repairs.

SURFACE PREPARATION

Adhere to the following surface preparation requirements or the repair material manufacturer's requirements, whichever is more stringent.

Prior to starting the repair operation, delineate all surfaces and areas assumed to be deteriorated by visually examining and sounding the concrete surface with a hammer or other approved method. The Engineer is the sole judge in determining the limits of deterioration.

Prior to concrete removal, introduce a shallow saw cut, ½" in depth, around the repair area at right angles to the concrete surface. Sawcut should be located a minimum 2" beyond the perimeter of the deteriorated concrete area to be repaired. Remove all concrete within the sawcut to a minimum depth of ½". If concrete removal exposes reinforcing steel, remove all deteriorated concrete 1" below the reinforcing steel with a 17 lb (maximum) pneumatic hammer, with points that do not exceed the width of the shank, or with hand picks or chisels, as directed by the Engineer. Do not cut or remove the existing reinforcing steel. Unless specifically directed by the Engineer, do not remove concrete deeper than 1" below the reinforcing steel.

Abrasive blast all exposed concrete surfaces and existing reinforcing steel in repair areas to remove all debris, loose concrete, loose mortar, rust, scale, etc. After blasting, examine the reinforcing steel to ensure at least 90% of the original diameter remains. If there is more than 10% reduction in the rebar diameter, splice in and securely tie supplemental reinforcing bars as directed by the Engineer. This might require additional removal of concrete, in order to achieve an appropriate splice length of the reinforcing steel.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

Thoroughly clean the repair area of all dirt, grease, oil, or foreign matter, and remove all loose or weakened material by abrasive blasting before applying concrete repair material. Acid etch with 15% hydrochloric acid, only if approved by the Engineer. Follow acid etching by scrubbing and flushing with copious amounts of clean water. Check the cleaning using moist pH paper. Water cleaning is complete when the paper reads ten (10) or higher.

Follow all abrasive blasting with vacuum cleaning.

The time between removal of deteriorated concrete and applying concrete repair material shall not exceed 72 hours. If the time allowance exceeds 72 hours, prepare the surface at the direction of the Engineer before applying concrete repair material.

APPLICATION AND SURFACE FINISH

Apply repair material to damp surfaces only when allowed by repair material recommendations and approved by the Engineer. Prepare damp surfaces in accordance with the *Standard Specifications* and/ or repair material manufacturer's recommendations. Use a blowpipe to facilitate removal of free surface water. Only oil-free compressed air is to be used in the blowpipe.

When surface preparation is completed, mix and apply repair material in accordance with the *Standard Specifications* and/ or repair material manufacturer's recommendations.

Use aggregate that is washed, kiln-dried, and bagged. Maximum size of aggregate shall not exceed 2/3 of the minimum depth of the repair area, or 3/4 of the depth of excavation behind the reinforcing steel, whichever is smaller.

Unless otherwise required by the repair material manufacturer, apply bonding agent to all repair areas immediately prior to placing repair material.

Repair areas shall be formed unless otherwise approved by the Engineer. Form and finish all repaired areas, including chamfered edges, as close as practicable to their original "As Built" dimensions and configuration. After applying the repair material, remove excessive material and provide a smooth, flush surface, unless directed otherwise.

Cure finished Class A concrete repair material by maintaining 95% relative humidity at the repair and surrounding areas by fogging, moist curing, or other approved means for seven (7) days. Cure polymer modified concrete repair material in accordance with manufacturer's recommendations.

REPAIR MATERIAL OPTIONS

(A) Polymer Modified Concrete Repair Material

Repair material shall be polymer modified cement mortar for vertical or overhead applications and shall be suitable for applications in marine environments. Material shall be approved for use by NCDOT. Submit repair material to the Engineer for review and approval prior to beginning the work. Color of repair material shall be concrete gray.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

(B) Class A Concrete Repair Material

Repair material shall be Class A Portland Cement Concrete as described in Article 1000-4 of the *Standard Specifications*.

TEMPORARY WORK PLATFORM

Prior to beginning any repair work, provide details for a sufficiently sized temporary work platform at each repair location. Design steel members to meet the requirements of the *American Institute of Steel Construction Manual*. Design timber members in accordance with the *National Design Specification for Stress-Grade Lumber and Its Fastenings* of the National Forest Products Association. Submit the platform design and plans for review and approval. The design and plans shall be sealed and signed by a North Carolina registered Professional Engineer. Do not install the platform until the design and plans are approved. Drilling holes in the superstructure for the purpose of attaching the platform is prohibited. Upon completion of work, remove all anchorages in the substructure and repair the substructure at no additional cost to the Department.

MEASUREMENT AND PAYMENT

Concrete Repairs will be measured and paid for at the contract unit price bid per cubic foot and will be full compensation for removal, containment and disposal off-site of unsound concrete including the cost of materials, reinforcing steel, labor, tools, equipment and incidentals necessary to complete the repair work. Depth will be measured from the original outside concrete face. The Contractor and Engineer will measure quantities after removal of unsound concrete and before application of repair material. Payment will also include the cost of abrasive blasting, surface cleaning and preparation, blast cleaning of reinforcing steel, placement of new reinforcing steel, cost of temporary work platform, testing of the soundness of the exposed concrete surface, furnishing and installation of repair mortar material, curing and sampling of concrete, and protection/cleaning of adjacent areas from splatter or leakage.

Reinforcing Steel that is required for the repairs will be in accordance with Section 425 of the *Standard Specifications*.

Payment will be made under:

Pay Item	**Pay Unit**
Concrete Repairs	Cubic Feet

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

EPOXY RESIN INJECTION (SPECIAL)

1.0 GENERAL

For repairing cracks, an approved applicator is required to perform the epoxy resin injection. Make certain the supervisor and the workmen have completed an instruction program in the methods of restoring concrete structures utilizing the epoxy injection process and have a record of satisfactory performance on similar projects.

The applicator furnishes all materials, tools, equipment, appliances, labor and supervision required when repairing cracks with the injection of an epoxy resin adhesive.

2.0 SCOPE OF WORK

The Engineer will determine a minimum crack width to repair. Interior bent columns and caps, and end bent caps, bascule piers, trunnion columns, wingwalls, and backwalls are potential locations for crack repairs.

3.0 COOPERATION

Cooperate and coordinate with the Technical Representative of the epoxy resin manufacturer for satisfactory performance of the work.

Have the Technical Representative present when the job begins and until the Engineer is assured that his service is no longer needed.

The expense of having this representative on the job is the Contractor's responsibility and no direct payment will be made for this expense.

4.0 TESTING

The North Carolina Department of Transportation Materials and Tests Unit will obtain cores from the repaired concrete for testing, for all repairs except those located on trunnion columns. If the failure plane is located at the repaired crack, a minimum compressive strength of 3000 psi is required of these cores. Do not obtain cores from trunnion columns.

5.0 MATERIAL PROPERTIES

Provide a two-component structural epoxy adhesive for injection into cracks or other voids. Provide modified epoxy resin (Component "A") that conforms to the following requirements:

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

	Test Method	Specification Requirements
Viscosity @ 40 ± 3°F, cps	Brookfield RVT Spindle No. 4 @ 20 rpm	6000 - 8000
Viscosity @ 77 ± 3°F, cps	Brookfield RVT Spindle No. 2 @ 20 rpm	400 - 700
Epoxide Equivalent Weight	ASTM D1652	152 - 168
Ash Content, %	ASTM D482	1 max.

Provide the amine curing agent (Component "B") used with the epoxy resin that meets the following requirements:

	Test Method	Specification Requirements
Viscosity @ 40 ± 3°F, cps	Brookfield RVT Spindle No. 2 @ 20 rpm	700 - 1400
Viscosity @ 77 ± 3°F, cps	Brookfield RVT Spindle No. 2 @ 20 rpm	105 - 240
Amine Value, mg KOH/g	ASTM D664*	490 - 560
Ash Content, %	ASTM D482	1 max.
* Method modified to use perchloric acid in acetic acid.		

Certify that the Uncured Adhesive, when mixed in the mix ratio that the material supplier specifies, has the following properties:

Pot Life (60 gram mass)
- @ 77 ± 3°F - 15 minutes minimum
- @ 100 ± 3°F - 5 minutes minimum

Certify that the Adhesive, when cured for 7 days at 77 ± 3°F unless otherwise specified, has the following properties:

	Test Method	Specification Requirements
Ultimate Tensile Strength	ASTM D638	7000 psi (min.)
Tensile Elongation at Break	ASTM D638	4% max.
Flexural Strength	ASTM D790	10,000 psi (min.)
Flexural Modulus	ASTM D790	3.5×10^5 psi
Compressive Yield Strength	ASTM D695	11,000 psi (min.)
Compressive Modulus	ASTM D695	$2.0 - 3.5 \times 10^5$ psi
Heat Deflection Temperature Cured 28 days @ 77 ± 3°F	ASTM D648*	125°F min. 135°F min.
Slant Shear Strength,	AASHTO T237	

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

5000 psi (34.5 MPa) compressive strength concrete Cured 3 days @ 40°F wet concrete Cured 7 days @ 40°F wet concrete Cured 1 day @ 77°F dry concrete		 3500 psi (min.) 4000 psi (min.) 5000 psi (min.)
* Cure test specimens so that the peak exothermic temperature of the adhesive does not exceed 77°F.		

Use an epoxy bonding agent, as specified for epoxy mortar, as the surface seal (used to confine the epoxy resin during injection).

6.0 EQUIPMENT FOR INJECTION

Use portable positive displacement type pumps with interlock to provide positive ratio control of exact proportions of the two components at the nozzle to meter and mix the two injection adhesive components and inject the mixed adhesive into the crack. Use electric or air powered pumps that provide in-line metering and mixing.

Use injection equipment with automatic pressure control capable of discharging the mixed adhesive at any pre-set pressure up to 200 ± 5 psi and equipped with a manual pressure control override.

Use equipment capable of maintaining the volume ratio for the injection adhesive as prescribed by the manufacturer. A tolerance of ± 5% by volume at any discharge pressure up to 200 psi is permitted.

Provide injection equipment with sensors on both the Component A and B reservoirs that automatically stop the machine when only one component is being pumped to the mixing head.

7.0 PREPARATION

Follow these steps prior to injecting the epoxy resin:

- Remove all dirt, dust, grease, oil, efflorescence and other foreign matter detrimental to the bond of the epoxy injection surface seal system from the surfaces adjacent to the cracks or other areas of application. Acids and corrosives are not permitted.
- Provide entry ports along the crack at intervals not less than the thickness of the concrete at that location.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

- Apply surface seal material to the face of the crack between the entry ports. For through cracks, apply surface seal to both faces.
- Allow enough time for the surface seal material to gain adequate strength before proceeding with the injection.

8.0 EPOXY INJECTION

Begin epoxy adhesive injection in vertical cracks at the lower entry port and continue until the epoxy adhesive appears at the next higher entry port adjacent to the entry port being pumped.

Begin epoxy adhesive injection in horizontal cracks at one end of the crack and continue as long as the injection equipment meter indicates adhesive is being dispensed or until adhesive shows at the next entry port.

When epoxy adhesive appears at the next adjacent port, stop the current injection and transfer the epoxy injection to the next adjacent port where epoxy adhesive appeared.

Perform epoxy adhesive injection continuously until cracks are completely filled.

If port to port travel of epoxy adhesive is not indicated, immediately stop the work and notify the Engineer.

9.0 FINISHING

When cracks are completely filled, allow the epoxy adhesive to cure for sufficient time to allow the removal of the surface seal without any draining or runback of epoxy material from the cracks.

Remove the surface seal material and injection adhesive runs or spills from concrete surfaces.

Finish the face of the crack flush to the adjacent concrete, removing any indentations or protrusions caused by the placement of entry ports.

10.0 BASIS OF PAYMENT

Payment for epoxy resin injection will be at the contract unit price per linear foot for "Epoxy Resin Injection". Such payment will be full compensation for all materials, tools, equipment, labor, and for all incidentals necessary to complete the work.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

PLATFORM EXTENSIONS (SPECIAL)

DESCRIPTION

This work consists of field measuring existing conditions, field drilling and installation of adhesively anchored anchor bolts, field welding, fabricating and installing structural steel brackets, installing pultruded fiber-reinforced plastic (FRP) grating, installing steel pipe railings, providing access to platform locations for construction and inspection, and furnishing and installing associated attachments and hardware at the locations shown on the plans and as specified herein.

There is approximately 290 square feet of FRP grating to be installed.

MATERIALS

Select the FRP grating from one of the following manufacturers or provide and Engineer approved equivalent.

Company	Product
Fibergrate Composite Structures Inc.	Safe-T-Span
Seasafe, Inc.	GatorDeck
American Grating LLC	Open I-Bar
Strongwell Corporation	Duradek/Duragrid

The color will be selected by the Engineer from the manufacturer's standard colors.

Grating must be at least 1 inch deep for outrigger modifications and 1.5 inches deep for submarine cable platform extensions and shall meet manufacturer's published recommended loadings for 100 pounds per square foot uniform loading or 300 pounds concentrated loading with deflection not to exceed 1/4 inch for span lengths indicated on plans. Ensure surface is slip resistant.

Ensure the fiberglass resin used to manufacture FRP grating is suitable for an outdoor marine environment, year round usage and includes ultraviolet (UV) inhibitors.

Attach FRP grating according to the manufacturer's recommendations.

Field measure dimensions prior to fabrication, including size and location of required holes or cutouts. Fabricate gratings to the field dimensions with tolerances as indicated on the approved shop drawings.

Coat all cut or sanded surfaces with resin, containing air inhibiting additives, according to the manufacturer's recommendations.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

Steel pipe railings shall be ASTM A53, extra strong, galvanized pipe. All areas damaged by welding and handling shall be given one coat of zinc rich paint. The zinc rich paint shall meet the requirements of Section 1080-9 of the Standard Specifications.

Structural Steel shall conform to ASTM A709 Grade 50, galvanized in accordance with ASTM A123 and shall be in accordance with Sections 440 and 1072 of the Standard Specifications.

Unless otherwise designated on plans, bolts, nuts, and washers shall be high -strength and shall conform to Sections 440 and 1072 of the Standard Specifications and galvanized in accordance with ASTM 153.

Adhesively anchored anchor bolts shall conform to Section 420-13 of the Standard Specifications. For field testing requirements, refer to plans.

All welding shall be in accordance with AWS D1.1 and AASHTO/AWS D1.5 and the standard specifications.

CONSTRUCTION

Prepare platform modifications as shown on the plans using procedures outlined on the plans.

The contractor shall provide access to platform locations to facilitate their installation and to facilitate inspection by the engineer.

Bolting and field welding modifications shall be performed in accordance with Section 440 of the Standard Specification and as noted on plans.

Install gratings and associated hardware in conformance with the approved shop drawings and the manufacturer's recommendations.

Install hold-down clips spaced at 4 feet maximum with a minimum of four clips per grating panel or as recommended by the manufacturer for this application.

Field drill holes for hold-down clips and touch up supporting members in conformance with the manufacturer's recommendations. Galvanizing on supporting members shall be touched up as required using zinc rich paint per section 1080-9 of the Standard Specifications. The contractor has the option to use short slotted holes or oversized holes in connection angles to allow for adjustability in the field. If modified holes are used in connection angles, submit size and location to engineer for review prior to fabrication.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

SUBMITTALS

Submit structural steel and FRP grating shop drawings showing product details, FRP grating layout, dimensions, cross sections, fastening details and all other fabrication and installation details for approval.

Provide sample of grating of chosen color to engineer to accompany shop drawings for review.

MEASUREMENT AND PAYMENT

Platform Extensions shall be paid for at the lump sum price bid and shall be full compensation for field measurement existing conditions, field drilling and installation of adhesively anchored anchor bolts, field welding, fabricating and installing structural steel brackets, installing pultruded fiber-reinforced plastic (FRP) grating, installing steel pipe railings, providing access to platform locations for construction and inspection, and furnishing and installing associated attachments and hardware at the locations shown on the plans and as specified herein. The complete work shall be paid for using the following pay item:

Pay Item	**Pay Unit**
Platform Extensions	Lump Sum

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

UNDER STRUCURE WORK PLATFORM **(SPECIAL)**

Prior to performing any repairs on the structure (fixed spans or movable span), where the contractor wishes to furnish and install a temporary under structure work platform, provide details for a sufficiently sized under structure work platform that will provide access for performing the repairs shown on the plans.

The under structure work platform is to be used for work that is not covered by work platforms or containment systems that are included in other pay items.

The Contractor shall determine the size and required capacity of the platform, but the capacity shall not be less than that required by Federal or State regulations. Design steel members to meet the requirements of the American Institute of Steel Construction Manual. Design timber members in accordance with the "National Design Specification for Stress-Grade Lumber and Its Fastenings" of the National Forest Products Association. The platform shall be constructed of materials capable of withstanding damage from any of the steel repairs or other repair work required on this project and shall be fireproof. Submit the platform design and plans for review and approval.

The design and plans shall be sealed and signed by a North Carolina registered Professional Engineer. Do not install the platform until the design and plans are approved. Drilling holes in the superstructure for the purpose of attaching the platform is prohibited. Upon completion of work, remove all anchorages in the substructure and repair the substructure at no additional cost to the Department.

The platform shall be cleaned after each work day to prevent materials from falling or washing into the river.

Under Structure Work Platform will be paid at the lump sum contract price and will be full compensation for the design, materials, installation, maintenance, and removal of the platform

Payment will be made under:

Pay Item	**Pay Unit**
Under Structure Work Platform	Lump Sum

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

COAST GUARD COORDINATION **(SPECIAL)**

At no time during work will the waterway be closed or narrowed to navigation without prior approval from the Coast Guard. The contractor is required to maintain close and regular contact with the Coast Guard, Sector North Carolina to keep them informed to activities in the waterway. The U.S. Coast Guard Sector North Carolina contacts are LT Derek Burrill at (910)-772-2230 or BM1 Poden Petrus ar (910)-772-2212 or email ncmarineevents@uscg.mil. The contractor must also contact the 5th Coast Guard District Bridges Branch, Mr. Hall Pitts (757) 398-6222 or email at Hal.R.Pitts@uscg.mil.

The Contractor shall bear full responsibility for all required coordination with the Coast Guard. Advance coordination with the Coast Guard for any anticipated disruptions to waterway traffic shall begin within 30 days following award of Contract and prior to commencing on-site activities. Approval for scheduled waterway disruptions shall be initiated approximately 45 days in advance, and confirmed no less than 30 days but no more than 45 days, in advance of the first disruption.

All work shall be conducted so that free navigation of the waterway is not unreasonably interfered with and the present navigable depths are not impaired. Timely notice of any and all events that affect navigation shall be given to the District Commander during the work on the moveable span. The channel shall be promptly cleared of all obstructions placed therein or caused by the contractor.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

REPLACEMENT OF OPEN STEEL GRID DECK **SPECIAL**

Description

This work involves the removal of the existing open steel grid deck; grinding smooth of all existing welds that attach the grid deck to the stringers/supports; taking field measurements; temporarily and permanently installing the new grid deck, including any necessary shimming; field touch-up of galvanizing; welding skid resistant studs on the new grid deck.

Grid deck shall be designed for HS20-44 loading. Signed and sealed plans and design calculations shall be prepared by a professional engineer, registered in the state of North Carolina, and shall be submitted for approval to the engineer prior to beginning fabrication.

Modified grid deck as indicated by the plans also is included in this specification. Portions of the new steel open grid deck noted as “modified grid deck” shall not have diagonal bars and shall have additional supplemental bars as shown on the plans.

There is approximately 12,800 square feet of steel open grid deck to be replaced. This area includes the area of modified grid deck.

Quality Assurance

Manufacturer of the steel decking shall conform to the following minimum codes and standards:

1. Manufacturer must be a current member of the Bridge Grid Flooring Manufacturers Association. BGFMA shop practices and fabrication tolerances for grid bridge floors shall apply.
2. Manufacturer must have American Institute of Steel Construction (AISC) certification for Simple Steel Bridges.
3. All welding is to meet AWS D1.5 Bridge Welding Code, 2015.
4. Manufacturer must have an AWS certified welding inspector present during manufacturing.

Contractor's representative must take field measurements prior to the preparation of shop drawings.

Submittals

Submit shop drawings showing product detail, bridge deck layout, dimensions, joining details including cross section, fastening details, adjacent construction interface, and all other fabrication and installation details for approval, prior to beginning fabrication.

Handling

Deliver the steel grid deck to the job site free of any defects and bearing proper identifying marks.

During all stages of construction, store fabricated grid and materials in a dry, protected, and well-ventilated area, above ground, blocking grid and materials to maintain any fabrication camber and/or design flatness.

Do not overstress the steel grid deck units during lifting and assembly. Submit lifting locations and lifting procedures for review and approval by engineer. Avoid twisting or bending of the steel grid

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

deck in the weak (perpendicular to the main bar) direction. Do not lift the steel grid deck from the cross bars, distribution bars, or supplemental bars.

Materials

The grid decking shall consist of panels fabricated from ASTM A709 steel, in panel widths determined by the contractor and approved by the Engineer.

The steel grid deck shall consist of the following elements:

1. Main bars: 5-3/16" deep, spaced at 7 ½”, and weigh 5.3 lbs./ft.
2. Supplemental bars shall be 1” x ¼”, one between the main bars at 4-way grid deck and 5 between main bars at modified grid deck.
3. Cross bars: 2 ½” x ¼” spaced at 3 ¾” c /c.
4. Diagonal bars shall be 1” x ¼”, one between the main bars.
5. Bottom cross bars shall be 5/8" dia. round bars.
6. 5/16" diameter, 3/8" high studs shall be welded to the panels at the crossing as shown on the plans.
7. End trim bars shall be provided at both ends of the span and where shown on the plans.
8. Steel grid decking shall be galvanized in accordance with ASTM A123. Repair any defects in galvanizing in accordance with ASTM A780. Do not use materials containing aluminum to restore defective areas.
9. All steel shall be in conformance with Section 1072 of the Standard Specifications and shall be ASTM A709, Grade 50 or Grade 50W, or ASTM A572 Grade 50.
10. Steel grid decking, not including the modified grid deck areas, shall have a minimum section modulus (steel only) of: S_{top} = 4.038 in^3/ft and S_{bot} = 4.321 in^3/ft

All elements shall be serrated on their top surfaces. Serration pattern shall be at maximum of 1" c/c. The grid deck shall provide a skid resistance number (S/N) of 53 at 40 mph (prior to stud installation) when tested in accordance with ASTM E274. Cost of testing shall be included in the bid price for the steel open grid decking. The decking shall be assembled such that the top of all elements are in the same plane. Notching (other than serrations) of the grid deck main beams at supports will not be permitted. Notching of the bottom cross bars will not be permitted.

The grid shall be welded at all intersections.

The steel grid decking shall be fabricated in accordance with Bridge Grid Flooring Manufacturer's Association tolerances. Tolerances between sections shall provide for no more than ¼” clearance between adjacent sections.

All welding shall use E70XX electrodes. Electrodes shall be compatible with ASTM A709 steel.

Installation

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

Install the steel grid decking in accordance with the drawings, specifications, approved shop drawings, manufacturer's installation standards, and the most recent version of BGFMA TS-02, Installation Tolerances and Guidelines for Open Grid Decks and BGFMA TS-03, Installation Tolerances and Guidelines for Grid Reinforced Concrete Bridge Decks published by the BGFMA.

Contractor shall submit a grid deck replacement sequence to the Engineer for review prior to removal of any existing grid decking.

Field assemble panels of the steel grid deck for proper fit before welding the grid deck to the supports. Place the steel grid deck panels on the structure with careful consideration given to the alignment and elevation of each adjacent panel. Measure from fixed points to avoid cumulative error.

Before any welding is performed, load or clamp the steel grid deck to make a tight joint with full bearing.

After installation of panels, top flange of stringers and any other areas of painting damaged shall be painted in accordance with Section 442 of the Standard Specifications. Top flange shall be cleaned to the satisfaction of the engineer prior to painting.

Based on the contractor’s construction schedule and to accommodate required bridge openings, if new grid deck panels are to be temporarily installed, removed, and reinstalled prior to final welding to the stringers, temporary clamping of the grid panels to the stringers will be permitted. Optional clamp details are provided in the plans to facilitate grid deck construction. If used, the clamp details shall be shown on the grid deck shop drawings and proposed locations of their use shall be provided. Clamps shall be capable of fully securing the grid deck panels to the existing superstructure when in the opened or closed position.

Ensure that steel grid deck panels are straight prior to installation. If straightening is required, use methods that will not injure the metal or the galvanizing that are approved by the Engineer. Obtain the Engineer’s approval prior to commencing straightening.

Measurement and Payment

Replacement of Open Steel Grid Deck shall be paid for at the lump sum price bid and shall be full compensation for taking necessary field measurements, the removal of the existing open steel grid deck, grinding of the existing welds, preparing the existing steel to accept the new steel grid deck, installing new skid resistant studs to the new grid deck as shown on the plans, the design, fabrication, galvanizing, and installation of the new open steel grid floor and any clamping, removal, or reinstallation of panels required for bridge openings.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

REPLACEMENT OF FILLED STEEL GRID DECK **SPECIAL**

Description

This work involves the removal of the existing concrete filled steel grid deck; grinding smooth of all existing welds that attach the filled grid deck to the stringers/supports; taking field measurements; temporarily and permanently installing the new grid deck to be concrete filled, including any necessary shimming and bolting; field touch-up of galvanizing; placing formwork and placing and finishing concrete fill.

Filled grid deck shall be designed for HS20-44 loading. Signed and sealed plans and design calculations shall be prepared by a professional engineer, registered in the state of North Carolina, and shall be submitted for approval to the engineer prior to beginning fabrication.

There is approximately 3,840 square feet of concrete filled grid deck to be replaced.

Quality Assurance

Manufacturer of the steel decking shall conform to the following minimum codes and standards:

1. Manufacturer must be a current member of the Bridge Grid Flooring Manufacturers Association. BGFMA shop practices and fabrication tolerances for grid bridge floors shall apply.
2. Manufacturer must have American Institute of Steel Construction (AISC) certification for Simple Steel Bridges.
3. All welding is to meet AWS D1.5 Bridge Welding Code, 2015.
4. Manufacturer must have an AWS certified welding inspector present during manufacturing.

Contractor's representative must take field measurements prior to the preparation of shop drawings.

Submittals

Submit shop drawings showing product detail, concrete mix to be used, bridge deck layout, dimensions, joining details including cross section, fastening details, adjacent construction interface, and all other fabrication and installation details for approval, prior to beginning fabrication.

Handling

Deliver the steel grid deck to the job site free of any defects and bearing proper identifying marks.

During all stages of construction, store fabricated grid and materials in a dry, protected, and well-ventilated area, above ground, blocking grid and materials to maintain any fabrication camber and/or design flatness.

Do not overstress the steel grid deck units during lifting and assembly. Submit lifting locations and lifting procedures for review and approval by engineer. Avoid twisting or bending of the steel grid deck in the weak (perpendicular to the main bar) direction. Do not lift the steel grid deck from the cross bars, distribution bars, or supplemental bars.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

Materials

The grid decking shall consist of panels fabricated from ASTM A709 steel, in panel widths determined by the contractor and approved by the Engineer.

The steel grid deck shall consist of the following elements:

1. Main bars: 5-3/16" deep, spaced at 7 ½", and weigh 5.3 lbs./ft.
2. Supplemental bars shall be 1" x ¼", one between the main bars.
3. Cross bars: 2 ½" x ¼" spaced at 3 ¾" c /c.
4. Diagonal bars shall be 1" x ¼", one between the main bars.
5. Bottom cross bars shall be 5/8" dia. round bars.
6. End trim bars shall be provided at both ends of the span and where shown on the plans.
7. Steel grid decking shall be galvanized in accordance with ASTM A123. Repair any defects in galvanizing in accordance with ASTM A780. Do not use materials containing aluminum to restore defective areas.
8. All steel shall be in conformance with Section 1072 of the Standard Specifications and shall be ASTM A709, Grade 50 or Grade 50W, or ASTM A572 Grade 50.
9. Steel grid decking in filled grid regions shall have a minimum section moduli (properties of steel only) of: S_{top} = 4.038 in^3/ft and S_{bot} = 4.321 in^3/ft
10. High strength bolts, nuts, and washers used for connections between filled grid sections and the open (unfilled) grid section and for bolted splices between adjacent filled grid panels shall conform to Sections 440 and 1072 of the NCDOT Standard Specifications.
11. Reinforcing steel splice bars shall conform to Sections 420 and 1070 of the NCDOT Standard Specifications as applicable and shall be galvanized.

All elements shall be serrated on their top surfaces. Serration pattern shall be at maximum of 1" c/c. The grid deck shall provide a skid resistance number (S/N) of 53 at 40 mph (prior to stud installation) when tested in accordance with ASTM E274. Cost of testing shall be included in the bid price for the steel open grid decking. The decking shall be assembled such that the top of all elements are in the same plane. Notching (other than serrations) of the grid deck main beams at supports will not be permitted. Notching of the bottom cross bars will not be permitted.

The steel grid shall be welded at all intersections.

The steel grid decking shall be fabricated in accordance with Bridge Grid Flooring Manufacturer's Association tolerances. Tolerances between sections shall provide for no more than ¼" clearance between adjacent sections.

All welding shall use E70XX electrodes. Electrodes shall be compatible with ASTM A709 steel.

Metal Form Pans: Provide vertical steel sheet metal form pans that conform to the latest specification of ASTM A366 or A1011. Provide bottom sheet metal form pans of galvanized

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

metal conforming to ASTM A653.

Concrete: Concrete in-fill shall be normal-weight and shall be Class AA in accordance with Section 1000 of the NCDOT Standard Specifications, except use a maximum coarse aggregate that does not exceed 3/8” in size and concrete shall meet the physical and testing requirements given in the Concrete for Repair special provision included herein, including the requirement to achieve a compressive strength of 4500 psi within 3 hours.

Installation

Install the steel grid decking in accordance with the drawings, specifications, approved shop drawings, manufacturer's installation standards, and the most recent version of BGFMA TS-02, Installation Tolerances and Guidelines for Open Grid Decks and BGFMA TS-03, Installation Tolerances and Guidelines for Grid Reinforced Concrete Bridge Decks published by the BGFMA.

Contractor shall submit a filled grid deck replacement sequence to the Engineer for review prior to removal of any existing grid decking.

During the period of time when portions of the existing filled grid deck is removed, existing machinery and other equipment below the filled grid deck region that will be temporarily exposed to the weather shall be temporarily protected from the weather until the new filled grid is constructed. Contractor shall submit a procedure and method for temporary protection measures.

Field assemble panels of the steel grid deck for proper fit before welding the grid deck to the supports. Place the steel grid deck panels on the structure with careful consideration given to the alignment and elevation of each adjacent panel. Measure from fixed points to avoid cumulative error.

Before any welding is performed, load or clamp the steel grid deck to make a tight joint with full bearing.

After installation of panels, top flange of stringers and any other areas of painting damaged shall be painted in accordance with Section 442 of the Standard Specifications. Top flange shall be cleaned to the satisfaction of the engineer prior to painting.

Based on the contractor’s construction schedule and to accommodate required bridge openings, if new grid deck panels are to be temporarily installed, removed, and reinstalled prior to final welding to the stringers, temporary clamping of the grid panels to the stringers will be permitted. Optional clamp details are provided in the plans to facilitate grid deck construction. If used, the clamp details shall be shown on the grid deck shop drawings and proposed locations of their use shall be provided. Clamps shall be capable of fully securing the grid deck panels to the existing superstructure when in the opened or closed position.

Contractor shall coordinate concrete placement and curing operations with NCDOT and USCG as required to accommodate bridge openings.

Ensure that steel grid deck panels are straight prior to installation. If straightening is required, use methods that will not injure the metal or the galvanizing that are approved by the Engineer. Obtain the Engineer’s approval prior to commencing straightening.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

For filled grid deck, install vertical steel sheet metal form pans in the grid prior to galvanizing. Install bottom sheet metal form pans after galvanizing and fit metal forms tightly to retain the concrete and prevent excessive leakage. Protect all sheet metal form pans during shipment and store to retain their shape until grid deck installation.

Do not place concrete until steel grid deck is in the proper position on the bridge and final welding to supports is complete. Place, cure, and finish concrete in accordance with Section 420 of the NCDOT Standard Specifications.

During concrete placement, thoroughly clean any concrete seepage around the metal forms or on the structural steel with a high-pressure water hose prior to setting of the concrete. Do not disturb the metal forms with the high-pressure water stream.

Remove and repair all unsatisfactory concrete as directed by the Engineer.

Existing sheet metal forms that require removal and replacement as indicated on the plans and associated with construction of the filled grid deck shall be included in the work covered by this specification. This includes, but is not limited to, the formwork in the vicinity of the deck-end joints at the existing end diaphragms.

Materials, tools, equipment, and labor required to remove and replace concrete in the vicinity of the deck-end joints over the existing end diaphragm shall be included in the work covered by this specification.

Measurement and Payment

Replacement of Filled Steel Grid Deck shall be paid for at the lump sum price bid and shall be full compensation for removing of the existing concrete filled steel grid deck; grinding smooth of all existing welds that attach the filled grid deck to the stringers/supports; taking field measurements; temporarily and permanently installing the new grid deck to be concrete filled, including any necessary shimming and bolting; field touch-up of galvanizing; removal and replacement of existing sheet metal forms; placing new sheet metal forms; removal and replacement of existing superstructure concrete; and placing and finishing Class AA concrete fill.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

SILANE DECK TREATMENT (SPECIAL)

DESCRIPTION

This work consists of preparation of concrete bridge deck and approach slab surfaces and the furnishing and application of alkylalkoxysilane (silane) penetrant sealers, with 100% solids, to seal bridge deck surfaces and cracks. Prepare the surface of the concrete deck and apply the silane bridge deck sealer in accordance with this special provision and as indicated on the plans, or as approved by the Engineer.

Work includes: bridge deck surface preparation, placement of silane deck sealer, and any incidentals necessary to complete the project, as specified or as indicated on the plans.

SUBMITTALS

Submit for approval the following requested items and any other relevant documents:

- A safety data sheet (SDS) for each shipment of the silane materials.
- Silane material information and manufacturer's written preparation and application instructions.
- Certification from an independent testing laboratory that the materials meet the requirements of these provisions. Do not incorporate these materials into the project until the Engineer has accepted and approved the certification for the material.
- The dates of manufacture of the silane materials, their lot numbers and date of shelf-life expiration for each lot number.
- A table indicating the likely cure time, in minutes, to allow vehicular traffic on the silane-treated deck surface. Provide time for the allowable ambient temperature range, in increments of 10º F.
- A work plan for each structure that includes estimated times for surface preparation and silane application.

MATERIAL DELIVERY AND STORAGE

Store at the site sufficient quantities of silane materials to perform the entire application.

Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact. Ensure that each container is clearly marked by the manufacturer with the following information:

a. Manufacturer's name and address.
b. Product name.
c. Date of manufacture.
d. Expiration date.
e. LOT identification number.
f. Container serial number.

Provide the Engineer a certification from the manufacturer, confirming that the silane materials meet the requirements of this special provision. Do not incorporate these materials into the project until the Engineer has accepted and approved the certification for the material. Submit such certification for each LOT of material delivered to the project. In each certification, identify the serial or LOT numbers of the containers certified.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

The Engineer may require samples from each LOT or container of materials delivered to the project or from containers at the point of use. When samples are required, furnish samples in accordance with the Engineer's instructions.

Store silane materials in unopened containers in a clean, dry area between 40° F and 90° F. Store containers in a manner that prevents leakage or spillage.

MANUFACTURER'S REPRESENTATIVE

On the first bridge to be treated, provide a manufacturer's representative on site for the duration of the surface preparation and silane application work, to provide expert assistance on surface preparation, storage, mixing, application, clean-up, and disposal of materials.

MATERIALS

Provide silane from a single manufacturer, and provide silane that conforms to requirements indicated in Table 1, below.

Table 1
SILANE PROPERTIES

Property	Test Method	Requirement
Silane Content		100%
VOC content	EPA method 24	Less than 350 g/l
Surface Appearance after Application		Unchanged
Flash Point	ASTM D3278	140° F, minimum
Resistance to Chloride Ion Penetration	AASHTO T259 and T260	Less than: 0.52 pounds/yd^3(criteria of 1.5) at 1/2 inch level; 0.00 pounds/yd^3(criteria of 0.75) at 1 inch level
Water absorption test	ASTM C 642	0.50% maximum/48 hours; 1.5% maximum/50 days
Scaling resistance	ASTM C 672	(non-air-entrained concrete) 0 rating "No Scaling" (100 cycles)
NCHRP 244		
Water weight gain	Series II - cube test	85% reduction, minimum
Absorbed chloride		87% reduction, minimum
Absorbed chloride	Series IV - Southern climate	95% reduction, minimum

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

SURFACE PREPARATION

Prepare the surface of the concrete deck for application of the silane by shotblasting in order to remove all existing grease, slurry, oils, paint, dirt, striping, curing compound, rust, membrane, weak surface mortar, or any other contaminants that could interfere with the proper adhesion, penetration, and the curing of the silane material.

Prepare a final surface that adheres to the following requirements:

1) For areas to receive deck seal treatment, clean by shotblasting. Where approved by the Engineer, abrasive sandblasting may be used in areas that cannot be accessed by the shotblaster. Select the size of shot or sand, and travel speed of the equipment to provide a uniformly clean surface with a uniform profile. Remove striping to the maximum extent determined to be practical by the Engineer using up to three passes with shotblasting, sandblasting, or other approved equipment. Do not expose cleaned surfaces to vehicular traffic unless approved by the Engineer. If the deck becomes contaminated before placing the silane deck sealer, shotblast or abrasive sandblast the contaminated areas to the satisfaction of the Engineer, at no additional cost.

2) Prior to silane application, protect cracks on the concrete bridge deck from materials that can interfere with the penetration and the curing of the silane material. Just prior to placement of the silane, remove, by magnets and oil-free compressed air and vacuuming, any loose particles, such that no excess particles remain. The concrete deck shall be completely dry. Power washing will not be allowed.

3) The silane manufacturer may suggest cleaning and preparation methods other than those detailed by this special provision. The Engineer must approve such alternative methods prior to implementation.

SILANE APPLICATION

Test Area

- Test a small area of the surface (minimum 5 ft. by 5 ft.) before general application to ensure desired performance results, aesthetics, and application rates and to verify application technique. Allow 5–7 days for the product to react fully before evaluating. Application rates may vary depending on field conditions.
- Conduct at least one absorption test in the test area, using a Rilem Tube Test. Acceptable results are no loss of water in the Rilem tube over a period of 20 minutes. Adjust application to achieve required repellent performance.
- The manufacturer's representative shall assist the Contractor in determining the application rates. Use test applications on actual surfaces to determine accurate application rates. Extremely porous surfaces may require two coats of silane.
- Do not begin production application of silane until Engineer has approved the test area, including approval of aesthetics, color, texture, and appearance.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

Application

Immediately before placing silane, all exposed surfaces shall be completely dry and blown clean with oil-free compressed air to remove any loose dust and debris. Apply silane as soon as practical after the exposed surfaces have been properly prepared and conditions are satisfactory:

- Stir material thoroughly before and during application.
- Apply silane with low-pressure spray or by flooding, followed by brooming or squeegeeing for even distribution, in accordance with manufacturer's instructions.
- Maintain operating pressures in sprayers used for application of the silane sealer material sufficiently low so that atomization or misting of the material does not occur.
- Begin the application of the silane at the lowest elevation and proceed upward, toward higher elevations, unless otherwise approved by the Engineer.
- Apply even distribution of silane. Avoid ponding of silane; take care when applying the silane, so that running or puddling does not occur.
- Apply silane in a single application to the concrete deck surface with enough material to saturate the surface. Remove excess material with a broom or squeegee and dispose of excess material appropriately. If a second coat is required, it should be applied "wet on wet" before first coat dries.
- Allow product to penetrate the bridge deck and dry, as required by the manufacturer, prior to opening to traffic.

LIMITATIONS OF OPERATIONS

- Prior to application of any silane sealer, cure concrete or concrete repairs for a minimum of 21 days.
- Do not use silane material after the shelf life date.
- Do not return unused material in opened containers to storage for later use. Either apply such material to appropriate areas on concrete deck surfaces or remove and appropriately dispose of it at offsite locations provided by the Contractor.
- If expansion joints are not being replaced or have been replaced prior to shotblasting, they shall be protected from damage from the shotblasting operation. Deck drains and areas of curb or railing above the proposed surface shall be protected from the shotblasting operation.
- Pick up and store all blast media and contaminants in a vacuum unit. Do not create dust during the blasting operation that will obstruct the view of motorists in adjacent roadways. Store, handle, and dispose of blast media and contaminants in accordance with all applicable local, state, and federal requirements.
- Cover deck joint seal and elastomeric material, plug deck drain scuppers, seal cracks on underside of deck, and use other necessary protective measures to prevent leakage of silane below the concrete deck, to protect waterways, bridge components, pedestrians, vehicles, roadway, vegetation, and any other items or areas below or near the bridge.
- Application of sealant by spray methods will not be permitted when wind speeds are 20 mph or more, or if in the opinion of the Engineer, unsatisfactory results will be obtained. Other application methods or rescheduling will be required.
- Avoid application with hand pump sprayers. For small areas of silane application, the use of hand pump sprayers might be allowed, but must be approved by the Engineer.
- Protect traffic from rebound, dust, overspray, and construction activities. Provide appropriate shielding, as required and/or directed by the Engineer.
- The Contractor shall provide suitable coverings (e.g. heavy-duty drop cloths) as needed to protect all exposed areas not to receive silane treatment, such as asphalt pavement, curbs, sidewalks, parapets, etc.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

- Contractor shall protect from overspray all pedestrians, vehicles, plants and vegetation, and other areas not receiving silane application.
- Clean and/or repair all damage or defacement resulting from Contractor's operations to the Engineer's satisfaction at no additional cost to the Department.
- The equipment used for silane application must be clean of foreign materials and approved by the Engineer before use.
- The surface to receive the treatment shall be dry for at least 48 hours before treatment and shall be free from sand, surface dust and dirt, oil, grease, chemical films, and other contaminants prior to application of the silane.
- The surface, air, and material temperatures shall be between 40°F and 90°F during application.
- Do not apply silane materials during cold, hot, or wet weather conditions or when adverse weather conditions are forecasted within twelve (12) hours of the completion of the silane application. Correct any coating damaged by rain or moisture by an additional application or as required by the silane manufacturer.
- Protect prepared surfaces from precipitation and heavy dew during and after the application of the silane.
- Conduct the work in a continuous operation, with the silane application as soon as practical following surface preparation.
- Apply silane during the lowest temperature period of the day, typically between 1:00 a.m. and 9:00 a.m., when the cracks are open to the greatest extent.
- Clean up, dispose of any surplus material, and restore any disturbed areas unless otherwise directed.
- 100% Silane is a combustible liquid; take appropriate precautions during handling, storage, and operations. KEEP AWAY FROM OPEN FLAME.
- Work crews should wear appropriate personal protection equipment and follow manufacturer's recommendations when applying silane. Refer to the SDS and all applicable local, state, and federal laws, and rules and regulations of authorities having jurisdiction over the project, for specific guidance for personal and environmental protection and safety requirements.
- Silane Deck Treatment operations shall be coordinated with Traffic Management Plans.

MEASUREMENT AND PAYMENT

Shotblasting Bridge Deck will be measured and paid for at the contract unit price per square yard and will be full compensation for the shotblasting and necessary sandblasting and handwork to prepare the entire concrete bridge deck, and removal and disposal of all waste material generated.

Silane Deck Treatment will be measured and paid for at the contract unit price per square yard and will be full compensation for bridge deck surface and crack preparation; for furnishing and applying the silane deck treatment; for protection of waterways, bridge, and other nearby surfaces, vehicles, and pedestrians; and for all labor, tools, and incidentals necessary to complete the work.

Payment will be made under:

Pay Item	**Pay Unit**
Shotblasting Bridge Deck	Square Yard
Silane Deck Treatment	Square Yard

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

PAINTING EXISTING STRUCTURE (SPECIAL)

DESCRIPTION

This work shall consist of furnishing all labor, equipment, and materials necessary to clean and paint the structural steel of the existing bridge. Work includes: removal, containment and disposal of the existing paint system; preparation of the surface to be painted and applying the new paint system; a containment enclosure; and any incidentals necessary to complete the project as specified and shown on the plans.

CERTIFICATION

The existing paint systems include toxic substances such as red lead oxide, which are considered hazardous if improperly removed. The contractor shall be currently SSPC QP 2, Category A certified, and have successfully completed lead paint removal and field painting on similar structures within 18 months prior to this bid.

The apparent low bidder shall submit a list of projects for which QP 2 work was performed within the last 18 months including owner contact information and submit to the Assistant State Structures Engineer (Operations) a "Lead Abatement Affidavit" by 12:00 noon of the third day following the opening of bids. This form may be downloaded from: **http://www.ncdot.gov/projects/ncbridges/#stats**.

The Engineer will evaluate the work history to verify all lead abatement work was completed in accordance with contract specifications, free of citation from safety or environmental agencies. Lead abatement work shall include, but not be limited to: abrasive blasting; waste handling, storage and disposal; worker safety during lead abatement activities (fall protection, PPE, etc.); and containment. This requirement is in addition to the contractor pre-qualification requirements covered by Article 102-2 of the *2018 Standard Specifications*.

TWELVE-MONTH OBSERVATION PERIOD

The Contractor maintains responsibility for the coating system for a 12-month observation period beginning upon the satisfactory completion of all the work required in the plans or as directed by the Engineer. The Contractor shall guarantee the coating system under the payment and performance bond (refer to Article 109-10 of the *2018 Standard Specifications*). To complete successfully the observation period, the coating system shall meet the following requirements after 12 months service:

(A) No visible rust, contamination or application defect is observed in any coated area.
(B) Painted surfaces have a uniform color and gloss.
(C) Painted surfaces have an adhesion that meets an ASTM D3359, 3A rating.

Final acceptance is made only after the paint system meets the above requirements.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

SUBMITTALS

Submit all of the following to the Engineer for review and approval before scheduling the pre-construction meeting. Allow at least 2 weeks for the review process.

(A) Work schedule which shall be kept up to date, with a copy of the revised schedule being provided to the Engineer in a timely manner,
(B) Containment system plans and design calculations in accordance with SSPC Guide 6, Class 2A and other project requirements, signed and sealed by a Professional Engineer licensed by the State of North Carolina,
(C) Bridge wash water sampling and disposal plan,
(D) Subcontractor identification,
(E) Lighting plan for night work in accordance with Section 1413 of the *2018 Standard Specifications*,
(F) Traffic control plan with NCDOT certified supervisors, flaggers and traffic control devices,
(G) Health and safety plan addressing at least the required topics as specified by the SSPC QP 1 and QP 2 program and including hazard communication, respiratory health, emergency procedures, and local hospital and treatment facilities with directions and phone numbers, disciplinary criteria for workers who violate the plan and accident investigation. The plan shall address the following: hazardous materials, personal protective equipment, general health and safety, occupational health and environmental controls, fire protection and prevention, signs signals, and barricades, materials handling, storage, use, and disposal, hand and power tools, welding and cutting, electrical, scaffolds, fall protection, cranes, derricks, hoists, elevators, and conveyors, ladders, toxic and hazardous substances, airless injection and HPWJ.
(H) Provide the Engineer a letter of certification that all employees performing work on the project have blood lead levels that are below the OSHA action level.
(I) Provide the Engineer with Competent Person qualifications and summary of work experience.
(J) Environmental Compliance Plan
(K) Quality Control Plan (Project Specific) with quality control qualifications and summary of work experience.
(L) Bridge and Public Protection Plan (Overspray, Utilities, etc. - Project/Task Specific)
(M) Abrasive Blast Media
    (1) Product Data Sheet
    (2) Blast Media Test Reports in accordance with Article 1080-12 of the *2018 Standard Specification*.
(N) Coating Material
    (1) NCDOT HICAMS Test Reports (testing performed by NCDOT Materials and Tests Unit),
    (2) Product Data Sheets,
    (3) Material Safety Data Sheets,
    (4) Product Specific Repair Procedures, and

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

(5) Acceptance letters from paint manufacturer's for work practices that conflict with Project Special Provisions and/or paint manufactures product data sheets.

PRE-CONSTRUCTION MEETING

Submittals shall be reviewed and approved by the Engineer prior to scheduling the pre-construction meeting. Allow no less than 2 weeks for a review process. When requesting a pre-construction meeting, contact the Engineer at least 7 working days in advance of the desired pre-construction date. The contractor's project supervisor, Competent person, quality control personnel and certified traffic control supervisor shall be in attendance at the pre-construction meeting in order for the Contractor and NCDOT team to establish responsibilities for various personnel during project duration and to establish realistic timeframes for problem escalation.

CONTAINMENT SYSTEM

Prior to performing any construction or painting operations on the structure, the Contractor shall furnish the Engineer with plans and design calculations for a sufficiently designed containment system, which will provide access for any repairs on structural steel members, cleaning and surface preparations for structural steel members, and coating operations for structural steel members of the bridge. The containment system shall not be installed, and no work shall begin, until the Engineer has reviewed and approved, in writing, the submitted containment system plans and design calculations. Containment system plans and design calculations shall be prepared, sealed, and signed by a Professional Engineer licensed by the State of North Carolina. Allow a minimum of two weeks for review of the containment plans and calculations.

The containment system shall meet or exceed the requirements of Class 2A containment in accordance with SSPC Guide 6. The Contractor shall determine the required capacity of the containment system, which, at a minimum, shall include loads due to wind, repair materials and repair operations, equipment, and tools; however, the capacity shall not be less than that required by Federal or State regulations. Design steel members to meet the requirements of the American Institute of Steel Construction Manual. Design timber members in accordance with the "National Design Specification for Stress-Grade Lumber and Its Fastenings" of the National Forest Products Association. The containment system shall be constructed of materials capable of withstanding damage from any of the work required on this project and shall be fireproof.

In the containment system plans, describe how debris is contained and collected. Describe the type of tarpaulin, bracing materials, and the maximum designed wind load. Describe the dust collection system and how a negative pressure of 0.03 inches of water column is maintained inside the enclosure, while blasting operations are being conducted. Describe how the airflow inside the containment structure is designed to meet all applicable OSHA Standards. Describe how water run-off from rain will be routed by or through the enclosure. Describe how wash water will be contained and paint chips separated. Describe what

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

physical containment will be provided during painting application to protect the public and areas not to be painted.

Drilling holes in the superstructure for the purpose of attaching the containment system is prohibited.

The Contractor will be responsible for certifying the containment system has been constructed in accordance with the approved plans.

The containment system shall be cleaned after each workday.

Upon completion of work, remove all anchorages in the substructure and repair the substructure at no additional cost to the Department.

Protect non-metallic parts of bearings from blasting and painting (i.e.: Pot Bearings, Elastomeric Pads, and Disc Bearings).

The containment system shall allow the bascule span to remain operational to accommodate bridge openings as required by the USCG.

WASH WATER SAMPLING AND DISPOSAL PLAN

All wash water shall be collected and sampled prior to disposal. Representative sampling and testing methodology shall conform to 15A NCAC 02B.0103, "Analytical Procedures". Wash water shall be tested for pollutants listed in 15A NCAC 02B.0211(3), 15A NCAC 02T.0505(b)(1) and 15A NCAC 2T.0905(h). Depending on the test results, wash water disposal methods shall be described in the disposal plan. Wash water shall be disposed of in accordance with all current Federal and State regulations. See link for NCDOT Guidelines for Managing Bridge Wash Water: **http://www.ncdot.gov/projects/ncbridges/#stats**.

WASTE HANDLING OF PAINT AND ABRASIVES

Comply with all Federal, State, and local regulations. Failure to comply with the regulations could result in fines and loss of qualified status with NCDOT.

Comply with the Resource Conservation and Recovery Act (RCRA - 40 CFR 261 - 265) and the Occupational Safety and Health Act (OSHA - 29 CFR 1910 - 1926) regulations for employee training, and for the handling, storage, labeling, recordkeeping, reporting, inspections and disposal of all hazardous waste generated during paint removal.

A summary of Generator Requirements is available at the above NCDOT web link, which cites the specific regulations for each Generator category. Quantities of waste by weight and dates of waste generation shall be recorded. Waste stored at the project site shall be properly labeled. All waste, hazardous or non-hazardous, requires numbered shipping manifests.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

The North Carolina Department of Environment and Natural Resources (NCDENR) have adopted RCRA as the North Carolina Hazardous Waste Management Rules and are responsible for enforcement. The "Hazardous Waste Compliance Manual for Generators of Hazardous Waste" is published by the Compliance Branch of the Division of Waste Management of NCDENR, and can be found at: **http://portal.ncdenr.org/web/wm/hw/rules**.

Use a company from the below list of approved waste management companies. Immediately after award of the contract, arrange for waste containers, sampling, testing, transportation, and disposal of all waste. No work shall begin until the Contractor furnishes the Engineer with a written waste disposal plan. Any alternative method for handling waste shall be pre-approved by the Engineer.

Southern Logistics, Inc. – 312 Orville Wright Dr., Greensboro, NC 27409
(Ph. 336-662-0292)
A&D Environmental – PO Box 484, High Point, NC 27261
(Ph. 336-434-7750)
Poseidon Environmental Services, Inc. – 837 Boardman-Canfield Rd #209, Youngstown, OH
(Ph. 330-726-1560)
Clean Harbors Reidsville, LLC – 208 Watlington Industrial Drive, Reidsville, NC 27320
(Ph. 336-342-6106)

All removed paint and spent abrasive media shall be tested for lead following the SW-846 TCLP Method 1311 Extraction, as required in 40 CFR 261, Appendix 11, to determine whether it shall be disposed of as hazardous waste. Furnish the Engineer certified test reports showing TCLP results and Iron analysis of the paint chips stored on site, with disposal in accordance with "Flowchart on Lead Waste Identification and Disposal" at:

http://portal.ncdenr.org/c/document_library/get_file?p_l_id=38491&folderId=328599& name=DLFE-9855.pdf.

All sampling shall be done in presence of the Engineer's representative.

The Competent Person shall obtain composite samples from each barrel of the wash water and waste generated by collecting two or more portions taken at regularly spaced intervals during accumulation. Composite the portions into one sample for testing purposes. Acquire samples after 10% or before 90% of the barrel has accumulated. The intent is to provide samples that are representative of widely separated portions, but not the beginning and end of wash water or waste accumulation.

Perform sampling by passing a receptacle completely through the discharge stream or by completely diverting the discharge into a sample container. If discharge of the wash water or waste is too rapid to divert the complete discharge stream, discharge into a container or transportation unit sufficiently large to accommodate the flow and then accomplish the sampling in the same manner as described above.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

Comply with the NCDENR Hazardous Waste Compliance Manual for Generators of Hazardous Waste. Record quantities of waste by weight and dates of waste generation. Until test results are received, store all waste, and label as "NCDOT Bridge Paint Removal Waste - Pending Analysis" and include the date generated and contact information for the Division HazMat Manager or Project Engineer. Store waste containers in an enclosed, sealed, and secured storage container protected from traffic from all directions. Obtain approval for the protection plan for these containers from the Engineer. If adequate protection cannot be obtained by use of existing guardrail, provide the necessary supplies and equipment to maintain adequate protection. Once test results are received and characterized, label waste as either "Hazardous Waste - Pending Disposal" or "Paint Waste - Pending Disposal".

Once the waste has been collected, and the quantities determined, prepare the appropriate shipping documents and manifests and present them to the Engineer. The Engineer will verify the type and quantity of waste and obtain a Provisional EPA ID number from the:

NC Hazardous Waste Section
North Carolina Department of Environment & Natural Resources
1646 Mail Service Center
Raleigh, NC 27699
Phone (919) 508-8400, Fax (919) 715-4061

At the time of shipping, the Engineer will sign, date, and add the ID number in the appropriate section on the manifest. The maximum on-site storage time for collected waste shall be 90 days. All waste whether hazardous or non-hazardous will require numbered shipping manifests. The cost for waste disposal (including lab and Provisional EPA ID number) is included in the bid price for this contract. Note NC Hazardous Waste Management Rules (15A NCAC 13A) for more information. Provisional EPA ID numbers may be obtained at this link:

http://portal.ncdenr.org/web/wm/provisional-hw-notification-page.

Testing labs shall be certified in accordance with North Carolina State Laboratory Public Health Environmental Sciences. List of certified laboratories may be obtained at this link:

http://slphreporting.ncpublichealth.com/EnvironmentalSciences/Certification/CertifiedLaboratory.asp.

All test results shall be documented on the lab analysis as follows:

1. For leachable lead:
   a. Soils/Solid/Liquid- EPA 1311/200.7/6010

Area sampling will be performed for the first 2 days at each bridge location. The area sample will be located within five feet of the containment and where the highest probability of leakage will occur (access door, etc.). Results from the area sampling will be given to the Engineer within 72 hours of sampling (excluding weekends). If the results of the samples

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

exceed 20 µg/m^3 corrective measures shall be taken and monitoring shall be continued until 2 consecutive sample results are less than 20 µg/m^3.

TWA may suspend the work if there are visible emissions outside the containment enclosure or pump monitoring results exceeding the level of 30 µg/m^3.

Where schools, housing and/or buildings are within 500 feet of the containment, the Contractor shall perform initial TSP-Lead monitoring for the first 10 days of the project during abrasive blasting, vacuuming and containment removal. Additional monitoring will be required during abrasive blasting 2 days per month thereafter. Results of the TSP monitoring at any location shall not exceed 1.5 µg/m^3.

EQUIPMENT MOBILIZATION

The equipment used in any travel lanes and paved shoulder shall be mobile equipment on wheels that has the ability to move on/off the roadway in less than 30 minutes. All work conducted in travel lanes shall be from truck or trailer supported platforms and all equipment shall be self-propelled or attached to a tow vehicle at all times.

QUALITY CONTROL INSPECTOR

Provide a quality control inspector in accordance with the SSPC QP guidelines to ensure that all processes, preparation, blasting and coating application are in accordance with the requirements of the contract. The inspector shall have written authority to perform QC duties to include continuous improvement of all QC internal procedures. The presence of the engineer or inspector at the work site shall in no way lessen the contractor's responsibility for conformity with the contract.

QUALITY ASSURANCE INSPECTOR

The quality assurance inspector which may be a Department employee or a designated representative of the Department shall observe, document, assess, and report that the Contractor is complying with all of the requirements of the contract. Inspectors employed by the Department are authorized to inspect all work performed and materials furnished. Such inspection may extend to all or any part of the work and to the preparation, fabrication, or manufacture of the materials to be used. The inspector is not authorized to alter or waive the requirements of the contract. Each stage in preparing the structure to be coated which includes but not limited to washing, blasting, coating testing and inspection shall be inspected and approved by the Engineer or his authorized representative.

SUBLETTING OF CONTRACT

Only contractors certified to meet SSPC QP 2, Category A, and have successfully completed lead paint removal and field painting on all similar structures within 18 months prior to this bid are qualified for this work. Work is only sublet by approval of the Engineer.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

PREPARATION OF SURFACES

Before any other surface preparation is conducted, all surfaces shall be power washed to remove dust, salts, dirt, and other contaminants. All wash water shall be contained, collected, and tested in accordance with the requirements of NCDOT Managing Bridge Wash Water specification. Obtain approval of the Engineer and allow all cleaned surfaces to dry to the touch and without standing water before beginning surface preparation or painting activities.

Surface preparation is done with materials meeting Article 1080-12 of the *2018 Standard Specifications*. No silica sand or other silica materials are permitted for use. The profile shall be between 1.0 and 3.0 mils when measured on a smooth steel surface. Conduct and document at least 2 tests per beam/girder and 2 tests per span of diaphragms/cross bracing.

Spread tarpaulins over all pavements and surfaces underneath equipment used for abrasive blasting as well as equipment and containers used to collect abrasive media. This requirement will be enforced during activity and inactivity of equipment.

Before the Contractor departs from the work site at the end of the workday, collect all debris generated during surface preparation and all dust collector hoses, tarps or other appurtenances containing blasting residue in approved containers.

Clean a 3" x 3" area at each structure to demonstrate the specified finish, and the inspector will preserve this area by covering it with tape, plastic or some other suitable means so that it can be retained as the Dry Film Thickness (DFT) gauge adjustment standard. An acceptable alternative is for the Contractor to provide a steel plate with similar properties and geometry as the substrate to be measured.

The contractor and or quality assurance representative shall notify the Engineer of any area of corroded steel that has lost more than 50% of its original thickness.

All parts of the bridges not to be painted and the travelling public shall be protected from overspray. Submit a plan to protect all parts of bridge that are not required to be painted and a plan to protect the traveling public and surrounding environment while applying all coats of paint to a structure.

Ensure that chloride levels on the surfaces are 7 $\mu g/cm^2$ or lower using an acceptable sample method in accordance with SSPC Guide 15. The frequency of testing shall be 2 tests per span after all surface preparation has been completed and immediately prior to painting. Select test areas representing the greatest amount of corrosion in the span as determined by the Engineers' representative. Additional testing may be required if significant amounts of chloride are detected.

All weld splatter, slag or other surface defects resulting in a raised surface above the final paint layer shall be removed prior to application of primer coat.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

PAINTING OF STEEL

Paint System 1, as specified in these special provisions and Section 442 of the *2018 Standard Specifications*, is to be used for this work. System 1 is an inorganic zinc primer, two coats acrylic paint, and one stripe coat of acrylic paint over blast-cleaned surfaces in accordance with SSPC-SP-10 (Near White Blast). Perform all mixing operations over an impervious surface with provisions to prevent runoff to grade of any spilled material. The contractor is responsible for reporting quantities of thinner purchased as well the amounts used. No container with thinner shall be left uncovered, when not in use.

Apply 2" stripe coat, by brush or roller only, to all exposed edges of steel including fasteners before applying the finish coat. Locate the edge or corner in the approximate center of the paint stripe.

Any area where newly applied paint fails to meet the specifications shall be repaired or replaced by the Contractor. The Engineer approves all repair processes before the repair is made. Repaired areas shall meet the specifications. The Contractor applies an additional finish coat of paint to areas where the tape adhesion test is conducted.

MATERIALS

Only paint suppliers that have a NCDOT qualified inorganic zinc primer may furnish paints for this project. All paints applied to a structure shall be from the same supplier. Before any paints are applied the Contractor shall provide the Engineer a manufacturer's certification that each batch of paint meets the requirements of the applicable Section 1080 of the *2018 Standard Specifications*.

The inspector randomly collects a one pint sample of each paint product used on the project. Additional samples may be collected as needed to verify compliance to the specifications.

Do not expose paint materials to rain, excessive condensation, long periods of direct sunlight, or temperatures above 110°F or below 40°F. In addition, the Contractor shall place a device that records the high, low, and current temperatures inside the storage location. Follow the manufacturer's storage requirements if more restrictive than the above requirements.

INSPECTION

Surface Preparation for System 1 shall be in accordance with SSPC SP-10. Any area(s) not meeting the requirements of SSPC SP-10 shall be remediated prior to application of coating. Surface inspection is considered ready for inspection when all blast abrasive, residue and dust is removed from surfaces to be coated.

(A) Quality Assurance Inspection

The Contractor furnishes all necessary OSHA approved apparatus such as ladders, scaffolds and platforms as required for the inspector to have reasonable and safe

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

access to all parts of the work. The contractor illuminates the surfaces to be inspected to a minimum of 50-foot candles of light. All access points shall be illuminated to a minimum of 20-foot candles of light.

NCDOT reserves the right for ongoing QA (Quality Assurance) inspection to include but not limited to surface contamination testing, adhesion pull testing, and DFT readings as necessary to assure quality.

Inform the Engineer and the Division Safety Engineer of all scheduled and unannounced inspections from SSPC, OSHA, EPA and/or others that come on site. Furnish the Engineer a copy of all inspection reports except for reports performed by a third party and or consultant on behalf of the Contractor.

(B) Inspection Instruments

At a minimum, furnish the following calibrated instruments and conduct the following quality control tests:

(1) Sling Psychrometer - ASTM E337 - bulb type
(2) Surface Temperature Thermometer
(3) Wind Speed Indicator
(4) Tape Profile Tester - ASTM D4417 Method C
(5) Surface Condition Standards - SSPC VIS-1 and VIS-3
(6) Wet Film Thickness Gage - ASTM D4414
(7) Dry Film Thickness Gage - SSPC-PA2 Modified
(8) Solvent Rub Test Kit - ASTM D4752
(9) Adhesion Test Kit - ASTM D3359 Method A (Tape Test)
(10) Adhesion Pull test - ASTM D4541
(11) Surface Contamination Analysis Kit or (Chloride Level Test Kit) SSPC Technology Guide 15

(C) Quality Control

Maintain a daily quality control record in accordance with Article 442-13 of the *2018 Standard Specifications* and make such records available at the job site for review by the inspector and submit to the Engineer as directed. In addition to the information required on M&T-610, submit all Dry Film Thickness (DFT) readings on a form equivalent to M&T-611.

(1) Measure DFT at each spot on the attached diagram and at the required number of locations as specified below:

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

(a) For span members less than 45 feet; three random locations along each girder in each span.
(b) For span members greater than 45 feet; add one additional location for each additional 10 feet in span length.

DFT measurements for the prime coat shall not be taken for record until the zinc primer has cured in accordance with ASTM D4752 (MEK Rub Test) with no less than a four resistance rating.

Stiffeners and other attachments to beams and or plate girders shall be measured at no less than five random spots per span. Also, dry film thickness is measured at no less than six random spots per span on diaphragms/“K” frames.

Each spot is an average of three to five individual gage readings as defined in SSPC PA-2. No spot average shall be less than 80% of minimum DFT for each layer applied; this does not apply to stripe coat application. Spot readings that are non-conforming shall be re-accessed by performing additional spot measurements not to exceed one-foot intervals on both sides of the low areas until acceptable spot averages are obtained. These non-conforming areas shall be corrected by the Contractor prior to applying successive coats.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

<u>Less than 36" in height and/or bottom flanges less than 16" in width</u>.

7 Spot Areas

21 Individual DFT Readings

***D areas are only included when flange thickness is one inch (1") or greater.**

<u>36" in height or greater and/or bottom flanges greater than 16" in width</u>.

10 Spot Areas

30 Individual DFT Readings

***D areas are only included when flange thickness is one inch (1") or greater.**

(2) Two random adhesion tests (1 test=3 dollies) per span are conducted on interior surfaces in accordance with ASTM D4541 (Adhesion Pull Test) after the prime coat has been properly cured in accordance with ASTM D4752 (MEK Rub Test) with no less than a 4 resistance rating, and will be touched up by the Contractor. The required minimum average adhesion is 400 psi.

(3) Cure of the intermediate and stripe coats shall be accessed by using the thumb test in accordance with ASTM D1640 (Curing Formation Test) prior to the application of any successive layers of paint.

(4) One random Cut Tape adhesion test per span is conducted in accordance with ASTM D3359 (X-Cut Tape Test) on interior surface after the finish

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

coat is cured. Repair areas shall be properly tapered and touched up by the Contractor.

SAFETY AND ENVIRONMENTAL COMPLIANCE PLANS

Personnel access boundaries are delineated for each work site using signs, tape, cones, or other approved means. Submit copies of safety and environmental compliance plans that comply with SSPC QP 2 Certification requirements.

HEALTH AND SAFETY RESPONSIBILITIES

This project may involve toxic metals such as arsenic, lead, cadmium and hexavalent chromium. It is the contractor's responsibility to test for toxic metals and if found, comply with the OSHA regulations, which may include medical testing.

Ensure a "Competent Person" as defined in OSHA 29 CFR 1926.62; one who is capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them; is on site during all surface preparation activities and monitors the effectiveness of containment, dust collection systems and waste sampling. Before any work begins, provide a written summary of the Competent Person's safety training.

Comply with Subarticle 442-14(B) of the *2018 Standard Specifications*.

Comply with Subarticle 442-14(D) of the *2018 Standard Specifications*. Ensure employee blood sampling test results are less than 50 micrograms per deciliter. Remove employees with a blood sampling test of 50 or more micrograms per deciliter from work activities involving any lead exposure.

An employee who has been removed with a blood level of 50 micrograms per deciliter or more shall have two consecutive blood sampling tests spaced one week apart indicating that the employee's blood lead level is at or below 40 micrograms per deciliter before returning to work activities involving any lead exposure.

All OSHA recordable accidents that occur during the project duration are to be reported to the Engineer within twenty-four (24) hours of occurrence. In addition, for accidents that involve civilians or property damage that occurs within the work zone the Division Safety Engineer shall be notified immediately.

Prior to blasting operations, the Contractor shall have an operational OSHA approved hand wash station at each bridge location and a decontamination trailer at each bridge or between bridges unless the work is on the roadway, or the Contractor shall show reason why it is not feasible to do so and provide an alternative site as approved by the Engineer. The Contractor shall assure that all employees whose airborne exposure to lead is above the PEL shall shower at the end of their work shift.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

STORAGE OF PAINT AND EQUIPMENT

Provide a location for materials, equipment, and waste storage. Spread tarpaulins over all pavements and surfaces underneath equipment used for abrasive recycling and other waste handling equipment or containers. All land and or lease agreements that involve private property shall disclose to the property owner that heavy metals may be present on the Contractor's equipment. Prior to storing the Contractor's equipment on private property, provide a notarized written consent signed by the land owner received by the Engineer at least forty-eight (48) hours before using property. All storage of paint, solvents, and other materials applied to structures shall be stored in accordance with Section 442 of the *2018 Standard Specifications* or the manufacturers' requirements. The more restrictive requirements will apply.

UTILITIES

Protect all utility lines or mains that may be supported on, under, or adjacent to bridge work sites from damage and paint overspray.

MEASUREMENT AND PAYMENT

The cost of inspection, surface preparation, and repainting the existing structure is included in the lump sum price bid for *Cleaning and Repainting of Bridge #11*. This price is full compensation for furnishing all inspection equipment, all paint, cleaning abrasives, cleaning solvents and all other materials; preparing and cleaning surfaces to be painted; applying paint in the field; protecting work area, traffic and property; and furnishing blast cleaning equipment, paint spraying equipment, brushes, rollers, any other hand or power tools and any other equipment.

Pollution Control will be paid at the contract lump sum price which will be full compensation for all collection, handling, storage, air monitoring, and disposal of debris and wash water, all personal protective equipment, and all personal hygiene requirements, and all equipment, material and labor necessary for the daily collection of the blast debris into specified containers; and any measures necessary to ensure conformance to all safety and environmental regulations as directed by the Engineer.

Painting Containment for Bridge #11 will be paid at the lump sum contract price and will be full compensation for the design, materials, installation, maintenance, and removal of the containment system.

Payment will be made under:

Pay Item	**Pay Unit**
Cleaning and Repainting of Bridge #11	Lump Sum
Pollution Control	Lump Sum
Painting Containment for Bridge #11	Lump Sum

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

DESCRIPTION OF BRIDGE

Bridge #11: This bridge was built in 1978 and carries US 74 / US 133 over the Northeast Cape Fear River. The superstructure of the movable bascule span that is to be cleaned and painted consists of cantilever bascule girders, trussed floor beams, overhang brackets, top and bottom lateral bracing, stringers, diaphragms, fascia beams, steel barrier, trunnion struts, bearings and inspection walkways with safety railings. Refer to the plans and reference plans for member sizes and spacings. Each leaf of the bascule span to be cleaned and painted is approximately 155’-0” long and 65’-0” wide. The total length of the bascule span is 310’-0” long. The bascule span has both open and filled steel grid deck that is attached to the stringers. The existing paint system is aluminum over red lead, and the estimated area to be cleaned and painted is **106,000** sq. ft.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

REPAIRS TO PRESTRESSED CONCRETE GIRDERS (SPECIAL)

DESCRIPTION

Work includes removal of concrete in spalled and/ or delaminated areas of the existing prestressed concrete girders and concrete diphragms, in reasonably close conformity with the lines, depth, and details shown on the plans, described herein, and as established by the Engineer. This work also includes straightening, cleaning, and replacement of reinforcing steel; repair and retensioning of damaged prestressing strand; application of HRCSA corrosion penetrant; doweling/ adhesively anchoring new reinforcing steel or studs; removing all loose materials; removing and disposing of debris; formwork; applying repair material; and protecting adjacent areas of the bridge and environment from work operations. The repair material shall be one of the materials described below, unless otherwise noted in the plans or provisions.

The location and extent of repairs shown on the plans are general in nature. The Engineer shall determine the extent of removal in the field based on an evaluation of the condition of the exposed surfaces.

The Contractor shall coordinate removal operations with the Engineer. No more than 30% of the bearing area under a beam shall be removed without a temporary support system and approval from the Engineer.

Any portion of the structure that is damaged from construction operations shall be repaired to the Engineer's satisfaction, at no extra cost to the Department.

SUBMITTALS

Submit all of the following to the Engineer for review and approval before scheduling the pre-construction meeting. Allow 40 calendar days for review and approval, or acceptance, of working drawings, from the date they are received, until they are returned by the Engineer.

(A) HRCSA (High Ratio Co-Polymerized Calcium Sulfonate) Penetrant
(B) Polymer Modified Concrete Repair Material
(C) Epoxy Mortar Repair Material
(D) Temporary Work Platform
(E) Strand Splice Device

GENERAL SURFACE PREPARATION

Prior to starting the repair operation, confirm and delineate all surfaces and areas assumed to be deteriorated by visually examining and sounding the concrete surface with a hammer (14 ounce or larger) or other approved method. The Engineer is the sole judge in determining the limits of deterioration.

Remove surface concrete to verify that ½" sawcut depth will not damage existing reinforcing steel or prestressing strand. If confirmed, introduce a shallow saw cut a minimum ½" in

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

depth around the repair area, at right angles to the concrete surface. Within the limits of the sawcut, remove all concrete to a minimum depth of ½". Remove all unsound concrete in the repair area, and where the bond between existing concrete and reinforcing steel has been compromised, or where more than half of the diameter of the reinforcing steel is exposed, remove concrete 1 inch behind the reinforcing steel. For concrete removal, use a 17-pound (maximum) pneumatic hammer with points that do not exceed the width of the shank or use hand picks or chisels as directed by the Engineer. Do not cut or remove the existing reinforcing steel. Unless specifically directed by the Engineer, do not remove concrete deeper than 1 inch below the reinforcing steel. Prevent cutting, stretching, or damaging of reinforcing steel.

Remove concrete and prepare concrete substrate such that placement of repair material in forms will adequately fill the repair area and will not result in air pockets or honeycombed area. Inside faces should generally be normal to the exterior face, except that the top should slope up toward the front of the form at an approximate 1-to-3 slope. Provide air vents as necessary. Interior corners should be rounded to a radius of approximately one inch.

As necessary, remove grease, wax, salt, oil, and other contaminants by scrubbing with an industrial grade detergent or degreasing compound followed by a mechanical cleaning. Remove dirt, dust, laitance, and curing compounds by gritblasting, sanding, or etching with 15% hydrochloric acid. Acid etch only if approved by the Engineer. Follow acid etching by scrubbing and flushing with copious amounts of clean water. Check the cleaning using moist pH paper. Water cleaning is complete when the paper reads 10 or higher.

Abrasive blast all exposed concrete surfaces and existing reinforcing steel and strand in the repair area to clean the area and remove all loose materials. Use a wire brush or other hand tools to clean all exposed reinforcing steel and strand not sufficiently cleaned by blasting operations.

After blast cleaning, examine the reinforcing steel and prestressing strand. If there is more than 10% reduction in the diameter of reinforcing steel, splice in and securely tie supplemental reinforcing bars within the original concrete cover. Lap the bars sufficiently to develop the full strength of the bar and, if necessary, provide additional removal of concrete to achieve the required splice length. Reinforcing steel that is required for the repairs shall be in accordance with Section 425 of the Standard Specifications.

At beam ends where the end of prestressing strand might be free and not anchored in concrete, cut and remove prestressing strand back to even with the prepared concrete substrate. If the length of free, unanchored prestressing strand exceeds 12", or if more than one column of prestressing strand is exposed, notify the Engineer immediately.

If four or more prestressing strands have 50% or greater section loss from their original diameter, one half of the compromised strands shall be repaired by splicing of new strand section at the location of the section loss. Device for splicing shall be a turnbuckle type device and shall be submitted for approval before beginning work. New splice section shall match size of existing strand, and splice device shall be sized for that size strand. Do not splice two adjacent strands unless approved by the Engineer. For strands that are to be

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

spliced, remove concrete such that full section of the prestressing strand is exposed for a minimum of six inches on each side of the section loss area. Following device manufacturer's recommendations, prepare the strand, removing concrete as necessary, and install splice device and new splice strand. Tensioning of the splice shall be turn-of-the-nut method.

At locations where strand splicing is required, replacement of concrete with repair material shall provide a minimum cover of one inch.

Follow all cleaning, remove all dust and loose material with air blast or vacuum cleaning.

Apply HRCSA Penetrant to the prepared reinforcing steel and prestressing strand. Do not apply excessive amount of HRCSA Penetrant; HRCSA shall not extend onto surrounding concrete by more than ¼". HRCSA (High Ratio Co-Polymerized Calcium Sulfonate) Penetrant shall be Zero VOC, 100% Solids Penetrant/Sealer (Minimum 15% active sulfonate, a total base number of 135 to 165, must maintain a 9-11 to 1 ratio Active Sulfonate to Total Base Number as determined by Total Base Number Determination testing, Procedure No. 817/4.9/T1401). Allow HRCSA penetrant to dry before placing concrete repair material. Drying time is temperature, humidity, and film thickness dependent. Use manufacturer's recommended drying schedule to estimate the drying time of the penetrating sealer for application of the concrete repair material. If the manufacturer's recommendations allow, the use of forced air pressure to dry the surface will be permitted.

In repair areas that exceed one square foot (1.0 ft^2) install adhesively anchored ¼" diameter stainless steel studs in concrete on a 6" x 6" grid. Depth of embedment of adhesively anchored studs shall be 2". Install studs such that concrete cover on the studs is a minimum one inch (1").

REPAIR MATERIAL OPTIONS

Polymer Modified Concrete Repair Material

Repair material shall be polymer modified cement mortar/grout for vertical or overhead applications and shall be suitable for applications in marine environments. Material shall be approved for use by NCDOT. Submit repair material to the Engineer for review and approval prior to beginning the work. Color of repair material shall be concrete gray.

Prior to the application of polymer modified cement mortar/grout, prepare concrete substrate as indicated in "General Surface Preparation," above. Final preparation of the substrate concrete surface prior to repair material application shall be in accordance with the repair material manufacturer's recommendations.

When surface preparation is completed, mix and apply repair mortar in accordance with manufacturer's recommendations. Use aggregate that is washed, kiln-dried, and bagged. Aggregate size for repair material shall not exceed 2/3 the minimum depth of the repair area. As recommended by the repair material manufacturer, apply bonding agent to all repair areas immediately prior to placing repair mortar. Repair areas shall be formed,

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

unless otherwise approved by the Engineer. Form areas to establish the original neat lines of the member being repaired, unless otherwise approved by the Engineer.

Unless otherwise allowed by the repair material recommendations, forms shall remain in place until repair material achieves 75% of its design compressive strength.

After placing the repair mortar and form removal, remove excessive material and provide a smooth, flush surface.

Epoxy Mortar Repair Material

Use a two-component paste epoxy bonding agent for the epoxy mortar conforming to the requirements for Type 2 epoxies as outlined in Section 1081 of the NCDOT *Standard Specifications for Roads and Structures*, January 2018 and Type III epoxies as outlined in ASTM C881.

Prior to the application of epoxy mortar/grout, prepare concrete substrate as indicated in "General Surface Preparation," above. Final preparation of the substrate concrete surface prior to repair material application shall be in accordance with the repair material manufacturer's recommendations.

When surface preparation is completed, mix and apply repair epoxy mortar in accordance with manufacturer's recommendations. Use aggregate that is washed, kiln-dried, and bagged. Aggregate size for repair material shall not exceed 2/3 the minimum depth of the repair area. Repair areas shall be formed, unless otherwise approved by the Engineer. Form areas to establish the original neat lines of the member being repaired, unless otherwise approved by the Engineer.

Unless otherwise allowed by the repair material recommendations, forms shall remain in place until repair material achieves 75% of its design compressive strength.

After placing the repair mortar and form removal, remove excessive material and provide a smooth, flush surface.

TEMPORARY WORK PLATFORM

Prior to beginning any repair work, provide details for a sufficiently sized temporary work platform at each repair location. Design steel members to meet the requirements of the American Institute of Steel Construction Manual. Design timber members in accordance with the "National Design Specification for Stress-Grade Lumber and Its Fastenings" of the National Forest Products Association. Submit the platform design and plans for review and approval. The design and plans shall be sealed and signed by a North Carolina registered Professional Engineer. Do not install the platform until the design and plans are approved. Drilling holes in the superstructure for the purpose of attaching the platform is prohibited. Upon completion of work, remove all anchorages in the substructure and repair the substructure at no additional cost to the Department.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

MEASUREMENT AND PAYMENT

Repairs to Prestressed Concrete Girders will be measured and paid for at the contract unit price bid per cubic foot and will be full compensation for removal, containment and disposal off-site of unsound concrete, including the cost of materials, reinforcing steel, labor, tools, equipment and incidentals necessary to complete the repair work. Depth will be measured from the original outside concrete face. The Contractor and Engineer will measure quantities after removal of unsound concrete and before application of repair material. Payment will also include the cost of sandblasting, surface cleaning and preparation, cleaning of reinforcing steel, placement of new reinforcing steel, furnishing and application of HRCSA penetrant, furnishing and installation of temporary work platform, testing of the soundness of the exposed concrete surface, furnishing and installation of repair mortar/grout material, curing and sampling of mortar/grout, and protection/cleaning of adjacent areas from splatter or leakage.

Splicing of Prestressing Strand will be measured and paid for at the contract unit price bid per each and will be full compensation for removal, containment and disposal off-site of unsound concrete and compromised prestressing strand, including the cost of materials, prestressing strand, turnbuckle strand splice device, labor, tools, equipment and incidentals necessary to complete the repair work. The Contractor and Engineer will determine quantities after removal of unsound concrete and blast cleaning of prestressing strand and before prestressing strand repair. Payment will also include the cost of blast cleaning, removal of concrete necessary for installation of splice devices, installation of splice devices, and tensioning of the strand and splice section.

Payment will be made under:

Pay Item	**Pay Unit**
Repairs to Prestressed Concrete Girders	Cubic Feet
Splicing of Prestressing Strand	Each

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

EPOXY PROTECTIVE COATING (SPECIAL)

DESCRIPTION

Epoxy protective coating shall be field-applied to the ends of existing concrete girders as indicated on the plans. Epoxy Protective Coating shall conform to Section 420-18 of the 2018 NCDOT Standard Specifications for Roads and Structures.

MEASUREMENT AND PAYMENT

Epoxy Protective Coating will be measured and paid for by the contract unit price bid per square foot and shall be full compensation for furnishing all material, labor, tools and equipment necessary for preparing and coating locations as specified.

Pay Item	Pay Unit
Epoxy Protective Coating	Square Feet

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

STRUCTURAL STEEL FOR REPAIRS (SPECIAL)

Description

This work involves performing structural steel repairs on the bascule span as shown on the plans. The work includes field measuring existing conditions, installation of temporary shoring/blocking, fabricating repair steel, installing steel repairs, field drilling bolt holes, field welding, removing deteriorated portions of members and connectors, providing access to repair locations for construction and inspection, and placing sealant at repair locations as described herein and as shown on the plans.

Material

Structural Steel shall conform to ASTM A709, Grade 50 and shall be in accordance with Section 440 of the Standard Specifications.

Unless otherwise designated on the plans, bolts shall be high-strength and shall conform to Section 440 of the Standard Specifications.

The structural steel shall be painted in accordance with Section 442 of the Standard Specifications and in accordance with provisions for "Painting Existing Structure." Color of finish coat of paint shall match color of existing steel.

Perimeter sealant for steel repairs shall be a silicone caulk or steel epoxy listed on the NCDOT's Approved Products List.

Materials used for temporary support of members, if needed, shall be submitted to the Engineer for review.

Construction Details

Perform structural steel repairs as shown on the plans using procedures outlined on the plans.

The Engineer in the field will determine lengths and limits of deterioration to be repaired using the details shown on the plans. The Engineer, at his/her discretion, may order additional repairs to be performed based on the existing conditions at the time of construction. The contractor will be compensated for additional repairs ordered by the Engineer at the unit price bid for this item.

Contractor shall provide access to repair locations to facilitate their installation and to facilitate inspection by the Engineer.

Contractor shall field measure repair locations as required to facilitate development of fabrication drawings. Shop drawings shall indicate which dimensions have been field-measured. Field measurements shall be performed prior to submittal of the fabrication drawings to Engineer for review.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

Contractor shall coordinate steel repairs with cleaning and painting operations.

Bolting and field welding operations shall be performed in accordance with Section 440 of the Standard Specification and as noted on the plans.

Traffic management plans shall be implemented as required to perform structural steel repairs shown on the plans. Live loading shall be shifted away from, or lane(s) shall be closed near the repair location as indicated on the plans for the respective repair types.

Upon completion of structural steel repairs, sealant shall be applied to the perimeter of the repair as shown on the plans. Surface preparation and application of the sealant shall be in accordance with the manufacturer's recommendations.

Measurement and Payment

Structural Steel for Repairs shall be paid at the unit price bid per pound of steel and shall be full compensation for the removal of existing bolts, removal of deteriorated members, surface preparation, field drilling, field welding, field measuring, installation of temporary shoring/blocking, fabrication, placing sealant, providing access to repair locations, and all necessary equipment and labor required to install the structural steel repairs shown on the plans.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

CLASS II SURFACE PREPARATION (SPECIAL)

DESCRIPTION

This provision addresses the surface preparation activities required prior to placement of silane deck treatment.

Work includes: removal of unsound bridge deck concrete and existing patches in past deck repair areas; cleaning, repairing or replacing reinforcing steel and any incidentals necessary to prepare the bridge deck for placement of concrete for deck repair and silane deck treatment, as specified herein or as shown on the plans.

EQUIPMENT

- Equipment capable of sawing concrete to a depth of 1".
- Power driven hand tools for removal of unsound concrete are required that meet the following requirements:
    - Pneumatic hammers weighing a nominal 15 lbs. or less.
    - Pneumatic hammer chisel-type bits that do not exceed the diameter of the shaft in width.
- Hand tools, such as hammers and chisels, for removal of final particles of unsound concrete.
- Self-propelled vacuum capable of picking up dust and other loose material from prepared deck surface.
- Equipment to supply oil-free and moisture-free compressed air for final surface preparation.

The equipment must operate at a noise level less than 90 decibels at a distance of 50 feet.

MANAGEMENT AND DISPOSAL OF CONCRETE DEBRIS

All concrete debris shall become the property of the Contractor. The contractor shall be responsible for disposing of all debris generated by surface preparation operations, in compliance with applicable regulations concerning such disposal.

All costs associated with management and disposal of all debris shall be included in the payment of this and other items.

SURFACE PREPARATION

Prior to any construction, take the necessary precautions to ensure debris from Class II Surface Preparation is not allowed to fall below the bridge deck.

Remove all existing asphalt overlays and all loose, disintegrated, unsound or contaminated concrete to the limits shown on the plans with the following requirements.

During surface preparation, precaution shall be taken to assure that traffic is protected from rebound, dust, and construction activities. Appropriate shielding shall be provided as required and

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

directed by the Engineer. During surface preparation, the Contractor shall provide suitable coverings, as needed to protect all exposed areas not to receive overlay, such as curbs, sidewalks, parapets, etc. All damage or defacement resulting from surface preparation shall be repaired to the Engineer's satisfaction at no additional cost to the department.

A. Class II Surface Preparation (Partial Depth): At locations specified on the plans or identified by the Engineer for Class II Surface Preparation, remove by chipping with hand tools all existing patches and unsound concrete.

All existing patches shall be removed under Class II surface preparation. The Contractor shall use hand tools to remove the patch. Areas indicated on the plans that require Class II surface preparation, including the locations of existing patches, are from the best information available. The Contractor shall verify prior to surface preparation the location of all existing patches.

Spalled or unsound areas of the deck shall be removed to sound concrete at locations noted in the contract plans or as directed by the Engineer. Remove existing spalled or unsound areas of the bridge concrete deck by methods approved by the Engineer.

Provide a 1" deep saw cut around the perimeter of areas noted for bridge deck or patch removal. Remove, using the type of tools listed above, all concrete or patch material within the sawcut to a minimum depth of 1" and as necessary to remove unsound concrete. All loose and unsound concrete or patch material shall be removed.

If the condition of the concrete is such that deep spalls or sheer faces result, notify the Engineer for the proper course of action.

Thoroughly clean the newly exposed surface to be free of all grease, oil, curing compounds, acids, dirt, or loose debris in accordance with this special provision.

Dispose of the removed concrete, clean, repair or replace rusted or loose reinforcing steel, and thoroughly clean the newly exposed surface. Care shall be taken not to cut, stretch, or damage any exposed reinforcing steel.

In overhangs, removing concrete areas of less than 0.60 ft^2/ft length of bridge without overhang support is permitted unless the Engineer directs otherwise. Overhang support is required for areas removed greater than 0.60 ft^2/ft length of bridge. Submit details of overhang support to the Engineer for approval prior to beginning the work.

B. Preparation of Reinforcing Steel: Remove concrete without cutting or damaging existing steel unless otherwise noted in the plans. Clean, repair, or replace rusted or loose reinforcing steel. Damaged reinforcing steel, such as bars with nicks deeper than 20% of the bar diameter, shall be repaired or replaced. Reinforcing steel which has a cross section reduced to 75% or less shall be replaced with new reinforcing steel of similar cross section area. Replacement bars shall be Grade 60 and meet the material requirements of Section 1070 of the Standard Specifications. Replacement bars shall be spliced to existing bars using either minimum 30 bar diameter lap splices to existing steel with 100% cross sectional area or approved mechanical connectors.

For reinforcing steel left unsupported by the concrete removal process, support and protect the exposed reinforcing steel against displacement and damage from loads, such as those caused

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

by removal equipment and delivery buggies. All reinforcing steel damaged or dislodged by these operations shall be replaced with bars of the same size at the contractor's expense.

Reinforcing steel exposed and satisfactorily cleaned and prepared will not require additional cleaning, if encased in concrete within seven (7) days. Rebar exposed for more than seven (7) days shall be satisfactorily cleaned and prepared, prior to placement of the new concrete. The satisfactory cleanliness and preparation of the reinforcing steel shall be determined by the Engineer.

When large areas of the deck on composite bridges are removed resulting in the debonding of the primary reinforcing bars, the removal shall be performed in stages to comply with the construction sequence shown on the plans or as directed by the Engineer.

C. Concrete Deck Repair: Repair and fill the Class II surface preparation areas of the existing bridge concrete deck prior to the application of the silane deck treatment, at locations shown in the plans, or as determined by the Engineer. For concrete deck repairs:
   - removal and surface preparation of the repair area shall be in accordance with and shall be paid for under the pay item in this special provision.

For Concrete for Deck Repair, see additional special provision.

All repairs shall be placed and finished to match substrate deck grade prior to silane deck treatment, in order to provide a uniform thickness.

D. Safety: Provide a containment system for handling expected and unexpected blow thru of the deck. The containment system shall retain runoff water and debris and protect the area under the bridge deck. The Contractor shall be responsible for any injury or damage caused by these operations. The containment system shall remain in place until the concrete has been cast and attained minimum strength.

Provide adequate lighting when performing deck preparation activities at night. Submit a lighting plan to the Engineer for approval prior to beginning work.

BASIS OF PAYMENT

Class II Surface Preparation will be measured and paid for at the contract unit price per square yard and will be full compensation for Class II deck preparation where required by the plans. The cost will also include removal and disposal of unsound and contaminated concrete, removal of all existing patches, cleaning, repairing, or replacing of reinforcing steel, and all materials, labor, tools, equipment and incidentals necessary to complete the work.

Payment will be made under:

Pay Item	Pay Unit
Class II Surface Preparation	Square Yard

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

BRIDGE JOINT DEMOLITION (SPECIAL)

DESCRIPTION
This provision addresses the removal of existing bridge deck joint material, including existing joint metalwork, and adjacent concrete to facilitate the installation of new bridge deck joints at the locations noted in the plans.

EQUIPMENT
Use the following surface preparation equipment:

- Sawing equipment capable of sawing concrete to a depth of 1”.
- Power driven hand tools for removal of concrete are required that meet the following requirements:
  Pneumatic hammers weighing a nominal 15 lbs (7 kg) or less.
  Pneumatic hammer chisel-type bits that do not exceed the diameter of the shaft in width.
- Hand tools such as hammers and chisels for removal of final particles of concrete.

REMOVAL AND PREPARATION
Prior to any construction, take the necessary precautions to ensure debris from joint demolition is not allowed to fall below the bridge deck.

Remove existing joint material by methods approved by the Engineer. Provide a 1” deep saw cut around the perimeter of areas noted for bridge deck removal.

Remove concrete adjacent to the joint to the limits shown on the plans by chipping with hand tools. Use a small chipping hammer (15 lb. class) to prepare the edges of the repair area to limit micro fractures. In addition, all loose and unsound concrete shall be removed.

In overhangs, removing concrete areas greater than 0.60 ft2/ft length of bridge will require overhang support. Submit the overhang support method to the Engineer for approval.

Care shall be taken not to cut, stretch, or damage any exposed reinforcing steel. Dispose of the removed concrete.

If the condition of the concrete is such that deep spalls or sheer faces result, notify the Engineer for the proper course of action.

Clean, repair or replace rusted or loose reinforcing steel. Thoroughly clean the newly exposed surface to be free of all grease, oil, curing compounds, acids, dirt, or loose debris.

Bridge joint demolition work shall be coordinated with the Traffic Management Plan.

MEASUREMENT AND PAYMENT
Bridge Joint Demolition will be measured and paid for at the contract unit price bid per square foot and will be full compensation for removal, containment and disposal of existing joint material and concrete and shall include the cost of labor, tools, equipment and incidentals necessary to complete the work.

Pay Item	Pay Unit
Bridge Joint Demolition	Square Feet

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

BIRD DETERRENT SCREENING **(SPECIAL)**

DESCRIPTION
This work includes taking field measurements, fabricating, furnishing, and erecting a bird repellent system to prevent bird access to the areas indicated in the plans.

SUBMITTALS
Submit shop drawings showing product detail, layout, dimensions, fastening details, and all other fabrication and installation details for approval, prior to beginning fabrication.

MATERIALS
Metal Screen – Provide Type 316 stainless steel expanded metal screen of size indicated in the plans. Provide Type 316 stainless steel for all framing, stitching and connection hardware, unless otherwise noted on plans.

Anchor bolts – Type 304 stainless steel anchor bolts. Adhesively anchor in accordance with the 2018 Standard Specifications Section 420-13. No field testing of adhesively anchored bolts is required.

Unless otherwise designated on the plans, bolts, nuts and washers shall be high-strength and shall conform to Section 440 of the Standard Specifications.

FABRICATION AND INSTALLATION
Bird Deterrent Screening shall be installed after cleaning and painting of the existing superstructure is complete.

Weld stainless steel in accordance with AWS D1.6 and AASHTO/AWS D1.5. Welding of the metal screen or framing to the superstructure is not permitted.

Grind smooth any burrs, nicks, projections or any rough portions of the metal screen prior to installation. The finished metal screen will have no openings exceeding two inches in any direction.

MEASUREMENT AND PAYMENT
Bird deterrent screening will not be measured and payment will be made on a lump sum basis. This price shall include preparing shop drawings, as well as all work and hardware associated with furnishing and installing completely the bird deterrent screening at the bascule piers as shown on plans and specified herein.

Payment will be made under:

Pay Item	**Pay Unit**
Bird Deterrent Screening	Lump Sum

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

PLASTIC GLAZING PANELS (SPECIAL)

DESCRIPTION
This work includes furnishing and installing of a plastic glazing panel screen to the areas indicated in the plans.

MATERIALS
(a) Structural Steel – ASTM A36, in accordance with Section 440 and 1072 of the Standard Specifications.

(b) Fasteners –

(1) High Strength Bolts – ASTM F3125, Grade A325

(2) Carbon Steel Bolts – ASTM A307, Grade A

(3) Washers – ASTM F844

(4) Neoprene Washers – 1/16" thick neoprene @ 50 durometer hardness

(5) Nuts – ASTM A563A, Hex

(6) Welding – Refer to AWS D1.5 and AWS D1.6

(7) Stainless Steel Hinges and latch – Type 304

(c) Plastic Glazing Panels – Lexan™, UV and mar resistant panels as manufactured by GE Plastics or an approved equal. The panels shall have a minimum thickness of 0.20 inches. The color shall be clear, and the material shall be transparent.

(d) Painting – The structural steel shall be painted in accordance with Section 442 of the Standard Specifications. Paint system and color shall be compatible with paint system used for overall structure cleaning and repainting. Refer to Special Provision for Painting Existing Structure.

FABRICATION AND INSTALLATION
The plastic glazing panel shall be attached to the floorbeam at each bascule pier, as indicated in the plans.

Use caution when tightening the plastic glazing panels to the steel framework, so that excessive force does not crack the plastic glazing panels.

Bolting and field welding shall be performed in accordance with Section 440 of the Standard Specifications and as noted on plans.

Installation shall be coordinated with cleaning and repainting operations in the areas of the plastic glazing panels.

SUBMITTALS
The contractor shall submit plastic glazing panel shop drawings showing product details, panel and framing layout, field measured dimensions, fastening details and all other fabrication and installation details for approval.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

MEASUREMENT AND PAYMENT

Plastic glazing panels will not be measured and payment will be made on a lump sum basis. This price shall include furnishing and installing completely the plastic glazing panels attached to the floorbeams at bascule piers as shown on plans and specified herein.

Payment will be made under:

Pay Item	**Pay Unit**
Plastic Glazing Panels	Lump Sum

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

EMBEDDED GALVANIC ANODE **(SPECIAL)**

1. DESCRIPTION

The work under this Project Special Provision includes furnishing all labor, tools, materials, equipment and services necessary to properly install embedded galvanic anodes.

Embedded galvanic anodes are designed to provide localized corrosion protection. When placed at the appropriate spacing along the perimeter of concrete patches or along the interface between new/existing concrete, the anodes mitigate active corrosion and the formation of new corrosion sites in the adjacent existing concrete.

2. QUALITY CONTROL

2.1 Quality Control Plan:

Include the work under this Project Special Provision in the Contractor General Requirements set forth in NCDOT Specification Division 1. For the embedded anode system the plan shall include but not be limited to, method and frequency of Contractor's QC testing, continuity testing procedures, galvanic anode installation, and time dedicated for training.

2.2 QC Certification:

Manufacturer Certification for specific materials is required. Unless otherwise required the Contractor shall perform all quality control testing with verification by the Cathodic Protection Specialist. The Contractor shall use certified materials from a Department approved source where applicable.

2.3 Personnel Qualifications:

Manufacturer Corrosion Technician

1. The contractor will enlist and pay for a technical representative employed by the galvanic anode manufacturer to provide training and on-site technical assistance during the initial installation of the galvanic anodes. The technical representative shall be a NACE-qualified corrosion technician (Cathodic Protection Technician–CP2 or higher).

2. The qualified corrosion technician shall have verifiable experience in the installation and testing of embedded galvanic protection systems for reinforced concrete structures.

3. The contractor shall coordinate its work with the designated corrosion technician to allow for site support during project startup and initial anode installation. The corrosion technician shall provide contractor training and support for development of application procedures, verification of electrical continuity, and project documentation.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

3. MATERIALS

3.1 Anodes:

Embedded galvanic anodes shall be Anode Type 1A Class C. The anodes shall be pre-manufactured with a nominal 100 grams of zinc in compliance with ASTM B418 Type II cast around a pair of uncoated, non-galvanized steel tie wires and encased in a highly alkaline cementitious shell.

The anode unit shall contain no added sulfate nor shall it contain added chloride, bromide or other constituents that are corrosive to reinforcing steel. Anode units shall be supplied with integral unspliced wires for directly tying to the reinforcing steel.

Contractor shall supply manufacturer's certifications for the embedded galvanic anodes for approval.

The galvanic anodes used shall include verification of the following information:

1. The zinc anode is alkali-activated with an alkaline cementitious shell that is designed to maintain the anode acitivity
2. Contain no added constituents corrosive to reinforcing steel or detrimental to concrete, e.g. chloride, bromide, sulfate, etc.
3. Documented test results from field installations showing that the anodes have achieved a minimum of 10 years in service.
4. A minimum of five projects of similar size and application
5. Anode units shall be supplied with solid zinc core (ASTM B418) cast around uncoated, non-galvanized, non-spliced steel tie wires for wrapping around the reinforcing steel and twisting to provide a durable steel to steel connection between the tie wire and the reinforcing steel
6. Third party product evaluation, such as from Concrete Innovations Appraisal Service, BBA, etc.

3.2 Repair Materials:

Repair mortars, concrete and bonding agents shall be portland cement-based materials with suitable electrical conductivity less than 15,000 ohm-cm. Non-conductive repair materials such as epoxy, urethane, or magnesium phosphate shall not be permitted. Repair materials with significant polymer modification and/or silica fume content may have high resistivity. Insulating materials such as epoxy bonding agents shall not be used unless otherwise called for in the design. If higher resistance repair materials are used, or the resistivity is unknown, use mortar with a resistivity of less than 15,000 ohm-cm to create a conductive bridge to the substrate prior to repair material installation.

Deliver, store, and handle all materials in accordance with manufacturer's instructions. Anode units shall be stored in dry conditions in the original unopened containers in a manner to avoid exposure to extremes of temperature and humidity.

Contractor shall submit manufacturer's certification for low conductivity mortar or repair concrete, as applicable, for approval.

4. EQUIPMENT AND INSTRUMENTATION

Contractor shall provide as a minimum, but not limited to detailed technical specifications of all equipment and instrumentation intended for use in the Project.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

5. INSTALLATION

Install anode units and repair material immediately following preparation and cleaning of the steel reinforcement.

Galvanic anodes shall be installed along the perimeter of the repair at a maximum spacing of 18 in.

Place the galvanic anodes as close as possible to the patch edge while still providing sufficient clearance between anodes and substrate to allow the repair material to fully encase the anode with a minimum concrete or mortar cover over the anode of 1 in. (25mm). If necessary, increase the size of the repair cavity to accommodate the anodes.

1. Place the anode such that it fits tightly against a single bar or at the intersection between two bars and secure to each clean bar.

2. If less than 1 in. (25 mm) of concrete cover is expected, place anode beneath the bar and secure to clean reinforcing steel.

D. The tie wires shall be wrapped around the cleaned reinforcing steel at least one full turn in opposite directions and then twisted tight to create a secure electrical connection and allow no anode movement during concrete placement.

E. If repair materials with resistivity greater than 15,000 ohm-cm are to be used or if the resistivity is unknown, pack mortar with a resistivity less than 15,000 ohm-cm between the anode and the substrate concrete to create a conductive grout bridge ensuring no voids exist.

F. Electrical Continuity

1. Confirm electrical connection between anode tie wire and reinforcing steel by measuring DC resistance (ohm Ω) or DC potential (mV) with a multi-meter.

2. Electrical connection is acceptable if the DC resistance measured with the multi-meter is 1 Ω or less or the DC potential is 1 mV or less.

3. Confirm electrical continuity of the exposed reinforcing steel within the repair area. If necessary, electrical continuity shall be established by tying discontinuous steel to continuous steel using steel tie wire.

4. Electrical continuity between test areas is acceptable if the DC resistance measured with multi-meter is 1 Ω or less or the potential is 1 mV or less.

6. MEASUREMENT AND PAYMENT

Embedded Galvanic Anode

Price and Payment will be full compensation for all work and materials specified in this Project Special Provision and all incidental items necessary to provide a function Embedded Galvanic Anode Cathodic Protection System

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

Payment will be made under:

Pay Item	**Pay Unit**
Embedded Galvanic Anode	Each

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

THERMAL SPRAYED ANODE **(SPECIAL)**

1. DESCRIPTION

The work under this Project Special Provision includes the installation of the following cathodic protection (CP) system on the approach spans.

1.1 Metalizing:

The system requires the application of arc-sprayed zinc (anode) to selected damaged areas (as described in the Contract Documents) that exhibit corrosion problems. This application shall be performed by thermal spraying (metalizing) the concrete with the required surface preparation necessary to produce a good bond between the zinc and concrete. A good bond is essential to provide an efficient system.

Furnish labor, materials, testing and installation equipment, and apply zinc anodes on all surfaces within the limits defined in the Contract Documents or as directed by the Engineer.

The work shall be performed in accordance with the Transportation Management Plans and the Contract Plans regarding time, location, and methods. All work is subject to the approval of the Engineer.

The Contactor shall be responsible for compliance with any federal, state, or local codes regulating the quality of the surface waters and other environmental and worker safety requirements.

2. METALIZING CONTRACTOR/SUBCONTRACTOR QUALIFICATIONS

The metalizing Contractor conducting the installation of the metalized coating must be engaged in thermal spray operations and shall have a minimum of three years of previous experience in metalizing operations with concrete. Provide locations and contact names of successful previous projects for verification at the preconstruction conference.

3. QUALITY CONTROL

3.1 Quality Control Plan:

Include the work under this Project Special Provision in the Contractor General Requirements set forth in NCDOT Specification Division 1. The portion of the Quality Control Plan covering cathodic protection shall be certified by the Cathodic Protection Specialist. For the metalizing system the plan shall include but not be limited to, method and frequency of Contractor's QC testing, continuity testing procedures, zinc anode application, time dedicated for training, thickness measurements, metalizing equipment, method(s) for initial activation of the cathodic protection systems. The zinc rebound containment system(s) and waste disposal methods shall also be submitted. Submit the Quality Control Plan and Cathodic Protection Specialist's qualifications to the Engineer for approval prior to commencing any of the cathodic protection work.

3.2 Cathodic Protection Report:

Provide a final report produced by the Cathodic Protection Specialist for the metalizing system. The report shall describe the general characteristics of the systems and installation

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

sequence. The report shall describe the general characteristics of the metalizing work, the thickness and bond strength results for each metalized component, the results of the connectivity tests and the locations of any continuity bond wires installed. The report and all collected data shall be in typed form and a digital version of the report must be provided along with 4 bound hard copies.

3.3 QC Certification:

Manufacturer Certification for specific materials is required in addition to the Contractor's certification. Unless otherwise required the Contractor shall perform all quality control testing with verification by the Cathodic Protection Specialist. The Contractor shall use certified materials from a Department approved source where applicable.

3.4 Personnel Qualifications:

3.4.1 Metalizing Spray Technician Qualifications:

The Thermal Spray Technician must have a minimum of three years of experience in the operation of Thermal Spray Equipment which includes experience on at least three projects of similar scope using a wire metalizing arc unit.

3.4.2 Cathodic Protection Specialist Qualifications and Responsibilities:

3.4.2.1 Qualifications:

Provide the services of an independent Cathodic Protection Specialist with the following qualifications:

1. A National Association of Corrosion Engineers (NACE) certification in cathodic protection of level CP-4 or a qualified P.E.
2. A minimum of 5 years of experience in the installation and testing of impressed current and galvanic CP systems to protect reinforced concrete structures,
3. Performed quality control and performance testing of CP systems for concrete structures in a minimum of three projects the past five years.
4. Provide the experience record of the CP Specialist(s).

CP Technician(s), who work under the CP Specialist's direction, shall have the following qualification:

1. A minimum of 2 years of experience in the installation and testing of CP systems to protect reinforced concrete structures.

The CP Specialist shall be a subcontractor and may be one individual for multiple cathodic protection systems or multiple individuals responsible for each of the single systems. The CP Specialist shall be independent and shall not be affiliated with the Contractor, the Contractor's Organization, the anode distributor or a subcontractor on the project.

No cathodic protection work will be allowed if at any time an approved CP Specialist is not active or otherwise involved in the Project.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

3.4.2.2 Responsibilities:

4.4.2.2.1 Metalizing Cathodic Protection Specialist Services:
For this work the CP Specialist shall be responsible for the following tasks:

1. Supervise every phase of the application of the thermally sprayed zinc, the continuity testing and corrections of rebar, and any other function further specified for the system.
2. Inspection and testing of the test patch areas for the determination of the target bond strength for the applied zinc and submitting the proposed target bonds for approval of the Engineer.
3. Review and random verification of electrical continuity test results.
4. Review all contractor documents related to the cathodic protection work prior to submittal to the Department for approval.
5. Training Contractor's and Department personnel in performing the required quality control testing for cathodic protection.
6. Visit the project site at a minimum frequency of once per month to inspect the work performed and conduct random testing of at least 25% of the components metalized during his/her absence. Meet and directly update the Engineer (verbally and in writing) regarding quality of the work in progress. These random tests shall be in addition to the Contractor's QC tests specified in this Project Special Provision.
7. Conduct all other specified testing to meet the requirements of the Contract Documents.
8. Provide Cathodic Protection report in accordance with Section 3.2.
9. Certify Quality Control Plan in accordance with Section 3.1.

3.5 Inspection and Testing Access:
Contractor shall provide safe access to the areas to be metalized for Cathodic Protection Specialist and/or his representative and to the Department for inspection.

4. MATERIALS

4.1 Material Certification and Test Results:
Contractor shall provide, as a minimum, technical data sheets, test results and certifications for the following:.

1. Metalizing zinc anode wire; shall indicate chemical composition, wire diameter, lot number, manufacturing date and relative manufacturing data where applicable.
2. Abrasive blasting material data sheet and MSDS;
3. Water based inorganic zinc silicate metalizing overcoat;
4. Epoxy coating for connection plates in accordance with anode manufacturer's recommendations

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

4.2 Metalizing Wire:
The metalizing material shall be essentially pure zinc (99.9% pure) produced in wire form of 1/8 inch standard size which can be molten and sprayed with the equipment described in this Project Special Provision.

4.3 Blasting Media Containment:
Contractor shall provide schematics of containment system for blasting media. The containment system shall prevent the blasting media from falling into the water or onto the ground/roadway below the bridge. Contractor is responsible for installing and removing containment measures and disposal of blasting media.

4.4 Continuity bond wire:
Continuity bond wire shall be No. 10 AWG steel, ASTM A1064, Grade 65. Other wires may be approved by the Engineer.

5. EQUIPMENT AND INSTRUMENTATION

Contractor shall provide as a minimum, but not limited to detailed technical specifications of all equipment and instrumentation intended for use in the Project.

5.1 Metalizing Equipment:
Zinc application equipment must meet the following minimum requirements:

5.1.1 Metalizing Unit:
The metalizing unit shall be a portable, electric arc spray unit capable of spraying zinc wire of 1/8"diameter and should meet the following minimum requirements.

1. The application gun shall be provided with a self-contained electric arc.
2. Spray pattern shall be elliptical in shape and have provisions for adjustments to circular pattern.
3. The application gun shall be capable of operating remotely from the wire feed unit at a distance of no less than 10 feet.
4. The wire feed unit must have moisture/oil separators provided within the unit itself (in addition to the separators already in the line) and shall be enclosed as to protect the anode wire from the environment.
5. The wire feed method shall be dual drive wheel, push type system only. Other wire feed systems may only be given temporary approval based on performance.
6. The system shall be capable of operation at 500 amps continuous duty cycle.
7. The system shall be able to operate remotely from the power supply unit for a minimum distance of 50 feet.
8. The wire feed unit and thermal spray gun assembly shall be reasonably portable and capable of operating from a reach-all, scaffolding, boat, or a small barge.

5.1.2 DC Power Supply Unit:
The power supply unit shall be a gasoline or diesel engine driven, direct current power source with a minimum NEMA output rating of 600 amps at 40 volts operating at 80 percent duty cycle.

Alternate power supplies may be approved based on satisfactory recommendation of the metalizing unit manufacturer.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

The power supply shall be capable of operation at constant current or constant voltage modes with fully adjustable output over the entire voltage and current range and shall be capable of connection to the metalizing unit at a minimum distance of 50 feet. An ammeter, voltmeter, and oil pressure and engine temperature gauges shall be mounted in the Control Panel of the unit. The gauges shall be maintained clean and readable at all times during the metalizing operation.

5.1.3 Air Supply Equipment:
The air supply unit shall be capable of delivering a minimum of 250 CFM of air at 100 pounds of pressure and having an adjustable pressure range of 50 to 125 pounds per square inch (psi). The air compressor shall produce moisture free air at the blast nozzle. When used in conjunction with the metalizing unit and an operator temperature control unit, the system shall be capable of maintaining a minimum air volume of 175 CFM at 90 pounds of pressure at the gun head.

The air compressor shall be provided with a moisture/oil separators mounted within the unit and additional separators or filters as necessary to produce moisture free air. Separators and filters shall be serviced at a minimum of once per day to provide moisture free air. Air moisture and pressure shall be tested daily prior to commencing production.

5.1.4 Abrasive Blast Equipment:
The blasting equipment shall be a conventional force fed pressure type stationary sandblaster. The nozzle size shall be such that a minimum of 80 psi is maintained at the blast nozzle. The sandblasting unit shall be securely mounted on the barge (or boat) for the duration of the project. The unit shall be equipped with a minimum 1 1/4 inch piping and valves to provide a sufficient air-sand volume. The blast hose shall be capable of withstanding a working pressure of 175 psi.

6. CONSTRUCTION METHODS

6.1 Arc-Sprayed Zinc Construction Methods:

6.1.1 General:
This system requires the application of sprayed zinc (anode) to selected damaged areas that exhibit severe corrosion problems after concrete restoration has been completed. The application shall be performed by thermal spraying (metalizing) the concrete with the required surface preparation necessary to produce an acceptable target bond between the zinc and the concrete as further described. A good bond is essential to provide an efficient system.

The Contractor shall apply zinc anodes on all surfaces within the cathodic protection zones defined in the Contract Documents or as directed by the Engineer.

6.1.2 Surface Preparation Execution:
Blasting for preparation of the surfaces to receive metalizing shall be performed by the group in charge of the metalizing application and achieving the established target bond. Different levels of abrasive blasting may be necessary to achieve the target bond for different types of concrete.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

6.2 Surface Preparation for Sprayed Zinc Cathodic Protection:

6.2.1 Concrete Removal:

All concrete removal shall be made under the requirements of the Project Special Provision for Repairs to Prestressed Concrete Girders.

6.2.2 Blasting:

All concrete surfaces to be metalized shall be thoroughly blasted with silica sand or other suitable material to remove all existing coatings, cement splatter or foreign materials prior to zinc application. Sandblasting of the concrete should leave a clean, rough surface, which leaves the appearance of medium grit sandpaper without exposing the coarse aggregate.

The abrasive stream should be directed against the work surface at an angle of approximately 15 degrees from the plane and not in excess of 30 degrees unless necessary to reach specific areas. Level of sandblasting of the concrete surface to achieve the highest possible bond of the zinc shall be determined in the field for every type of concrete present to receive metalizing. Blast material must be plant packaged and maintained in a clean and dry condition at all times. Material stored in the sand-blaster pot overnight shall not be used.

Although not anticipated, any steel component requiring metalizing shall receive an abrasive blast to the extent that a near white appearance is obtained as per NACE 2 as referenced in NACE12/AWS C2.23/SSPC- CS23 Standard.

6.2.3 Electrical Continuity:

Electrical continuity of the reinforcing steel and any other metallic component in the concrete shall be tested under supervision of the Cathodic Protection Specialist and corrected by the Contractor as shown in the Contract Documents. Although part of the cathodic protection work, continuity shall be provided during the concrete restoration operation. Care shall be observed as not to damage any rebar connecting rods or wires for connection plates which may have been installed during the concrete restoration work.

6.2.4 Connection for Connection Plates:

The Contractor shall have the option to install the threaded connection rods for the connecting plates during the concrete removal/restoration operation or the surface preparation for metalizing work. However, the surface of the concrete to be in contact with the connection plates shall be sufficiently smooth and uniform as to provide 100% contact between the plates and the concrete.

The Contractor will locate connection plates on solid (original) concrete. Location of the plates will vary by components based on location of spalls. Place the connection plate after applying initial metalizing to the area under the plate and then metalize over the plate extending a minimum of 2 inches in every direction from the plate as shown in the Contract Documents.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

6.3 Arc-Sprayed Zinc Anode Application:

6.3.1 Test Sections-Target Bond:

Prior to commencing the arc-spraying operation, the Contractor shall metalize a minimum of 4 on-site test sections with minimum dimensions of four square feet each. These test sections shall be used to determine the field application rate for the specified thickness and the grain size, texture acceptability and target adhesion strength. The test sections shall be representative of all of the concrete conditions present on the bridge to receive metalizing. Bond strength on the test sections shall be measured at no less than 3 hours and no more than 24 hours after metalizing and shall be conducted as described by ASTM D4541. All bond tests shall be made in triplicate and the results averaged.

Preliminary test areas and adhesion tests shall be performed on the bridge prior to commencing production metalizing. Adhesion strength shall be measured on all test sections to determine the target bond for production and acceptance for each type of concrete to receive metalizing. The types of concrete anticipated to receive metalizing are existing prestressed concrete girders, existing concrete diaphragms, and concrete patch material. Mock-ups of concrete patch materials to be metalized shall be prepared for this test. Target bond shall be established based on the higher strengths obtained from the test areas. It is expected that a minimum of 100 psi of bond strength will be achieved and strengths lower than the expected will not be accepted. Various levels of sandblasting of the test sections of concrete may be necessary to determine the proper surface condition to achieve the target bond.

6.3.2 Cleaning:

Prior to zinc application, the concrete surface shall be air blasted to remove any residue from the abrasive blasting operation. Air stream shall be 100% moisture free and discharge a minimum pressure of 50 psi.

6.3.3 Zinc Application:

No metalizing shall be performed until concrete removal/restoration and surface preparation have been approved by the Engineer.

Thermal spraying operation shall not be performed during periods where rainfall, high seas, rough waters or any other wet conditions are present. Zinc spraying shall not be performed when excessive wind is blowing which could interfere with the operation as determined by the Engineer.

Metalizing shall only be applied to surface areas that have been properly prepared as per this Project Special Provision. Metalizing shall be continuous and un-interrupted within the location being metalized. Overlaps of the zinc will only be allowed for deficiencies correction. On previously metalized components, the existing zinc shall be 100% removed prior to metalizing.

Zinc application shall be performed employing multiple spray passes crossing at a 90 degree angle to achieve a coating thickness of 15 to 20 mils as determined by thickness measurements on test coupons or by other means acceptable to the Engineer.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

6.3.4 Metalizing Time Window:

Coordinate the metalizing and concrete restoration operations such that metalizing is completed and connected to the reinforcement on each component at no less than 10 days and no more than 90 days after placing the concrete for the concrete restoration operation. Any metalizing to be accepted after 90 days (not to exceed 120 days) following the placement of the concrete shall be tested and certified by the Cathodic Protection Specialist as having a low probability of corrosion activity around the repaired area.

No metalizing will be approved if placed after 120 days following the placement of the concrete. Metalizing shall be completed within two hours following sandblasting and before any contamination on the concrete develops. If concrete is not metalized within two hours or contamination develops, concrete shall be sandblasted prior to metalizing.

6.3.5 Thickness Measurements:

A minimum of one thickness measurement shall be obtained at 25 square feet intervals and recorded. Thickness measurements shall be obtained using a spherical anvil and spindle micrometer with digital display capable of performing measurements ranging from Zero to One inch. Electronic thickness measuring devices may be allowed as approved by the Engineer.

Where deficient coat thickness values are found, the deficient section and the immediate surface around (minimum of one square foot or within three inches), shall receive additional coating so that the coat thickness of the repaired area will reach a minimum of 15 mils. This shall be performed immediately (not to exceed 2 hours) following the first application or the entire element shall be re-metalized.

6.3.6 Bond Strength Test:

The Contractor shall conduct a minimum of one coating adhesion strength test (pull-off test) on each metalized element or at every 100 square feet as applicable (if the metalized area is larger than 100 square feet in one component). Each test shall be made in triplicate and the values averaged. Results shall be recorded.

Pull-off tests shall be conducted using a mechanical 0 to 500 psi, fixed alignment adhesion tester as per ASTM -D 4541. Pull-off strength shall be a minimum of 90% of the target values determined from the preliminary on-site test areas on the bridge. Measurements shall be obtained at no less than 24 hours after metalizing but at no more than 72 hours. Limits of areas not meeting the required bond strength shall be identified and marked, and then blasted clean of all sprayed metal prior to re-spraying as directed by the Engineer.

6.3.7 Zinc Uniformity:

Surfaces not intended to be metalized that are adjacent or in close proximity to the surface to be metalized, shall be protected with suitable masking during the zinc application. The masked surfaces shall form neat horizontal and vertical lines. Surfaces of the zinc coated sections shall be uniform in appearance, free of visible coating defects such as; cracking, burning, blistering and un-coated areas and/or other defects that will affect the function and/or durability of the coating. The Contractor shall visually inspect the surface of the metalizing to ensure the above using a lens with a minimum magnification of 10x.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

6.3.8 Zinc Defects:
If a defective coating area is found, the correction shall be performed in the same manner as for deficient thickness correction. Sandblasting of the defective areas may be required as directed by the Engineer. Cold overlaps during reapplication may be necessary. However, re-application on the sprayed zinc anode over previously metalized areas shall not blister burn or otherwise damage the bottom anode layer. Should this occur, the entire element shall be sandblasted to remove the zinc and re-metalized.

6.3.9 Overcoat:
After zinc coating is approved satisfactory by the Engineer, the Contractor shall apply a coat of water based inorganic zinc silicate over the metalized areas of the structure. This work shall be performed within 72 hours after the metalizing.

Coating shall be spray applied only and in accordance with the manufacturer recommended thickness and specifications. No roller application is allowed and brush application can only be used as touch-up for correction of small deficient areas. The silicate coating application shall extend six inches beyond the metalized areas in each direction whenever possible and shall have a minimum dry-film thickness of 5-8 mils. Thickness measurements of the silicate overcoat shall be made at a minimum of 2 locations per metalized element or as directed by the Engineer. Areas not to be coated shall be properly masked to protect them from over-spraying or over-run, and to form neat horizontal or vertical lines.

7. METHOD OF MEASUREMENT

7.1 General:
All survey work shall be incidental to the cathodic protection systems installation.

7.2 Thermal Spray Anode:
The quantity to be paid will be the area, in square feet, of the completed and accepted metalized work.

8. BASIS OF PAYMENT

8.1 Thermal Spray Anode:
Price and payment will be full compensation for all work specified in this Project Special Provision and all incidental items necessary to provide a functional metalizing system.

Pay Item	Unit
Thermal Sprayed Anode	Square Feet

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
PROJECT NO. 15BPR.14
NEW HANOVER COUNTY
REHABILITATION OF
ISABEL HOLMES BASCULE BRIDGE AND FIXED APPROACH SPANS

PROJECT SPECIAL PROVISIONS – MECHANICAL

- Mechanical Operating Machinery (Special)

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

MECHANICAL SPECIAL PROVISIONS

MECHANICAL OPERATING MACHINERY

PART 1. GENERAL

1.1 DESCRIPTION OF WORK

This specification includes:

1. The removal of all existing main motors, motor brakes, machinery brakes, associated bearings and shafting, and motor couplings. The furnishing of all materials and tools required to install, align, lubricate and test the new main motors, motor brakes, machinery brakes, and associated couplings and shafting, and the modification of the existing machinery support frame.

2. The furnishing of all materials and tools required to open, clean, inspect, repair and lubricate all floating shaft couplings on each leaf (8 total). The installation of new seals (3 each) and lubrication fittings for each coupling. The driving of coupling keys back into their keyways.

3. The draining, flushing, and refilling of the oil in the primary reducers (2 total) and furnishing any and all equipment necessary to do so.

4. The removal of the existing auxiliary drive, including motors, gearing, couplings, associated bearings and shafting, and support weldments. The furnishing of all materials and tools required to install, align, lubricate and test the new auxiliary drive motor, couplings, bearings, gearboxes, weldments, and other associated components.

5. The replacement of the existing span control components and support weldment. The furnishing, testing, and installing of new rotary cam limit switch couplings, gearboxes, timing hubs, weldments, and all associated new supports and hardware. See the Electrical plans for details on the new rotary cam limit switch and resolver.

6. The furnishing of all materials and tools required for the removal of the existing air buffers and all associated components and hardware.

7. The furnishing of all materials and tools required for the adjustment of the existing center lock guides and receivers with new shims.

8. The furnishing of any and all material and tools required to adjust the span locks, live load bearings, and center locks. The removal of the existing anchor bolts for two (2) of the live load bearing locations (6 bolts per bearing). Furnishing and installing of new anchor bolts, and removal and installation of concrete to facilitate installation of the new live load bearing anchor bolts. Furnishing and installation of shims at two (2) of the live load bearing locations. Furnishing and installation of span-mounted receiver bolts at one (1) of the live load bearing locations (8 bolts total). Furnishing of all materials and tools required to remove, send to the original manufacturer for an evaluation and recondition, and reinstall all four (4) of the existing live load span lock actuators. The original manufacturer shall replace seals, clean, re-lubricate and paint the units.

9. The furnishing of any and all materials and tools required to install new balance material at the bascule girders, and to remove a select amount of existing counterweight balance blocks from the counterweight pockets.

The Contractor shall supply shims, mounting hardware, including turned bolts and all other necessary parts required for installation of these components. All other materials, lubricants, labor, and any and all

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

equipment necessary to perform the work shall be provided by the Contractor. Erection, installation, lubrication, testing, and alignment shall be provided by the Contractor for all components.

Provide all apparatus, tools, devices, materials and labor to clean, install, erect, align, adjust, lubricate and test the new and rehabilitated components in an approved manner as provided herein. Any apparatus, tools, devices, materials and labor, not specifically stated or included, which may be necessary for the work, shall be furnished by the Contractor.

The work shall include cleaning, rehabilitating, manufacture, fabrication, testing, erection, installation, lubricating, and placing into satisfactory service, the rehabilitated components in an approved manner as provided herein, all in accordance with these special provisions and contract drawings or as directed by the NCDOT. The installation and adjustment shall be by millwrights experienced in this class of work. The Contractor shall maintain the movable span balance throughout the entire Contract.

NOTE: Reference to a specific manufacturer, brand, model or catalog number is intended to describe the quality and characteristics of the item or material referenced, and shall not be interpreted as excluding equivalent products by other manufacturers. All proposed substitutions shall be submitted to the Engineer for approval. The Contractor shall be responsible for providing details and calculations of any and all changes to supports, components, layouts, etc, that result from these proposed substitutions.

1.2 REFERENCES

The issue date of references included in these project special provisions need not be more current than provided by the latest Change Notice to this specification. 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. The latest revisions only shall be used for all references.

American Association of State Highway and Transportation Officials (AASHTO) Movable Highway Bridge Design Specifications, 2007, 2nd Edition (published by the American Association of State Highway and Transportation Officials).

American Society for Testing and Materials (ASTM), latest version of all applicable standards.

American National Standards Institute (ANSI), latest version of all applicable standards.

American Gear Manufacturer's Association (AGMA), latest version of all applicable standards.

American Society of Mechanical Engineers (ASME), latest version of all applicable standards.

Society of Automotive Engineers (SAE), latest version of all applicable standards.

American Welding Society (AWS), Structural Welding Code, D1.5, latest version of all applicable standards.

American Bearing Manufacturers Association (ABMA), latest version of all applicable standards.

American Iron and Steel Institute (AISI), latest version of all applicable standards.

American Institute of Steel Construction (AISC), latest version of all applicable standards and specifications.

Society for Protective Coatings (SPC).

North Carolina Department of Transportation's (NCDOT) Standard Specifications.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

1.3 QUALITY ASSURANCE

1.3.1. Quality Control

A. Inspection. Materials and fabrication procedures are subject to inspection and testing in the mill, shop and field by the NCDOT and/or their Engineering Representative. Such inspections and tests will not relieve the Contractor of responsibility for providing materials and fabrication procedures in compliance with specified requirements.

B. Design of Items and Connections. All details shown on the Contract Drawings are typical and apply to general conditions on the bridge, unless otherwise indicated. All dimensions and details shall be verified at the site and submitted to the NCDOT and/or their Engineering Representative before proceeding with any work and to avoid causing subsequent delay in work.

C. The NCDOT shall be notified immediately for clarification whenever any portion of work is unclear or not accurately defined.

D. Certified Test Reports. As used herein, certified test reports refer to reports of tests conducted on previously manufactured materials or equipment intended for use on the Isabel Holmes Bascule Bridge. Tests shall have an accuracy and precision inherent to conventional industrial test instruments and equipment. Certification of truthfulness and accuracy shall be required by an authorized representative of the testing agency.

E. Factory Tests. As used herein, factory tests refer to tests required to be performed on the actual materials or equipment proposed for use prior to shipment to the construction site. Results of the tests shall be submitted in accordance with the provisions of this Contract for laboratory test results. “Factory” tests shall be performed at the manufacturer’s plant or supplier’s premises, or at a separate, independent accredited test laboratory, if appropriate.

F. Quality Assurance Testing. The NCDOT or designated Engineering inspectors may select sample materials for quality assurance testing for specification compliance. Testing may be on-site or by an independent laboratory. Test results shall be furnished to the NCDOT for reference, or for other applicable disposition if not in compliance.

G. Warranty. The Contractor shall remedy defects due to quality of work, erection, materials or design for a period of one year after final tests and acceptance have been made, at his own expense. The Contractor shall furnish a satisfactory guarantee to ensure correction of defects. If necessary, such defects may be corrected by other capable Contractors, as approved by the NCDOT, at the expense of the Contractor.

H. Contractor Experience

The following lists of Contractor experience shall be submitted to the NCDOT.

1. The Contractor shall submit a tabulation of experience in the installation of movable bridge components, specifically for bascule bridges. The experience shall specifically show past projects involving bascule bridge span balancing, as well as coordinating a United States Coast Guard bridge operation alteration.

2. The on-site supervisory personnel of the mechanical work shall have conducted a minimum of two successful mechanical component rehabilitations on a bascule bridge in the past 10 years.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

1.4 SUBMITTALS

Submittals shall be in Portable Data Format (PDF). All PDF files shall be unlocked and not password protected. All shop drawings generated in computer-aided design and drafting software (CADD) shall be submitted as an original PDF generated from the CADD software package. All catalog cuts and other documents shall be text searchable PDF documents when possible. Catalog cuts and other documents must clearly highlight all details. Scanned catalog cuts and other documents shall be scanned using 300 dpi resolution, and in 8-bit up to 24-bit color.

All shop drawings, catalog cuts, certified drawings, and procedures shall be assigned a unique item number. Transmit each submittal with a sequentially numbered transmittal letter, summarizing the included items with description and number. Re-submittals shall carry the same item number and have the revision number added.

1.4.1. General

A. The Contractor shall submit copies of producer or manufacturer data, e.g. specifications, test results and installation instructions for the following items and materials including (but not excluding other items or materials not specifically mentioned):

1. Mill reports and physical tests of all metals.

2. Bolts, nuts, washers, and other fasteners.

3. Lubricants as endorsed by machinery manufacturers.

4. Paint.

5. Standard and custom-manufactured purchased components.

B. Manufactured Items

1. The Contractor shall submit shop drawings to the NCDOT for approval. These shall include complete details, classification of materials, schedules for fabrication and shop assembly, procedures and diagrams showing sequence and details for erection and approval.

2. Shop drawings shall be given a suitable title to describe the parts detailed thereon. Each drawing shall be identified by the complete project name and number and shall include:

a. Dimensions, callouts and notes to completely define the form, fit, function, manufacturing process and allowable deviations for each item.

b. Material specifications for each item.

c. Heat treatment or specific hardness requirements where applicable.

d. The surface finish of machined surfaces and tolerances for each dimension for which a specific fit is required. A general tolerance block shall be used to define the tolerances of all other dimensions. Fits and finishes shall meet or exceed the more rigorous of the AASHTO specifications or suggested manufacturer's specifications. In the absence of requirements in the AASHTO specifications, cited manufacturer tolerances or specifications shall apply when drawings call out a particular manufacturer and model "or equal". In no manner shall "suggested manufacturer"

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

indicate a sole-sourced intent on the part of the NCDOT when competitive products exist.

e. Quantity required.

f. Dimensions of all principal elements within the item.

g. Certified external dimensions affecting interfaces or installations.

h. Gross weight.

i. Method and recommended type of lubrication.

3. Shop drawings for fabricated or purchased assemblies shall include:

a. Complete data on the design and construction of all detail components furnished as part of the machinery under this Contract as presented in B.2 above.

b. All proprietary items (e.g. enclosed reducers, brakes, etc) shall be shown in outline on the shop drawings.

c. Complete assembly diagrams shall be provided for proprietary components that show each part contained within the item and its corresponding manufacturer's part number. The diagrams shall be sufficient to enable complete disassembly and re-assembly of the subject component and enable the definition and procurement of proper spare/replacement parts.

In the event that any part is modified in any manner from the way it is described or delivered by its original manufacturer, the Contractor shall deliver a drawing which details each modification, and the part shall be assigned a unique part number to assure procurement of proper spare/replacement parts.

Component assembly drawings shall include:

i. Certified external dimensions and clearances affecting interfaces or installations.

ii. Gross weight.

iii. Capacity and normal operating ratings.

iv. Method and recommended type of lubrications, including location and type of fittings and provisions for adding, draining, and checking the level of each lubricant employed.

v. Inspection openings, seals, and vents.

d. Complete shop bills of materials shall be included for all machinery parts. If the bills are not shown on the shop drawings, prints of the bills shall be furnished for approval in the same manner as specified for the drawings.

e. Complete assembly and erection drawings shall be furnished. These

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

drawings shall provide identification of, and essential locating dimensions for each part or assembly with respect to the bridge or foundation.

f. The Contractor shall determine the final dimensions of parts involving commercial products, such as motors, gearboxes, electrical equipment, etc., from certified drawings of the commercial products before making shop drawings.

g. Certified drawings shall be submitted with the affected shop drawings. Certified drawings shall be submitted for approval prior to purchase of all standard or semi-standard machinery components.

4. Shop drawings, which have not been approved or require correction, shall be resubmitted until such time as they are acceptable to the NCDOT. Resubmission and approval shall not be considered a cause for delay. The Contractor shall bear all costs or damages, which may result from the ordering or fabrication of any materials prior to the acceptance of the shop drawings. As a means of expediting delivery prior to acceptance of the shop drawings, the Contractor may request in writing from the NCDOT approval to order raw materials of the correct type for later fabrication from accepted shop drawings. Such approval by the NCDOT shall be in writing. After acceptance of the shop drawings, the Contractor shall supply the NCDOT with additional copies of the accepted drawings as may be required.

1.4.2 Procedures

Specific and detailed procedures shall be submitted to the NCDOT for approval prior to commencing construction for the following work items:

A. Main machinery support frame modification – The Contractor shall include a detailed plan for the modifications of the existing machinery frame as detailed on the plans. This plan shall include preheat, welding, and post-welding procedures. The plan shall be submitted for approval by a Professional Engineer.

B. The Contractor shall include detailed procedures for main machinery testing, installation, and alignment of components. These procedures shall be submitted to the Engineer for approval prior to construction.

C. Floating shaft coupling cleaning, repairing, and lubricating – The Contractor shall include all methods to open the floating shaft couplings, clean and repair coupling teeth, drive keys back into keyways, perform a non-destructive test on the coupling teeth, and lubricate couplings before reassembly.

D. Primary reducer oil replacement – The Contractor shall coordinate with the original reducer manufacturer and prepare a detailed plan to drain, flush, and refill the oil in the primary reducers and replace the air breathers. The Contractor shall submit this procedure, along with written confirmation from the original gearbox manufacturer, for approval by a Professional Engineer.

E. Rotary cam limit switch weldment replacement – The Contractor shall include a detailed plan for removing the existing span control assembly and all methods to install the new anchor bolts with non-shrink grout, weldment, and new span control components. The Contractor shall show how the components will be properly aligned.

F. Span lock and center lock adjustment – The Contractor shall include all methods to install shims at the center lock guides and receivers. The Contractor shall also include the

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

methods to change out the existing span-mounted receiver bolts and shims at the live load bearing. These procedures shall be worked in conjunction, and the contractor shall show how the lock bar and receiver alignment will be maintained.

G. Live load bearing anchor bolt replacement – The Contractor shall include all methods to remove existing concrete and anchor bolts at two of the four live load bearings (6 bolts per bearing) and install new anchor bolts and concrete. This plan shall by submitted to the Engineer for approval.

H. Lubrication plan – The Contractor shall include shop and field lubricants and sealants endorsed by manufacturers in writing as well as application procedures for each. The dates that the lubricant was applied to each component shall be included.

I. Plan for the protection of machinery during cleaning and painting – The Contractor shall include a detailed plan for the complete protection of all machinery during cleaning and painting operations (including both machinery and structural painting). The plan shall be submitted for approval by the Engineer. The Engineer shall be provided access after protection is in place, before cleaning, and before painting. The NCDOT shall have final approval that adequate protection of machinery has been provided prior to the start of any cleaning work. After cleaning and painting, all debris shall be blown down and vacuumed prior to removing protection. The Contractor shall be responsible for any and all damages to the machinery that are a result of the cleaning and painting operations.

J. Cleaning and painting procedure – The Contractor shall include a procedure for cleaning and painting the required components that is compatible with the Standard Specifications and follow the requirements listed herein.

1.4.3 Mechanical Equipment, Installation, Operation, Maintenance and Lubrication Manual

Furnish excerpts for the new components to be added to the existing bridge Operations and Maintenance Manual. Develop these excerpts from the recommended practice of the machinery manufacturer and provide the suggested time intervals for maintenance as well as types and quantities of the recommended lubricants. The excepts will include certified dimensional drawings, installation instructions, ratings for normal and overload conditions, and any special handling, rigging, or installation instructions necessary to operate, maintain or disassemble and reassemble the components.

The lubrication of all parts and equipment shall be in accordance with the manufacturers' recommendations. The contractor shall furnish copies of letters from the various machinery manufacturers endorsing the lubricants which have been finally selected. Lubricants shall be selected for year round exposure at the bridge. The contractor shall coordinate the lubrication plans for the various machinery elements and minimize the number of different lubricants.

The Contractor shall provide three copies of the preliminary version and six copies of the final version of operation and maintenance manuals for the bridge operating machinery, span locks, and span balancing. The Contractor shall also submit each version in .pdf format.

This manual is considered a critical project deliverable. Acceptance of the Project will not be given as complete until this manual has been provided and is acceptable to the Engineer.

A. Construction

1. Binders shall be hardback vinyl, three-ring, loose-leaf type for binding 8-1/2 x 11 inch sheets. Binders shall preferably be 10 x 12 inches and not over three inches thick.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

2. The binder spine and front cover shall display labels containing the name of the bridge, the bridge location, the names of the Mechanical Prime and Sub Contractors, and the dates of the work.

3. The binder holes shall be reinforced for all contents.

4. The paper and ink shall resist smearing, fading and deterioration from age.

5. All lettering shall be clear and legible.

6. All material shall be new; copies from prior submittals shall not be used. This manual shall have index tabs for each major piece of equipment and system.

7. A table of contents shall indicate each chapter, section, specific equipment and page numbering.

B. Chapters

The volume shall have a format and be divided into chapters as follows.

1. Chapter 1 will be designated for general information and safety precautions. Applicable information from AASHTO shall be included.

2. Chapter 2 shall contain the operational description of major systems, subsystems, and major components. Manufacturer's data brochures (color originals where available), catalog cuts, and specification sheets shall be included.

3. Chapter 3 shall cover the functional description, including: block diagrams; schematic layout of the entire system; description of subsystem; functional relationship between systems and subsystems.

4. Chapter 4 shall cover scheduled maintenance, where applicable. This chapter shall provide all preventive maintenance procedures to the lowest repairable unit level and any checks, tests and measurements required on a periodic routine basis. Preventive maintenance indexes (PMI's) shall be provided in this section and shall be organized in tabular format to provide quick, easy reference to each preventive maintenance action performed according to the prescribed maintenance interval, as well as applicable preventive maintenance procedures contained within the manual.

5. Chapter 5 shall consist of troubleshooting diagrams (fault isolation trees) to be used by maintenance personnel for isolating fault to the lowest reparable limit level.

6. Chapter 6 shall cover all corrective maintenance procedures that are required to repair a particular system, piece of equipment or material back into satisfactory operating condition. This chapter shall provide step-by-step procedures for the replacement of defective parts. Reference shall be made according to the applicable test procedures established in Chapter 4. Warnings or precautions to be observed during maintenance shall be listed.

7. Chapter 7 shall provide step-by-step installation procedures to the lowest repairable limit level for a particular system, piece of equipment, or material.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

8. Chapter 8 shall consist of complete parts lists to the lowest repairable limit level for each system, piece of equipment, or material. Parts lists shall include exploded views of assemblies as required. The local representative of the parts supplier shall be listed.

9. Chapter 9 shall include the duration and contents of all guarantees and warranties.

10. Chapter 10 shall include half-size prints of approved shop drawings (as-built). The prints shall be folded to fit into the manual.

11. Chapter 11 shall consist of a spare parts inventory list, which NCDOT shall store on or off site. Spare parts inventory list shall include the minimum quantity recommended to be stocked by NCDOT at any time. These shall be items that are frequently replaced and/or have long delivery times when ordered and/or are critical to bridge operations if not stocked by NCDOT.

The Contractor shall include recommendations, in writing from the vendor, for the Engineer's approval, all lowest repairable units for each system, piece of equipment, or material. A lowest repairable unit shall be defined as that equipment which cannot be economically repaired, or which requires skills and equipment beyond those available by the owner's maintenance personnel. The lowest repairable unit concept shall be used to prepare all written maintenance, repair, inspection, testing, replacement, and installation procedures for the mechanical maintenance manual covered herein.

Parts lists shall be in tabular form and shall include each part name, description, name of manufacturer's order/part number and shop drawings reference. Parts lists shall be supported by adequately labeled exploded views or pictorial views where applicable. All special tools, jigs, fixtures, test and calibration equipment used in any maintenance, inspection repair or adjustments shall be included.

With the exception of shop drawings, all illustrations (block diagrams, schematic diagrams, exploded views, pictorial views printed circuit board layouts, etc.) shall be single line artwork. All lettering on illustrations shall be by lettering guide or equivalent to illustrate call-outs. All text shall be clear and legible in final form.

All written test and descriptive material shall be plainly written.

Paragraph numbering will be sequential and indicate chapter location. Roman numerals shall not be used.

Front matter shall include a cover page with descriptive title, project, contractor and engineer. A table of contents shall be provided to indicate each chapter and paragraph subtitles, numbering and page locations.

Safety warnings or cautions shall be visibly highlighted within each maintenance procedure. Use of such highlights shall be limited only to critical items and shall not be used in excessive manner which would reduce their effectiveness.

C. Content Requirements

Vendors' and suppliers' listings shall include names, addresses and telephone numbers.

Neatly typewritten index near the front of the manual shall furnish immediate information as to location in the manual of all emergency data regarding the installation.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

Complete instructions regarding operating, lubricating, adjusting and maintenance of all equipment involved shall be included.

Where the contents of the manuals include manufacturer's catalog pages, clearly indicate the precise items included in this installation and delete all manufacturer's data with which this installation is not concerned.

All results of testing required by these specifications shall be included.

All added material within the manuals shall be new. Copies used for prior submittals or used in construction of the project are not acceptable.

Manuals shall have index tabs for fast and easy reference to equipment and material. Tabs shall index each system and piece of equipment.

D. Manual

Make a preliminary manual submittal of three copies to the Engineer for review and approval; make a submittal of six copies of the final manual in to the Engineer. Also, submit each version in .pdf format.

Submittal of preliminary and final manual editions shall be furnished to the Engineer according to the approved official progress schedule.

Preliminary manual editions shall present all technical material for the mechanical volume to the greatest extent possible with respect to text, tabular matter, and illustrations. Preliminary manual editions shall be single column, double-spaced, and typewritten. Illustrations shall preferably consist of line drawings. (Sketches or photographs may be used if final line drawings are unavailable at the time of submittal.) All applicable shop drawings shall be included.

Preliminary manual editions shall be as technically complete as the final manual edition. All illustrations shall be in final form. Reduced size shop drawings shall be included.

Final manual editions shall be technically accurate and complete and shall represent the "as-built" system, piece of equipment, or material given final acceptance by the Engineer. All illustrations, text, and tabular material shall be in final form; all shop drawings (as-built) shall be included.

E. Included Items

Information shall be furnished for the following new items of mechanical machinery.

1. Main drive gearmotors

2. Right angle bevel gearboxes

3. Motor and machinery brakes

4. New and rehabilitated couplings

5. Disconnect coupling shifter mechanism

6. Shafts and keys

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

7. Center locks

8. Span locks

9. Auxiliary drive gearmotors

10. Span control equipment assembly

11. Counterweight balance blocks

12. Lubrication schedule and diagram

13. Standard operating instructions and emergency operating instructions (two separate sets of directions)

PART 2. PRODUCTS

2.1 MACHINERY, COMPONENTS AND MATERIALS

A. General

1. Materials and components shall conform to the drawings and referenced standards.

2. Hardness and toughness shall be tested and reported for any items or details where plans and special provisions require hardness or CVN toughness values.

3. No item shall be fabricated without sufficient advance notice given to the NCDOT to permit inspection.

a. The Contractor shall furnish all facilities and provide for the free access at the plant or shop for the inspection of machinery, components, material and quality of work.

b. Initial nominal acceptance of a material or item shall not preclude subsequent rejection if defects are found upon later inspection or discovery.

c. The Contractor shall furnish the NCDOT with the number of copies of purchase orders as requested.

d. Unless otherwise provided, the Contractor shall furnish without charge, test specimens required herein, and all labor, testing machines, tools and equipment necessary to prepare the specimens and to make the physical tests and analyses. Two copies of test reports and chemical analyses shall be furnished to the NCDOT.

B. Standard Products

1. Materials and equipment shall be commercial standard or cataloged products of manufacturers regularly engaged in production of such materials or equipment, and shall have at least five (5) years of satisfactory commercial or industrial use prior to bid opening and the latest design that complies with the requirements on these contract documents.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

2. Where two or more units of the same class of equipment are required, these units shall be products of a single manufacturer; however, the component parts of the system need not be the products of the same manufacturer.

3. Each major assembled component shall have a conspicuous, durable, permanently affixed nameplate that includes at least the following information: the manufacturer's name, address, the component model number, serial number, rated capacity, and pertinent factory setting(s). The nameplate of the distributing agent will not be acceptable.

4. Materials of equal or greater strength, ductility, CVN toughness or corrosion resistance than shown on the design drawings can be proposed, but are subject to approval by the NCDOT.

5. Electrodes for welding shall comply with AWS D1.5.

6. Steel for weldments and miscellaneous components shall be ASTM A709 Grade 50, unless otherwise specified on the contract documents, fine grain practice is mandatory, and always weldable grades as designated by applicable ASTM standards. Welding materials and methods shall conform to the AWS Structural Welding Code for Bridges AWS D1.5.

7. Heavy hexagonal head bolts, heavy hexagonal nuts, and hardened washers shall conform to ASTM F3125 Grade A325, Type 1, A563 Grade DH, and F436 Type 1 respectively. ASTM A307 and SAE Grade 1, 2, or 4 bolts shall not be used.

   Threads for bolts, nuts, and cap screws shall conform to the unified thread standards, coarse thread series with a Class 2A tolerance for bolts and Class 2B tolerance for nuts, in accordance with ANSI B1.1, unless otherwise specified.

8. Turned bolts shall be made from a material and have a strength equal to ASTM F3125 Grade A325, Type 1. Heavy hexagonal nuts, and hardened washers complying with A563, Grade DH, and F436-1 respectively shall be used with the turned bolts.

9. Stainless steel for fasteners, threaded rods, pins and dowels where specified shall be Type 316 Stainless Steel, with a minimum tensile strength of 85,000 psi and shall meet or exceed ASTM F593, Alloy Group 2, Condition CW, unless otherwise specified. Stainless steel for hex nuts shall be Type 316, with a minimum proof strength of 85,000 psi and shall meet or exceed ASTM F594, Alloy Group 2, Condition CW, unless otherwise specified. Stainless Steel washers where specified shall be Type 316. Stainless Steel clevis pins shall be ASTM A276, Type 316, Condition S, Cold Finished.

   Stainless steel bolts shall generally be tightened to produce a tension of 70% of the proof load. Include friction coefficient data for any thread lubricant with installation procedures to confirm torque magnitudes.

10. Where shown on the drawings, all machinery shims required for leveling and alignment of equipment shall be stainless steel, ASTM A240, Type 316.

11. Unless otherwise specified herein or on the contract drawings, keys for all components shall be made from cold-finished carbon steel squares or flats that meet the requirements of ASTM A668, Class K, with a minimum tensile strength of 105,000 psi, and minimum yield strength of 80,000 psi, or approved equal or

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

greater strength alternative.

12. Unless otherwise specified herein or on the contact drawings, shafting shall be ASTM A108 Cold Finished Steel with a minimum tensile strength of 75,000 psi and a minimum yield strength of 60,000 psi. Forged shafting shall be ASTM A291 Alloy Steel with a minimum tensile strength of 80,000 psi and a minimum yield strength of 60,000 psi.

13. The paint system shall be compatible with the NCDOT's Standard Specifications and shall be submitted for approval.

C. Manufacturer's Recommendations

When installation procedures for an item or component are required to be in accordance with the recommendation of the manufacturer, printed copies of the recommendations shall be furnished to the Engineer prior to installation. Installation of the item will not be allowed to proceed until the recommendations are received. Failure to furnish these recommendations can be cause for rejection of the material.

2.2 DETAILS AND WORKMANSHIP

A. Machinery components shall be finished, assembled, and adjusted in an approved manner and according to the best shop practice. The limits of accuracy that are to be observed in machining the work, and the allowances for all metal fits shall be placed on the Contractor's working drawings. Fits and finishes of machinery parts shall be as called for herein or on the contract drawings.

B. Fits and finishes, when not included on these contract documents, shall be in accordance with AASHTO specifications for movable bridges or vendors' recommended specifications, whichever is more rigorous, and as modified below.

Surface finishes are given as the roughness height in micro-inches.

Part	Fit	Finish
Machinery base on steel		250
Machinery base on masonry		500
Shaft journals	RC6	8
Journal bushings	RC6	16
Split bushing in base	LC1	125
Solid bushing in base (to 1/4" wall)	FN1	63
Solid bushing in base (over 1/4" wall)	FN2	63
Hubs on shafts (to 2" bore)	FN2	32
Hubs on shafts (over 2" bore)	FN2	63
Turned bolts in finished holes	LC6	63
Sliding bearings	RC6	32
Keys and keyways (top and bottom)	LC4	63
Keys and keyways (sides)	FN2	63
Machinery parts in fixed contact	-	125

The above fits for cylindrical parts shall also apply to the major dimensions of non-cylindrical parts.

C. Where surface finishes are indicated on the drawings or specified herein, the symbols used or finishes specified are in accordance with ANSI B46.1, "Surface Texture". Values of roughness height are specified in micro-inches as an arithmetical average deviation from the mean line. Roughness specified is the maximum value, and any smoother finish will be

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

satisfactory. Compliance with specified surface will be determined by trained sense of feel and by visual inspection of the work compared to a standard roughness gage and in accordance with the provisions of ANSI B46.1. Values of roughness width and waviness are not specified, but shall be consistent with the general type of finish specified by the roughness height. Flaws such as scratches, ridges, holes, peaks, cracks or checks, which will make the part unsuitable, will be cause for rejection.

D. Unspecified surface finishes shall conform to the AASHTO specifications. Mating surfaces shall be machined to provide even, true bearing. Surfaces with rotating or sliding contact shall be highly polished and finished true to the given dimensions.

E. All work shall be laid out to secure proper matching of adjoining unfinished surfaces. Large discrepancies between adjoining unfinished surfaces, shall be remediated to realize proper alignment. Depressions or holes not affecting the strength or function of the parts may be filled in a manner approved by the NCDOT.

F. Mechanical Component Requirements

1. Shafting and Pins

a. Rounds and shafts shall be true, straight and free from flaws, piping, laps, seams, or cracks. All shafts shall have finished ends with a 60-degree lathe center with a clearance hole at the exact center of the shaft. Stepped shafts shall have fillets finished smoothly to adjacent surfaces without tool marks or scratches. Surface finish for fillets shall have a maximum roughness of 63 micro-inch according to ANSI B46.1, unless a finer finish is required.

b. All forged shafts shall be reduced to size from a single bloom or ingot until perfect homogeneity is secured. The blooms or ingots, from which shafts or pins are to be made, shall have a cross-sectional area at least three times that required after finishing. No forging shall be done at less than red-heat. Forged rounds for shafts and pins shall be true, straight, and free from any defect.

c. All shafts and pins shall be accurately finished, round, smooth, and straight; and when turned to different diameters, they shall have rounded fillets at the shoulders. Each shaft or pin having a uniform diameter of 8 inches or more and each shaft or pin having several diameters, of which the smallest is 8 inches or more, shall be bored lengthwise through the center to a diameter approximately one fifth the smallest diameter. The wall of the center bore shall be examined for cracks and fissures. Shafts and pins exhibiting defects will not be accepted. Shafts that are bored with an inspection hole shall have the ends prepared for the attachment of a centering device equivalent to the lathe center. All such devices shall be furnished as part of the work.

d. Turned, ground and polished shafting straightness tolerance shall be 0.002 inches per foot for shafts up to and including 1-1/2 inches in diameter and 0.003 inches per foot for shafts over 1-1/2 inches in diameter. All shafts shall be free from camber and shall run without vibration, noise, or chatter at all speeds up to and including at all operation speeds.

e. All journal bearing areas on shafts and pins shall be accurately turned, ground, and polished with no trace of tool marks or scratches on the

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

journal surface or adjoining shoulder fillets. The journal bearing area shall have an 8 micro-inch finish or better. Journal diameters shall be finished to the limits of an ANSI Class RC6 running fit, unless otherwise noted. Bearing seats on shafts with rolling element bearings shall have a surface finish of 63 micro-inch, unless otherwise specified by the bearing manufacturer.

2. Keys, Keyways, and Set Screws

a. Keys and keyways shall conform to the dimensions and tolerances for square and flat keys of the ANSI Standard B17.1, "Keys and Keyseats," unless otherwise specified. Keys shall be machined for an FN2 side fit (Class 3) and an LC4 fit on top and bottom with keyways in shafts and hubs and a 63 micro-inch finish or better. Keyway corners and key chamfers shall be cut with the fillet radius and chamfer as suggested by ANSI B17.1. All keys shall be effectively held in place, preferably by setting them into closed-end keyways milled into the shaft. The ends of all such keys shall be rounded to a half circle equal to the width of the key. Keyways shall not extend into any bearing. If two keys are used, they shall be located 120 degrees apart. Custom keys shall be provided as necessary for manufactured and existing components to meet the required key fits and finishes.

b. Set screws shall not be substituted for keys for transmitting torsion; they may be used only for holding keys or light parts in place. They shall be safety-type headless set screws with cup points set in counterbored seats. Unless otherwise ordered, they shall be secured in place by use of self-locking threads.

3. Bearings

Anti-friction, stainless steel, pillow-block bearings with a 1-1/4 inch bore shall be provided for the auxiliary drive shifter coupling handle. Bearings shall be the product of a manufacturer of established reputation who has had bearings of comparable size, type, and materials in successful service for at least 10 years.

4. Hubs and Bores

The hubs of all couplings shall be finished on both faces and polished where the hub face performs the function of a collar to prevent shaft movement. The hubs shall be bored concentric with the outside of couplings. Unless otherwise noted or recommended by the manufacturer, all other hubs shall have a 32 micro-inch finish or better for 2 inch or smaller bore, or a 63 micro-inch finish or better for a bore larger than 2 inches.

5. Shims

Where shown on the plans, all machinery shims required for leveling and alignment of equipment shall be stainless steel, neatly trimmed to the dimensions of the assembled parts and drilled for all bolts that pass through the shims. In general, total shim thickness available shall be no less than equal to twice the nominal thickness shown on the plans, and sufficient varying thicknesses shall be furnished to secure 0.03125-inch variations of the shim allowance including one shim equal to the full allowance. The Contractor shall provide shims with less than 0.03125-inch variations if required to meet proper machinery installation alignment

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

tolerances. Shims shall be placed to provide full contact between machinery and machinery supports. Shims shall be shown in detail on the shop drawings. Shim packs shall be individually packed to prevent damage from handling during shipment to the project site. Packaging shall be clearly marked with the plan sheet number and item number of the part for which the shim pack was fabricated.

6. Turned Bolts

The bodies of turned bolts shall be finished to 63 micro-inches or better, as defined by AASHTO. Threads for the turned bolts and nuts shall conform to the Unified Thread Standards, coarse thread series with a Class 2A tolerance for bolts and Class 2B tolerance for nuts, in accordance with ANSI B1.1, unless otherwise specified. Turned bolts are designated by their nominal thread size. The turned bolt body shall be 1/16” larger in diameter than the nominal size specified, and shall have an LC6 fit with reamed holes. Bolt head and nut bearing surfaces shall be flat and square with the axis of the bolt holes and shall be spot faced if necessary. Unless otherwise noted, bolt holes in machinery parts required for connecting to supporting steelwork shall be sub-drilled (in the shop) smaller than the turned bolt diameter and shall be reamed together with supporting steel either during assembly or at erection, after the parts are correctly assembled and aligned. Positive type locking shall be provided. Double heavy hex nuts are preferred. Where two heavy nuts are not used, heavy hex and jam nuts shall be used. Alternate locking methods shall be submitted to the Engineer for approval. Turned bolts shall be installed with a hardened plain washer meeting ASTM F436 at the head and nut ends.

Turned bolts shall generally be tightened to produce a tension of 70% of the proof load. Include friction coefficient data for any thread lubricant with installation procedures to confirm torque magnitudes.

7. Welding

Welding shall comply with AWS D1.5. Welded steel machinery parts shall be given a stress relief heat treatment prior to machining. The Contractor shall submit a schedule of the proposed stress relief heat treatment to the Engineer for approval. The schedule shall include a description of the part and an explanation of the proposed heat treatment, including the rate of heating, the soaking temperature, the time at the soaking temperature, the rate of cooling, and the temperature at which the part is to be withdrawn from the chamber. Soaking times of less than one hour will not be approved. Welds in all machinery support mounting weldments shall be 100% inspected by non-destructive methods. Acceptance criteria shall be that described in AWS D1.5.

All welding shall be by certified welders.

Welding for stainless steel shall conform to AWS D1.6.

Submit all weld procedures and welding qualifications prior to the start of work.

Minimum size fillet welds: Unless otherwise specified, the minimum weld size allowed is shown below:

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

Material Thickness	Minimum Size Fillet**
to 1/2" inclusive	3/16"*
over 1/2" to 3/4"	1/4"*
over 3/4" to 1 1/2"	5/16"*
over 1 1/2" to 2 1/4"	3/8"
over 2 1/4" to 6"	1/2"
over 6"	5/8"

* single pass weld must be used.

** weld size is determined by the thicker of the two parts joined unless a larger size is required by calculated stress. The weld size need not exceed the thickness of the thinner part joined.

8. Couplings

a. Gear-type, full-flexible (double engagement) couplings or semiflexible (single engagement) couplings with floating shafts or brakewheels shall be used to connect all machinery components, except where other types of flexible couplings are called for on the plans. The couplings shall be made of forged alloy steel, have exposed bolts, curved face teeth, and provide for at least a 3/4-degree misalignment per gear mesh. Installation misalignment should be limited to no more than 1/8 degree per gear mesh.

b. Gear-type couplings shall be the standard product of an established manufacturer.

c. Special type couplings shall be as shown on the plans.

d. Coupling hubs shall be bored by the coupling manufacturer to the required size and tolerances, including keyways, and each hub shipped to the proper location for installation on its shaft by the manufacturer of the connected component.

e. Brakewheel couplings are semiflexible (single engagement) couplings in which the rigid hubs have a bore of 4-3/8 inches and engage with stub shafts that are bolted to the brakewheels. The flexible hub of these couplings shall have a bore of 3-5/8 inches and engage with the floating shafts of the main drive train. The coupling shall have a minimum torque rating of 66,150 lb-in.

f. The right angle bevel gearbox couplings, other than the auxiliary shifter coupling, shall be single engagement gear couplings with a minimum torque rating of 66,150 lb-in. The rigid hub bore shall match the mating component and the flex hub bore shall be 3-5/8 inches.

9. Right Angle Enclosed Gearing

a. Provide two right angle spiral bevel gearboxes with a 1:1 ratio as shown in the plans, or approved equal.

b. The enclosed gears for the main drive machinery shall be designed in accordance with the current AGMA Standards and as shown in the plans. Gear quality shall be class 10 or better. The reducers shall have cast iron housings. The reducers shall have a torque rating of 34,000 lb-in while operating at 750 RPM. Each reducer shall have a air breather with an

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

adequate filter to prevent particulate matter from entering the housing positioned on the top face. The shaft seals shall incorporate two single lip Viton seals, one with a dust lip. The housings shall be leak-proof and shall be tested in the shop for leakage.

c. The bearings required to support the speed reducing gears shall be rolling element type with high radial and axial load capacity, selected to provide 40,000 hours of B-10 life while transmitting full rated horsepower of one drive motor. An oil level and drain plug shall be provided for each reducer to permit easy withdrawal and replacement of oil.

d. Shaft Extensions and Couplings: The shaft extensions on each side of the reducers shall be of such length and diameter that they may be turned and keyseated for the gear couplings. Coupling halves shall be shipped to the reducer manufacturer for assembly on the shaft extensions.

e. Nameplate: Gearboxes shall be provided with a permanent AGMA nameplate stating the horsepower rating, speeds, ratio and thermal rating. Manufacturer's nameplate shall include the manufacturer's name, address, model number, and serial number (nameplate of distributing agent will not be acceptable).

f. Prior to construction, the manufacturer shall supply to the Engineer for review, a complete set of calculations demonstrating adherence to design criteria presented herein including AGMA ratings.

g. Cast iron housings shall be sufficiently rigid so that deflection is negligible under full load and will maintain acceptable bearing running clearances and gear contact.

h. Reducers shall be the product of a manufacturer of established reputation who has had reducers of comparable size and construction in successful service for at least ten years.

i. Gearboxes shall be painted with the manufacturer’s premium, high performance, epoxy paint system recommended for outdoor applications in harsh marine environments, which shall include a prime coat along with two coats of epoxy paint and shall be submitted to the Engineer for approval.

10. Motor and Machinery Brakes

a. Span drive motor and machinery brakes shall be electro-hydraulic thruster type drum brakes, Magnetek/Mondel Hi-Tork 300M, Mill Duty series, 13" diameter, Catalog # 13" MBT/E ED 30/5, or approved equal. Each brake shall have a low force hand release lever that will permit release of the brake without energizing the thruster motor, and shall be mounted on the side of the brake that provides the most access for operation. Brakes shall be adjustable to independently regulate the time for setting of the brake. One motor brake and one machinery brake shall be provided for each drive motor, as shown on the plans. Each brake shall be factory set for 330 ft-lbs of braking torque and automatically adjust for lining wear. The brakes shall be supplied with stainless steel pivot pins, bearings at all main pivots, and any other optional features necessary for corrosion protection. The

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

brakes shall be painted with a finish coat of Federal Safety Orange prior to final assembly.

b. The brakes shall operate at 460 volts, 3 phase, 60 Hz. Each motor and machinery brake shall be equipped with three separate limit switches for interlocking span control supervision and indications. Two brake limit switches shall provide for sequence interlocking on span control operation and for indication of the set and release status of the brakes. The other brake limit switch shall provide for lock-out of the span control circuitry when any brake is hand released and for indication. Brake limit switches shall be NEMA 4 rated, oil-tight and furnished and mounted on each brake frame by the manufacturer.

c. Each motor and machinery brake shall operate on a Magnetek/Mondel brake wheel (or approved equal), 13” diameter, 5.75” wide as shown on plans. The brake wheel hub shall be bolted to a stub shaft with socket head cap screws which mates with a 1025G single engagement gear coupling. The brake wheel hub length, bore, and keyslot to match the mating components and as shown on plans. All exposed surfaces shall be painted as specified elsewhere herein. The brake wheels are of a special design and shall be modified as shown on the plans.

d. The motor and machinery brakes shall be supplied with a set delay valve. Motor brake set delay shall be initially set at 1.5 second, and machinery brake set delay shall initially be set at 3 seconds. This delay may be adjusted in the field at the discretion of the Engineer.

e. Each motor and machinery brake shall be supplied with a Type 3R stainless steel cover, with slots for drive shaft, and access to the brake release lever without removal of the cover. Cover shall have a hinged lid for inspection purposes.

11. Main Span Drive Motor

a. The main span drive consists of two 100 HP, 1788 RPM gearmotors, with an output speed of 617 RPM per leaf. These gearmotors shall have a minimum output torque of 10220 lb-in and a service factor of 2.7.

b. The main drive gearmotor shall be a helical in-line 2.89:1 ratio gearmotor with heavy duty bearings, an extended output shaft (3-1/2 inch dia. By 9 inches long) and fluoro rubber seals. Synthetic lubricant shall be used. Nord SK82 VL 280SP/4 CUS, or approved equal.

c. Only one gearmotor at a time drives each leaf. The bridge shall not operate if the wind is above 50 mph (7 psf).

d. Encoders shall be supplied with the gearmotors. Refer to the Electrical Specifications and Electrical plans for further motor requirements.

12. Auxiliary Span Drive

a. The auxiliary span drive is used when both main drive motors are inoperative. The emergency drive is engaged by a manually operated clutch coupling connected between the auxiliary drive gearmotor and one

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

shaft of a right angle reducer, through to one input shaft of the main differential reducer.

b. The emergency gearmotor drive consists of a 10 HP, 1750 RPM motor, attached to a 34.23:1 helical/bevel foot mounted gear reducer with an output speed of 52 RPM. These gearmotors shall have a minimum output torque of 12,230 lb-in and a service factor of 3.1. The gearmotor shall be an SEW-Eurodrive with K97 size reducer, and a DRN132M4 motor or approved equal.

c. The clutch coupling between the gearmotor and the right angle gearbox input shaft shall be a FALK 1030G72 (or approved equal) gear type disconnect coupling with a special hand operated shifter mechanism as shown on the plans. The shifter handle shaft shall be Type 316 stainless steel. The long hub of the coupling shall be mounted to the auxiliary gearmotor output shaft and the short hub mounted to the right angle reducer shaft. The shifter mechanism shall be able to be locked in either the engaged or disengaged position. The shifter mechanism shall have a limit switch trip lever; the limit switch disables the main drive motors when the auxiliary motor is engaged.

d. All auxiliary drive gearmotors shall have the protective canopy option.

13. Live Load Bearing Anchor Bolts and Replacement Concrete

The new live load bearing anchor bolts shall be 1-1/2 inch in diameter and conform to ASTM F1554 Grade 55 Class 2A with ASTM A563 Grade A heavy hex nuts and ASTM F436 hardened washers. Anchor bolts shall be 23-1/2 inches long with 2-1/2 inches of threads at each end. All anchor bolts and hardware shall be hot dip galvanized in accordance with ASTM A153. Anchor bolts shall be snug tightened which is defined as the condition with the full tightening effort of a worker using a 12-inch wrench.

Structural steel surfaces shall be coated with a primer that is compatible with the paint system being used for Cleaning and Repainting of Bridge #11. See structural special provisions.

Prior to the application of concrete, square up edges in repair areas, thoroughly clean surfaces and remove all loose materials. Remove grease, wax, salt, and oil contaminants by scrubbing with an industrial grade detergent or degreasing compound followed by a mechanical cleaning. Remove concrete using air hammers, or other approved methods. Remove dirt, dust, laitance and curing compounds by gritblasting, sanding, or etching with 15% hydrochloric acid. Acid etch only if approved by the Engineer. Follow acid etching by scrubbing and flushing with copious amounts of clean water. Check the cleaning using moist pH paper. Water cleaning is complete when the paper reads 10 or higher. Follow all mechanical cleaning with vacuum cleaning. Apply an NCDOT approved bonding agent to all concrete replacement surfaces immediately prior to placing replacement concrete. Install concrete formwork in accordance with Section 420-3 of the *Standard Specifications*. Apply concrete to damp surfaces only when approved. In such instances, remove all free water by air-blasting. After installing replacement concrete, remove excessive material and provide a smooth, flush surface.

Use NCDOT approved rapid-setting concrete repair material suitable for this work.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

Furnish Department approved pre-packaged concrete or bulk concrete materials in a mix proportioned to satisfy provisions for Class AA Concrete detailed in Section 1000-4 of the *Standard Specifications* or as otherwise noted in these provisions. Concrete mix shall meet the following requirements:

Physical Property	Threshold Limitation	Test Method
Compressive Strength (at 3 hrs.)	4500 psi (min.)	ASTM C39/C109
Slump	4 in. (min.) 7 in. (max.)	AASHTO T119
Water to Cement Ratio	0.450 (max.)	N/A
Modulus of Elasticity (at 28 days)	5200 ksi (max.)	ASTM C469
Coefficient of Thermal Expansion (at 28 days)	4.5 in./in./°F (min.) 5.5 in./in./°F (max.)	AASHTO T336
Concrete Setting Times Initial Final	 30 min. (max.) 40 min. (max)	ASTM C191

Concrete shall be capable of placement on existing concrete substrate surfaces within the following temperature limitations:

40^0 F (min.)

100^0 F (max.)

Measurement for determination of concrete material compositions shall be in accordance with Section 1000-8 of the *Standard Specifications*.

Submit pre-packaged concrete mix contents or concrete mix design, including laboratory compressive strength data, for a minimum of six 4-inch by 8-inch cylinders at an age of 3 hours and 1 day to the Engineer for review. Include test results for the slump and air content of the laboratory mix. Perform tests in accordance with AASHTO T119 and T152.

Provide aggregates that are free from ice, frost and frozen particles when introduced into the mixer.

For equipment, proportioning and mixing of concrete compositions, see Section 1000-12 of the *Standard Specifications* and the Special Provision entitled "Volumetric Mixer". Prior to beginning any work, obtain approval for all equipment to be used for surface preparation, mixing, placing, finishing, and curing the replacement concrete.

Cure the replacement concrete in accordance with Section 420-15 of the *Standard Specifications*.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

14. Rotary Cam Limit Switch Assembly

The new rotary cam limit switch anchor bolts shall be ASTM F1554 Grade 55 Class 2A with 5-1/2 inches of threads at one end. The bolts shall be installed with leveling nuts, ASTM A563 Grade A heavy hex nuts, ASTM F436 hardened washers, and a non-shrinking grout from the NCDOT approved products list. All anchor bolts and hardware shall be hot dip galvanized in accordance with ASTM A153.

The three new flexible couplings for each leaf shall be Ruland double disc couplings model DCD36, or approved equal, and shall be mounted as shown on the plans. The coupling shall have stainless steel hubs and have zero backlash. Coupling bores and keyways shall match mating components. The couplings shall have a static torque rating of 450 lb-in. They shall allow 2-degree angular misalignment and 0.012 inch parallel misalignment.

A timing hub adjustable coupling, Candy Controls model TH-5 or approved equal, with bores and keyways to match mating components as shown on the plans. The timing hub shall have stainless steel hubs, fasteners, and set screws.

The new span control gearbox shall be a 8:1 ratio, parallel shaft, double worm gearbox with one input and one output shaft with keys. Housing shall be aluminum casting. The gearbox shall be an Ohio Gear DOT, Assembly B gearbox, or approved equal.

A new stub shaft and a new floating shaft shall be fabricated as shown on the plans. Keys shall be provided as listed on the plans. New component support plates, shim packs, and stainless steel mounting hardware shall be provided for new span control equipment. Support height and mounting hardware shall be determined by the Contractor and be appropriate for the equipment approved for installation.

See the Electrical plans for additional notes and requirements for the rotary cam limit switch and resolver.

15. Lead Counterweight Bricks and Support Steel

The counterweight bricks shall be by Mayco Industries or approved equal. All machining and coatings shall be done in lead supplier's shop. The bricks shall be fully encapsulated with Amercoat 235 epoxy coating in "haze gray" color. The lead brick material shall be in accordance with Federal Specification QQ-L-171 Grade B.

16. Live Load Span Lock Limit Switch Mounting

The new span lock limit switch shall be mounted on an angle that is replaced in kind. The anchor bolts shall be ASTM F1554 Grade 55 Class 2A. The bolts shall be installed with ASTM A563 Grade A heavy hex nuts, ASTM F436 hardened washers, and a non-shrinking grout from the NCDOT approved products list. All anchor bolts and hardware shall be hot dip galvanized in accordance with ASTM A153.

PART 3. EXECUTION

3.1 OPERATIONS AND WIND REQUIREMENTS DURING CONSTRUCTION

During construction where one motor operation is necessary, maximum wind loads for operating

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

and holding the bridge in the open position must be temporarily adjusted. For one motor operations, it is assumed that there will be one functioning motor brake and one functioning machinery brake. The deck is not considered open during the painting phase. The following wind requirements and brake settings shall be followed:

Temporary Main Drive Scenario:		1 Existing Motor	1 New Main Gearmotor	1 New Auxiliary Gearmotor**
Temporary Maximum Wind Loads (psf)	Bridge Operation (mph)	2.3 (30)	2.3 (30)	2.5 (31)
	Holding Bridge Open (mph)	20 (88)	10 (63)	10 (63)
Temporary Brake Settings (ft-lbs)	Max Brake Capacity	800	400	400
	Motor Brake	765	400	385
	Machinery Brake	765	400	385
Time to Raise or Lower (min)		* 4	* 5	26

*Running the temporary main drive at half speed.
**Only allowed as emergency back up to temporary drive.

3.2 SHOP ASSEMBLY AND OPERATION

A. Machinery components mounted on common bedplate shall be shop assembled with turned bolts to verify their correct fit prior to shipment. Any components requiring selective assembly shall be match-marked for future assembly.

B. The various parts of units or groups, such as gear reducers, shaft couplings, and bearings, before leaving the shop shall be marked according to mating, location and correct relation to facilitate reassembling at the bridge site. Stamp markings shall be made in areas of the part or assembly that are not subjected to significant stress during operation.

C. The main gearmotor shall be tested in the shop by running the motor for 30 minutes in each direction. Gearmotor housings shall be checked for lubrication leaks at bearing covers, seals, inspection covers, oil drains, bolts and welds. Noise level of the gearbox shall not exceed 90 dB while operating at maximum speed when the microphone is located 3 feet from the housing. Temperature rise of any component shall not exceed 100 degrees F over ambient.

D. The auxiliary gearmotor, shifter coupling, and right angle gearbox shall be shop assembled. The clutch on the auxiliary right angle gearbox shall engage the auxiliary gearmotor to test run the machinery for 30 minutes in each direction. Gearbox and reducer housings shall be checked for lubrication leaks at bearing covers, seals, inspection covers, oil drains, bolts and welds. Noise level of each gearbox and right angle reducer shall not exceed 90 dB while operating at maximum speed when the microphone is located 3 feet from the housing. Temperature rise of any component shall not exceed 100 degrees F over ambient.

3.3 FLOATING SHAFT COUPLING CLEANING, REPAIRING, AND LUBRICATING

The Contractor shall complete the following steps to repair all eight floating shaft couplings.

A. All floating shaft couplings are to be disassembled and cleaned of existing lubrication. Clean the coupling gear teeth of corrosion with a wire brush while ensuring minimal removal of material.

B. Hand dress all spline teeth with pitting and section loss, ensuring all rough areas are smoothed. Perform non-destructive testing of all internal and external spline teeth via wet magnetic particle testing to determine if any cracks are present in the teeth.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

C. The floating shafts shall be temporarily removed. Clean keyways of old lubrication and debris and drive the keys back until they are fully seated in their keyways. Peen over the ends of the keyways to prevent future movement of the keys.

D. Install new coupling seals in all three locations on each coupling. With the bridge in the closed position, replace the top lubrication plug of each coupling with a permanent grease fitting. After ensuring the coupling surfaces are free from moisture and debris, hand pack the couplings with an appropriate lubrication, reassemble the couplings, and add additional lubrication through the fittings of each.

3.4 DELIVERY, STORAGE and HANDLING

A. All components and materials shall be delivered to the site in accordance with the approved schedule of work. Any special provisions used for material handling shall be provided by the Contractor. No equipment shall be shipped to the field without being successfully tested and calibrated.

B. Components and materials shall be properly packaged and protected from initial shipment until the time of installation.

C. Assembled units shall be mounted on skids or otherwise crated for protection during shipment and storage.

D. Finished and unpainted metal surfaces that would be damaged by corrosion, shall be coated with a .030" minimum film thickness, as soon as practicable after finishing, of No-Ox-Id, A-Special, as manufactured by San-Chem Company, Chicago, Illinois, or approved equal. This coating shall be removed from all surfaces prior to lubrication for operation and from all surfaces prior to painting after erection. If the anti-rust coating on any part becomes compromised prior to part installation, the coating shall be restored immediately. As an alternative, metallic components may be wrapped in paper treated with volatile corrosion inhibitors (VCIs) or polyethylene VCIs, and further wrapped in polyethylene. VCIs are available from Daubert Chemical of Burr Ridge, IL; VCI 2000 of Northbrook, IL; Daubert Cromwell of Alsip, IL; or CorTec of St. Paul, MN. When weatherproof containers are used, they shall be lined with multiple bags of silica gel desiccant. Regular inspections should be performed to ensure finished surfaces are not in areas where condensation is occurring.

E. Material storage on site shall afford easy access for inspection and identification, protection from the ground and prevent distortion or damage.

F. The Contractor shall dispose of all removed materials in accordance with all pertinent existing legal and environmental requirements and guidelines for material disposal in effect at the time of letting. The NCDOT shall specifically identify which items are to be retained. Retained items shall be delivered and stored as directed by the NCDOT, and all others shall be properly discarded as required.

3.5 ERECTION

A. Erection work shall not commence until the required items have been completed and approved for installation, and until preparations by others where required have been satisfactorily completed.

B. The Contractor shall provide personnel and supervising engineers familiar and experienced in the installation of movable bridge machinery, especially for bascule bridges. The

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

Contractor shall provide all the precision equipment that may be required for the proper and accurate installation of the machinery.

C. Prior to erection, all finished surfaces, which were coated by a rust-inhibiting coating, shall have the coating removed with gasoline, benzene, or other approved solvent. While machinery parts are being erected, and work is interrupted, they shall be covered by a sound tarpaulin or other durable waterproof covering. Prevent soil and waterway contamination by appropriate containment. Collect and dispose of waste solvents, coating, and expendables per state and federal regulations.

D. The machinery: motors, brakes, shafts, couplings, span locks, and the like shall be erected and adjusted by competent mechanics and millwrights skilled in the type of work involved. Representatives of the machinery manufacturers shall be present during final assembly. They shall be provided with all necessary precision measuring and leveling instruments as may be required. The machinery shall be erected with exactness so the various parts are truly aligned in their proper positions and, when entirely assembled, will operate smoothly without binding or undue looseness of the components.

E. All parts of the machinery shall be erected in accordance with erection marks and match-marks. When the final position of the machinery will change upon application of the full dead load, the final adjustments shall be made after the dead load is fully applied. Before final drilling or reaming, all parts shall be adjusted to exact alignment by means of shims furnished for each part. After final alignment and bolting, all components shall operate smoothly.

F. Bolt holes in structural steel for connecting machinery with turned bolts shall, in general, be drilled from the solid after final alignment of the machinery. Sufficient erection holes, sub-drilled 1/8 to 1/4 of an inch undersize for temporary bolts, may be used for erection and alignment of the machinery. When the machinery is aligned in its final position, full-size holes for the permanent turned bolts shall be sub-drilled and reamed; full-size bolts installed; and the temporary bolts removed.

G. Throughout the installation, bolts and nuts shall be adjusted or tightened only with wrenches that fit; tightening with chisels and hammers will not be permitted.

H. Installation and alignment of all mechanically connected machinery and electrical equipment shall be conducted under supervision of the machinery manufacturer's field engineer.

I. The machinery and all machine-like elements or parts shall be assembled, erected, aligned, and adjusted at the bridge site under the direct and continuous supervision of the Engineer, to whom the Contractor shall afford every opportunity and facility to satisfy himself that the work is being done in accordance with the contract drawings, specifications, and acceptable construction practices.

J. Field Inspection and Testing

All field testing and alignment verification shall be performed in the presence of the Engineer. The Engineer shall be given at least two weeks notification prior to all testing.

1. Main Operating Machinery

a. All span drive machinery shall be assembled complete as to all shafts, couplings, bearings, brakes, motors, gearboxes, and reducers and adjusted so that all components are aligned to within the manufacturer's recommended

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

installation tolerances. Adjustments shall be made with stainless steel shims. All primary gear reducer output shaft couplings shall then be uncoupled and all disconnected coupling components secured to prevent damage during rotation. Disengage the auxiliary shifter coupling. The span shall be locked in the seated position during the entire time the primary gear reducer output shaft couplings are uncoupled. Test run the machinery for 30 minutes in each direction for each main motor. Gearbox and reducer housings shall be checked for lubrication leaks at bearing covers, seals, inspection covers, oil drains, bolts and welds. Noise level of each gearbox and reducer shall not exceed 90 dB while operating at maximum speed when the microphone is located 3 feet from the housing. Temperature rise of any component shall not exceed 100 degrees F over ambient.

2. Auxiliary Operating Machinery

a. All span drive machinery shall be assembled complete as to all shafts, couplings, bearings, brakes, gearboxes, and reducers and adjusted so that all components are aligned to within the manufacturer's recommended installation tolerances. Adjustments shall be made with stainless steel shims. All primary gear reducer output shaft couplings shall then be uncoupled and all disconnected coupling components secured to prevent damage during rotation. The span shall be locked in the seated position during the entire time the primary gear reducer output shaft couplings are uncoupled. The clutch on the auxiliary right angle gearbox shall engage the auxiliary gearmotor to test run the machinery for 30 minutes in each direction. Gearbox and reducer housings shall be checked for lubrication leaks at bearing covers, seals, inspection covers, oil drains, bolts and welds. Noise level of each gearbox and reducer shall not exceed 90 dB while operating at maximum speed when the microphone is located 3 feet from the housing. Temperature rise of any component shall not exceed 100 degrees F over ambient.

3. Span Locks and Center Locks

a. After adjusting each lock assembly, they shall each be field tested by operating through not less than 3 cycles while the span is in the closed position.

b. Span lock and center lock assemblies shall also be operated during the electrical sequence testing performed under the electrical specification.

4. Alignment of all machinery shall be rechecked after all connections and drives have been installed and in operation for a minimum of 10 span openings/closings.

3.6 BASCULE SPAN BALANCING

A. A Licensed Professional Engineer must perform the testing and all balance calculations, and shall provide evidence of successful strain gage balancing experience on a minimum of three (3) bascule bridges within the previous five years. Submit a complete test procedure, along with the resume of the Professional Engineer conducting the tests, for review and approval 14 days prior to the initial balancing test.

The test procedure must include the following: Test method, list of equipment, sample calculations, torque zeroing method and report format.

Currently, each span has a toe reaction ranging from 5,000 to 5,500 lbs and an angle of center of gravity ranging from 8 to 18 degrees. Tests shall be done after counterweight changes (addition of bascule girder added weight and removal of counterweight pocket blocks) and after the deck replacement. After completing balance tests, submit a formal

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

report signed and sealed by the Professional Engineer who conducted the tests. The report must include the following: introduction, test procedure and equipment, method of analyzing recorded data, presentation of results, conclusions, calculations and graphical representation of torque, strain, and span balance plotted against bridge angle.

B. When testing, strain gages shall be mounted on the two north and two south cross shafts to record torsional strain which shall be converted into loads to each corner of each bascule leaf. The strain gages shall be configured in such a way as to cancel the effects of bending, so they only measure torsional strain in each shaft. The microstrain shall be recorded on a strip chart or digital data acquisition system simultaneously with span angle indication for a minimum of three complete opening cycles while running on the existing main motors. Span imbalance for each corner of the span shall be determined. The percentage of full load torque of the span drive motor(s) and the friction for the bascule drive system measured for the full operating cycle shall also be determined and submitted.

C. The Contractor will be responsible for adjusting the balance as necessary during construction. The Contractor shall develop and maintain a spreadsheet to track all additions and removals of components and materials to and from the bascule span and counterweights. The spreadsheet and all associated calculations shall be submitted to the Engineer for approval prior to the start of work. These calculations shall include span balance changes and wind loading characteristics of any painting containment details and shall be provided in terms of additional loading on the span drive equipment.

D. When weight adjustments are necessary to maintain the balance condition, weight shall be added to the bascule girders in accordance with the approved calculations, and as shown on the drawings. The bridge balance conditions shall be adjusted the same day that construction activities result in any alteration of the bridge balance, and prior to any required openings for waterway traffic. At no time shall any brakes or span locks be released or disengaged, respectively, until bridge balance has been properly adjusted. Temporary equipment and tools shall be removed from the lift span prior to each bridge operation, and therefore need not be included in the balance spreadsheet.

E. The new bascule girder mounted counterweight bricks and related support steel shown on the plans are provided for three purposes:

1. A portion of the new counterweight (5,000 lbs per girder) is intended to bring the bascule span into a more acceptable balance condition (approximately 3,500 lbs toe reaction, see Part F below for more details).

2. A portion of the new counterweight (5,000 lbs per girder) is to allow for removal of a similar amount of existing balance blocks from the counterweight pockets (equally distributed among all pockets per leaf). The counterweight pockets are currently full, this will provide space for future adjustments by NCDOT. The number of blocks to be removed from each pocket shall be determined by the Contractor.

3. Lead bricks will be added to the girder to offset the weight of the structural steel repairs and the new grid deck. See the plans for additional details and quantities.

F. The Contractor shall be responsible for all labor and materials required to provide an acceptable balance, as directed by the NCDOT. All testing, data analysis, and weight adjustments shall be carefully documented and formally submitted.

Adjust the balance of the lift span to meet the following requirements (all reactions listed are dead load only, no live loading):

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

During Construction, Bridge Operation Not Permitted. Bridge is in the Closed Position, with Span Locks Engaged: The bascule spans must be span heavy, with a minimum positive toe reaction for each span of 1,000 lbs with the bridge in the closed position.

During Construction, Bridge Operation Permitted: The bascule spans must be span heavy in the closed position, with a positive toe reaction for each span between 1,000 lbs and 5,500 lbs and an angle of the center of gravity no greater than 20 degrees above or below a horizontal line passing through the trunnion. The span shall have a maximum imbalance torque of 732 ft-kips.

Final Balance Condition of Bridge Following Construction: The bascule spans must be span heavy in the closed position, with a positive toe reaction for each span between 3,000 lbs and 4,000 lbs and an angle of the center of gravity no greater than 20 degrees above or below a horizontal line passing through the trunnion. The span shall have a maximum imbalance torque of 532 ft-kips. Final balance testing shall follow the test requirements listed in "B" above. Tests shall be recorded for a minimum of 3 operations for each main motor and auxiliary motor.

Once the desired final span balance is achieved, submitted and accepted by the NCDOT, the Contractor can proceed with final test operating the span. The span locks and center locks shall be independently tested with three full cycles before full bridge operations. The span shall be tested with at least ten complete full operating cycles (four for each main motor and two for the auxiliary motor), including all necessary systems of the bridge. Machinery shall be monitored during these openings for leaks, noise, excessive vibration, hot components, and misalignment.

3.7 PAINTING

A. Cleaning and painting of machinery metalwork surfaces shall be compatible with the NCDOT standard requirements for cleaning and structural painting and shall be indicated on the shop drawings. Factory painted machinery items shall be hand tool or solvent cleaned and overcoated with the top coat of the specified paint system in the appropriate color as indicated in this section for movable and stationary components.

B. Manufactured or purchased machinery items shall be painted with the manufacturer's premium, high performance, epoxy paint system, recommended for outdoor applications in harsh marine environments, which shall be submitted to the Engineer for approval. If the manufacturer does not have a recommended high performance paint system, the components shall be painted according to the paint system and requirements specified herein. Factory painted machinery items shall either be painted with a top coat color matching as close as possible to the top coat color, as discussed herein, or shall be hand tool and solvent cleaned and overcoated with the top coat of the specified paint system in the appropriate color as discussed herein. The Contractor shall coordinate required paint colors with the machinery component manufacturers. Manufacturer's paint system and coat colors shall be submitted to the Engineer for approval.

C. The paints shall be of one manufacturer and shall conform to the chemical and performance requirements of the manufacturer's published technical data application information, and the referenced specifications.

D. All metalwork to be painted shall receive the 3-coat specified paint system in the shop with the exception of the finished, bearing, and lubricated surfaces.

E. The Contractor will not be allowed to clean or paint at night. All cleaning and painting shall be performed only during daylight hours.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

F. Coatings application shall be in accordance with the manufacturer's recommendations, SSPC-PA 1 Paint application Specification No. 1 and these specifications, whichever is more stringent.

G. Coatings shall be applied only to surfaces prepared in accordance with the manufacturer's recommendations and these specifications.

H. Paint systems may be applied by conventional air spray, airless spray equipment or brush in accordance with the manufacturer's recommendations and these specifications.

I. The painted surfaces shall be free from dry spray, over spray, runs, sags, drips, excessive paint build-up, ridges, waves, laps, streaks, brush marks and variations in color, texture and finish (glossy or dull). The coverage shall be complete and each coat shall be so applied as to produce an even film of uniform thickness, completely coating corners and crevices, and bonded to the underlying surface. When spot repairs are necessary, the edges of the surrounding coating shall be feathered, leaving surfaces prior to painting, tapered and free of loose or damaged coating. Care shall be exercised to avoid over spraying or spattering paint on surfaces not to be coated. Damage to surfaces not to be coated shall be repaired by the Contractor at the Contractor's expense.

J. All items not to be painted shall be covered or protected from cleaning and painting and shall be cleaned of overspray. The coverage and protection measures shall be submitted to and approved by the Engineer.

K. Color for the top coat shall be Federal Safety Orange ANSI Z53.1 for all moving parts in the machinery room including shafts, couplings, and brake wheels. Bearing and lubricated surfaces shall not be painted. Color for the top coat of stationary parts in the machinery house shall be Federal Safety Green.

L. Before application of paint <u>in the shop</u>, surfaces which require painting shall be cleaned of all chips, burrs, dirt, rust, mill scale, sand, grease, and other extraneous materials by employing methods such as chipping, grinding, wire brushing, solvents, followed by the required abrasive blast cleaning and residual dust removal by compressed air. Finished machined surfaces not to be painted shall be masked or shielded from abrasive blasting operations. After cleaning, surfaces requiring paint shall be painted with one prime coat. After coupling hubs are installed on all shafts in the shop, the remaining exposed portion of shaft shall be painted, with care to protect any adjacent bearing or seal. Bearing or sliding surfaces that are not to be painted will be coated with temporary protective materials as approved by the Engineer. Nameplates shall be protected to remain clean and free of paint.

M. After the machinery items have been installed in final position on the bridge, all surfaces which require paint, including bolts and portions of shafts remaining exposed after assembly, shall be cleaned of grease, oil, and loose materials by the use of solvents and compressed air, and all unprimed or damaged shop prime coated surfaces shall be repaired with the touch-up primer followed by a full intermediate coat. The Contractor shall take special care to avoid painting of machinery bearing and sliding surfaces and to mask and protect from paint these surfaces and all nameplates, legend plates, and escutcheons mounted on machinery.

N. After completion of the operating tests and acceptance of the machinery, all oil, grease, dirt, and other foreign matter shall again be cleaned from the exposed machinery surfaces. The exposed surfaces shall then be given a third field coat, the top coat, which shall color-code the machinery to identify fixed and moving parts as indicated previously and as shall be shown on the shop drawings.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

O. Should the top coat of paint submitted and approved for use on the structural metalwork not be available in the safety colors required for the machinery metalwork. A substitute top coat meeting the color requirements and that is equal in performance to the top coat specified and compatible with the specified intermediate coat shall be submitted for approval by the Engineer. The Contractor shall place a cautionary sign in the machinery room on each leaf to explain the color code. Details of the sign including text, dimensions, mounting locations, and materials shall be submitted to the Engineer for approval.

3.8 LUBRICATION

A. The Contractor shall furnish a lubrication plan for all new and rehabilitated machinery for approval. The plan shall be developed from recommended practice of the machinery manufacturers. The Contractor shall coordinate the lubrication plans for the various machinery elements and minimize the number of different lubricants. The Contractor shall furnish copies of letters from the various machinery manufacturers endorsing the lubricants which have been finally selected. Lubricants shall be selected for year round exposure at the bridge.

B. The Contractor shall provide two lever type lubrication guns with three foot hoses. Fittings shall be located in a protected and convenient position for use and shall be connected to the points requiring lubrication by pipe extensions where necessary. These pipe extensions shall be kept as short as practical and shall be rigidly supported at the fittings and at intermediate points. Pipe extensions shall be 1/4 inch seamless threaded stainless steel with stainless steel threaded lubrication fittings. Fittings on proprietary parts shall be replaced if necessary with fittings that have been selected as standard for the bridge.

C. The Contractor shall furnish a lubrication diagram for the machinery above which shall show:

1. Location of each machinery part that requires lubrication.
2. Name of part.
3. Generic specification of lubricant.
4. Specific lubricant (manufacturer's designation).
5. Frequency of lubrication.
6. Quantity (volume and whether to change the lubricant or top off).

The diagram shall be submitted to the Engineer for approval and the approved diagram shall be mounted in the operator's house and in each machinery area with a suitable and approved frame and glass cover.

D. A reduced size copy of the lubrication diagram shall be included in the Operating and Maintenance Manuals.

E. The Contractor shall lubricate components as recommended by individual component manufacturer recommendations and approved lubrication diagram prior to all shop, field and acceptance tests. The Contractor shall be responsible for lubricating all machinery components, equipment and assemblies in accordance with manufacturer recommendations and approved lubrication diagram just prior to handing the completed project over to NCDOT.

During installation, the Contractor shall lubricate all rotating and sliding parts of the machinery (including the span lock bars), and fill all reducers, gearboxes, pillow block housings, and flexible couplings with lubricants indicated on the approved charts. All lubricants listed on the lubrication charts shall be approved for use in each proprietary unit

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

by the manufacturer thereof. The Contractor shall furnish an additional supply for future maintenance use to include 25 pounds of coupling grease. The contractor shall have the Project Engineer or his representative verify the lubrication of each piece of equipment before it is put into operation.

Lubricant compounds shall be recommended and certified by the manufacturer in writing for the use and requirements called for. Lubricants shall be recommended use year round with consideration to ambient temperature ranges that will be experienced by the various components. Synthetic lubricants may be proposed but shall be compatible with all seals and sealing compounds that may be exposed to the lubricant. Contractor shall furnish the Engineer a copy of the certification.

After erection is complete, the Contractor shall make a thorough inspection to ensure that all parts are aligned as closely as practicable without actual operation, and that all bolts are properly tightened. All gear housings shall be filled to the proper level, and all rotating and sliding parts shall be supplied with lubricants. All lubrication requirements listed in the lubrication schedule herein shall be performed by the Contractor until the final acceptance by NCDOT.

3.9 CONTRACTOR SUPERVISED OPERATION OF THE BRIDGE

A. This work consists of operation of the bridge during construction activities and supervision of NCDOT personnel in the operation of the bridge.

B. NCDOT will provide bridge operators for operating the bridge throughout the duration of the work. However, the Contractor shall supervise, and be in responsible charge of, bridge operations from the time that the normal operating procedure is affected by construction activities until the work is complete and the bridge is fully operable in its final form and as approved by the Engineer. During this period, the Contractor shall also be the primary contact for coordination before, during, and after operations. This coordination shall include all on site personnel and activities, and other agencies as required by this contract, such as the USCG. The Contractor shall provide the Engineer with proposed dates for commencement and conclusion of temporary Contractor supervised operation of the bridge.

C. Factors that are considered as affecting the normal operating procedure include: work on the bridge machinery, work on the bridge electrical control system, work on the Operator's House, work that affects the barrier gates, any work that affects span balance, Contractor staff, materials and/or equipment on the lift span or interfering with the bridge operator's view of roadway or waterway traffic.

D. The Contractor shall maintain and provide any required adjustments and/or corrections to the mechanical and electrical equipment of the bridge during construction and through the period of temporary Contractor supervised operation.

E. Provide a minimum of two men to supervise the operation of the bridge for a period of 14 calendar days (24 hours a day) after the bridge is fully operational. These men shall be able to operate the bridge, supervise its operation, and to make any adjustments or corrections that may be required in the mechanical equipment of the bridge. They shall instruct and qualify the NCDOT personnel in the operation of the bridge. NCDOT personnel shall be fully trained at the end of Contractor supervised operations. Any adjustments or corrections required during the 14-day period after final acceptance shall be at no additional cost.

F. The Contractor shall perform work in a way that allows for continued operation of the

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

bridge.

PART 4. MEASUREMENT AND PAYMENT

4.1 METHOD OF MEASUREMENT

The Bridge Mechanical Operating Machinery, including the main gearmotor (with an encoder), auxiliary gearmotor, right angle gearboxes, couplings, shifter coupling assembly, shafts, brakes, bearings, span and center lock assemblies, span control equipment drives and couplings, live load bearing work, counterweight balance work, machinery supports, shims, and hardware, shall be measured as a unit acceptably completed as shown on the contract drawings and as specified. All limit switches shall be paid under Bridge Electrical and Control System.

The Mechanical Equipment, Installation, Operation, Maintenance and Lubrication Manual will not be separately measured.

4.2 BASIS OF PAYMENT

Payment for Mechanical Operating Machinery will be made at the contract lump sum price bid for which price and payment shall be full compensation for furnishing all labor, materials, equipment, and incidentals necessary to complete the work under the item in accordance with the Contract Drawings and these Special Provisions, including painting, lubricating, and all other features necessary to insure the satisfactory operation of the bridge.

Lubricants, oil seals, gaskets, and other non-metallic materials will not be measured for payment but the cost thereof shall be included in the prices stipulated for the machinery.

Payment will be made under:

Description	Units
Mechanical Operating Machinery	Lump Sum

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
PROJECT NO. 15BPR.14
NEW HANOVER COUNTY
REHABILITATION OF
ISABEL HOLMES BASCULE BRIDGE AND FIXED APPROACH SPANS

PROJECT SPECIAL PROVISIONS – ELECTRICAL

- Bridge Electrical Work (Special)
- Bridge Backup Generator (Special)
- Submarine Cables (Special)
- Traffic Gates (Special)
- Traffic Signals (Special)

NORTH CAROLINA PROFESSIONAL SEAL 044780 ENGINEER JOSEPH G. STRENKOSKI

DocuSigned by:
Joe Strenkoski
BC58212F3FAD4FA...

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

BRIDGE ELECTRICAL WORK: **PSP**

Description

This section covers all products, labor, services, incidentals, and related work necessary to furnish, install, test, and put into permanent service all electrical work as shown on the Plans. All work shall be in accordance with the Plans, all applicable sections of the *2018 Standard Specifications*, and the provisions herein. Bridge Electrical Work shall be closely coordinated by the Contractor with other project construction activities to minimize disruptions to bridge operations, disruptions to roadway traffic, and disruptions to waterway navigation.

References

The following publications form a part of these Special Provisions by this reference and shall have the same force and effect as if printed herewith in full. Unless otherwise noted, the version of referenced standards or publications is the version in effect at the bid opening time for this contract.

AASHTO LRFD Movable Highway Bridge Design Specifications

NECA 1 – Standard for Good Workmanship in Electrical Contracting

NETA Acceptance Testing Specifications

NFPA 70 – National Electrical Code

NFPA 70E – Standard for Electrical Safety in the Workplace

North Carolina Electrical Code

All applicable State and Local codes

Additionally, all work shall comply with all additional requirements of the Authorities Having Jurisdiction. It shall be the responsibility of the Contractor to contact the proper Authorities prior to beginning work in order to determine all requirements, as well as to maintain relevant communications with such Authorities throughout construction.

Submittals

The contract documents are intended only to depict the general intent of this contract; they are not of sufficient detail to be used in lieu of required submittals. All required additional detail development shall be provided at no additional cost.

The Contractor or electrical subcontractor shall have on staff or shall retain an Electrical Engineer who shall coordinate and supervise the preparation of all electrical submittals, and fully review and check all submittal items, including those originally prepared by all sub-contractors and vendors, for compatibility with all new and existing work, and coordination with other submittal items prior to submission for compliance with the requirements of the contract documents.

(A) Product Submittals

(1) Brochures, catalog cuts and specification sheets, and other product literature for all standard or semi-standard products. Submittals shall be marked to clearly identify the intended product selections with all applicable options.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

(2) Certified drawings for standard or semi-standard products when requested by the Engineer, or as otherwise required by the contract documents. Certified drawings shall clearly depict all critical dimensions, as well as all electrical and mechanical ratings. Where motors are provided with special modifications (encoders, extended shafts, etc.), these modifications shall be reflected on the certified drawings. Manufacturer's standard catalog drawings are not acceptable in place of certified drawings.

(3) Test certificates for raw materials or components when requested by the Engineer, or as otherwise required by the contract documents.

(4) Submit manufacturer generated time-current trip curves for all major breakers and fuses used, suitable for use in a protective device coordination study. Major breakers include incoming electric service breaker, generator breaker, panelboard main breakers, primary breakers feeding all 480 Volt transformers, and all motor branch circuit breakers and motor circuit protectors.

(5) Product submittals shall be provided for all products proposed for installation, even if the proposed products are identical to those specified by the contract documents.

(6) Approval shall be obtained for all submittals prior to the purchase, delivery to the site, or commitment to this project of the respective equipment or materials.

(B) Working Drawings

(1) Shop and assembly drawings for fabricated items and assemblies shall be provided prior to installation.

(2) Layout and installation drawings shall be submitted for approval prior to installation of the following: electrical cabinets and equipment enclosures, conduits, cable trays, luminaires, switches, and junction boxes, and any components for which mounting provisions have not been detailed on the Plans, or any components for which the Contractor is proposing alternate mounting provisions from those shown on the Plans. Layout and installation drawings shall show proposed locations, dimensions, and clearances to floors, walls, ceilings, structural members, mechanical components, and other nearby objects and equipment. Items must be shown in their proper relative positions and be dimensioned. Drawings shall explicitly show National Electrical Code required "working" and "dedicated equipment" spaces about electrical equipment. Drawings shall clearly show the Contractor's proposed method of attachment, mounting methods, specific hardware, any and all holes to be drilled or cut in structural steel or masonry, etc.

(3) Three-line and elementary point-to-point wiring diagrams shall be submitted for approval prior to installation of conduit and wiring. All conductors shall be identified on the diagrams by wire numbers that match the same respective conductors or connections shown on all other component or equipment Shop Drawings or Wiring Diagrams. Each conductor shall be assigned only one wire number which shall be continuous from the origin point to the termination point of the conductor, and consistent on all diagrams on which the conductor appears,

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

regardless of which vendor or manufacturer produced the diagrams. Wiring diagrams are not intended to be to scale, but shall show all conduits, raceways, boxes, cabinets, and equipment enclosures, etc. Items shall be shown in their approximate geographic orientation to each other to the extent practical.

(4) Conduit and raceway layout diagrams shall show each raceway utilized, with all wire numbers installed therein, in tabular or spreadsheet format. Spare conductors shall also be assigned wire numbers. Different symbols shall be used to clearly distinguish between concrete encased/in-wall and exposed conduits, as well as cable trays, flexible cables, wireways, junction boxes, terminal cabinets, equipment, and enclosures.

(5) Conductor tabulations shall be provided on Microsoft Excel compatible spreadsheets and clearly indicate all wire numbers passing through or terminating in each raceway, box, cabinet, and equipment enclosure. All raceways, boxes, cabinets, and equipment enclosures shall be included on the tabulations. Tabulations shall include device served and function of each conductor. Spare conductors shall also be listed. Spreadsheets shall be set up to be sortable by wire number, raceway, cabinet, or equipment served.

(6) Nameplate lists for electrical equipment, including proposed text shall be provided. The text of nameplates which are part of a product depicted on a shop drawing shall be clearly shown on that shop drawing.

(C) Control System Design

(1) In conjunction with working drawings above, submit shop drawings for PLC control system and flux vector drives. Shop drawings shall include complete wiring diagrams showing internal and field interconnection of all control system and drive system components, dimensioned cabinet layout drawings, and corresponding bill of materials.

(2) Submit calculations verifying dynamic braking resistor sizing and selection.

(3) Submit preliminary bridge HMI screen design information for each HMI. Information shall include menu structure trees showing screen navigation, example screens (color printouts) of each type to be provided, and color conventions. Example screens shall also demonstrate how bridge operating data collection will be accessed and displayed.

(4) The preliminary PLC program with complete documentation (PDF format) and the preliminary bridge HMI screen design information shall be developed and submitted for approval prior to shop testing.

(D) As-Built Drawings

(1) The Contractor shall maintain on site a full-size set of Working Drawings as described above, as well as Contract Plans, marked up with changes/revisions in red to reflect the as-built or as-installed conditions. Drawing markups shall include the date of the revision.

(2) Such plans and drawings shall be updated weekly, so that no changes or deviations are more than one week old without being correctly recorded on the

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

Plans and drawings. Any proposed deviations from the above required drawings, once the drawings have been approved, shall be submitted as revisions for the Engineer's approval prior to installation of the proposed revisions.

(3) All drawings affected by such revisions shall be revised by the Contractor. All such as-built or as-installed plans and drawings shall be continuously available for the Engineer's inspection in the Contractor's field office on site, and shall be turned over to the Engineer at the completion of construction.

(4) At the completion and acceptance of the project, the Contractor shall develop and furnish the necessary Electrical Bridge Operation and Maintenance Manual as required elsewhere in these Special Provisions.

(5) Results of all tests shall be submitted to the Engineer as described elsewhere in these Special Provisions.

(E) As-Built Documentation and Software Backups

(1) The Control System Vendor shall provide hard copies of the as-built PLC ladder logic program listing complete with all cross references, contact labels, and rung comments. The labels on all input and output points shall match those shown on the contract drawings. One copy shall be provided for the main control panel, and other copies shall be supplied as required by the Electrical Bridge Operation and Maintenance Manual specification requirements. An electronic searchable “PDF” version of the program listing shall also be provided.

(2) The Control System Vendor shall provide a complete electronic backup of the PLC ladder logic program for each PLC including contact labels, program labels, PLC configuration, and all related files in a format that can be read and downloaded by the PLC programming software. These files shall also be copied to the hard drive of the laptop computer.

(3) As-built electronic backups shall be provided for each HMI display. All reference data files and source code shall be provided.

(4) The Control System Vendor shall provide hard copies of the as-built drive parameter listings for each drive. One copy shall be provided for the drive panel, and other copies shall be supplied as required by the Electrical Bridge Operation and Maintenance Manual specification requirements. An electronic “PDF” or text file version of the drive parameter listings shall also be provided.

(5) If parameter backup software is available from the flux vector drive manufacturer, provide as-built electronic backup files of each drive’s parameters and the appropriate licensed copy of the software, manuals, and necessary programming cable. Provide configured memory card backup of drive parameters when available from the flux vector drive manufacturer.

(6) Submit as-built hardcopy and software backups, where applicable, for all programmable devices including Ethernet switches. Include documentation for all hardware switch and jumper settings.

(7) Electronic backups shall be provided on compact disk, or a media approved by the Department. Six copies shall be provided.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

(8) All passwords shall be provided to the Department.

(F) Schedules and Procedures

(1) Proposed schedules and procedures shall be submitted for approval prior to commencing work including sequence of electrical work, temporary power and control provisions, temporary roadway traffic controls, temporary navigation lighting and signaling, and control system testing/startup/adjustment

(2) All proposed schedules and procedures shall be fully coordinated with the overall project schedule and approved schedule of work.

(3) Submit detailed procedures and checklists for control systems shop and site testing.

(G) Training Documents

The training/instruction program syllabus and training materials for the control system training must be submitted and approved by the Engineer at least two weeks prior to scheduling the training program.

(H) Qualifications Documents

Concurrent with submission of the bid, each bidder shall identify the intended Control System Vendor (assembler/supplier of the integrated control system) and submit a sufficient previous experience log to verify that the Vendor meets the requirements listed herein. The equipment furnished by the Control System Vendor shall include, but not necessarily be limited to, the PLC and all associated components, the PLC program, control cabinets, bridge control console, resolvers, encoders, limit switches, flux vector drives, main drive motors, and motor control center.

All software (developmental and runtime), passwords, and hardware required to configure, modify, and operate this system shall be included in this contract and shall be turned over to NCDOT at the completion of the work. All applicable drawings, PLC programming, HMI programming, and device configurations shall not be considered proprietary and all final installations shall be solely owned by NCDOT.

Qualifications

The contract documents assume that all contractors and/or sub-contractors undertaking electrical work related to this project are properly qualified, skilled, and experienced in the type of work involved. It is similarly assumed that all vendors and manufacturers selected by the Contractor to provide products for this project are properly qualified, skilled, and experienced in the fabrication and/or manufacturer of the products involved.

The Contractor will not be relieved of the responsibility to satisfy the requirements of the contract documents due to lack of qualifications, skills, or experience, stated or implied, of any contractor, sub-contractor, vendor, and/or manufacturer.

(A) Electrical Contractor

(1) The Electrical Contractor shall be properly licensed by the State of North Carolina and be primarily and regularly engaged in the installation and service of industrial electrical power distribution and control systems.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

(2) The Electrical Contractor shall employ on site supervisory personnel who are licensed electricians experienced in the installation and maintenance of industrial electrical power distribution and control systems.

(3) The Electrical Contractor shall have been in the business of installing and servicing industrial electrical power distribution and control systems for at least ten continuous years as of the bid date.

(4) In lieu of sub-contracting the electrical work to a separate Electrical Contractor, Prime Contractor personnel satisfying all of the above requirements may perform the electrical work.

(5) Documentation demonstrating that the Electrical Contractor satisfies the requirements of these Special Provisions shall be provided prior to commencing any electrical work. If no separate sub-contractor is to be used, the Prime Contractor shall be clearly identified as the Electrical Contractor and documentation demonstrating that the Prime Contractor satisfies the requirements of these Special Provisions shall be provided.

(B) General Vendors and Manufacturers

(1) Vendors and/or manufacturers for electrical systems, sub-systems, and/or products, other than the control system, shall be primarily and regularly engaged in providing the items for which they are responsible.

(C) Control System Vendor

(1) The Control System Vendor shall be primarily and regularly engaged in the integration, installation, startup, and maintenance of industrial control systems, with demonstrable experience with PLC programming, HMI programming, and variable speed drive configuration.

(2) The Control System Vendor must be able to demonstrate experience in movable bridge control systems by having completed five previous successful movable bridge control systems, all of which shall have incorporated a PLC system with flux vector variable speed drives.

(3) All applicable previous project references, including names of bridge owners and contact persons with phone numbers, must be submitted with the bid document.

(4) Control System Vendors unable to demonstrate compliance with the above requirements will not be accepted, which may be deemed cause for disqualification and rejection of the bid.

Materials

In addition to the materials and equipment shown and described on the Plans and in these Special Provisions, the Contractor shall provide all junction boxes, conductors, conduits, raceways, fittings, connectors, and appurtenant hardware as may be necessary to provide a complete and properly functioning Bridge Electrical and Control System.

Unless otherwise noted, all electrical equipment shall be suitable for use on 60 hertz AC systems.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

Conduit and Wiring System

Furnish and install all materials necessary for both replacement and new installation of designated conduit, cable tray, general purpose wiring, flexible cables, junction boxes, terminal cabinets, and associated components.

Sizes shall be in accordance with the requirements of the National Electrical Code (NEC), and shall be sized to accommodate conductor pulling without damage to conductor insulation. Couplings, connectors, and fittings shall be of a type specifically designed and manufactured for the application and for the conduit material. Conduit hubs shall be compatible with both the conduit and the enclosure material.

(A) PVC Coated Rigid Metal Conduit

(1) The conduit shall be hot dip galvanized inside and out with hot galvanized threads. All female threads on fittings and couplings shall be protected by urethane coating. Overall conduit shall be UL listed with the PVC coating as the primary corrosion protection and the underlying galvanized coating as supplemental protection.

(2) Exterior PVC coating shall be minimum 40 mils thick. The adhesion of the PVC coating to the conduit shall be greater than the strength of the coating itself. Interior coating shall be urethane, minimum 2 mils in thickness.

(3) A PVC sleeve extending one pipe diameter or two inches, whichever is less, shall be formed at every female fitting opening except unions. The inside sleeve diameter shall be matched to the outside diameter of the conduit.

(4) U-bolts, conduit clamps, and mounting hardware shall have similar PVC coated construction, shall be compatible with the PVC conduit, and shall be provided by the same manufacturer as the conduit. Other hardware shall be constructed of stainless steels.

(5) PVC coated rigid metal conduit shall be installed using tools and methods which will not cause damage to the PVC coating. Any areas on the exterior of the conduit which have been damaged during installation shall be coated with an exterior patching compound as recommended by the conduit manufacturer.

(6) Installers of PVC conduit shall be trained in the proper techniques for cutting, bending, threading, and repairing the PVC conduit.

(B) Rigid Metal Conduit (RMC)

(1) Rigid metal conduit shall be manufactured from high strength steel, hot-dip galvanized inside and out, and manufactured in accordance with ANSI C80.1.

(2) Threads shall be full-cut, NPT taper, and be hot galvanized after cutting.

(3) RMC shall be listed to UL Safety Standard 6.

(C) Liquid-tight Flexible Metal Conduit (LFMC)

(1) Flexible conduit shall be UL listed, with smooth liquid-tight PVC jacket and hot-dipped galvanized flexible steel core.

(2) The flexible conduit jacket material shall be abrasion resistant and resistant to

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

water, oils, corrosive atmospheres, sunlight, and weather.

(D) Cable Tray

(1) Cable tray shall be UL listed ladder type, fabricated from aluminum. The cable tray system shall be designed with 20% spare capacity and shall be sized to meet NEC requirements.

(2) Trapeze type cable tray supports shall be provided. Trapeze type supports shall consist of hot galvanized steel angles or channels, suspended by galvanized threaded rods. Threaded rod connections to the angle shall be double-nutted on both sides. Cable tray shall be secured to the trapeze angle with hold down clamps. Angles, channels and rods shall be sized by the Contractor, subject to approval by the engineer, to support the total cable tray plus cable load with a 1.5 safety factor. Support spacing shall be per NEC and manufacturers requirements.

(3) Cable tray system shall be electrically continuous throughout. Bonding jumpers shall be provided at all flexible splices and discontinuities.

(4) Metal barrier strips shall be used to separate power, VFD power, and control conductors where they share the same cable tray. Mounting brackets or bolted connections for the barriers shall be placed at minimum 3’ 0” spacing.

(5) All conduits terminating at cable tray shall use insulated throat grounding bushings and shall be bonded to cable tray with bonding jumper sized as required by the NEC.

(6) Cable trays installed outdoors or in exposed machinery areas shall include manufacturer supplied protective covers.

(E) Junction Boxes, Pull Boxes, and Terminal Cabinets

(1) Unless specified otherwise, junction boxes, pull boxes, terminal cabinets, and other miscellaneous wiring device boxes located outdoors, in machinery areas, or unconditioned areas of the bascule piers shall be NEMA 4X weatherproof, cast aluminum or stainless steel. Doors shall be gasketed to be weather-tight, per NEMA 4. Similar items located in the control house electrical and generator rooms shall be NEMA 12 rated.

(2) Hinges, bolts, screws, and other hardware shall be brass or stainless steel. All stainless-steel cover fasteners shall be treated with anti-seize compound.

(3) Enclosure doors or covers shall be electrically bonded with flexible copper jumpers.

(4) Terminal cabinets shall be provided with interior mounting panels for mounting of terminal strips. Cabinets that may house power and control conductors shall be sectionalized with dividers between power, VFD power, and control sections. Terminal blocks shall be NEMA type as described elsewhere in these specifications, sized and rated appropriately for the connected conductors.

(5) Junction boxes or conduit fittings with threaded, screw-on type covers shall not be used. These type boxes have had some historical problems with corrosion in the cover threads.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

(F) General Purpose Wiring

(1) All conductors shall be copper, ASTM Class B stranding. Solid conductors shall not be used. Aluminum conductors shall not be used.

(2) Wire and cable for general power and control circuits shall be rated 600 volts minimum. Wire and cable for drive motor power wiring shall be rated 2000 volts minimum.

(3) Cable fittings shall be specifically designed for the use with the type and size of cable. Fittings shall be provided with sealing gaskets to preserve the NEMA enclosure rating of the boxes and/enclosures they are used with.

(4) All point-to-point wiring internal to the PLC cabinets, control console, control cabinets, and drive cabinets shall be stranded copper Type THWN-2, MTW, or approved equal. Control wire shall be minimum 14 AWG, unless a smaller size is approved by the Engineer for wiring interconnections for PLC I/O cards. Power wire shall be sized as required.

(5) Grounded Conductors (Neutrals) shall be color coded Per NEC Article 250.

(6) 120/240/208 volt power circuit conductors shall be colored coded as follows: Phase A - Black, B - Red, C – Blue.

(7) 277/480 volts power circuit conductors shall be color coded as follows: Phase A - Brown, B - Orange, C – Yellow.

(8) Control cabinet conductor color coding shall follow UL 508A for Industrial Control Panels.

(G) Messenger Supported Power and Control Cable

(1) Multi-conductor power cables shall be UL Listed Type TC-ER cable or have a rating for use as an aerial cable with a messenger, XHHW-2, rated 600V and 90 degrees Celsius. Cables shall have integral ground conductor. Conductors shall be stranded copper. Cable shall have overall sunlight and oil resistant PVC jacket suitable for use in wet locations.

(2) Twisted shielded pair cables to be installed on a messenger shall be type TC-ER or have a rating for use as an aerial cable with a messenger. Cables shall be 600V rated with bare copper stranded conductors. Cables shall have individually shielded conductors plus one overall shield. Cables shall have UV resistant outer PVC jacket suitable for use in wet locations.

(3) Coax cable to be installed on a messenger shall be rated for use as an aerial cable where supported by a messenger. Cable shall be coax, type RG11/U with outer shield and UV resistant PVC jacket suitable for use in wet locations. Solid conductors shall be permitted for coax cable. Coax cables for aerial use shall also meet requirements detailed in CCTV section of this specification.

(H) Flexible Multi-Conductor Power and Control Cable

(1) Cables used for flexible loop applications shall be high strand count, highly flexible, pre-assembled cables rated for continuous flexing. Cables shall be UL

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

type SOW, or approved equivalent. All conductors shall be tinned copper with ASTM B172 and/or B174, Class K stranding. Cables shall have weather and sunlight resistant jackets, suitable for use in exposed locations and for operation from -67 degrees Fahrenheit to +194 degrees Fahrenheit.

(I) Variable Frequency Drive Shielded Motor Cable

(1) Cable shall be rated for use with AC motors in VFD applications, 100% shield coverage, with 2000V rating, UL listed, 3 phase conductors, ground conductor or symmetrical ground conductors, XLPE insulation, type TC-ER.

(J) Ethernet Cable

(1) Ethernet cable shall be rated TIA/EIA Category 5 or 5e, NEC type CM, CMR, CMB or equivalent, shielded, with bonded pairs, and suitable for installation in raceways or cable tray. Outer jacket shall be sunlight and oil resistant PVC, 600V rated.

(2) Solid conductors shall be permitted for Ethernet cable.

(3) Ethernet cable shall be compatible with RJ45 connectors. The Contractor shall have the necessary training and tools to terminate the cable and to perform testing.

(K) Communications Cable

(1) Communications cable shall be UL listed industrial communication cable with stranded tinned copper conductors. Provide cables with an overall jacket insulation rating of 600V.

(2) Cables shall have overall foil or foil and braided shielding with twisted pairs or shielded twisted pairs as required by application and equipment served. Minimum individual conductor size for field cables in conduit shall be 18AWG.

(L) Fiber Optic Communications Cable

(1) Fiber optic cables shall contain twelve individual 62.5µm multimode optical fibers. Cable shall be of heavy duty, all dielectric (non-conductive) construction. Fibers shall be housed in one or more gel-filled buffer tubes. Tubes shall be bundled together with a dielectric strength member and water-blocking filler system, surrounded by a polyethylene outer jacket.

(2) Cable shall have an operating range of -40°F to 158°F and a minimum crush resistance of 125lbs/in - short and 63lbs/in - long. Outer jacket shall be moisture and UV resistant.

(3) Coordinate connector and additional cable requirements as required for full compatibility with connected equipment.

(M) Instrumentation Cable

(1) UL Listed shielded instrumentation cable with PVC outer jacket and individually shielded conductor pairs, cable rated at 600 volts. Shall be listed as type TC or MC, overall sunlight and oil resistant jacket, suitable for use in wet locations, and rated for use in cable trays. Conductor configuration shall be as required for equipment served, minimum 18 AWG.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

(2) Cables for encoders and resolvers shall be shielded in accordance with the respective device manufacturer's recommendations for the wiring lengths and arrangements involved on this project.

(N) CCTV Cable

(1) Cable for CCTV shall be RG-11/U type, 75 ohms impedance, coax or triax as required by camera manufacturer. Cable shall have a solid copper core and braided copper shield with minimum 95% coverage.

(2) Jacket shall be rated for outdoor installation and UV resistant with insulation rated for a minimum of 300V.

(3) Pan, Tilt, Zoom (PTZ) CCTV camera control shall be RS-485 twisted pair as required by camera manufacturer.

(O) Messenger Cable and Hardware

(1) Messenger cables shall be 3/8” diameter or larger, stainless steel, 7 x 19 strand, minimum 40% IACS, Suncor Stainless or equivalent.

(2) Cable rings shall be compatible stainless steel construction and appropriately sized for the messenger and cable to be supported. Rings shall be provided at spacing detailed on the Plans.

(3) Anchors shall be epoxy type. Additional hardware shall be galvanized steel.

(P) Public Address System Cables

(1) System cable, used to connect the handset unit in the Operator House to the amplifier enclosures, shall be eight-conductor cable composed of: (1) 14 AWG twisted pair, (1) 14 AWG ground conductor, (1) 18 AWG control conductor, and (2) 18 AWG twisted pairs. Cable shall be constructed with a PVC/nylon insulation and have an outer PVC jacket. System cable shall be rated 600V, 90 degrees Celsius, type TC, UL listed for use in outdoor installations in cable tray, direct burial and aerial installations when supported by a messenger. Cable shall be installed using a minimum bending radius of 10 times the outer diameter.

(2) Loudspeaker cable, used to connect speaker amplifier enclosures and loudspeakers, shall be two-conductor cable composed of: (1) 18 AWG twisted triplet. Cable shall be constructed with a PVC/nylon insulation and have an outer PVC jacket. System cable shall be rated 600V, 90 degrees Celsius, type TC, UL listed for use in outdoor installations in cable tray, direct burial and aerial installations when supported by a messenger.

Power Distribution Equipment

New power distribution equipment shall be provided to replace existing equipment. The appropriate arc flash warning labels shall be applied to all power distribution equipment.

(A) Motor Control Center

(1) Motor starter units shall be provided with thermal magnetic molded case circuit breakers, or instantaneous trip breakers (motor circuit protectors), sized in accordance with the National Electrical Code. The circuit breaker shall have a

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

clearly marked trip position. Motor starter units shall have manual operating controls and indicator lights on the doors of the respective units as shown in the plans. Half-height units shall not be used except for circuit breaker or fused feeder units.

(2) Full voltage contactors and motor starters shall be UL listed electrically held, multiple pole contactor type, NEMA type, with ratings and sizes as shown on the Plans or as required for the equipment served. Starters smaller than NEMA Size 1 shall not be used. Contactors for reversing starters shall be electrically and mechanically interlocked. Electrically isolated auxiliary contacts shall be provided as required for control circuits, plus one normally-open and one normally-closed spare per contactor.

(3) Starters shall include overload relays with ambient compensated, Class 20, bimetallic heater elements. Heater elements shall be field replaceable. Relays shall be manual reset type, with electrically isolated auxiliary contacts as required. Starter compartments shall include external overload reset buttons on the door.

(4) Contractor shall coordinate size of the shipping splits and any additional lifting provisions with manufacturer as required for transport into the new bridge control house. All splicing of bus bars and other reconnecting of MCC sections shall be detailed and included in the Contractor's shop drawings for MCC. The motor control center shall be mounted on neoprene vibration isolation pads. Vibration isolation pads shall be sized and located in accordance with recommendations of the vibration isolation equipment manufacturer.

(5) Control transformers, where required to limit control circuit loading from motor starters, shall be totally encapsulated, 65VA minimum, with primary and secondary fuses.

(6) Motor starter compartments shall include manual control switches and indicators as shown on the Plans. Switches and indicator lights shall be as described elsewhere in these Special Provisions.

(B) Distribution Panels and Panelboards

(1) Distribution panels and panelboards shall be equipped with thermal-magnetic molded case circuit breakers, with ratings as shown on the Plans. Circuit breaker connections to the copper bus shall be bolt-on with vibration-proof hardware.

(2) Panelboard bus bar connections to the branch circuit breakers shall be the "distributed phase" or "phase sequence" type. Three-phase, four-wire bussing shall be such that only three adjacent single-pole breakers are individually connected to each of the three different phases in such a manner that two- or three-pole breakers can be installed at any location.

Bridge Control System

The bridge control system shall be furnished by the Control System Vendor complete with all PLC’s, HMI’s, control cabinets and consoles, relays and any other devices necessary to provide a complete and operational system as intended by these Contract Plans and Special Provisions. Contractor should closely coordinate cabinet sizes with available space and room layouts,

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

staging of construction, access to locations, and providing required NEC working space.

Control system voltage shall be as shown on the Plans, supplied from dedicated branch circuits.

(A) Control Equipment Cabinets

(1) PLC and I/O cabinets shall be freestanding style, NEMA 12, constructed of 12 gauge steel. Powder coated finish (outside and inside). Each cabinet shall incorporate a door switch operated interior lighting kit, a utility receptacle, and a cooling fan/filter kit powered from a separate circuit.

(2) Remote I/O cabinets in machinery areas shall be wall mounted, NEMA 4X, constructed of 14 gauge stainless steel. The cabinet shall incorporate a door switch operated interior lighting kit, a utility receptacle, and a thermostatically controlled heating / anti-condensate element powered from a separate circuit. Cabinets shall be hinged type with pad-lockable door latch.

(3) Provide custom control console as shown on the Plans with NEMA 12 equivalent rating.

(4) All spare PLC I/O points shall be assigned wire numbers and wired to terminals for future use.

(5) NEMA 4 rated Ethernet programming port and receptacle by Grace Engineered Products, or equivalent, shall be installed on the main PLC cabinet, I/O cabinet, and control console doors.

(B) Relays

(1) General purpose control relays and relays for switching power circuits shall be UL listed NEMA type control relays. Relay contacts shall be field reversible cartridge type, number as required, plus one spare contact. Contacts shall be rated at least 10 amperes at 300 volts AC. Relays shall include an LED indicator light, neon indicator light, or a mechanical flag indicator for indicating when the relay is energized.

(2) Isolating relays shall be UL listed general purpose plug-in type relays with DPDT contacts rated 10 amperes at 300 volts AC, 60 hertz. Relays shall include a LED indicator light, neon indicator light, or mechanical flag for indicating when the relay is energized. Sockets suitable for DIN rail or panel mounting, with retainer clips, shall be provided for each relay. Isolation relays shall be used for interfacing with drives, interfacing with other systems, or for isolating PLC inputs and outputs. Isolation relays shall not be used for accomplishing logical control functions.

(3) Time delay relays shall be UL listed electronic time delay relays. Adjustment knobs shall be accurately time-calibrated, with high resolution markings. Time delays shall be as indicated on the Plans. Each timing relay shall be selected with a timing range such that the anticipated setting will be within 40%-60% of the full range. Relay identification information, screw terminals, and terminal markings shall be located on the front of the relay. Relays shall be of modular construction, with field replaceable coils and contacts. Coils shall be 120 volts AC, or as otherwise required. Contacts shall be rated at least 5 amperes at 120 volts AC, or

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

higher as required by the application. Relays requiring sockets shall be provided with retainer clips.

(C) Programmable Logic Controller System

(1) Bridge control logic functions shall be performed by a programmable logic controller, ControlLogix 1756 series as manufactured by the Allen-Bradley Company, or equal accepted by the Engineer. The PLC processor shall utilize ladder-logic programming, with an advanced instruction set including: file handling, sequencing, diagnostics, shift register(s), program control instructions, timing, and mathematical functions. Processor memory shall be a minimum of 2MB with non-volatile memory card for program and configuration backup. The PLC processor shall include a dedicated USB port for programming and firmware updates.

(2) In general, except for traffic control and other specific exceptions as may be granted by the Engineer, all control logic, timing, counting and other control functions shall be performed by the PLC. All necessary modules, interfaces internal and external to the controlled equipment, and other accessories shall be included to provide a complete working system. Interconnection between processors and I/O racks shall be via Ethernet.

(3) Two identical PLC processors shall be provided, each with its own dedicated rack, Ethernet module, and power supply. Both PLCs shall be installed and wired in place. One shall be active, and the other shall be in totally de-energized reserve. The reserve PLC and its power supply shall be electrically-isolated from the power source and I/Os via a multi-pole transfer switch or relay(s). Transfer shall be performed via a maintained position selector switch mounted on the front of the PLC cabinet door. Upon transfer, the previously active PLC and its power supply shall be de-energized and electrically isolated.

(4) I/O cards shall be from the same product series as the PLC. I/O cards shall utilize a rack type chassis which provides a high-speed communication path between modules and facilitates easy replacement of individual cards.

(5) Digital I/O modules shall provide LED indicating lights for each input or output point on the module. Thirty-two (32) point digital I/O modules shall not be used.

(D) HMI (Human Machine Interface) Displays

(1) HMI computers shall be completely compatible with the PLC system and shall include all necessary communications drivers and hardware.

(2) Enclosures shall be rated NEMA 4X (indoor use only).

(3) Display backlight rated life shall be a minimum of 50,000 hours at 40 degrees Celsius to half-brightness. Touchscreen shall be rated for 1 million presses.

(4) System memory shall be a minimum of 512MB RAM and 512MB storage, with 80MB nonvolatile storage for application files.

(5) HMI shall include SD card slot(s). SD card slot shall permit backup and restoration of application files. As-built backups of applications files shall be

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

provided on appropriately sized SD memory cards.

(6) HMI's shall utilize Windows CE operating system with Extended Features and MS Office Viewers.

(7) HMI software shall provide a full featured graphics editor with powerful editing tools, drawing objects, pre-configured operator devices, and animation capacity.

(8) PLC cabinet HMI shall have a 19" display and shall include capability to perform historical data logging of bridge operations as described elsewhere in these Special Provisions.

(E) Laptop Computer

(1) Laptop computer shall be semi-ruggedized type (moisture, dust, vibration, and drop-shock resistant, and designed using MIL-STD-810G test procedures), with all necessary software, cables, and interface modules for programming the PLC's and configuring the drives. Programming capabilities shall include both on-line and off-line PLC ladder logic programming. The software and any required interface module shall be furnished by the PLC manufacturer and shall include extensive documentation.

(2) The laptop computer shall meet the following minimum requirements, unless specified otherwise by the PLC manufacturer: 2.0GHz (or higher) Intel Core processor, 4Gb system RAM, minimum 500Gb shock-mounted hard drive, built in touchpad, CD-RW / DVD-R, 14" High Definition 720p LED display, and Windows 10 Professional operating system. Ports shall include USB 2.0, USB 3.0, serial, VGA, HDMI, and RJ-45 10/100/1000 Ethernet ports. Laptop shall also provide integrated 802.11a/b/g/n/ac Wi-Fi/Wireless. Laptop shall include a 120-volt AC power adaptor, long life battery, multiple format memory card reader, protective carry bag, original manuals, software packages with license information and original packaging materials.

(3) All software shall be licensed to the Department.

(4) A licensed copy of hard drive imaging software, Norton Ghost or equivalent, shall be provided and installed on the laptop. A hard drive image file for the configured laptop shall be provided on compact disk.

(F) Ethernet Switches

(1) Industrial type Ethernet switches shall be provided to network the PLC processor (active or backup) to PLC I/O racks, variable frequency drives, HMI touchscreens, and to provide multiple remote programming ports.

(2) Operating range shall be -25 to +70 deg C and 5-95% relative humidity.

(3) Managed type switches shall provide a memory card slot to backup configuration data with a spare configured card.

(4) Switches shall have RJ45 10/100 Mbps copper and fiber optic ports as shown on the Plans with at least one spare copper port per switch. Provide multimode fiber optic ports compatible with connected fiber optic cable type and network optical transmission characteristics.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

(G) Circuit Protection and Surge Protection

(1) Provide supplementary circuit protectors where indicated in the Plans and where required by the NEC. Circuit protectors shall be UL recognized, DIN rail mountable type with tripping characteristic curve to match device type to be protected, sized as required for connected devices and conductors. Supplementary circuit protectors shall be Allen-Bradley 1492-SP, or approved equal.

(2) Control circuit conductors which extend to external devices, such as limit switches or sensors, shall be protected with fuses. Fused terminal blocks shall be rated 30 amperes at 600 volts AC and include LED or neon blown fuse indicators. Fuses shall be fast acting type, sized as required to prevent nuisance opening under normal operating conditions. Fuse blocks shall be Allen-Bradley 1492-WFB, or approved equal.

(3) SPD's shall be installed for the incoming 120VAC control power for each control cabinet and console. SPD's shall be UL1449 4th Edition recognized, DIN rail mount, with replaceable plug in module, minimum 40kA, rated for 120VAC, with visual status or fault indication.

(H) Terminal Blocks

(1) Splices for conductors inside cabinets and enclosures shall be made only on terminal blocks.

(2) All terminal blocks shall be clearly labeled according to Control System Vendor's and Contractor's approved wiring diagrams. Labels shall be machine printed, clearly readable, and smudge-free.

(3) NEMA type terminal blocks shall be UL recognized, screw clamp type, corrosion resistant zinc plated brass and copper construction, 600V AC/DC rated, minimum 25A.

(4) IEC type terminal blocks shall be UL recognized, finger safe, DIN rail mount, screw type, and with corrosion resistant plated components. Rating shall be a minimum of 300V AC/DC and 10A.

(5) Power type terminal blocks shall be UL recognized, 600V AC/DC rated, and rated for use with copper conductors. Blocks shall be enclosed finger safe type or shall be supplied with manufacturer's protective covers. Number of poles, amp rating, and wire size configuration shall be as required for the associated conductors.

(6) Provide all required accessories for terminal blocks including DIN rail, separation/end plates, retainers, jumpers, ground blocks, labels, and hardware.

(I) Push-Buttons, Switches, and Pilot Lights

(1) Pushbuttons, key-switches, and selector switches shall be UL listed, size 30.5 millimeter, with operation as indicated on the Plans. Switches shall be of die cast metallic construction with corrosion resistant plating, rated NEMA 4/13. Contact blocks shall be screw down stackable type. Contacts shall be rated 10 amperes at 120 volts AC. Terminals shall be corrosion resistant screw type.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

(2) Pilot lights shall be UL listed, LED type, with colors as indicated on the Plans. Pilot lights shall be size 30.5 millimeter, NEMA 4/13 rated. Lenses shall be interchangeable plastic Fresnel type. Pilot light construction shall permit changing bulbs by removing lens.

(3) Legend plates for pushbuttons, selector switches, and pilot lights shall be one-piece type, black with white text. Text shall be as indicated on the Plans. Miscellaneous control cabinet labels shall be engraved white on black plastic, with 1/4 inch high letters. Labels shall be fastened to the cabinets with stainless steel machine screws.

(J) UPS and DC Power Supplies

(1) Uninterruptible power supplies (UPS) shall be installed to provide short term (5 minute +/-) backup power to HMI's.

(2) UPS shall be UL recognized or UL listed, DIN rail mount, 120VAC input, current rating as required for application, and with output signals for battery mode and alarm.

(3) DC power supplies shall be UL recognized or UL listed, DIN rail mount with finger safe terminals, 120VAC input/24VDC output, and with current rating as required for application. Operating range shall be -25 to +70 deg C and 0-95% relative humidity.

(K) Temporary Controls

(1) The Contractor shall be responsible for providing temporary control systems as shown on the Plans and as required to maintain bridge operations during construction.

(2) Coordinate temporary controls with mechanical and structural construction activities and Contractor's approved sequence of construction.

(L) PLC Programming

(1) The PLC program shall be written in ladder logic, with complete I/O identification, annotations, and comments indicating purpose of each coil and program logic module.

(2) The ladder logic shown on the Plans is conceptual only. Additional logic development and program writing by the Control System Vendor will be necessary to complete the program suitable for operating the bridge.

(3) In addition to hardware I/O addressing identification, the PLC program's "Tag name" for each I/O address shall be listed on the corresponding electrical drawings.

(4) The PLC logic shall assure correct sequence of manually initiated operations, and likewise control fully automatic operations. The bridge operating sequence will be interrupted if certain critical faults occur or an interlock is not satisfied.

(5) Program shall be designed to indicate fault conditions on the control console with dedicated indicator lights and on the HMI displays. If multiple faults are assigned

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

to one indicator light, a specific description of the cause shall be shown on the HMI displays.

(6) For the documented PLC program listing, all contacts shall include a cross reference of their coil locations, and all coils shall be cross referenced with a list of their contact locations.

(7) Any necessary temporary PLC programming to accommodate installation and staging of equipment shall be provided. The final, as-built PLC programming shall have all unused logic and documentation removed.

(M) HMI Programming – Control Console

(1) Two identical HMI's shall be provided and programmed for operator use on the control console. They shall have identical programming, but two primary menu branches shall be configured to permit the HMI's to be used for different purposes.

(2) The control console HMI's shall be primarily used for monitoring, with limited control capability.

(3) Primary menu branch 1 shall be configured to navigate to screens associated with bridge equipment operating status. This should include screens showing the current status of each traffic gate (fully raised limit switch, fully lowered limit switch, motor operating status, motor overload, fault/timeout condition), the current status of each individual span and center lock (driven limit switch, pulled limit switch, motor operating status, motor overload, fault/timeout condition), the current status of each individual brake (set limit switch, released limit switch, hand released limit switch, motor operating status, motor overload, fault/timeout condition), and bridge angular position for each leaf. A separate screen shall be provided to show only the bridge angular positions for both leaves in large format.

(4) Primary menu branch 2 shall be configured to navigate to screens displaying alarm messages/history, status and operating data from each flux vector drive, power monitor information, and generator status information.

(5) Drive status screens shall display drive digital input and output states, motor speed in RPM, motor torque in %, speed setpoints, operation status, and faults with descriptions for active drives.

(6) The power monitor information screen shall display three phase voltage and current values for the incoming 480VAC power.

(7) Generator status screen shall display backup generator warnings and faults including low fuel level, low oil pressure, high coolant temperature, and service reminders.

(8) Menu branch 2 shall also provide access to I/O status screens with current on/off states of all PLC digital inputs and outputs and scaled values for all analog I/O. Each individual I/O point shall be identified with the corresponding hardware address, tag name, and short description of the connected device.

(N) PLC Cabinet HMI Programming

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

(1) The HMI on the PLC cabinet is intended to be used for maintenance adjustments, troubleshooting, and data collection.

(2) A hardwired key-switch shall be provided to permit bridge control functions from the HMI by authorized maintenance personnel.

(3) In addition to all the screens available on the Control Console HMI's, additional password protected maintenance screens for maintenance functions as described on the Plans shall be provided. These shall permit timer and speed adjustments, enabling of specific program functionality, and access to operating system functionality.

(4) Data collection screens shall permit display of current operating data as well as retrieval and display of historical data. HMI hard drive or non-volatile storage capacity shall be sized to retain required historical data for a minimum of four weeks.

(O) Data Collection – specific data to be recorded includes the following:

(1) Time and date at Traffic Signals to Red.

(2) Time and date at Control Power On.

(3) All PLC digital I/O states at Control Power On.

(4) All PLC digital I/O state transitions with Control Power On (with time/date stamp and span positions).

(5) Bypass usage (with time/date stamp).

(6) Manual mode usage (with time/date stamp).

(7) All alarms and faults (with time/date stamp).

(8) Active main drive motor digital signals, torques, and speeds at 2-3 second intervals during operation.

(9) Angular positions for each span at 2-3 second intervals.

(10) Time and date at Control Power Off.

(11) Time and date at Traffic Signals Green.

(12) Parameters for each operation shall include: total duration of roadway traffic disruption, raise times for each span, lower times for each span, total time at bridge fully open position, peak motor torque (%) for each span during raising and lowering, maximum motor speed for each span during raising and lowering (rpm), and number of warnings and faults.

(13) Cumulative parameters shall include: total usage of each bypass switch, total span operations.

Flux Vector Drives

Variable speed drives for the main drive motors shall be three phase AC drives providing true closed loop (encoder feedback) flux vector speed and torque control for use with AC squirrel cage drive induction motors. Provide integration and testing of main drive motors with flux

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

vector variable speed drives and encoders. Coordinate motor configuration and encoder with mechanical requirements.

(A) Drives

(1) Drives shall be heavy duty horsepower rated.

(2) Drive shall utilize microprocessor-based control and shall include an operator interface, with backlit LCD display and keypad, usable for drive status monitoring and adjustment of all parameters.

(3) Operating modes shall be fully programmable and selectable via external control inputs. Drive shall provide discrete inputs, discrete outputs, analog inputs, analog outputs, and shall be configured for operation as depicted on the drawings to utilize a hardwired control interface with the PLC.

(4) Drive shall provide for at least three (3) preset speeds selectable via external discrete control input, independently adjustable acceleration and deceleration times, and two (2) independently adjustable torque limit settings selectable via external discrete control input to allow for a reduced bridge seating torque.

(5) Motor stall protection, if provided, shall be either disabled, or adjustable time delay up to 10 seconds for reduced-torque stalled-motor seating without producing a drive error or fault.

(6) Drive shall be capable of producing 150 percent full load torque at the drive motor for 60 seconds, and at least 175 percent for at least ten seconds.

(7) Drive shall include built in communication capability including Ethernet. Ethernet shall be utilized to allow the PLC to monitor drive operating conditions, electrical parameters, and fault messages.

(8) Provide drive manufacturer's software package and necessary programming cables for configuration and backup of drive parameters. Provide hardcopies of as-built drive parameters and software backup files.

(B) Drive Cabinets

(1) Cabinet shall be heavy duty, free standing, disconnect type, industrial control enclosure of 12 gauge or heavier steel, with continuously welded seams, fully gasketed NEMA 12, heavy duty lifting eyes, stiffeners as required, three-point latching mechanism with lockable handle(s) interlocked with main disconnect switch, and 10 gauge steel inner panel for equipment mounting.

(2) The cabinet shall have a cooling fan/filter kit and an anti-condensation heater. A thermostat(s) shall be used to control the cooling fan and heater operation. Both devices shall not operate at the same time, and there shall be a small temperature dead-band where neither device shall not operate.

(3) A door switch operated LED lighting kit shall be provided.

(4) Relays, terminal blocks, control switches, indicator lights, and other required components shall be as described elsewhere in these Special Provisions.

(5) Input Line Reactors shall be UL Recognized, three phase, 3% impedance

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

specifically designed for use with AC adjustable speed drive systems, sized by the drive manufacturer for the drive.

(6) Contactors shall be UL listed, three pole, 120 volt AC coil, sized as required for drives, with field replaceable contacts and auxiliary contacts as required for PLC feedback.

(C) Braking Resistors

(1) Dynamic braking resistors shall be sized to provide 150 percent braking torque.

(2) Resistors shall be sized for a duty cycle consisting of 3 minutes on at 150 percent followed by 6 minutes off.

(3) Resistor cabinets mounted in interior locations shall be corrosion resistant, galvanized, NEMA 1 ventilated cabinets. Ventilation openings shall be screened or otherwise protected to prevent entry of small rodents. Resistor cabinets mounted in exterior locations shall be rated for outdoor installation with stainless steel cabinets.

(4) Each resistor cabinet shall include a junction box with terminal blocks designed for the connection of standard 90 Degree C field wiring to the drive. The terminals in the junction box shall be connected to the resistors by high temperature silicon or Teflon wiring.

(5) Resistors shall include a thermal sensing switch to detect an over-temperature condition.

(6) Cabinet sizes and clearances shall be coordinated with the space in which they will be installed.

Closed-Circuit Television System

Provide and install a complete and functional Closed-Circuit Television (CCTV) system composed of a Digital Video Recorder (DVR) in the control house, an additional viewing monitor located next to existing, existing PTZ controller near viewing monitors, existing RS-232 to biphase converter, (4) fixed dome cameras, (2) Pan, Tilt, Zoom (PTZ) cameras, and associated power supplies as detailed on the Plans. CCTV cables shall be described elsewhere in this Special Provision.

All CCTV system components shall be fully compatible. DVR, viewing monitor, PTZ controller, RS-232 to biphase converter shall be installed in the control room of the operator house in a location near the control desk which can be easily accessed by the operator. Proposed locations of CCTV equipment to be installed in the control house shall be submitted to the engineer for approval. Cameras shall be installed at locations shown on the Plans.

Public Address System

Provide and install a complete and functional public-address (PA) system composed of one main handset in the operator house, an audio message interface unit to store and play pre-recorded messages, a line balance unit installed directly below the handset, (4) loudspeakers, and (4) amplifier units as detailed on the Plans. System and speaker cables shall be as described elsewhere in this Special Provision.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

All PA system components shall be fully compatible. Handset, audio message interface, and line balance units shall be installed in the control room of the operator house in a location near the control desk which can be easily accessed by the operator. Proposed locations of public address equipment to be installed in the control house shall be submitted to the Engineer for approval. Speakers shall be installed at locations shown on the Plans.

Heating, Ventilation, and Air Conditioning System

Provide and install a complete and function Heating, Ventilation, and Air Conditioning (HVAC) system composed of an outdoor heat pump unit with motor disconnect switch, (2) indoor heat pumps each with wall switch, and a programmable controller as detailed on the Plans.

All HVAC system components shall be fully compatible. Refrigerant piping between outdoor and indoor units, insulation, control wires, etc. shall be installed per system manufacturers requirements. The outdoor and indoor heat pumps and switches shall be installed at locations shown on the Plans. The programable controller shall be installed in the control room of the operator house in a location that can be easily accessed by operator. Proposed locations of HVAC equipment shall be submitted to the Engineer for approval.

Electrical Bridge Operation and Maintenance Manual

Upon completion and acceptance of the Bridge Electrical and Control System, the Contractor shall develop and furnish (6) copies of a complete operation and maintenance manual for the bridge electrical and control system, as described herein. An electronic PDF format version of the manual shall also be provided.

Submit a preliminary electronic version to the Engineer for review and approval. Final manual editions shall be technically accurate and complete and shall represent the "as-built" system, piece of equipment, or material given final acceptance by the Engineer.

(A) Manuals Construction

(1) Binders shall be hardback vinyl three ring loose-leaf type for binding 8-1/2 by 11 inch sheets. Binders shall be of manageable size, preferably 12 inches by 10 inches and not over 3 inches thick.

(2) Binder spine and front cover shall display labels containing the name of the bridge, the bridge location, the names of the Contractor, Electrical Subcontractor, and Control System Vendor, and dates of the work.

(3) The binder holes shall be reinforced for all contents. The paper and ink shall resist smearing, fading and deterioration from age. All lettering shall be clear and legible.

(4) All material shall be new. Copies used for prior submittals shall not be used. Manuals shall have index tabs for each major group of equipment and/or subsystem. A table of contents shall indicate each chapter, section, specific equipment, and page numbering.

(B) Manuals Content

(1) General information and safety precautions. Throughout the manual, critical safety warnings and cautions shall be visibly highlighted.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

(2) Names, addresses, and telephone numbers of all vendors and equipment suppliers.

(3) Operational descriptions of particular systems, subsystems, and major components. Manufacturer's data brochures (color originals where available), catalog cuts, and specification sheets shall be included, as well as installation and adjustment instructions, trouble-shooting charts, warranty information, maintenance instructions, lubrication information, replacement parts lists, and diagrams.

(4) Where contents of manuals include manufacturer's catalog pages, clearly indicate the precise items used in this installation.

(5) All material within the manuals shall be new. Copies used for prior submittals or used in construction of the project are not acceptable.

(6) Complete set of descriptive operating instructions for all bridge systems including step-by-step raise and lower operations, both automatic and manual. The instructions shall include a separate description describing the functionality of each bypass switch and the associated precautions that need to be taken prior to using the bypass.

(7) Complete listing of all fault conditions with explanation of the cause and appropriate responses (operator and/or maintenance) for each.

(8) Color copies of all HMI screens with associated menu system descriptions.

(9) Complete set of as-built electrical drawings (half size, “Z” folded to fit manual)

(10) Ladder logic format PLC program listing for the control system with symbols, labels, comments, and cross reference listing.

(11) Complete set of flux vector drive parameter listings for each drive.

(12) As built documentation, operating instructions, and maintenance information for CCTV, Public-Address systems, and door access security systems.

(13) Duration and contents of all guarantees and warranties.

(C) Additional Materials

(1) Manuals shall incorporate similar as-built documentation from equipment from separate pay items including traffic gates, submarine cables, and bridge backup generator.

Construction Methods

Conduit threads shall be standard American National Tapered Pipe Threads. Threads shall be clean cut, straight and true, and of sufficient length to permit full-depth coupling. Conduits shall be tightened until conduit ends are together. All threaded connections shall be coated with conduit thread sealant. Sealant shall be a waterproof conductive type, explicitly manufactured for the respective conduit material.

All conduit and cable runs for power circuits with conductors size AWG 10 or smaller and control circuits shall contain a minimum of 10% spare conductors, but no less than two spare conductors, unless shown otherwise in the Plans. All major conduit runs shall include a water and UV resistant synthetic pull rope.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

Any removal, cutting or drilling through structural masonry to allow for conduit routing shall be approved by the Engineer. Sleeves for conduit holes through concrete walls and floors if required, shall be PVC pipe, epoxied or cast in place. Any sharp sleeve edges shall be filed or sanded smooth.

Conduits and raceways passing through block out openings and sleeves shall be sealed with an approved weatherproof and fire-resistant material. All unused openings shall be appropriately sealed or plugged with mechanical type seals by the Contractor, and locations shall be documented on the as-built plans.

Messenger Cables

Cable rings shall be provided and installed for messenger supported cables, spaced as shown on the Plans. Messenger cables shall be supported at intervals of 10’ maximum. Appropriately rated anchors and turn-buckles shall be installed as required to obtain proper tensioning of messengers.

Existing messenger cable anchors are permitted to be reused at locations where they are identified by the Contractor to be in good serviceable condition and they are adequately sized for new electrical cables to be supported. The Contractor shall submit sketches identifying proposed messengers to be reused with representative photos to the Engineer for approval.

Coordination

Coordinate electrical work with section Mechanical Operating Machinery. Coordination shall include synchronization of work schedules, main drive motor requirements, equipment motor and limit switch requirements, and mounting requirements for limit switches and sensors.

Coordinate electrical work with all structural repair work and with sections Bridge Backup Generator, Submarine Cables, Traffic Gates, and Operator House Renovation. Coordination with telecom utility provider as required for replacement of existing telephone connection box.

Arc Flash Hazard Analysis and Labeling

The Contractor shall be required to provide a power system study including arc flash analysis and apply the required warning labels for all electrical enclosures and equipment in compliance with NFPA 70E. Analysis shall include all generator services and motor contributions.

Electrical Testing

The Contractor shall be responsible for performing all testing, inspections, and any resulting corrective work as may be necessary in order to ensure that all work is functioning properly, and as otherwise required elsewhere in these Special Provisions. All such testing, inspections, demonstrations, and any resulting remedial work, will be deemed a normal part of the contract work and will not be considered cause for delay or additional payment.

Procedures and equipment used for the testing required by these Special Provisions shall be in accordance with manufacturer’s recommendations, NETA Acceptance Testing Standards, any other applicable industry standards, and shall be appropriate for the specific test being performed. Voltmeters, ammeters, etc. shall be true RMS type. Where recording instruments are required, they shall be three phase, strip chart or computer based type. All tools and instruments shall be specifically designed for measuring the quantity in question and be maintained in properly calibrated condition.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

All new conductors, including power and control shall be tested for continuity and conductor identification after placement. Continuity testing shall include all necessary tests to confirm that each conductor is continuous throughout its entire run. All new power conductors shall be Megger tested prior to energizing. Contractor shall measure conductor insulation wire-to-wire and wire-to-ground. All devices and loads shall be disconnected prior to Megger testing. Testing shall be performed at 1000 Volts DC with an approved instrument.

Ethernet cables shall be tested for continuity, length, data integrity, attenuation, and crosstalk. Communication and instrument cables shall be tested for continuity, for internal shorts (signal to signal, signal to shield), and as required by the connected equipment to be serviced.

Test all terminated fiber optic cables for continuity, polarity, and end-to-end insertion losses. Test all multi-mode fibers in all cables for losses using an OLTS power meter and source in accordance with TIA OFSTP-14. Compare measured loss for each segment to the calculated loss budget to ensure that losses are within acceptable industry standards. Replace any connectors identified to be defective.

Any conductors or cables that fail testing shall be replaced at the Contractor’s expense.

Check for proper tightening of mechanical lugs and terminals. Supply voltages and phase direction shall be measured and verified correct for the actual installed devices or equipment being served. Only after these preliminary checks may the circuit be energized. Verify rotation direction and proper operation of all three phase motors including main drives, auxiliary drives, brakes, locks, and traffic gates.

Control System Shop Testing

Shop testing of the control system logic is required on the complete assembled control system prior to shipment from the Control System Vendor's shop. The testing must be witnessed by the Engineer and any of the Department's designated representatives. The Department shall be notified at least two weeks prior to the test date. Testing shall include a complete run-through of the operating sequence for the lift span in all operating modes from all control panels. All safety interlocking in the control logic shall be individually confirmed during this test.

All PLC’s, HMI’s, control consoles, control relays, and other related control system components shall be wired/assembled in the proper cabinet(s) and ready for preparation for shipping, pending any corrections or adjustments necessitated by testing results, before performing these tests. The motor control center and variable speed drives shall be connected and utilized for this test. Except for the main drive motor, the various motors need not be present, but temporary indicator lights shall be provided and energized through the power contacts of the motor contactors and labeled according to the direction of motor rotation (i.e., raise, lower, etc.) where applicable. The main drive motor, or an approved representative substitute, shall be connected to the drive(s) for the test. For limit switches, toggle switches may be substituted and labeled clearly according to their function. Any errors found in the system shall be corrected and the respective portion of the test rerun.

Control System Site Operational Testing

The complete Bridge Electrical and Control System, including all associated equipment and subsystems, shall be subjected to as-installed operational testing. Such testing shall be as required to demonstrate that the item(s) under test meet all specified requirements and are

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

operating in a reliable manner. Site testing shall repeat all testing done as part of control system shop testing with installed equipment.

The Contractor shall also be prepared to conduct any additional miscellaneous operational tests and/or demonstrations as may be requested by the Engineer to establish that a given piece of equipment, system, or subsystem meets all specified requirements and is operating in a reliable manner.

Quality Control Inspections

In addition to the above quantitative tests, the Contractor shall also be responsible for performing all quality control inspections which may be required to ensure that all electrical system materials and components are properly installed. Such inspections shall include, but not be limited to, visual inspection of all electrical connections, visual inspection of all conduit, cable, device, and equipment installations, checking for proper tightening of all mechanical lugs and terminals, checking of all hardware connections, and checks for compliance with applicable electrical codes and regulations. The Contractor shall be responsible for coordinating with the Department and the North Carolina State Construction Office for all required electrical inspections.

Training

The Control System Vendor's field engineer/technician shall provide a three-day (eight hours per day) training/instruction program, presenting both operating and troubleshooting instructions to the operation and electrical maintenance personnel. The overall project need not be accepted for the instruction period to commence, but the control system operation, including all limit switch adjustments, must be deemed satisfactory by the Engineer and in need of no further major adjustments or modifications. This approval to begin the instruction period does not imply final acceptance of the overall project or any part thereof.

Soft-bound training manuals shall be provided to facilitate the training. Training manuals shall include color photographs and color HMI screen captures. Electronic PDF versions of manuals shall also be provided. Submit preliminary electronic versions to the Engineer for review and approval prior to beginning training.

(A) Operator Training Manuals Content shall include:

(1) General safety precautions and system checks.

(2) Step-by-step procedures for operating the bridge in manual and automatic modes including applicable photographs of the control console.

(3) Instructions for using console HMI displays.

(4) Description of safety interlocking.

(5) List of bypass switches with procedures and cautions for use.

(6) List of potential fault conditions with basic troubleshooting procedures and corrective actions.

(7) A minimum of (10) hardcopies of operator training manuals shall be provided.

(B) Maintenance Training Manuals Content shall include all operator training materials content above and the following:

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

(1) Instructions for using the Laptop computer and PLC programming software for on-line troubleshooting and uploading/downloading programs. Instructions shall include applicable color screen capture images showing software settings and describing menu navigation within the software.

(2) Instructions with color screen captures showing application file backup procedures for HMI displays and steps for configuring spare HMI displays. Include general explanation of steps necessary to modify screens using the HMI development software.

(3) Instructions for Vector-Controlled Frequency Drive troubleshooting and instructions for adjusting drive parameters on the local drive display and keypad. Also provide written instructions for using drive manufacturer's software package to restore drive parameters from backup files and any applicable procedures for use of removable memory cards.

(4) Instructions for use of PLC cabinet HMI for maintenance adjustments and use of data collection software for display of bridge operation data, retrieval of historical data, and data trending.

(5) Instructions and address settings for configuring all control system related Ethernet devices.

(6) Maintenance and adjustment procedures for field devices.

(7) A minimum of (6) hardcopies of maintenance training manuals shall be provided.

Warranty

All product warranty certificates, and similar warranty information, shall be stored at a single location on the project site and be turned over to the Owner prior to final acceptance of the project. Warranty information shall be clearly marked to identify the components covered and allow cross referencing back to the as-built contract and shop drawings. Where registration is necessary as a condition of warranty coverage, warranties shall be registered to the Owner.

Upon final acceptance of the completed Bridge Electrical Work by the Engineer, the Control System Vendor staff shall provide on-call warranty service for a period of two years. Field staff shall be capable of responding to an emergency within sixteen (16) hours.

When requested by the Department, within two years of the date of final acceptance, provide a minimum of three Project-site visits to adjust and calibrate components, make programming adjustments and revisions, and assist the Owner's personnel in making program changes and in adjusting equipment and controls. Provide up to 40 hours of services, exclusive of travel time, for these purposes.

Measurement and Payment

Bridge Electrical Work will not be measured, and payment will be made on a lump sum basis. The price is full compensation for all field site investigation, products, labor, tools, equipment, testing, and incidentals necessary to complete the work in accordance with these contract documents.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

Payment will be made under:

Pay Item	**Pay Unit**
Bridge Electrical Work	Lump Sum

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

BRIDGE BACKUP GENERATOR: **PSP**

Description

This work consists of the furnishing, installing and testing backup generator equipment which shall include, but need not be limited to, the following major equipment and facilities.

(A) Concrete generator pad with grounding system and security fencing

(B) Service disconnect switch and circuit breaker

(C) Automatic Transfer Switch (ATS)

(D) Diesel engine generator, enclosure and Fuel System

(E) Load bank

(F) Panelboard and transformer

(G) Lighting and utility receptacles

(H) Conduit, wiring, and miscellaneous hardware

All work shall be in accordance with the Plans, all applicable sections of the *2018 Standard Specifications*, and the provisions herein. Electrical wiring and conduit shall comply with the requirements of Section Bridge Electrical Work. It is the Contractor's responsibility to contact, arrange, and coordinate with the local Electric Utility Company.

In addition to the references in the General Requirements listed in Section Bridge Electrical Work, any standards and rules of the local utility shall apply, and any applicable federal, state, and local laws and/or regulations shall apply.

Submittals

Submit manufacturer's product specifications, electrical component specifications, wiring schematics, and drawings for generator, automatic transfer switch, load back, and related components. Submit shop drawings detailing interconnections between equipment, installation details, and equipment mounting framing.

Generator Pad – Submit plan and elevation, construction, reinforcement, equipment mounting locations, and conduit embedment.

Generator Pad, Grounding System, and Fencing

The Contractor shall perform all necessary site survey work and required regulatory permitting prior to the excavation of the generator pad location. This shall include identifying the locations of any existing utilities. The Contractor shall be responsible for coordination with all utilities involved. The Contractor shall also be responsible for providing the engineering, coordination, materials, and labor required to relocate any utilities affected by the construction of the new generator pad.

A grounding system shall be installed as described on the Plans. All non-current carrying

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

metallic parts and equipment within the generator pad shall be connected to the grounding system using properly sized conductors. All sections of the fence, including posts, fabric, gates, and barbed wire strands shall be bonded to the grounding system.

Grounding electrodes shall be solid copper one-piece or sectional ground rods. Sectional ground rods shall be threaded with matching threaded couplers. A testing access well shall be provided for each grounding electrode.

Exothermic welding system shall be utilized which is specifically designed for use in making grounding and lightning protection connections. System shall utilize weld material consisting of a mixture of copper oxide and aluminum powder which, when ignited, produces a molecular bond.

The Contractor shall excavate the site, install the grounding electrodes and conductors, bonding conductors, underground raceways for the new power and control system conductors, and any necessary aggregate base material, piles, and/or footings for the generator pad. It is the Contractor's responsibility to dispose of any excess excavated material in compliance with any applicable federal, state, or local regulations.

The Contractor shall bond and connect the grounding system to the utility grounding electrode as is required by the NEC.

A chain link fence shall be installed on the generator pad as described on the Plans and shall conform with the applicable requirements Section 866 of the NCDOT Standard Specifications. The generator concrete pad shall comply with the requirements of Section 825 of the NCDOT Standard Specifications.

Generator

The diesel generator set, enclosure, and fuel system shall have ratings as shown on the Plans, and as described herein. The complete diesel generator set, enclosure, fuel system, and automatic transfer switch shall be furnished by a single supplier who has regularly engaged in standby engine-generator sales, service, and installation, for single-source responsibility and service. The system shall meet the requirements of NEMA MG-1, and the generator set shall be listed to U.L. 2200, Stationary Engine Generator Assemblies and pass tests in accordance with NFPA 110 under the Prototype Test Support program.

The manufacturer shall verify the size and ratings of the specific diesel generator set selected and confirm compatibility with the flux vector drives of the size and type to be installed. If determination is made that a larger size generator is necessary, the Contractor shall be responsible for increasing the size of the generator, pad, associated electrical equipment, and wiring at no additional cost.

The diesel generator set shall be housed in a Level II sound-attenuated and weather protective aluminum enclosure with stainless steel hardware. The generator set shall also include a dual wall sub-base fuel tank sized to provide a minimum run time capacity of 48 hours at 50 percent load. Fuel tank shall include primary tank leak detection, low level fuel switch, and direct reading fuel level gauge. The cooling system shall include an integrally mounted radiator system. All inlets and outlets shall be provided with rodent barriers. Enclosure shall be equipped with exterior oil and coolant drains with interior valves for ease of service. Vibration isolators shall be provided as recommended by the manufacturer.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

Fuel shall be No. 2 diesel, and engine emissions shall be certified compliant with EPA requirements for stationary diesel generator sets in effect at the engine build date. The exhaust system shall be furnished with a residential grade silencer.

The diesel generator shall be equipped with a heavy duty 12 volt DC negative ground battery(ies) for engine starting, 100 amp battery charging alternator, and 120VAC battery trickle charger. 120VAC thermostatically controlled heaters shall be provided for the coolant system, lube oil system, and alternator. Alternator shall have class H insulation, and temperature rise shall be 125 degrees C (standby).

A generator main circuit breaker shall be furnished, having minimum ratings as shown on the Plans, and shall be U.L. 489 listed for 100% continuous operation and U.L. 869A for use as service equipment. A secondary three phase circuit breaker shall be provided to protect the load bank. Locations of circuit breakers and disconnects shall be clearly labeled for emergency use by firefighting personnel.

The generator control system shall provide total system integration, including automatic remote starting / stopping, precise frequency and voltage regulation, alarm and status message display, current protection, output metering, provisions for remote annunciator panel, and auto-shutdown at fault detection. Local control shall provide for starting and running the generators without transferring the load.

Provide and install a remote annunciator panel for the generator. Display shall provide generator status indicators including common alarm, running status, low oil pressure, high coolant temperature, low battery voltage, battery charger malfunction, and low fuel level.

Provide Modbus or Ethernet network connection as required to allow generator operating data, performance, warnings, and alarms to be monitored remotely by the bridge control system PLC.

The Contractor shall provide all fuel required for the diesel generator set up through and including testing, and shall fill the fuel tank of the new generator to full capacity after all testing and related construction is completed.

Automatic Transfer Switch

The transfer switch shall be listed under U.L. 1008, and rated as shown on the Plans. The transfer switch shall be housed in a NEMA 4X stainless steel enclosure.

The transfer switch shall include a retransfer inhibit input. This shall be connected the bridge control system and shall be used to prevent transfer back to utility power while the bridge is operating under generator power. The transfer switch shall have isolated relay output contacts for control system monitoring of the condition of the transfer switch by the bridge control system. The required signals are: source 1 connected, source 2 connected, source 1 available, source 2 available.

The transfer switch shall have a microprocessor-based controller with a digital display for monitoring power conditions and adjusting transfer switch parameters. Memory and settings shall be retained if power to the controller is lost. Features shall include programmable engine start delay timer, engine stop delay timer, transfer delay timers, transition timer, and generator set exerciser. Shall include indicator LED lamps for source availability, source connected, and exercise/test mode. The controller shall use over/under voltage and frequency sensing with adjustable dropout time delays.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

The transfer switch shall be compatible with the diesel generator control system and shall be from the same manufacturer as the diesel generator. The transfer switch shall have the capability to disable an external resistive load bank as required during generator startup and system testing.

Load Bank

The load bank shall be self-contained, freestanding type. It shall be suitable for installation on a concrete pad or structural base, with forklift channels in the base for lifting. The enclosure shall be Nema 3R outdoor weatherproof rated, constructed using heavy gage aluminized steel, and all exterior fasteners shall be stainless steel.

The load bank shall be designed and rated for continuous operation. Unit shall be rated for ambient temperature to 120 degrees Fahrenheit. Resistive elements shall be constructed of corrosion resistant materials, and shall be air cooled with an internal fan assembly.

Load bank shall have self-contained controls, circuit protection fuses/breakers, contactors, and cooling fan motor starters. Control power shall be 120VAC. Controls shall include automatic load regulation which automatically senses down-stream generator loads and maintains a programmable minimum load on the generator. Load bank shall be capable of automatically disabling load bank operation when power is required for bridge operations. All necessary current transformers, sensors, and accessories shall be provided.

Provide anti-condensation heater with associated controls.

Spare Parts and Manuals

Provide the following spare parts: (5) complete sets of all filters required by the generator, (6) fuses of each size and type used. A minimum of two complete sets of operating and maintenance manuals shall be provided for the generator, ATS, and load bank.

Hardware

(A) Anchor Bolts

ASTM F1554, Grade 105, Galvanized.

(B) Adhesive Anchors

Shall conform with Section 420-13 of the NCDOT Standard Specifications.

(C) Vibration Isolation

Vibration isolation pads and hardware for the generator per the manufacturer's recommendations.

Electric Utility Service

The Contractor shall furnish all necessary materials and labor for the connection of the electric utility service to the new generator equipment and to the bridge. This shall include any required upgrades to the existing electrical utility equipment. Power and metering materials, ratings, and installation shall conform to the requirements of the National Electrical Code (NEC) and of the local electrical utility company. The Contractor shall bear full responsibility for all electrical utility fees and costs associated with performing the work as described on the Plans and in these Specifications.

Prior to beginning work, the Contractor shall verify the A-B-C phase sequencing of the existing

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

service connection and at power panels on the bridge. The Contractor shall ensure that all new work shall match the phase sequencing of the existing service. The Contractor shall bear full responsibility for any equipment damaged as a result of improper phase sequencing.

Existing metering equipment may be reused if permitted by the electric utility company. The Contractor shall provide and install new metering equipment if required by the electric utility company.

The service disconnecting means shall be as indicated on the Plans and satisfying the requirements for such items given elsewhere in these Specifications. Disconnecting means shall be listed as "Suitable for Use as Service Entrance Equipment." Provide heavy duty laminated steel padlocks with hardened steel shackles and weather resistant thermoplastic shells, one for enclosure door, one for operating handle, and two spare. Padlocks shall be keyed alike, and shall be Masterlock No. 311, or approved equal. Weather and UV resistant warning labels satisfying OSHA/NFPA 70E shock and arc flash hazard requirements shall be affixed to the service disconnecting means.

The Contractor shall ensure that electrical service is solidly grounded.

Construction Methods

The Contractor shall be responsible for coordinating with the Department and the North Carolina State Construction Office to arrange all required inspections. Installation of the new equipment, testing, and cutover shall be coordinated with the Department and the Bridge Electrical Installation to minimize disruptions to normal bridge operations.

The installation of the diesel generator system shall be overseen by the diesel generator manufacturer's field service technician(s). Any and all adjustments necessary for a reliable and trouble-free system shall be made by the service technician. The Contractor is responsible for any associated costs for the service technician(s). Installation shall be in compliance with NFPA Standard 37, Combustion Engines, and any other local codes that may apply. Monitor primary leak detector during and after introduction of fuel to the empty tank. Means for tank grounding and anchoring to the concrete pad shall be provided. All fuel tanks shall be labeled by product, capacity, and manufacturer. Inspection and permits for use after the installation may be required by the local fire district regulating authority.

Free-standing enclosures, cabinets, and posts shall be anchored to the concrete pad with stainless steel or hot-dip galvanized anchor bolts. Stainless steel metallic shims shall be utilized to adjust and install enclosures, cabinets, and post plumb.

Utilize framing constructed of 4" by 4" by 1/4" wall hot dipped galvanized steel structural tubing posts to mount electrical equipment. Posts shall be placed at a maximum of 5' on center spacing. Horizontal framing shall utilize 4" by 4" by ¼" hot dipped galvanized steel angle and/or stainless steel erector systems such as Unistrut or B-Line.

Grounding bars or lugs shall be provided in each enclosure or cabinet. Service grounding and equipment grounding and bonding shall conform to requirements of Article 250 of the NEC and of the local electric utility company.

The Contractor shall provide the labor and materials to install all necessary interface wiring between the generator and transfer switch required by the Manufacturer. The Contractor shall also provide the additional electrical interfacing components and field wiring necessary to allow

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

ATS and Generator to be monitored and controlled by the Bridge Control system as shown on the Plans. Utility receptacles, switches, and lighting shall be provided as shown on the Plans.

On-Site Testing

The Contractor shall furnish all materials, equipment, fuel and labor to conduct all tests required herein. The Engineer shall be notified in advance of all tests and shall have the option to witness the tests. Written records of all tests shall include the type of test performed, date, personnel involved, equipment tested, name of test equipment or instrument used for the tests with serial number and test results. Test reports shall be signed and dated by the Contractor and submitted to the Engineer or other representative of the Department for review.

Prior to energizing, the service equipment shall be inspected for any unintentional grounding, phase reversal of feeder connections, short circuits, and the equipment is connected and wired as shown on the approved working drawings.

The Contractor shall perform all tests and inspection recommended by the equipment manufacturer and the electric utility company, unless specifically waived by the Engineer or by the representative of the Department. The Contractor shall engage the manufacturer's field service technician or engineer to perform the testing of the diesel generator and transfer switch.

The manufacturer's field service technician or engineer shall also provide routine maintenance procedure, operation, and troubleshooting training to the Department's maintenance personnel for the generator and automatic transfer switch.

When the entire installation of all electrical systems of the bridge is complete, the Contractor shall perform operational tests of the diesel generator and the transfer switches as a complete electrical service system to demonstrate that all electrical service equipment functions properly.

Measurement and Payment

Bridge Backup Generator will not be measured, and payment will be made on a lump sum basis. The contract lump sum price for *Bridge Backup Generator* will be full compensation for providing all labor, tools, equipment, hardware, and any incidentals necessary for installation.

New Electrical Service will be measured and paid in units of each. The contract unit price for New Electrical Service will be full compensation for all associated electric utility fees and for providing labor, tools, equipment, hardware, testing, and any incidentals necessary for connection to the electric utility service.

Payment will be made under:

Pay Item	**Pay Unit**
Bridge Backup Generator	Lump Sum
New Electrical Service	Each

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

SUBMARINE CABLES: **PSP**

Description

This section covers all wiring and related labor and appurtenances used to furnish, install, test, and put into permanent operation a complete submarine cable system for the bridge as shown on the plans and described herein.

This section is a component of the electrical specifications. The provisions and requirements of Section 8 – General Requirements for Bridge Electrical Work are hereby incorporated into this section by this reference, and shall have the same force and effect as if printed here in full.

All work shall be in accordance with the Plans and Bridge Electrical Work special provision.

Submittals

Submit descriptive data (catalog cut sheets, etc.) for the overall submarine cables, as well as the component conductors and cables. Descriptive data shall clearly address all requirements given herein.

Provide cross section drawings which clearly identify the quantity and positions of the various component conductors and cables, inner and outer jacket thicknesses, armor wire sizes, outer diameter of the assembled cable, and approximate weight per foot of the overall cable.

Submit detailed procedures and drawings for the following:

1. Trench excavation.
2. Excavated material collection, storage, and disposal.
3. Cable installation.
4. Backfilling.
5. Locations of existing cables to be abandoned.

Testing procedures and results as required elsewhere in this section and these specifications.

All required submittals must be approved by the Engineer prior to fabrication of, or purchase of materials for, the cables.

General Provisions

Prior to ordering the submarine cable, the Contractor shall review the submarine cable design with the Control Systems Vendor to verify that the cable has adequate conductors, cables, and spares for the control system requirements.

The Contractor shall verify the exact length of cable required for the installation based upon his specific intended routing.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

Submarine Cable Construction

Cables shall be designed and manufactured in accordance with ICEA S-95-658 (NEMA WC-70) and ICEA S-73-532 (NEMA WC-57).

Cables shall be specifically designed for underwater installation.

A minimum of 3 cables shall be provided. Each cable shall be continuous, and free of defects, splices, or repairs, from end to end.

Each cable shall contain the component conductors and cables as indicated on the Plans and/or the Contractor's approved shop drawings.

The component conductors and cables shall be individually labeled with printed legends consisting of numbers and words (e.g. 1-One, 2-Two, 3-Three, etc.). Labeling shall utilize color contrasting print, and remain legible after normal handling during installation.

All components shall be cabled into a tight concentric configuration. The direction of lay for adjacent layers shall be reversed. Non-hygroscopic fillers shall be included in the cable core as necessary to produce a substantially circular cross section. The bundled components shall be covered with a polyester binder tape, applied helically with a minimum 25% overlap.

The overall diameter of the cable over the outer jacket shall be not greater than 5 inches.

The cable manufacturer shall have been regularly and continuously engaged in the business of producing composite armored cables for underwater installation for a period of not less than 5 years as of the bid date. Recommended manufacturer is Draka USA. Other similarly qualified manufacturers may also be proposed.

HDPE pipe

High-Density Polyethylene empty pipe. (5.56) inch outer diameter.

Suitable for use in future installation of additional cables / conductors after main cable installation.

With water and UV resistant synthetic pull rope pre-installed in pipe by the manufacturer.

Armor

Galvanized steel wires, continuously coated with water and UV resistant high density polyethylene, per ICEA S-95-658. Minimum wire sizes and coating thicknesses shall be as follows.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

Calculated Diameter of Core Under Armor	Nominal Size of Wire Armor	Nominal Thickness of HDPE Coating
0 to 0.75 inches	12 BWG	20 mils
0.751 to 1.000 inches	10 BWG	25 mils
1.001 to 1.700 inches	8 BWG	30 mils
1.701 to 2.500 inches	6 BWG	35 mils
2.501 + inches	4 BWG	40 mils

The coated armor wires shall be applied over the inner jacket at a lay angle of 17 to 25 degrees, and provide a minimum coverage of 92%. The armored layer shall be covered with a 2 mil corrugated polyester binder tape (25% minimum overlap), followed by a 2 mil adhesive polyester tape (25% minimum overlap).

Inner and Outer Jackets

Two jackets shall be provided: an inner jacket between the cable core and wire armor, and an outer jacket over the wire armor.

Each jacket shall be a continuous, homogeneous layer of water and UV resistant high density polyethylene per ICEA S-95-658. Minimum jacket thickness shall be as follows.

Calculated Diameter of Cable Under Jacket	Average Jacket Thickness
0 to 0.425 inches	45 mils
0.426 to 0.700 inches	60 mils
0.701 to 1.500 inches	80 mils
1.501 to 2.500 inches	110 mils
2.500 + inches	140 mils

Testing

Individual conductors shall be AC spark tested in accordance with ICEA S-95-658. Test voltage shall be as follows.

Conductor Size	RMS AC Voltage
14 AWG to 10 AWG	7.5 kV
8 AWG to 2 AWG	10.0 kV
1 AWG to 4/0 AWG	12.5 kV
225 kcmil to 500 kcmil	15.0 kV
Over 500 kcmil	17.5 kV

The insulation resistance of individual conductors in the finished cable shall be measured in accordance with ICEA S-73-532, S-95-658, and T-27-581. The minimum acceptable insulation resistance shall be determined in accordance with the following formula.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

$R = (IRK)\log_{10}(D/d)$

Where: R = insulation resistance in megohms-1000 feet
IRK = insulation resistance constant (10,000 for XLPE)
D = diameter over the insulation
d = diameter under the insulation

The DC resistance of each individual conductor in the finished cable shall be measured. Measured resistance shall comply with ICEA S-73-532, S-95-658, and T-27-581.

The outer jacket of the finished cable shall be inspected for irregularity by AC spark testing in accordance with ICEA S-95-658 and T-27-581. The test shall be between the armor wires and the testing apparatus. Test voltage shall be as follows.

Jacket Thickness	Voltage
45 mils	4.0 kV
60 mils	5.5 kV
80 mils	7.0 kV
110 mils	10.0 kV
140 mils	12.5 kV

The shielded twisted pair cables, Ethernet, and fiber optic cable components shall be tested as described elsewhere in these Special Provisions.

Installation Testing

Upon completion of submarine cable installation and termination to submarine cable terminal cabinets, but prior to connecting to any circuit wiring, all individual conductors shall be Megger tested wire-to-ground using an approved ground reference. Within each submarine cable, individual conductors shall also be Megger tested wire-to-wire. 1 minute short term testing shall be performed with an approved instrument at 1000V DC. Any conductors not meeting a minimum acceptable insulation resistance value of 50 megohms shall be identified, labeled, and reported to the Engineer. If any conductors do not meet these minimum insulation resistance requirements, the Contractor shall be required to perform additional testing to confirm the integrity of the installed cable(s) to the satisfaction of the Engineer.

Testing results for each conductor along with ambient temperature and relative humidity shall be recorded in tabular format and submitted to the Engineer.

Packaging

Each cable shall be wound onto a suitable reel capable of supporting the weight of the cable during transportation and normal handling.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

The ends of each cable shall be suitably sealed to prevent moisture ingress during shipment and storage.

Construction Methods

The Contractor shall bear full responsibility for coordinating the installation of the submarine cables with the United States Army Corps of Engineers and all other federal, state, and/or local regulatory agencies having jurisdiction, all necessary permitting, and all costs associated therewith.

The underwater sections of the trenches shall be created by excavation of material from the channel bottom. Jetting may be used only if explicitly approved by the Corps of Engineers.

All material removed from the channel bottom during excavation of the trenches shall be stored by the Contractor. For each 100 cubic yards of material removed, a representative sample shall be tested for hazardous materials by an appropriately qualified testing laboratory. If any sample tests positive for hazardous materials, all excavated material shall be designated hazardous waste and stored in sealed containers.

All material excavated from the channel bottom shall be disposed of off-site in an approved manner and in accordance with all applicable federal, state, and/or local laws and regulations. Any material designated as hazardous waste shall be disposed of at an approved hazardous waste site.

The Contractor shall bear full responsibility for all costs associated with handling, storage, transportation, and disposal of all excavated material. The Contractor shall provide to the Engineer documentation concerning the amount of material removed, hauling permits, hauling way bills, and disposal site records.

The submarine cable trenches shall be constructed in such a way as to avoid cave-ins during placement of the cables and backfill.

Bedding and Cable Placement

1. The cables shall be placed in the trench and covered with bedding aggregate to a depth of at least (12) inches.

2. The remainder of the trench shall be filled with backfill aggregate to the elevation of the channel bottom.

3. Bedding and Backfill Material: Bedding Aggregate: ASTM C33, Coarse Aggregate Table 2, Size #67; Backfill Aggregate: ASTM C33, Coarse Aggregate Table 2, Size #1.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

The submarine cable depth shall be as directed by the Corps of Engineers; minimum as shown on plans.

The Contractor shall coordinate with the United States Coast Guard 45 days in advance of any obstruction to the waterway to perform this work.

The Department will submit the permit application for installation of the submarine cable to the Corps of Engineers, Division of Coastal Management and coordinate activities with all other review agencies. Issuance of the permit is anticipated to take several months. Contractor shall not perform in-water submarine cable installation prior to receiving all environmental permits. An in-water work moratorium for all ground-disturbing activities shall be observed from February 1st through September 30th. The Contractor shall schedule installation of the submarine cable no earlier than December 1, 2019. It is anticipated that installation of the submarine cables by jetting will not be allowed.

Measurement and Payment

Submarine Cables will be measured and paid for as one lump sum unit. The contract unit price for Submarine Cables will be full compensation for providing labor, tools, equipment, trench excavation, cables, conductors, and any incidentals necessary for installation.

Payment will be made under:

Pay Item	**Pay Unit**
Submarine Cables	Lump Sum

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

TRAFFIC GATES: **PSP**

Description

Remove existing traffic gates and install new traffic gates at locations shown on the Plans. This provision also includes relocation of the installation locations for (3) traffic gates. All work shall be in accordance with the Plans, all applicable sections of the *2018 Standard Specifications*, and the provisions herein.

Submittals

Submit manufacturer's product specifications, electrical component specifications, wiring schematics, wind ratings, and drawings for traffic gates and related components. Drawings shall be signed and sealed by a registered engineer qualified to perform this work.

For each location, the Contractor shall provide the gate manufacturer with accurate dimensions of the gate mounting, railings, barriers, and roadway. The Contractor shall be responsible for checking the gate manufacturer's shop drawing mechanical dimensions to verify the supplied gates will operate properly with no mechanical interferences throughout the gate's range of operation.

Materials

Gates shall be designed for use as a warning, traffic control, and access control gate. Gates shall be explicitly designed for traffic control on movable bridges.

Gate operating mechanism and arm construction shall be capable of reliable operation in the wind and weather conditions experienced at the project site and installed elevation with up to a 40' gate arm length. The traffic gate arms shall be sized to withstand a wind pressure in its normal up position defined by Section 3.8 of AASHTO's "LRFD Specification for Structural Supports for Highway Signs, Luminaires, and Traffic Signals", 1st edition, 2015 with a gust effect factor of 1.14 and a 10 year MRI. The Contractor shall refer to this standard specification and take the bridge location and elevation into consideration. Design the gate for compliance with the gate requirements, including sizing of the gate mounting, motor, cable anchorage provisions, and take into account all project specific conditions and wind loading conditions. Consider wind in the least favorable direction. Submit the associated back-up calculations to the Engineer for review.

Gongs

Warning gongs shall be provided and installed for oncoming outer gates, three locations. Gongs shall produce a sound level of 90db at 10 feet and shall operate using 120VAC power.

Housing shall be corrosion resistant, heavy duty cast aluminum with weather proof gasketed seals for access doors. Assembly shall include an aluminum mounting adaptor for mounting on top of the gate housing. Gong shell shall be spun silicon bronze.

Gate Arms

Gate arms shall utilize a heavy duty double rail 6005-T5 aluminum tube design. Stainless steel truss cables and a roadway bumper rod shall be furnished for longer arms when recommended by the manufacturer. Gate arms shall be covered with alternating red and white reflectorized stripes according to MUTCD requirements.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

Gate arm counterweights shall be hot-dip galvanized steel, sectional bolt-on type, sized and configured by the manufacturer to balance the arms throughout the entire range of gate arm movement. Use sectional counterweights to permit a 10 percent adjustment.

Approximate arm lengths as shown on the plans, the Contractor shall field verify all lengths before ordering components. To the extent possible, gate arm lengths shall be standardized to minimize the quantity of spare gate arm sizes required.

Housings

For gate locations with existing concrete barrier rails between the gate operating mechanism housing and the roadway, gate housings shall have a rear access configuration which organizes internal electrical and mechanical components to permit routine electrical/mechanical maintenance, troubleshooting, and manual operation from a single hinged door on the rear (opposite roadway) side of the housing. A gasketed, bolt-on access cover shall be provided on the front of the housing to permit removal of internal components for major repairs.

The gate operating mechanism housing shall be weatherproof and constructed from welded stainless-steel plate. All fasteners shall be corrosion resistant. Access doors shall be hung on bronze or stainless-steel hinges. Hinge pins and all other hardware shall be stainless steel. Doors shall have neoprene gaskets and provisions for padlocking. Door safety limit switches shall be provided for disabling the gate control circuit in the event a door is opened.

The Contractor shall coordinate gate housing mounting configurations with existing anchor bolt patterns at all locations where new gates will be attached to existing gate platforms.

Transmission

The gate mechanism linkage shall be driven by a fully enclosed, heavy duty worm gear, double reduction speed reducer. The transmission shall have an occasional momentary peak load rating of not less than the loads required by worst case load. The main arm shaft shall be approximately 2” in diameter. Gear ratio used shall produce an operation time of approximately 13 seconds.

The linkage shall utilize cranks keyed to the main arm shaft and transmission shaft with an adjustable connecting rod between a pair of self-aligning spherical rod ends. The cranks shall be “locked out” or in-line with the arm in the raised and lowered positions. The transmission shall provide a sinusoidal “S-curve” gate arm velocity for smooth acceleration and deceleration of the gate arm to prevent bounce or whip of the arm.

A heavy-duty torque limiter shall be provided to limit the torque transmitted to the operating mechanism due to excessive wind loads, physical obstruction, or instant reversing of heavy arm assemblies. The torque limiter shall be adjustable between approximately one-third to 2-times the worst case loading torque and factory adjusted/tested by the manufacturer based on installation requirements.

A hand crank and manual brake release shall be furnished for emergency operation in the event of electrical failure. An interlocking hand crank safety switch shall prevent motor operation during hand crank operation.

Motor shall be sized by the manufacturer, rated to operate at 480VAC, three-phase. Operations shall sustain a wind speed of 40 mph. Specific motor data shall appear on shop drawings. The motor shall be equipped with a solenoid release, automatic brake with a manual release lever to permit manual operation of the gate.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

Electrical Components

Gate power and control components shall be coordinated with Section Bridge Electrical Work. A minimum of 8 adjustable limit switch contacts shall be provided in the housing for indication and control of full raised and full lowered. Multiple contacts, both normally open and normally closed, shall be provided for each end (limit) of travel. Switches shall be double-pole, double-throw (Form CC) snap-action type. Safety switches shall be provided as described above for the enclosure door and the hand crank. All switches shall be rated for use with 120VAC control circuits.

Double faced red warning lights shall be mounted on gate arms per MUTCD requirements. Lamps shall be 12V 100,000 hour LED. Lights shall be circuited to alternately flash via the two circuits in the flasher unit with a steady burn light at the end of the arm. Flasher unit shall be moisture and corrosion resistant, continuous duty rated with internal overload protection and 120VAC transformer.

A motor disconnect switch shall be provided in each gate operator housing. The motor starters for the gates shall be supplied as part of the Motor Control Center described in section Bridge Electrical Work.

Terminal blocks shall be provided for landing all external wiring coming into the gate operator. Terminal blocks shall be numbered in accordance with full wiring diagrams provided by the manufacturer as part of shop drawing submittal. The mounting location of terminal blocks within the gate housing shall allow unobstructed access to them from the door opening.

Each gate housing shall include a 120VAC, 15 Amp GFCI receptacle and a vibration resistant maintenance work light.

Spare Parts

Provide the following spare parts: (1) complete gate arm assembly with lights for each arm length provided, (6) arm lights, (2) flasher modules, (1) rotary limit switch assembly, and (10) shear pins for arms (if applicable).

Hardware for Relocated Gates

(A) Anchor Bolts

¾” diameter ASTM F1554, Grade 105, Galvanized. New bolts for relocated gates only. Overall length as required to satisfy embedment requirements below and gate manufacturer’s mounting requirements.

(B) Adhesive Anchors

Shall conform with Section 420-13 of the NCDOT Standard Specifications.

(C) Bollards

4” schedule 40 steel pipe bollard, 36” height, welded steel construction, bolt down type with ½” steel base plate, (4) ¾” mounting holes, domed top, powder-coated safety yellow finish.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

Construction Methods

Removals – Carefully remove existing gates to preserve anchor bolts and conductors. Verify that power has been disconnected and locked out before performing work. Remove existing gate upright arm supports. NCDOT shall have the option of salvaging any or all removed gates. All selected gates and gate upright arm supports shall be delivered by the Contractor to a NCDOT designated location within 30 miles of the site. The Contractor shall be responsible for transportation and disposal of all components not salvaged by NCDOT.

Gate installation shall be coordinated with Section Bridge Electrical Work and Section Platform Extensions. New gates shall be installed as shown on the Plans.

For locations on existing gate outrigger platforms, anchor bolts shall be cleaned and inspected upon removal of existing gates for reuse with new gates. The Engineer shall be informed of any damaged bolts that are not suitable for reuse.

All locations of relocated gates and associated anchor bolt and conduit entry locations shall be field verified by the Contractor and approved by the Engineer prior to installation. Where epoxy adhesive anchors are utilized for anchor bolts, 6” minimum embedment is required. Conductor entry points shall be core drilled and sleeved with appropriately sized PVC conduit which is epoxied into place and has all sharp edges smoothed.

Gates shall be shimmed, bolted in place with new galvanized hardware, and grouted. Gates shall be adjusted so that gate arms in the fully lowered position are parallel with the roadway and when in the fully raised position are vertical. For locations having an opposing gate in the opposite lane of traffic, align gate arm tips in the lowered position to the extent possible. Ensure that traffic gate housings are electrically grounded.

All gates shall be tested for proper operation following installation. End of travel in both the raise and lower positions shall be adjusted as necessary. Gate limit switches shall be adjusted as necessary. Proper operation of each gate using the bridge control system shall be verified as shall all interlocking functions.

Measurement and Payment

The cost for preparing (3) new locations for relocated traffic gates as shown on the Plans is included in the lump sum price bid for *Traffic Gate Relocation*. The price is full compensation for all field measurements and site investigation; furnishing and installing all required anchor bolts, mechanical protection, and hardware; and any required modifications to existing roadway deck slabs and structures.

Traffic Gates will be measured and paid in units of each. The contract unit prices for *Traffic Gates* will be full compensation for providing labor, tools, equipment, hardware, testing, and any incidentals necessary for removal of existing gates and installation of new gates.

Payment will be made under:

Pay Item	**Pay Unit**
Traffic Gate Relocation	Lump Sum
Traffic Gates	Each

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

TRAFFIC SIGNALS: **PSP**

Description

Remove existing and install new traffic signal heads and backplates at existing locations shown on the Plans. All work shall be in accordance with the Plans, the applicable sections of the *2018 Standard Specifications*, and the provisions herein.

Submittals

Submit manufacturer's product specifications for components.

Materials

Signal heads shall be according to section 1705 of the *2018 Standard Specifications*. Backplates shall be according to section 1706 of the *2018 Standard Specifications*.

Construction Methods

Work shall be performed according to section 1705-3. Coordinate with section Bridge Electrical Work. Traffic signals shall be tested for proper operation with the bridge control system following installation.

Measurement and Payment

Vehicle Signal Head will be measured and paid in units of each. The contract unit prices for *Vehicle Signal Head* will be full compensation for providing labor, tools, equipment, testing, and any incidentals necessary for removal of existing heads and installation of new heads.

Backplate will be measured and paid in units of each. The contract unit prices for *Backplate* will be full compensation for providing labor, tools, equipment, testing, and any incidentals necessary for removal of backplates and installation of backplates.

Payment will be made under:

Pay Item	**Pay Unit**
Vehicle Signal Head (12", 3 Section)	Each
Backplate	Each

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
PROJECT NO. 15BPR.14
NEW HANOVER COUNTY
REHABILITATION OF
ISABEL HOLMES BASCULE BRIDGE AND FIXED APPROACH SPANS

PROJECT SPECIAL PROVISIONS - UTILITIES

- Bridge Tender House Sewer Line Replacement (Special)

NORTH CAROLINA PROFESSIONAL SEAL 20234 11/13/2013 ENGINEER THOMAS S SPEIGHT, JR

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

BRIDGE TENDER HOUSE SEWER LINE REPLACEMENT (SPECIAL)

DESCRIPTION

This work consists of replacing the existing bridge-mounted and buried sanitary sewer line and connecting the new sewer line to a new grinder pump that will be installed in the existing bridge tender house. The new grinder pump is not covered or paid for by this specification. This provision includes materials, equipment, labor and testing required to install a fully functional replacement sewer line in accordance with the plans and these provisions.

MATERIALS

Unless otherwise noted on the plans or herein, materials shall conform to the applicable sections and subsections of the 2018 NCDOT Standard Specifications. Materials include, but are not limited to, stainless steel sewer main, ductile iron carrier pipe, pipe insulation, heat tracing cable, threaded rods, pipe roller/hanger assemblies, adhesive anchoring material, pipe joints, pipe expansion joints, PVC pipe, pipe valves, and backfill materials.

CONSTRUCTION

As part of this work, the contractor shall remove and dispose of the existing non-functioning sanitary sewer line.

Contractor shall be responsible for verifying locations of all above ground and below ground utilities and shall report any conflicts or discrepancies for the proposed construction to the Engineer.

New pipe hanger assembly spacings shown on the Plans are approximate and may be slightly modified to accommodate field conditions.

Any erosion control measures deemed necessary during excavation and backfilling shall be provided and included under this item.

Refer to the Plans for additional construction requirements related to the bridge tender house sewer line replacement.

SUBMITTALS

Submit catalog cuts and piping schematics to the Engineer for review and approval. Final testing results shall be submitted to the Engineer for recordkeeping purposes.

MEASUREMENT AND PAYMENT

Bridge Tender House Sewer Line Replacement shall be paid for at the lump sum price bid and shall be full compensation for field measurements of existing conditions, field drilling and installation of adhesively anchored threaded rods, installing pipe hanger assemblies, installing piping, providing access to bridge-mounted pipe locations for construction and inspection, excavation and backfilling at the locations shown on the plans and as specified herein. The complete work shall be paid for using the following pay item:

Pay Item	Pay Unit
Bridge Tender House Sewer Line Replacement	Lump Sum

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
PROJECT NO. 15BPR.14
NEW HANOVER COUNTY
REHABILITATION OF
ISABEL HOLMES BASCULE BRIDGE AND FIXED APPROACH SPANS

ARCHITECTURAL SPECIFICATIONS
FOR
OPERATOR HOUSE RENOVATIONS

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

OPERATOR HOUSE RENOVATION (SPECIAL)

DESCRIPTION

This work includes all renovation work at the operator's house shown on the architectural plans and called for in the Architectural Specifications for Operator House Renovations.

For the detailed specifications for the operator house renovation, see Architectural Specifications for Operator House Renovations included herein.

MATERIALS

Provide materials in accordance with the Architectural Specifications for Operator House Renovations. The Contractor's attention is directed to the fact that there are numerous references to proprietary items listed throughout the contract documents. In each case where a sole source or specific product is listed, other products of equal quality may be used provided they meet or exceed the requirements of the special provisions and are approved for use.

CONSTRUCTION

Construct the Operator house renovation in accordance with the Architectural Specifications for Operator House Renovations.

MEASUREMENT AND PAYMENT

All work shown on the architectural drawings and called for in the Architectural Specifications for Operator House Renovations shall be paid for at the lump sum price bid for Operator House Renovation.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

SECTION 024119 - SELECTIVE DEMOLITION

PART 1 - 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 the following:

1. Demolition and removal of selected portions of a building or structure.
2. Salvage of existing items to be reused or recycled.

B. Related Sections include the following:

1. Division 1 Section "Summary of Work" for use of premises, and phasing, and Owner-occupancy requirements.
2. Division 1 Section "Temporary Facilities & Controls" for temporary utilities, temporary construction and support facilities, temporary security and protection facilities and environmental-protection measures for selective demolition operations.
3. Division 1 Section "Cutting and Patching" for cutting and patching procedures for selective demolition operations.
4. Divisions 15 and 16 for demolishing, cutting, patching, or relocating mechanical and electrical items.

1.3 DEFINITIONS

A. Remove: Detach items from existing construction and legally dispose of them off-site, unless indicated to be removed and salvaged or removed and reinstalled.

B. Remove and Salvage: Detach items from existing construction and deliver them to the Owner ready for reuse.

C. Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.

D. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

1.4 MATERIALS OWNERSHIP

A. Historic items, relics, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, antiques, and other items of interest or value to the Owner that may be encountered during selective demolition remain the Owner's property. Carefully remove and salvage each item or object in a manner to prevent damage and deliver promptly to the Owner.

1. Before demolition and throughout construction, all Prime Contractors shall be responsible to review with the Owner's, all items being removed by their trades. All items designated during this review to remain the Owner's property, shall be maintained in good condition and turned over to the Owner.

1.5 SUBMITTALS

A. Qualification Data: For Contractor.

B. Schedule of Selective Demolition Activities: Indicate the following:

1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
2. Interruption of utility services. Indicate how long utility services will be interrupted.
3. Coordination for shutoff, capping, and continuation of utility services.
4. Locations of proposed dust and noise-control temporary partitions and means of egress.
5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
6. Means of protection for items to remain and items in path of waste removal from the building.
7. Use of elevators and stairs.

Inventory: After selective demolition is complete, submit a list of items that have been removed and salvaged.

C. Pre-demolition Photographs or Recordings: Show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by selective demolition operations. Submit before Work begins.

D. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

1.6 QUALITY ASSURANCE

A. Demolition Firm Qualifications: An experienced firm that specializes in demolition work similar in material and extent to that indicated for this Project.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

B. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.

C. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

D. Standards: Comply with ANSI A10.6 and NFPA 241.

E. Pre-demolition Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Meetings." Review methods and procedures related to selective demolition including, but not limited to, the following:

1. Inspect and discuss condition of construction to be selectively demolished.
2. Review structural load limitations of existing structure.
3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
5. Review areas where existing construction is to remain and requires protection.

1.7 PROJECT CONDITIONS

A. The Owner will occupy portions of the building immediately adjacent to the selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.

1. Comply with requirements specified in Division 1 Section "Summary of Work."

B. Conditions existing at the time of inspection for bidding purposes will be maintained by the Owner as far as is practical.

1. Before selective demolition, the Owner will tag items to be removed or retained.

C. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.

1. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify the Architect and Owner. The Owner will remove the hazardous materials under a separate contract, or request a proposal to remove the hazardous materials.

D. Storage or sale of removed items or materials on-site is not permitted.

E. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

1. Maintain fire-protection facilities in service during selective demolition operations.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

F. All Contractors shall be responsible for verification of all existing building dimensions and conditions, including finishes and materials, systems shown and designated as existing on the Contract Drawings prior to starting demolition and construction. Any discrepancies in information indicated on the Contract drawings shall be directed in writing to the attention of the Architect prior to the start of demolition and construction. Verification of clearances required for all new equipment, piping, ductwork and related components shall be the Contractor's responsibility.

G. All Contractors shall patch, repair or replace all existing finishes and materials disturbed or damaged during demolition. All repair or replacement shall match adjacent existing and/or new finishes and materials as indicated.

H. See Architectural, Structural, Mechanical, Electrical and Plumbing drawings for demolition work required. Coordinate all Work by other Contractors, including, but not limited to, capping and disconnection of building services.

I. Existing conditions as appear in these Contract Documents may vary with actual conditions because of undocumented work performed by Owner's staff and by other contractors.

J. All Contractors shall be responsible for verification of all demolition conditions related to accepted Alternate bids, including finishes and materials, systems shown and designated as existing or new on the Contract Drawings prior to starting of demolition and construction. Any discrepancies in information indicated on the Contract Drawings shall be directed in writing to the attention of Architect prior to starting demolition and construction.

1.8 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped.

B. Survey existing conditions and correlate with requirements indicated to determine the extent of selective demolition required.

C. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

D. When unanticipated mechanical, electrical, or structural elements that conflict with the intended function or design are encountered, investigate and measure the nature and extent of the conflict. Promptly submit a written report to the Architect.

E. Engage a professional engineer to survey the condition of the building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective demolition operations.

F. Survey of Existing Conditions: Record existing conditions by use of measured drawings, preconstruction photographs, or preconstruction videotapes.

1. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproductions.

G. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems: Maintain services/systems indicated to remain and protect them against damage during selective demolition operations.

1. Comply with requirements for existing services/systems interruptions specified in Division 1 Section "Summary of Work."

B. Service/System Requirements: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.

1. The Owner will arrange to shut off indicated services/systems when requested by the Contractor. The Contractor may make these arrangements if approved by the Owner.
2. Arrange to shut off indicated utilities with utility companies.
3. If services/systems are required to be removed, relocated, or abandoned, before proceeding with selective demolition, provide temporary services/systems that bypass the area of selective demolition and that maintain continuity of services/systems to other parts of building.
4. Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing.

a. Where an entire wall is to be removed, existing services/systems may be removed with removal of the wall.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

3.3 PREPARATION

A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Comply with requirements for access and protection specified in Division 1 Section "Temporary Facilities & Controls"

B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
2. Provide temporary weather protection, during interval between selective `demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
4. Cover and protect furniture, furnishings, and equipment that have not been removed.
5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Division 1 Section "Temporary Facilities & Controls."

C. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

1. Strengthen or add new supports when required during progress of selective demolition.

3.4 SELECTIVE DEMOLITION, GENERAL

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.

5. Maintain adequate ventilation when using cutting torches.
6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
7. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
8. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
9. Dispose of demolished items and materials promptly.

B. Reuse of Building Elements: Do not demolish building elements beyond what is indicated in the Contract Documents without Architect's approval.

C. Removed and Salvaged Items:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area on-site.
5. Protect items from damage during storage.

D. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse. Paint equipment to match new equipment.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

E. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and reinstalled in their original locations after selective demolition operations are complete.

3.5 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

A. Concrete: Demolish in small sections. Cut concrete at junctures with construction to remain, using power-driven saw. Neatly trim openings to dimensions indicated.

B. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, then remove masonry between saw cuts.

C. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, then break up and remove.

D. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI-WP and its Addendum.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

1. Remove residual adhesive and prepare substrate for new floor coverings by one of the methods recommended by RFCI.

E. Roofing: Remove no more existing roofing than can be covered in one day by new roofing and so that building interior remains watertight and weathertight. Refer to Division 7 Sections for new roofing requirements.

1. Remove existing roof membrane, flashings, copings, and roof accessories as indicated in the demolition and renovation notes.

F. Air-Conditioning Equipment: Remove equipment without releasing refrigerants.

G. Refer to the drawings for additional demolition work if any for each room or building component.

H. Prepare existing remaining substrates to receive new finishes as indicated on the finish schedule. Preparation of substrates shall be in conformance with the installation requirements of each new finish.

3.6 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Except for items or materials indicated to be recycled, reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.

1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.

B. Burning: Do not burn demolished materials.

C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

3.7 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION 024119

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

SECTION 061000 ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Framing with dimension lumber.
2. Rooftop equipment bases and support curbs.
3. Wood blocking, cants, and nailers.
4. Wood furring and grounds.
5. Sheathing
6. Plywood backing panels.
7. Fire-retardant blocking and Plywood

1.3 DEFINITIONS

A. Exposed Framing: Framing not concealed by other construction.

B. Dimension Lumber: Lumber of 2 inches nominal or greater but less than 5 inches nominal in least dimension.

C. 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: The Southern Pine Inspection Bureau.
5. WCLIB: West Coast Lumber Inspection Bureau.
6. WWPA: Western Wood Products Association.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

requirements. Indicate type of preservative used and net amount of preservative retained.

2. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
3. Include copies of warranties from chemical treatment manufacturers for each type of treatment.
4. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.

1.5 INFORMATIONAL SUBMITTALS

A. 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 ALSC Board of Review.

B. Evaluation Reports: For the following, from ICC-ES:

1. Wood-preservative-treated wood.
2. Fire-retardant-treated wood.
3. Power-driven fasteners.
4. Powder-actuated fasteners.
5. Expansion anchors.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Stack lumber flat with spacers beneath and between each bundle to provide air circulation. Protect lumber from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. 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.

B. Maximum Moisture Content of Lumber: 15 percent for 2-inch nominal thickness or less, 19 percent for more than 2-inch nominal thickness unless otherwise indicated.

2.2 WOOD-PRESERVATIVE-TREATED LUMBER

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with the ground, Use Category UC3b for exterior construction not in contact with the ground, and Use Category UC4a for items in contact with the ground.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
2. For exposed items indicated to receive a stained or natural finish, use chemical formulations that do not require incising, contain colorants, bleed through, or otherwise adversely affect finishes.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.

C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

D. Application: Treat items indicated on Drawings.

2.3 FIRE-RETARDANT-TREATED MATERIALS

A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame spread index of 25 or less when tested according to ASTM E 84.

1. Use treatment that does not promote corrosion of metal fasteners.
2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

3. Interior Type: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity. Use where exterior type is not indicated.

C. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.

D. Application: Treat all rough carpentry blocking & plywood where indicated on the construction documents.

2.4 DIMENSION LUMBER FRAMING

A. Non-Load-Bearing Interior Partitions: Construction, Stud, or No. 3 grade, any species.

2.5 MISCELLANEOUS LUMBER

General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

1. Blocking.
2. Nailers.
3. Rooftop equipment bases and support curbs.
4. Cants.
5. Furring.
6. Grounds.

B. For items of dimension lumber size, provide Standard, Stud, or No. 3 grade lumber of any species.

C. For concealed boards, provide lumber with 15 percent maximum moisture content and any of the following species and grades:

1. Mixed southern pine; No. 2 grade; SPIB.
2. Hem-fir or hem-fir (north); Standard or No. 3 Common grade; NLGA, WCLIB, or WWPA.
3. Eastern softwoods; No. 2 Common grade; NeLMA.
4. Northern species; No. 2 Common grade; NLGA.

D. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.

E. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

F. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

2.6 PLYWOOD BACKING PANELS

A. Electrical, Phone and Data Equipment Backing Panels: DOC PS 1, fire-retardant treated, in thickness indicated or, if not indicated, not less than 1/2-inch nominal thickness.

2.7 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

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 or Type 304 stainless steel.

B. Nails, Brads, and Staples: ASTM F 1667.

C. Power-Driven Fasteners: NES NER-272.

D. Wood Screws: ASME B18.6.1.

E. Lag Bolts: ASME B18.2.1.

F. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.

G. 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 assemblies 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 and inspecting agency.

1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.
2. Material: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

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, grounds, and similar supports to comply with requirements for attaching other construction.

B. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

C. Install plywood backing panels by fastening to studs or masonry; coordinate locations with utilities requiring backing panels. Install fire-retardant treated plywood backing panels with classification marking of testing agency exposed to view.

D. Shear Wall Panels: Install shear wall panels to comply with manufacturer's written instructions.

E. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, tv brackets, trim, and other equipment shown on the drawings as Owner furnished equipment.

F. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

G. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

1. Use inorganic boron for items that are continuously protected from liquid water.
2. Use copper naphthenate for items not continuously protected from liquid water.

H. Securely attach rough carpentry work to substrate by anchoring and 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.

I. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

3.2 WOOD GROUND, SLEEPER, BLOCKING, AND NAILER INSTALLATION

A. Install where indicated and where required for screeding or attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

C. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than 1-1/2 inches wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

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.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

B. Furring to Receive Plywood or Hardboard Paneling: Install 1-by-3-inch nominal-size furring as indicated..

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.

B. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes sufficiently wet that moisture content exceeds that specified, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 061000

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

SECTION 072100 ROOF DECK AND INSULATION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes roof insulation over the properly prepared deck substrate.

B. Related Sections:
1. Section 07 05 00 – Common Work Procedures for Thermal and Moisture Protection.

1.3 REFERENCES

A. American Society for Testing and materials (ASTM):
1. ASTM C165 Standard Test Method for Measuring Compressive Properties of Thermal Insulation.
2. ASTM C208 Standard Specification for Cellulosic Fiber Insulation Board.
3. ASTM C209 Standard Test Method for Cellulosic Fiber Insulating Board.
4. ASTM C272 Standard Test Method for Water Absorption of Core Materials for Structural Sandwich Constructions.
5. ASTM C1396 Standard Specification for Gypsum Wallboard.
6. ASTM C518 Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
7. ASTM C578 Standard Specification for Perlite Thermal Insulation Board.
8. ASTM C728 Standard Test Methods for Fire Test of Roof Coverings.
9. ASTM C1289 Standard Specification for Faced Rigid Polyisocyanurate Thermal Insulation.
10. ASTM D5 Standard Test Method for Penetration of Bituminous Materials.
11. ASTM D36 Standard Test Method for Softening Point of Bitumen (Ring and Ball Apparatus).
12. ASTM D312 Standard Specification for Asphalt Used in Roofing.
13. ASTM D412 Standard Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers-Tension.
14. ASTM D1621 Standard Test Method for Compressive Properties of Rigid Cellular Plastics.
15. ASTM D1622 Standard Test Method for Apparent Density of Rigid Cellular Plastics.
16. ASTM D1863 Standard Specification for Mineral Aggregate Used on Built-Up Roofs.
17. ASTM D2126 Standard Test Method for Response off Rigid Cellular Plastics to Thermal Humid Aging.
18. ASTM D2178 Standard Specification for Asphalt Glass Felts used in Roofing and Waterproofing.
19. ASTM D4601 Standard Specification for Asphalt-Coated Glass Fiber Base Sheet Used in Roofing.
20. ASTM D5147 Standard Sampling and Testing Modified Bituminous Sheet Material.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

B. Factory Mutual Research (FM):
   1. Roof Assembly Classifications.

C. National Roofing Contractors Association (NRCA):
   1. Roofing and Waterproofing Manual.

D. Underwriters Laboratories, Inc. (UL):
   1. Fire Hazard Classifications.

E. Warnock Hersey (WH):
   1. Fire Hazard Classifications.

F. Steel Deck Institute, St. Louis, Missouri (SDI)

G. Southern Pine Inspection Bureau, Pensacola, Florida (SPIB)

H. Insulation Board, Polyisocyanurate (FS HH-I-1972)

1.4 SUBMITTALS

A. Product Data: Provide manufacturer's specification data sheets for each product in accordance with Division 01 Section Submittal Procedures. 01300.

B. Provide approval letters from insulation manufacturer for use of their insulation within this particular roofing system type.

C. Provide a sample of each insulation type.

D. Shop Drawings
   1. Submit manufacturer's shop drawings indicating complete installation details of tapered insulation system, including identification of each insulation block, sequence of installation, layout, drain locations, roof slopes, thicknesses, crickets and saddles.
   2. Shop drawing shall include: Outline of roof, location of drains, complete board layout of tapered insulation components, thickness and the average "R" value for the completed insulation system.

E. Certification
   1. Submit roof manufacturer's certification that insulation fasteners furnished are acceptable to roof manufacturer.
   2. Submit roof manufacturer's certification that insulation furnished is acceptable to roofing manufacturer as a component of roofing system and is eligible for roof manufacturer's system warranty.

1.5 QUALITY ASSURANCE

A. Fire Classification, ASTM E-108.

B. Manufacturer's Certificate: Certify that roof system furnished is approved by Factory Mutual, Underwriters Laboratories, Warnock Hersey or approved third party testing facility in accordance with ASTM E108, Class [A or B or C] for external fire and meets local or nationally recognized building codes.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

C. Manufacturer's Certificate: Certify that the roof system is adhered properly to meet or exceed the requirements of FM [1-90].

D. Pre-installation meeting: Refer to Division 07 roofing specifications for pre-installation meeting requirements.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver products to site with seals and labels intact, in manufacturer's original containers, dry and undamaged.

B. Store all insulation materials in a manner to protect them from the wind, sun and moisture damage prior to and during installation. Any insulation that has been exposed to any moisture shall be removed from the project site.

C. Keep materials enclosed in a watertight, ventilated enclosure (i.e. tarpaulins).

D. Store materials off the ground. Any warped, broken or wet insulation boards shall be removed from the site.

PART 2 – PRODUCTS

2.1 INSULATION MATERIALS

A. Thermal Insulation Properties and Approved Insulation Boards.
1. Rigid Polyisocyanurate Roof Insulation; ASTM C1289:
a. Qualities: Rigid, closed cell polyisocyanurate foam core bonded to heavy duty glass fiber mat facers.
b. Thickness: Minimum 4.5"
c. R-Value: Minimum 25.
d. Compliances: UL, WH or FM listed under Roofing Systems Federal Specification HH-I-1972, Class 1.
e. Acceptable Products:
1) ENRGY-3; Johns Manville
2) Hytherm; Dow
3) EnergyGuard; GAF
4) Approved Equivalent
2. Securock Roof Board
a. Qualities: Nonstructural, noncombustible, homogenous composition panel.
b. Board Size: Four by eight feet (4'x8').
c. Thickness: One half (1/2) inch.
d. R-Value: .5
e. Compliances: UL. WH or FM listed under Roofing Systems.
f. Manufacturer: USG

2.2 RELATED MATERIALS

A. Fiber Cant and Tapered Edge Strips: Performed rigid insulation units of sizes/shapes indicated, matching insulation board or of perlite or organic fiberboard, as per the approved manufacturer.
1. Acceptable Manufacturers:
a. The Garland Company, Inc.
b. Johns Manville
c. GAF
d. Approved Equivalent

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

B. Protection Board: Pre-molded semi-rigid asphalt composition board one half (1/2) inch.

C. Roof Board Joint Tape: Six (6) inches wide glass fiber mat with adhesive compatible with insulation board facers.

D. Roof Deck Insulation Adhesive: Insul-Lock HR - Dual-component, high rise foam adhesive as recommended by insulation manufacturer and approved by FM indicated ratings.
   1. Tensile Strength (ASTM D412)……250 psi
   2. Density (ASTM D1875)……..8.5 lbs./gal.
   3. Viscosity (ASTM D2556)……22,000 to 60,000 cP.
   4. 2 `Peel Strength (ASTM D903)…..17 lb/in.
   5. 3 `Flexibility (ASTM D816)……Pass @ -70°F

E. Fasteners: Corrosion resistant screw fastener as recommended by roof membrane manufacturer.
   1. Factory Mutual Tested and Approved with three (3) inches coated disc for I-90 rating, length required to penetrate metal deck one inch.

PART 3 – EXECUTION

3.1 EXECUTION, GENERAL

A. Comply with requirements of Division 01 Section “Common Execution Requirements.”

3.2 INSPECTOR OF SURFACES

A. Roofing contractor shall be responsible for preparing an adequate substrate to receive insulation.
   1. Verify that work which penetrates roof deck has been completed.
   2. Verify that wood nailers are properly and securely installed.
   3. Examine surfaces for defects, rough spots, ridges, depressions, foreign material, moisture, and unevenness.
   4. Do not proceed until defects are corrected.
   5. Do not apply insulation until substrate is sufficiently dry.
   6. Broom clean substrate immediately prior to application.
   7. Use additional insulation to fill depressions and low spots that would otherwise cause ponding water.
   8. Verify that temporary roof has been completed.

3.3 INSTALLATION

A. Attachment with Mechanical Fasteners
   1. Approved insulation board shall be fully attached to the deck with an approved mechanical fastening system. As a minimum, the amount of fasteners shall be in accordance with manufacturer’s recommendation for FM I-90 system. Otherwise, a minimum of one fastener per two square feet shall be installed.
   2. Filler pieces of insulation require at least two fasteners per piece if size of insulation is less than four square feet.
   3. Spacing pattern of fasteners shall be as per manufacturer’s recommendations to meet the FM requirements. Placement of any fastener from edge of

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

insulation board shall be a minimum of three inches, and a maximum of six (6) inches.

4. Minimum penetration into deck shall be as recommended by the fastener manufacturer. There is a one (1) inch minimum for metal, wood and structural concrete decks where not specified by the manufacturer. For gypsum and cement-wood fiber decks, penetration shall be determined from pull-out test results with a minimum penetration of one and one-half (1 ½) inches.
5. Gypsum and cementitious wood fiber decks: Where the roof deck is visible from the building interior, the contractor shall ensure no penetration of fasteners through underside of the deck. Any holes or spalling caused by fastener installation shall be repaired by the roofing contractor. Where the new roof system thickness exceeds an amount so that a minimum of 1 ½ of penetration cannot be achieved with an Olympic TB Fastener, or approved equivalent, then (and only then) toggle bolts may be used to secure installation to the deck.
6. Tape joints of insulation as per manufacturer's requirements.

B. Attachment with Insulation Adhesive Approved by Factory Mutual (FM).

1. Ensure all surfaces are clean, dry, free of dirt, debris, oils, loose ore embedded gravel, unadhered coatings, deteriorated membrane and other contaminants that may inhibit adhesion.
2. Apply insulation adhesive directly to the substrate using a ribbon pattern with one quarter to one half (1/4-1/2) inch wide beads 12 inches o.c., using either the manual applicator or an automatic applicator, at a rate of one (1) gallon per one hundred (150) square feet per cartridge.
3. Immediately place insulation boards into wet adhesive. Do not slide boards into place. Do not allow the adhesive to skin over before installing insulation boards.
4. Briefly step each board into place to ensure contact with the adhesive. Substrates with irregular surfaces may prevent the insulation board from making positive contact with the adhesive. Relief cuts or temporary weights may be required to ensure proper contact.
5. All boards shall be cut and fitted where the roof deck intersects a vertical surface. The boards shall be cut to fit a minimum of one quarter (1/4) inch away from the vertical surface.
6. Tape joints of insulation as per manufacturer's requirements.

3.4 CLEANING

A. Remove debris and cartons from roof deck. Leave insulation clean and dry, ready to receive roofing membrane.

3.5 CONSTRUCTION WASTE MANAGEMENT

A. Remove and properly dispose of waste products generated during installation. Comply with requirements of authorities having jurisdiction.

END OF SECTION

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

SECTION 075500 MODIFIED BITUMINOUS MEMBRANE ROOFING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Cold Applied 2-Ply Asphalt Roofing (Versiply). (2.2.)(3.4)

B. Accessories. (2.19)

C. Edge Treatment and Roof Penetration Flashings. (2.20)(3.9)

1.2 RELATED SECTIONS

A. Section 06100 - Rough Carpentry.

B. Section 06114 - Wood Blocking and Curbing: Wood nailers and cant strips.

C. Section 07220 - Insulation Board: Insulation and fastening.

D. Section 07620 - Sheet Metal Flashing and Trim: Weather protection for base flashings.

E. Section 07710 - Manufactured Roof Specialties: Counter flashing gravel stops, and fascia.

F. Section 15120 - Piping Specialties: Roof Drains, Sumps.

1.3 REFERENCES

A. ASTM D 41 - Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing.

B. ASTM D 312 - Standard Specification for Asphalt used in Roofing.

C. ASTM D 451 - Standard Test Method for Sieve Analysis of Granular Mineral Surfacing for Asphalt Roofing Products.

D. ASTM D 1970 - Specification for Sheet Materials, Self-Adhering Polymer Modified Bituminous, Used as Steep Roofing Underlayment for Ice Dam Protection.

E. ASTM D 1079 Standard Terminology Relating to Roofing, Waterproofing and Bituminous Materials.

F. ASTM D 1227 Standard Specification for Emulsified Asphalt Used as a Protective Coating for Roofing.

G. ASTM D 1863 Standard Specification for Mineral Aggregate Used as a Protective Coating for Roofing.

H. ASTM D 2824 Standard Specification for Aluminum-Pigmented Asphalt Roof Coating.

I. ASTM D 4586 Standard Specification for Asphalt Roof Cement, Asbestos-Free.

J. ASTM D 5147 Standard Test Method for Sampling and Testing Modified Bituminous Sheet Materials.

K. ASTM D 6162 Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using a Combination of Polyester and Glass Fiber Reinforcements.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

L. ASTM D 6163 Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Glass Fiber Reinforcements.

M. ASTM D 6164 - Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Polyester Reinforcements.

N. ASTM E 108 - Standard Test Methods for Fire Test of Roof Coverings

O. Factory Mutual Research (FM): Roof Assembly Classifications.

P. National Roofing Contractors Association (NRCA): Roofing and Waterproofing Manual.

Q. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA) - Architectural Sheet Metal Manual.

R. Underwriters Laboratories, Inc. (UL): Fire Hazard Classifications.

S. Warnock Hersey (WH): Fire Hazard Classifications.

T. ANSI-SPRI ES-1 Wind Design Standard for Edge Systems used with Low Slope Roofing Systems.

U. ASCE 7, Minimum Design Loads for Buildings and Other Structures

V. UL - Fire Resistance Directory.

W. FM Approvals - Roof Coverings and/or RoofNav assembly database.

X. FBC - Florida Building Code.

Y. Miami-Dade Building Code Compliance - N.O.A. (Notice of Acceptance).

Z. California Title 24 Energy Efficient Standards.

1.4 DESIGN / PERFORMANCE REQUIREMENTS

A. Perform work in accordance with all federal, state and local codes.

B. Exterior Fire Test Exposure: Roof system shall achieve a UL, FM or WH Class rating for roof slopes indicated on the Drawings as follows:
   1. Factory Mutual Class A Rating.
   2. Underwriters Laboratory Class A Rating.
   3. Warnock Hersey Class A Rating.

C. Design Requirements:
   1. Uniform Wind Uplift Load Capacity
      a. Installed roof system shall withstand negative (uplift) design wind loading pressures complying with the following criteria.
         1) Design Code: ASCE 7, Method 2 for Components and Cladding.
         2) Importance Category:
            a) IV
         3) Importance Factor of:
            a) 1.0
         4) Wind Speed: 155 mph
         5) Ultimate Pullout Value: 456 pounds per each of the fastener
         6) Exposure Category:
            a) D.
         7) Design Roof Height: ___ feet.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

8) Minimum Building Width: ___ feet.
9) Roof Pitch: 1/4:12.
10) Roof Area Design Uplift Pressure:
a) Zone 1 - Field of roof 38.1 psf
b) Zone 2 - Eaves, ridges, hips and rakes 64.0 psf
c) Zone 3 - Corners 96.3 psf

2. Snow Load: ___ psf.
3. Live Load: 20 psf, or not to exceed original building design.
4. Dead Load:
   a. Installation of new roofing materials shall not exceed the dead load capacity of the existing roof structure.

D. Energy Star: Roof System shall comply with the initial and aged reflectivity required by the U.S. Federal Government's Energy Star program.

1.5 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
1. Preparation instructions and recommendations.
2. Storage and handling requirements and recommendations.
3. Installation instructions.

C. Shop Drawings: Submit shop drawings including installation details of roofing, flashing, fastening, and insulation, including notation of roof slopes and fastening patterns of insulation and base modified bitumen membrane, prior to job start.

D. Design Pressure Calculations: Submit design pressure calculations for the roof area in accordance with ASCE 7 and local Building Code requirements. Include a roof system attachment analysis report, certifying the system's compliance with applicable wind load requirements before Work begins. Report shall be signed and sealed by a Professional Engineer registered in the State of the Project who has provided roof system attachment analysis for not less than 5 consecutive years.

E. LEED Submittals: Provide documentation of how the requirements of Credit will be met:
1. List of proposed materials with recycled content. Indicate post-consumer recycled content and pre-consumer recycled content for each product having recycled content.
2. Product data and certification letter indicating percentages by weight of post-consumer and pre-consumer recycled content for products having recycled content.
3. Product reflectivity and emissivity criteria to qualify for one point under the LEED credit category, Credit 7.2, Landscape & Exterior Design to Reduce Heat Island - Roof.

F. Recycled or Bio-Based Materials: Provide third party certification through UL Environment of roof System membranes containing recycled or bio based materials.

G. Verification Samples: For each modified bituminous membrane ply product specified, two samples, minimum size 6 inches (150 mm) square, representing actual product, color, and patterns.

H. Closeout Submittals: Provide manufacturer's maintenance instructions that include recommendations for periodic inspection and maintenance of all completed roofing work. Provide product warranty executed by the manufacturer. Assist Owner in preparation and submittal of roof installation acceptance certification as may be necessary in connection with fire and extended coverage insurance on roofing and associated work.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with NRCA Roofing and Waterproofing Manual.

B. Manufacturer Qualifications: Company specializing in manufacturing products specified with documented ISO 9001 certification and minimum of twelve years of documented experience and must not have been in Chapter 11 bankruptcy during the last five years.

C. Installer Qualifications: Company specializing in performing Work of this section with minimum five years documented experience and a certified Pre-Approved Garland Contractor.

D. Risk Minimization and Quality Assurance Services: Manufacturer to provide on site inspections and reports to owner once per week from start of project through completion.

E. Installer's Field Supervision: Maintain a full-time Supervisor/Foreman on job site during all phases of roofing work while roofing work is in progress.

F. Product Certification: Provide manufacturer's certification that materials are manufactured in the United States and conform to requirements specified herein, are chemically and physically compatible with each other, and are suitable for inclusion within the total roof system specified herein.

G. Source Limitations: Obtain all components of roof system from a single manufacturer. Secondary products that are required shall be recommended and approved in writing by the roofing system Manufacturer. Upon request of the Architect or Owner, submit Manufacturer's written approval of secondary components in list form, signed by an authorized agent of the Manufacturer.

1.7 PRE-INSTALLATION MEETINGS

A. Convene minimum two weeks prior to commencing Work of this section.

B. Review installation procedures and coordination required with related Work.

C. Inspect and make notes of job conditions prior to installation:
   1. Record minutes of the conference and provide copies to all parties present.
   2. Identify all outstanding issues in writing designating the responsible party for follow-up action and the timetable for completion.
   3. Installation of roofing system shall not begin until all outstanding issues are resolved to the satisfaction of the Architect.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store products in manufacturer's unopened packaging with labels intact until ready for installation.

B. Store all roofing materials in a dry place, on pallets or raised platforms, out of direct exposure to the elements until time of application. Store materials at least 4 inches above ground level and covered with "breathable" tarpaulins.

C. Stored in accordance with the instructions of the manufacturer prior to their application or installation. Store roll goods on end on a clean flat surface except store KEE-Stone FB 60 rolls flat on a clean flat surface. No wet or damaged materials will be used in the application.

D. Store at room temperature wherever possible, until immediately prior to installing the roll. During winter, store materials in a heated location with a 50 degree F (10 degree C) minimum temperature, removed only as needed for immediate use. Keep materials away

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

from open flame or welding sparks.

E. Avoid stockpiling of materials on roofs without first obtaining acceptance from the Architect/Engineer.

F. Adhesive storage shall be between the range of above 50 degree F (10 degree C) and below 80 degree F (27 degree C). Area of storage shall be constructed for flammable storage.

1.9 COORDINATION

A. Coordinate Work with installing associated metal flashings as work of this section proceeds.

1.10 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.11 WARRANTY

A. Upon completion of the work, provide the Manufacturer's written and signed Edge-To-Edge NDL System Warranty, warranting that, if a leak develops in the roof during the term of this warranty, due either to defective material or defective workmanship by the installer, the manufacturer shall provide the Owner, at the Manufacturer's expense, with the labor and material necessary to return the defective area to a watertight condition including Garland Metal Components.
   1. Warranty Period:
      a. 30 years from date of acceptance.

B. Installer is to guarantee all work against defects in materials and workmanship for a period indicated following final acceptance of the Work.
   1. Warranty Period:
      a. 2 years from date of acceptance.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer: Garland Company, Inc. (The); 3800 E. 91st St., Cleveland, OH 44105. ASD. Paxton Whitmore Phone: 804-334-6713. pwhitmore@garlandind.com. Web Site: www.garlandco.com.

B. Requests for substitutions will be considered in accordance with provisions of Section 01600.

C. The Products specified are intended and the Standard of Quality for the products required for this project. If other products are proposed the bidder must disclose in the bid the manufacturer and the products that they intend to use on the Project. If no manufacturer and products are listed, the bid may be accepted only with the use of products specified.
   1. Bidder will not be allowed to change materials after the bid opening date.
   2. If alternate products are included in the bid, the products must be equal to or exceed the products specified. Supporting technical data shall be submitted to the Architect/ Owner for approval prior to acceptance.
   3. In making a request for substitution, the Bidder/Roofing Contractor represents that it has:
      a. Personally investigated the proposed product or method, and determined that it is equal or superior in all respects to that specified.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

b. Will provide the same guarantee for substitution as for the product and method specified.
c. Will coordinate installation of accepted substitution in work, making such changes as may be required for work to be completed in all respects.
d. Will waive all claims for additional cost related to substitution, which consequently become apparent.
e. Cost data is complete and includes all related cost under his/her contract or other contracts, which may be affected by the substitution.
f. Will reimburse the Owner for all redesign cost by the Architect for accommodation of the substitution.

4. Architect/ Owner reserves the right to be the final authority on the acceptance or rejection of any or all bids, proposed alternate roofing systems or materials that has met ALL specified requirement criteria.
5. Failure to submit substitution package, or any portion thereof requested, will result in immediate disqualification and consideration for that particular contractors request for manufacturer substitution.

2.2 COLD APPLIED 2-PLY ROOF SYSTEM - VERSIPLY

A. Base (Ply) Sheet: One ply bonded to the prepared substrate with Interply Adhesive:
1. Viking CIF-2HM Base Sheet (80 mil):

B. Modified Cap (Ply) Sheet: One ply bonded to the prepared substrate with Interply Adhesive:
1. VersiPly Mineral:

C. Interply Adhesive: (1 and 2)
1. Weatherking :

2.3 ACCESSORIES:

A. Roof Insulation: In accordance with Section 07220.

B. Roof Insulation: Provide G-P Gypsum DenDeck Prime, G-P Gypsum DenDeck DuraGuard, USG Securrock for proper adhesion of the base sheet in accordance with Section 07220.

C. Nails and Fasteners: Non-ferrous metal or galvanized steel, except that hard copper nails shall be used with copper; aluminum or stainless steel nails shall be used with aluminum; and stainless steel nails shall be used with stainless steel, Fasteners shall be self-clinching type of penetrating type as recommended by the deck manufacturer. Fasten nails and fasteners flush-driven through flat metal discs not less than 1 inch (25 mm) diameter. Omit metal discs when one-piece composite nails or fasteners with heads not less than 1 inch (25 mm) diameter are used.

D. Glass Fiber Cant - Glass Cant: Continuous triangular cross Section made of inorganic fibrous glass used as a cant strip as recommended and furnished by the membrane manufacturer.

2.4 EDGE TREATMENT AND ROOF PENETRATION FLASHINGS

A. Pre-Manufactured Edge Metal: R-Mer Force Flash-less Snap-On Fascia Cover and Splice Plate.
1. Zinc-coated steel, ASTM A653, coating designation G-90, in thickness of 24 gauge, 22 gauge or 20 gauge, 36" to 48" by coil length, chemically treated, commercial or lock-forming quality
2. Aluminum, ASTM B209, alloy 3105-H14, in thickness of .032" nom. or .040" nom. or .050" nom. or .063" nom.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

B. Pre-Manufactured Edge Metal: R-Mer Force Flash-less Snap-On Fascia Extruded Base Anchor and Components.
   1. Base Anchor: 6005A-T61 extruded aluminum.
   2. Compression Seal for top of anchor: TPE thermoplastic elastomer.
   3. Sealant for Flange: Green-Lock Sealant XL: Single-component high performance 100% solids, interior and exterior polyether joint sealant.

C. Pre-Manufactured Edge Metal Finishes:
   1. Exposed and unexposed surfaces for mill finish flashing, fascia, and coping cap, as shipped from the mill
   2. Exposed surfaces for coated panels:
      a. Steel Finishes: fluorocarbon finish. Epoxy primer baked both sides, .2-.25 mils thickness as approved by finish coat manufacturer.
         Weathering finish as referred by National Coil Coaters Association (NCCA). Provided with the following properties.
         1) Pencil Hardness: ASTM D3363, HB-H / NCCA II-2.
         2) Bend: ASTM D-4145, O-T / NCCA II-19
         3) Cross-Hatch Adhesion: ASTM D3359, no loss of adhesion
         4) Gloss (60 deg. angle): ASTM D523, 25+/-5%
         5) Reverse Bend: ASTM D2794, no cracking or loss of adhesion
         6) Nominal Thickness: ASTM D1005
            a) Primer: 0.2 mils
            b) Topcoat, 0.7 mils min
            c) Clear Coat (optional, only used with 22 ga. steel) 0.3 mils
         7) Color: Provide as specified. (Subject to minimum quantities)

D. Manufactured Flashing Ply: R-MER Ply galvalume steel and modified membrane roof termination/flashing system comprised of a flexible, tie-in membrane, factory-bonded within a watertight, mechanical seal to a galvalume steel vertical flashing or fascia reveal profile. Siliconized modified polyester, epoxy primer baked both sides. Modified membrane is a 180 mil, Styrene-Butadiene-Styrene SBS (Styrene-Butadiene-Styrene) rubber modified membrane reinforced with a dual fiberglass scrim.
   1. Tensile Strength, ASTM D 5, 147
      a. 2 in/min. @ 73.4 +/- 3.6 deg. F MD 210 lbf/in CMD 210 lbf/in
      b. 50 mm/min. @ 23 +/- 3 deg. C MD 36.75 kN/m CMD 36.75 kN/m
   2. Tear Strength, ASTM D 5147
      a. 2 in/min. @ 73.4 +/- 3.6 deg. F MD 250 lbf CMD 250 lbf
      b. 50 mm/min. @ 23 +/- 3 deg. C MD 1112 N CMD 1112 N
   3. Elongation at Maximum Tensile, ASTM D5147
      a. 2 in/min. @ 73.4 +/- 3.6 deg. F MD 6.0% CMD 6.0%
      b. 50 mm/min. @ 23 +/- 3 deg. C MD 6.0% CMD 6.0%
   4. Low Temperature Flexibility, ASTM D5147: Passes -30 deg. F (-34 deg. C)
   5. Coating Properties:
      a. PencilHardness, NCCA II-2 - ASTM D3363, F-H
      b. Bend, NCCA II-19, ASTM D 4145, 2-T
      c. Adhesion / Cross-Hatch, ASTM D3359, no loss of adhesion
      d. Gloss (60 deg. angle), ASTM D 523, 90 +/- 5%
      e. Reverse Impact, ASTM D 2794no cracking or loss of adhesion
      f. Nominal Thickness, ASTM D 1005, primer and topcoat 1.0 mils.

E. Plumbing stacks should be 4lb (1.8kg) sheet lead formed and rolled.

F. Fabricated Flashings: Fabricated flashings and trim are specified in Section 07620.
   1. Fabricated flashings and trim shall conform to the detail requirements of SMACNA "Architectural Sheet Metal Manual" and/or the CDA Copper Development Association "Copper in Architecture - Handbook" as applicable.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

G. Manufactured Roof Specialties: Shop fabricated copings, fascia, gravel stops, control joints, expansion joints, joint covers and related flashings and trim are specified in Section 07710.
   1. Manufactured roof specialties shall conform to the detail requirements of SMACNA "Architectural Sheet Metal Manual" and/or the NRCA "Roofing and Waterproofing Manual" as applicable.

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. Inspect and approve the deck condition, slopes and fastener backing if applicable, parapet walls, expansion joints, roof drains, stack vents, vent outlets, nailers and surfaces and elements.

C. Verify that work penetrating the roof deck, or which may otherwise affect the roofing, has been properly completed.

D. If substrate preparation and other conditions are the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. General: Clean surfaces thoroughly prior to installation.
   1. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
   2. Fill substrate surface voids that are greater than 1/4 inch wide with an acceptable fill material.
   3. Roof surface to receive roofing system shall be smooth, clean, free from loose gravel, dirt and debris, dry and structurally sound.
   4. Wherever necessary, all surfaces to receive roofing materials shall be power broom and vacuumed to remove debris and loose matter prior to starting work.
   5. Do not apply roofing during inclement weather. Do not apply roofing membrane to damp, frozen, dirty, or dusty surfaces.
   6. Fasteners and plates for fastening components mechanically to the substrate shall provide a minimum pullout capacity of 300 lbs. (136 k) per fastener. Base or ply sheets attached with cap nails require a minimum pullout capacity of 40 lb. per nail.
   7. Prime decks where required, in accordance with requirements and recommendations of the primer and deck manufacturer.

B. Metal Deck: Metal deck shall be installed as specified in Section
   1. Fastening of the deck should comply with the anticipated live and dead loads pertaining to the building as well as applicable Code.
   2. Steel decks shall be minimum 22-gauge factory galvanized or zinc alloy coated for protection against corrosion.
   3. Suitable insulation shall be mechanically attached as recommended by the insulation manufacturer.
   4. Decks shall comply with the gauge and span requirements in the current Factory Mutual FM Approval Guide and be installed in accordance with Loss Prevention Data Sheet 1-28 or specific FM approval.
   5. When re-roofing over steel decks, surface corrosion shall be removed, and repairs to severely corroded areas made. Loose or inadequately secured decking shall be fastened, and irreparable or otherwise defective decking shall be replaced.

3.3 INSTALLATION - GENERAL

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

A. Install modified bitumen membranes and flashings in accordance with manufacturer's instructions and with the recommendations provided by the National Roofing Contractors Association's Roofing & Waterproofing Manual, the Asphalt Roofing Manufacturers Association, and applicable codes.

B. General: Avoid installation of modified bitumen membranes at temperatures lower than 40-45 degrees F. When work at such temperatures unavoidable use the following precautions:
   1. Take extra care during cold weather installation and when ambient temperatures are affected by wind or humidity, to ensure adequate bonding is achieved between the surfaces to be joined. Use extra care at material seam welds and where adhesion of the applied product to the appropriately prepared substrate as the substrate can be affected by such temperature constraints as well.
   2. Unrolling of cold materials, under low ambient conditions must be avoided to prevent the likelihood of unnecessary stress cracking. Rolls must be at least 40 degrees F at the time of application. If the membrane roll becomes stiff or difficult to install, it must be replaced with roll from a heated storage area.

C. Commence installation of the roofing system at the lowest point of the roof (or roof area), working up the slope toward the highest point. Lap sheets shingle fashion so as to constantly shed water

D. All slopes greater than 2:12 require back-nailing to prevent slippage of the ply sheets. Use ring or spiral-shank 1 inch cap nails, or screws and plates at a rate of 1 fastener per ply (including the membrane) at each insulation stop. Place insulation stops at 16 ft o.c. for slopes less than 3:12 and 4 feet o.c. for slopes greater than 3:12. On non-insulated systems, nail each ply directly into the deck at the rate specified above. When slope exceeds 2:12, install all plies parallel to the slope (strapping) to facilitate backnailing. Install 4 additional fasteners at the upper edge of the membrane when strapping the plies.

3.4 INSTALLATION COLD APPLIED ROOF SYSTEM

A. Base Ply: Cut base ply sheets into 18 foot lengths and allow plies to relax before installing. Install base sheet in Interply Adhesive: applied at the rate required by the manufacturer. Shingle base sheets uniformly to achieve one ply throughout over the prepared substrate. Shingle in proper direction to shed water on each large area of roofing.
   1. Lap ply sheet ends 8 inches. Stagger end laps 12 inches minimum.
   2. Solidly bond to the substrate and adjacent ply with specified cold adhesive at the rate of 2 to 2-1/2 gallons per 100 square feet.
   3. Roll must push a puddle of adhesive in front of it with adhesive slightly visible at all side laps. Use care to eliminate air entrapment under the membrane.
   4. Install subsequent rolls of modified across the roof as above with a minimum of 4 inch side laps and 8 inch staggered end laps. Lay modified membrane in the same direction as the underlayers but the laps shall not coincide with the laps of the base layers.
   5. Extend plies 2 inches beyond top edges of cants at wall and projection bases.
   6. Install base flashing ply to all perimeter and projection details.
   7. Allow the one ply of base sheet to cure at least 30 minutes before installing the modified membrane. However, the modified membrane must be installed the same day as the base plies.

B. Modified Cap Ply(s): Cut cap ply sheets into 18 foot lengths and allow plies to relax before installing. Install in interplay adhesive applied at the rate required by the manufacturer. Shingle sheets uniformly over the prepared substrate to achieve the number of plys specified. Shingle in proper direction to shed water on each large area of roofing.
   1. Lap ply sheet ends 8 inches. Stagger end laps 12 inches minimum.
   2. Solidly bond to the base layers with specified cold adhesive at the rate of 2 to 2-1/2 gallons per 100 square feet.

3. Roll must push a puddle of adhesive in front of it with adhesive slightly visible at all side laps. Care should be taken to eliminate air entrapment under the membrane.
4. Install subsequent rolls of modified across the roof as above with a minimum of 4 inch side laps and 8 inch staggered end laps. Lay modified membrane in the same direction as the underlayers but the laps shall not coincide with the laps of the base layers.
5. Allow cold adhesive to set for 5 to 10 minutes before installing the top layer of modified membrane.
6. Extend membrane 2 inches beyond top edge of all cants in full moppings of the cold adhesive as shown on the Drawings.

C. Fibrous Cant Strips: Provide non-combustible perlite or glass fiber cant strips at all wall/curb detail treatments where angle changes are greater than 45 degrees. Cant may be set in approved cold adhesives, hot asphalt or mechanically attached with approved plates and fasteners.

D. Wood Blocking, Nailers and Cant Strips: Provide wood blocking, nailers and cant strips as specified in Section 06114.
1. Provide nailers at all roof perimeters and penetrations for fastening membrane flashings and sheet metal components.
2. Wood nailers should match the height of any insulation, providing a smooth and even transition between flashing and insulation areas.
3. Nailer lengths should be spaced with a minimum 1/8 inch gap for expansion and contraction between each length or change of direction.
4. Nailers and flashings should be fastened in accordance with Factory Mutual "Loss Prevention Data Sheet 1- 49, Perimeter Flashing" and be designed to be capable of resisting a minimum force of 200 lbs/lineal foot in any direction.

E. Metal Work: Provide metal flashings, counter flashings, parapet coping caps and thru-wall flashings as specified in Section 07620 or Section 07710. Install in accordance with the SMACNA "Architectural Sheet Metal Manual" or the NRCA Roofing Waterproofing manual.

3.5 INSTALLATION EDGE TREATMENT AND ROOF PENETRATION FLASHING

A. Metal Edge:
1. Inspect the nailers to assure proper attachment and configuration.
2. Run base ply over the edge. Assure coverage of all wood nailers.
3. Install continuous cleat and fasten at 6 inches (152 mm) o.c.
4. Install new metal edge hooked to continuous cleat and set in bed of roof cement. Fasten flange to wood nailers every 3 inches (76 mm) o.c. staggered.
5. Prime metal edge and allow to dry. Do not prime when Green-Lock Membrane Adhesive is used for the base ply lightly sand metal to improve bond.
6. Strip in flange with base flashing ply covering entire flange in bitumen with 6 inches (152 mm) on to the field of roof. Assure ply laps do not coincide with metal laps.
7. Install the thermoplastic Cap Ply in bitumen or foam adhesive over the base flashing ply, 9 inches (228 mm) on to the field of the roof. Heat weld outside edge of the membrane to the Thermoplastic Cap Ply of the field.

B. Pre-Manufactured Flash-less Snap-On Metal Edge System:
1. Position base ply of the Built-Up and/or Modified Roofing membrane over the roof edge covering nailers completely, fastening eight (8) inches on center. Install membrane and thermoplastic cap ply with proper material and procedure according to manufacturer's recommendations. Cap ply shall stop at the edge of the roof and shall not turn over the edge of the nailers.
2. Prior to installing the base anchor, assure a level plane is present. If not, shim the roof edge surface as required.
3. Extruded base anchor: Apply two 1/4" beads of Green-Lock Sealant XL or equal on

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

the bottom surface of the top flange of the extruded anchor.

4. Set the extruded anchor on the edge and face fasten through pre-punched slots every 18 inches o.c. for 5.75 inch face fascia, and 18 inches o.c. staggered for any fascia size greater than 5.75 inches. Begin fastening 6 inches from ends.
5. Install Green-Lock Sealant XL or equal at the ends of the base frame to prevent water from running between base anchor joints.
6. Install compression seals every 40 inches on center in the slots located at the top of the extruded anchor.
7. Install fascia cover setting the top flange over the top flange and compression seals of the base anchor. Assure compression seals are in place during this process. Beginning on one end and working towards the opposite end, press downward firmly (do not rotate) until "snap" occurs and cover is engaged along entire length of miter.
8. Install splice plate at each end of the base anchor and fascia cover prior to the installation of the next adjacent ten-foot piece.

C. Plumbing Stack:

1. Minimum stack height is 12 inches (609 mm).
2. Run roof base ply over the entire surface of the roof. Seal the base of the stack with elastomeric sealant.
3. Prime flange of new sleeve. Install properly sized sleeves set in 1/4 inch (6 mm) bed of roof cement.
4. Install base flashing ply in bitumen.
5. Install thermoplastic cap ply in bitumen or foam adhesive.
6. Caulk the intersection of the membrane with elastomeric sealant.
7. Turn sleeve a minimum of 1 inch (25 mm) down inside of stack.

3.6 CLEANING

A. Clean up and remove daily from the site all wrappings, empty containers, paper, loose particles and other debris resulting from these operations.

B. Remove asphalt markings from finished surfaces.

C. Repair or replace defaced or disfigured finishes caused by Work of this section.

3.7 PROTECTION

A. Provide traffic ways; erect barriers, fences, guards, rails, enclosures, chutes and the like to protect personnel, roofs and structures, vehicles and utilities.

B. Protect exposed surfaces of finished walls with tarps to prevent damage.

C. Plywood for traffic ways required for material movement over existing roofs shall be not less than 5/8 inch (16 mm) thick.

D. In addition to the plywood listed above, an underlayment of minimum 1/2 inch (13 mm) recover board is required on new roofing.

E. Special permission shall be obtained from the Manufacturer before any traffic shall be permitted over new roofing.

3.8 FIELD QUALITY CONTROL

A. Inspection: Provide manufacturer's field observations at start-up and at intervals of approximately 30 percent, 60 percent and 90 percent completion. Provide a final inspection upon completion of the Work.

1. Warranty shall be issued upon manufacturer's acceptance of the installation.
2. Field observations shall be performed by a Sales Representative employed full-time

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

by the manufacturer and whose primary job description is to assist, inspect and approve membrane installations for the manufacturer.

3. Provide observation reports from the Sales Representative indicating procedures followed, weather conditions and any discrepancies found during inspection.
4. Provide a final report from the Sales Representative, certifying that the roofing system has been satisfactorily installed according to the project specifications, approved details and good general roofing practice.

3.9 SCHEDULES

A. Base (Ply) Sheet:
1. Viking CIF-2HM Base Sheet (80 mil): 80 mil SBS (Styrene-Butadiene-Styrene) rubber modified roofing membrane reinforced with a fiberglass scrim, performance requirements according to ASTM D 5147.
   a. Tensile Strength, ASTM D 5147
      1) 2 in/min. @ 73.4 +/- 3.6 deg. F MD 50 lbf/in XD 50 lbf/in
      2) 50mm/min. @ 23 +/- 2 deg. C MD 8.75 kN/m XD 8.75 kN/m
   b. Tear Strength, ASTM D 5147
      1) 2 in/min. @ 73.4 +/- 3.6 deg. F MD 100 lbf XD 100 lbf
      2) 50mm/min. @ 23 +/- 2 deg. C MD 444.8 N XD 444.8 N
   c. Elongation at Maximum Tensile, ASTM D 5147
      1) 2 in/min. @ 73.4 +/- 3.6 deg. F MD 2.0 % XD 2.0 %
      2) 50mm/min@ 23 +/- 2 deg. C MD 2.0 % XD 2.0 %
   d. Low Temperature Flexibility, ASTM D 5147, Passes -20 deg. F (-28.8 deg. C)

B. Modified Cap (Ply) Sheet:
1. VersiPly Mineral: 145 mil SBS (Styrene-Butadiene-Styrene) mineral surfaced, rubber modified roofing membrane with dual fiberglass reinforced scrim. ASTM D6163, Type III Grade S
   a. Tensile Strength, ASTM D 5147
      1) 2 in/min. @ 73.4 +/- 3.6 deg. F MD 220 lbf/in XD 220 lbf/in
      2) 50 mm/min. @ 23 +/- 2 deg. C MD 38.5 kN/m XD 38.5 kN/m
   b. Tear Strength, ASTM D 5147
      1) 2 in/min. @ 73.4 +/- 3.6 deg. F MD 300 lbf XD 300 lbf
      2) 50 mm/min. @ 23 +/- 2 deg. C MD 1335 N XD 1335 N
   c. Elongation at Maximum Tensile, ASTM D 5147
      1) 2 in/min. @ 73.4 +/- 3.6 deg. FMD 4.5% XD 4.5%
      2) 50 mm/min. @ 23 +/- 2 deg. C MD 4.5% XD 4.5%
   d. Low Temperature Flexibility, ASTM D 5147, Passes -30 deg. F (-34 deg. C)

C. Interply Adhesive:
1. Weatherking:Rubberized, polymer modified cold process asphalt roofing bitumen V.O.C. compliant ASTM D 3019. Performance Requirements:
   a. Non-Volatile Content ASTM D 4479 70%
   b. Density ASTM D1475 8.9 lbs./gal.
   c. Viscosity Stormer ASTM D562 400-500 grams
   d. Flash Point ASTM D 93 100 deg. F min. (37 deg. C)
   e. Slope: up to 3:12

END OF SECTION

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes:

1. Exterior sealants.
2. Exterior and interior traffic sealants.
3. Interior sealants.
4. Exterior and interior water immersed sealants.

B. Related Sections include the following:

1. Division 7 Section "Through Penetration Firestop System" for building joint-sealant systems.
2. Division 8 Section "Glazing" for glazing sealants.
3. Division 9 Section "Gypsum Board Assemblies" for sealing perimeter joints of gypsum board partitions to reduce sound transmission.
4. Division 9 Section "Acoustical Panel Ceilings" for sealing edge moldings at perimeters of acoustical ceilings.

1.3 SUBMITTALS

A. Shop Drawing:

1. Submit a Sealant Schedule, and related details, indicating specific installation and interface between sealants and building materials for each type of joint sealant and joint backing material used in this specification. Use SAME reference designations as indicated in this Specification for preparation of the Joint Sealant Schedule in Part 3.6. Submittals are subject to the requirements of Division 1 Specification Section “Submittals.”

B. Product Data:

1. For each joint-sealant product indicated.

C. Samples:

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

1. Submit standard cured color samples and charts for each sealant type illustrating full range of standard and custom colors.

D. Manufacturer's Certificate:

1. Signed by manufacturers of joint sealants certifying that products furnished comply with requirements and are suitable for the use indicated.
2. For manufacturer's products that include the phrase, "but are not limited to the following," the Contractor shall be responsible to provide certification that the submittal product complies with the specified product. This certification is subject to the requirements of Division 1 Specification Section "Submittals," Part 1, Definitions.

E. Qualifications Data:

1. 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. Provide SWRI (Sealant, Waterproofing and Restoration Institute) Validation Certificate.

F. Compatibility and Adhesion from sealant manufacturer indicating the following:

1. Building materials forming joint and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.
3. Preconstruction Compatibility and Adhesion Field Test for each sealant and building material.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data:

1. Submit recommended inspection intervals.
2. Submit instructions for repairing and replacing failed sealed joints.

1.5 QUALITY ASSURANCE

1. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project. Provide SWRI (Sealant, Waterproofing and Restoration Institute) Validation Certificate.

B. Source Limitations: Obtain each kind of joint sealant from single source from single manufacturer.

C. Mockups: Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

D. Preinstallation Conference: Conduct conference at Project site.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration date, pot life, curing time and mixing instructions for multicomponent materials.

B. Store and handle materials in compliance with manufacturer's written instructions to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants or other causes.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer.
2. When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below 40 deg F.
3. When joint substrates are wet.

B. Joint-Width Conditions: Do not proceed with installation of joint sealants where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.

C. Joint-Substrate Conditions: Do not proceed with installation of joint sealants until contaminants capable of interfering with adhesion are removed from joint substrates.

1.8 WARRANTY

A. General Warranty: Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Special Installer's Warranty: Written warranty, signed by Installer agreeing to repair or replace elastomeric joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

C. Special warranties specified in this Article exclude deterioration or failure of elastomeric joint sealants from the following:

1. Movement of the structure resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression caused by structural settlement or errors attributable to design or construction.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

2. Disintegration of joint substrates from natural causes exceeding design specifications.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience for the following sealant types:

1. Multi-component sealants cure by chemical reaction. Cure times are predictable depending on atmospheric temperature. Silicone sealant cure is not affected by temperature, however, frost and moisture at bond line will impair adhesion.
2. Single component sealants cure by reaction with moisture. Cure times will vary depending on atmospheric humidity and temperature.
3. Fast cure (FC) sealants provide lesser cure times than corresponding standard cure products. Longer cure times will permit more accumulation of dust and other air-borne contamination on surface of sealant, potentially causing apparent color change.
4. Sealant Types are M – Multi-Component and S – Single Component.
5. Sealant Grades are P – Pourable or Self-Leveling used for horizontal traffic joints and NS – Non-Sag or Gunnable used for vertical and non-traffic joints.
6. Sealant Classes are 25, 50, and 100/50 (extension/compression) representing movement capability in percent of joint width. Joint movement is based on the relative percentage of installed width. Design to a minimum of 4 times anticipated movement to accommodate design tolerances and expected movement based on coefficient of thermal expansion.
7. Sealant Uses are T – Traffic, NT – Non-Traffic, I – Immersion, M – Mortar, A – Aluminum, and O – Other. Use O includes color anodized aluminum, metals other than aluminum, painted surfaces, brick, stone, tile, and wood for example.
8. Immersion rated sealant applications require primer.

B. VOC Content of Interior Sealants: Sealants and sealant primers used inside the weatherproofing system shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

1. Architectural Sealants: 250 g/L.
2. Sealant Primers for Nonporous Substrates: 250 g/L.
3. Sealant Primers for Porous Substrates: 775 g/L.

C. Stain-Test-Response Characteristics: Where sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

D. Suitability for Contact with Food: Where sealants are indicated for joints that will come in repeated contact with food; provide products that comply with 21 CFR 177.2600.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

E. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range of standard and custom colors.

2.2 URETHANE SEALANT TYPES – For exterior or interior use.

A. **U1** - Multi-Component, Non-Sag, Urethane: ASTM C920, Type M, Grade NS, Class 50; Uses NT. Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

1. Pecora Corporation; Dynatrol II.
2. Polymeric Systems, Inc.; PSI-270.
3. Tremco, Inc.; Dymeric 240 FC.

B. **U2** - Multi-Component, Traffic-Grade Urethane: ASTM C920, Type M, Grade NS, Class 50; Uses T, Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:

1. Polymeric Systems, Inc.; PSI-270
2. Tremco, Inc.; Dymeric 240 FC.

C. **U3** - Single-Component, Non-Sag Urethane: ASTM C920, Type S, Grade NS, Class 100/50, Uses NT. Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

1. Sika Corporation, Construction Products Division; Sikaflex-15LM.
2. Tremco, Inc.; Dymonic 100

D. **U4** - Single-Component, Non-Sag Urethane: ASTM C920, Type S, Grade NS, Class 25, Uses NT. Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

1. Pecora Corporation; Dynatrol I-XL.
2. Sika Corporation, Construction Products Division; Sikaflex-1a.
3. Tremco, Inc.; Dymonic or Fulkem 116.

E. **U5** - Single-Component, Pourable, Traffic-Grade Urethane: ASTM C920, Type S, Grade P, Class 25, Uses T. Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

1. Pecora Corporation; Urexpan NR-201.
2. Tremco, Inc; Vulkem 45SSL.
3. Sika Corporation, Construction Products Division; Sikaflex-1CSL.

F. **U6** - Immersible, Single Component, Pourable, Traffic-Grade Urethane: ASTM C 920, Type S, Grade P, Class 25, Uses T and I. Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to the following:

1. Sika Corporation, Construction Products Division; Sikaflex-1CSL.
2. Tremco, Inc.; Vulkem 45 SSL.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

G. **U7** - Immersible, Multicomponent, Pourable, Traffic-Grade, Urethane Joint Sealant: ASTM C920. Type M, Grade P, Class 25, for Use T and I. Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

1. LymTal International, Inc.; Iso-Flex 880GB.
2. May National Associates, Inc.; Bondaflex PUR 2 SL.
3. Tremco, Inc.; Vulkem 245

2.3 SILICONE SEALANT TYPES – For exterior or interior use.

A. **S1** - Single-Component, Non-Staining, Non-Sag, Neutral-Curing Silicone: ASTM C920, Type S, Grade NS, Class 50, Uses NT. Subject to compliance with requirements, products that may be incorporated into the work include, but are not limited to the following:

1. Dow Corning Corporation; 756SMS, 791, 795 or 995.
2. Tremco, Inc.; Spectrem 3.
3. Pecora Corporation; 864, 895 or 898.

B. **S2** - Single Component, Non-Sag, Neutral-Curing Silicone: ASTM C920, Type S, Grade NS, Class 100/50, Uses NT. Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to the following:

1. Dow Corning Corporation; 790
2. Pecora Corporation; 301NS, 311NS.
3. Tremco, Inc.; Spectrem 1.

C. **S3** - Single Component, Non-Sag, Neutral-Curing Silicone: ASTM C920, Type S, Grade NS, Class 50, Uses NT. Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to the following:

1. Dow Corning Corporation; 791, 795 or 995.
2. Pecora Corporation; 864, 895 or 898.
3. Tremco, Inc.; Spectrem 2, Proglaze SSG.

D. **S-4** - Single Component, Field-Tintable, Non-Sag, Neutral-Curing Silicone: ASTM C920, Type S, Grade NS, Class 50, Uses NT. Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to the following:

a. Pecora Corporation; 890 FTS.
b. Tremco, Inc.; Spectrem 4TS.

E. **S5** - Mildew-resistant, Single Component, Acid-Curing Silicone: ASTM C920, Type S, Grade NS, Class 25, uses NT. Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to the following:

1. BASF Building Systems; Omniplus
2. Dow Corning Corporation; 786 Mildew Resistant.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

3. Tremco, Inc.; Tremsil 200 Sanitary.

2.4 LATEX SEALANT TYPES – For Interior Use Only

A. **L1** – Acrylic Latex or Siliconized Acrylic Latex, ASTM C834, Type OP, Grade NF. Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to the following:

1. BASF Building Systems; Sonolac.
2. Pecora Corporation; AC-20+.
3. Tremco, Inc.; Tremflex 834.

B. **L2** - Acoustical Joint Sealant for Exposed and Concealed Joints: ASTM C1311 Manufacturer's standard Non-sag, paintable, no staining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E90. Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to the following:

1. Tremco, Inc.; Acoustical Sealant.
2. Pecora Corporation; AC-20 FTR, AIS-919.
3. USG Corporation; SHEETROCK Acoustical Sealant.

2.5 SOLVENT-RELEASE-CURING-JOINT SEALANTS:

A. **B1** - Butyl-Rubber-Based Joint Sealant: ASTM C 1311. Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to the following.

1. Tremco, Inc.; Tremco Butyl Sealant.
2. Bostik, Inc.; Chem-Calk 300.
3. Pecora Corporation; BC-158.

2.6 PREFORMED JOINT SEALANTS – For exterior or interior applications per manufacturer's standards.

A. **PF1** - Preformed Silicone Joint Sealants: Manufacturer's standard sealant consisting of procured low-modulus silicone extrusion, in sizes to fit joint widths indicated, combined with a neutral-curing silicone sealant for bonding extrusions to substrates. Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to the following:

1. Dow Corning Corporation; 123 Silicone Seal
2. Pecora Corporation; Sil-Span
3. Tremco, Inc.; Simple Seal.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

B. **PF2** - Preformed Foam Joint Sealant: Manufacturer's standard preformed, precompressed, open-cell foam sealant manufactured from urethane foam with minimum density of 10 lb/cu.ft. (160 kg/cu.m) and impregnated with a nondrying, water-repellent agent. Factory produce in precompressed sizes in roll or stick form to fit joint widths indicated; coated on one side with a pressure-sensitive adhesive and covered with protective wrapping. Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to the following:

1. Tremco, Inc.; illbruk illmod 600.
2. EMSEAL Joint Systems, Ltd.; Emseal 25V.
3. School International, Inc.; Sealtite, Sealtite 50N.

2.7 JOINT SEALANT BACKING

A. General: Provide sealant backings of material that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Cylindrical Sealant Backings: ASATM C 1330, of type indicated below and size and density to control sealant depth and otherwise contribute to producing optimum sealant performance, paired to the sealant type. List the type on the Sealant Schedule.

1. **Type C**: Closed-cell material with a surface skin.
2. **Type O**: Open-cell material.

   a. Bostik, Inc.
   b. Pecora Corporation
   c. Tremco, Inc.

2.8 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant back materials, free of oil residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

2.9 EXISTING WORK

A. Mechanically remove existing sealant.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

B. Clean joint surfaces of residual sealant and other contaminates capable of affecting sealant bond to joint surface.

C. Allow joint surfaces to dry before installing new sealants.

PART 3 - 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.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining from above cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint surfaces include, but are not limited to, the following:

    a. Concrete.
    b. Masonry.
    c. Unglazed surfaces of ceramic tile.
    d. Exterior insulation and finish systems.

3. Remove laitance and form-release agents from concrete.
4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous surfaces include, but are not limited to, the following:

    a. Metal.
    b. Glass.
    c. Porcelain enamel.
    d. Glazed surfaces of ceramic tile.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of sealant backings.
2. Do not stretch, twist, puncture, or tear sealant backings.
3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

E. Install sealants using proven techniques to comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses in each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint profile per Figure 8A in ASTM C 1193, unless otherwise indicated.
4. Provide flush joint profile where indicated per Figure 8B in ASTM C1193.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

5. Provide recessed joint configuration of recess depth and at locations indicated per Figure 8C in ASTM C 1193.

    a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

G. Installation of Preformed Silicone-Sealant System: Comply with the following requirements:

1. Apply masking tape to each side of joint, outside of area to be covered by sealant system.
2. Apply silicone sealant to each side of joint to produce a bead of size complying with preformed silicone-sealant system manufacturer's written instructions and covering a bonding area of not less than 3/8 inch (10 mm). Hold edge of sealant bead ¼ inch (6 mm) inside masking tape.
3. Within 10 minutes of sealant application, press silicone extrusion into sealant to wet extrusion and substrate. Use a roller to apply consistent pressure and ensure uniform contact between sealant and both extrusion and substrate.
4. Complete installation of sealant system in horizontal joints before installing in vertical joints. Lap vertical joints over horizontal joints. At ends of joints, cut silicone extrusion with a razor knife.

H. Installation of Preformed Foam Sealants: Install each length of sealant immediately after removing protective wrapping. Do not pull or stretch material. Produce seal continuity at ends, turns, and intersections of joints. For applications at low ambient temperatures, apply heat to sealant in compliance with sealant manufacturer's written instructions.

I. Acoustical Sealant Installation: At sound-rated assemblies and elsewhere as indicated, seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations.

3.4 CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.5 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

3.6 JOINT-SEALANT SCHEDULE

Sealant types should be selected from the available listed products in Part 2 of this specification section. These sealants shall be indicated on the submittal schedule, using the same reference designation as indicated in Part 1.3.A. of this specification section.

A. Exterior or Interior Sealant Joints

1. Applications:

a. Control and expansion joints in cast-in-place concrete.
b. Joints between [architectural] [structural] precast concrete units.
c. Control and expansion joints in unit masonry.
d. Control and expansion joints in stone masonry.
e. Butt joints between metal panels.
f. Joints between different materials listed above.
g. Perimeter joints between materials listed above and frames of doors, windows, storefronts, louvers and similar openings.
h. Control and expansion joints in soffits and overhead surfaces.

2. Other exterior joints in vertical surfaces and non-traffic horizontal surfaces for which no other sealant is specified

B. Interior Food Contact Sealant Joints.

1. Applications:

a. Joints in kitchen counter tops and work surfaces.
b. Joints between food service equipment and surrounding construction.
c. Other interior joints where incidental food contact may occur.

C. Interior Sanitary Sealant Joints.

1. Applications:

a. Joints in toilet room and bathroom counter tops.
b. Joints between plumbing fixtures and adjacent materials.
c. Joints between locker room lockers and adjacent materials.
d. Joints between food service equipment and surrounding construction.
e. Other interior joints in wet areas where needed to limit mold and mildew growth.

D. Immersed Sealant Joints.

1. Applications:

a. Joints in fountains and water features.
b. Joints in swimming pools.
c. Joints in vertical and horizontal surfaces of other potable water storage structures.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

E. Metal Lap and Bedding Sealant Joints.

1. Applications:

a. Concealed lap and hook joints in sheet metal flashing and trim.
b. Bedding joints under metal thresholds and saddles.
c. Bedding joints between sheet metal flashing and other materials.

F. Preformed Joint Sealants:

1. Applications:

a. Control and expansion joints in cast-in-place concrete.
b. Joints between [architectural] [structural] precast concrete units.
c. Control and expansion joints in unit masonry.
d. Control and expansion joints in stone masonry.
e. Butt joints between metal panels.
f. Joints between different materials listed above.
g. Perimeter joints between materials listed above and frames of doors, windows, storefronts, louvers and similar openings.
h. Control and expansion joints in soffits and overhead surfaces.
i. Other exterior joints in vertical surfaces and non-traffic horizontal surfaces for which no other sealant is specified.
j. Joints between EIFS and other materials.

END OF SECTION 079200

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

SECTION 081100 STEEL DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Standard hollow-metal steel doors.
2. Standard hollow-metal steel frames.
3. Borrow-lite frames and transom frames.
4. Fire-rated door and frame assemblies.

B. Related Sections include the following:

1. Division 4 Section "Unit Masonry Assemblies" for building anchors into and grouting standard steel frames in masonry construction.
2. Division 8 Section "Glazing" for glazed lites in standard steel doors and frames.
3. Division 8 Sections for “Door Hardware” for standard steel doors.
4. Division 9 Section “Painting” for field painting standard steel doors and frames.

1.3 DEFINITIONS

A. Minimum Thickness: Minimum thickness of base metal without coatings.

1.4 SUBMITTALS

A. Product Data: Include construction details, material descriptions, core descriptions, label compliance, fire-resistance and temperature-rise ratings, and finishes for each type of steel door and frame specified.

B. Shop Drawings: In addition to requirements below, provide a schedule of standard steel doors and frames using same reference numbers for details and openings as those on Drawings:

1. Elevations of each door design.
2. Details of doors, including vertical and horizontal edge details.
3. Frame details for each frame type, including dimensioned profiles.
4. Details and locations of reinforcement and preparations for hardware.
5. Details of each different wall opening condition.
6. Details of anchorages, accessories, joints, and connections.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

7. Details of glazing frames and stops showing glazing.
8. Details of conduit and preparations for electrified door hardware and controls.
9. Details of removable transoms and supports.

C. Samples for Initial Selection: For units with factory-applied color finishes.

1. For each type of exposed finish required, prepared on Samples of not less than 3 by 5 inches.

D. Oversize Construction Certification: For standard steel door assemblies required to be fire rated and exceeding limitations of labeled assemblies; include statement that doors comply with requirements of design, materials, and construction but have not been subjected to fire test.

E. Product Test Reports: Based on evaluation of comprehensive fire tests performed by a qualified testing agency, for each type of standard steel door and frame.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

B. Testing Agency Qualifications: An independent agency qualified according to ASTM E 329 for testing indicated, as documented according to ASTM E 548.

C. Source Limitations: Obtain standard steel doors and frames through one source from a single manufacturer.

D. Fire-Rated Door and Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated.

1. Test Pressure: Test according to NFPA 252 or UL 10C. After 5 minutes into the test, the neutral pressure level in furnace shall be established at 40 inches (1000 mm) or less above the sill.
2. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a testing agency acceptable to authorities having jurisdiction that doors comply with standard construction requirements for tested and labeled fire-protection-rated door assemblies except for size.
3. Temperature-Rise Rating: At exit enclosures, provide doors that have a temperature-rise rating of 450 deg F (250 deg C) maximum in 30 minutes of fire exposure.

E. Smoke-Control Door Assemblies: Comply with NFPA 105 or UL 1784.

F. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver doors and frames palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.

1. Provide additional protection to prevent damage to finish of factory-finished doors and frames.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store doors and frames under cover at Project site. Place units in a vertical position with heads up, spaced by blocking, on minimum 4-inch- (102-mm-) high wood blocking. Avoid using nonvented plastic or canvas shelters that could create a humidity chamber.

1. If wrappers on doors become wet, remove cartons immediately. Provide minimum 1/4-inch (6-mm) space between each stacked door to permit air circulation.

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify openings by field measurements before fabrication and indicate measurements on Shop Drawings.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish opening dimensions and proceed with fabricating standard steel frames without field measurements. Coordinate wall construction to ensure that actual opening dimensions correspond to established dimensions.

1.8 COORDINATION

A. Coordinate installation of anchorages for standard steel frames. 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.

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:

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

1. Amweld Building Products, LLC.
2. Ceco Door Products. (**Imperial Series - Resistant to 130 mph force– Basis of Design**)
3. CURRIES Company.
4. Republic Builders Products Company.
5. Steelcraft.

2.2 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum A60 (ZF120) zinc-iron-alloy (galvannealed) coating designation.

D. Electrolytic Zinc-Coated Steel Sheet: ASTM A 591/A 591M, Commercial Steel (CS), Class B coating; mill phosphatized.

E. Supports and Anchors: After fabricating, galvanize units to be built into exterior walls according to ASTM A 153/A 153M, Class B.

F. Inserts, Bolts, and Fasteners: Provide items to be built into exterior walls, hot-dip galvanized according to ASTM A 153/A 153M.

G. Powder-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching standard steel door frames of type indicated.

H. Grout: Comply with Division 4 Section "Unit Masonry Assemblies."

I. Grout: Comply with ASTM C 476, with a slump of 4 inches (102 mm) for standard steel door frames built into concrete or masonry, as measured according to ASTM C 143/C 143M.

J. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool with 6- to 12-lb/cu. ft. (96- to 192-kg/cu. m) density; with maximum flame-spread and smoke-developed indexes of 25 and 50 respectively; passing ASTM E 136 for combustion characteristics.

K. Glazing: Comply with requirements in Division 8 Section "Glazing."

L. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil (0.4-mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

2.3 HURRICANE RESISTANT STEEL DOORS

A. General: Provide doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces, unless otherwise indicated. Comply with ANSI A250.8.

1. Design: Flush Panel.
2. Core Construction: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, mineral-board, or vertical steel-stiffener core that produces doors complying with ANSI A250.8.

   a. Thermal-Rated (Insulated) Doors: Where indicated, provide doors fabricated with thermal-resistance value (R-value) of not less than **4.0 deg F x h x sq. ft./Btu (0.704 K x sq. m/W)** when tested according to ASTM C 1363. Injected polyurethane foam core has superior insulation characteristics with U-factor of .29 (Cecco Door Products -Trio-E Series, Basis of Design)

      1) Locations: Exterior doors and interior doors where indicated.

3. Vertical Edges for Single-Acting Doors: Beveled edge

   a. Beveled Edge: 1/8 inch in 2 inches (3 mm in 50 mm).

4. Vertical Edges for Double-Acting Doors: Round vertical edges with 2-1/8-inch (54-mm) radius.
5. Top and Bottom Edges: Closed with flush or inverted 0.042-inch- (1.0-mm-) thick end closures or channels of same material as face sheets.
6. Tolerances: Comply with SDI 117, "Manufacturing Tolerances for Standard Steel Doors and Frames."

B. Exterior Doors: Face sheets fabricated from galvaneal steel sheet. Provide doors complying with requirements indicated below by referencing ANSI A250.8 for level and model and ANSI A250.4 for physical-endurance level:

1. Level 3 and Physical Performance Level A (Extra Heavy Duty), Model 3 (Seamless). 14 Gage
2. Construct doors with vertical steel stiffeners spaced 6” on center. Tack weld rib ends together and to top and bottom channels. Spot weld ribs to door face sheets at 6” on center.

2.4 STANDARD STEEL FRAMES

A. General: Comply with ANSI A250.8 and with details indicated for type and profile.

B. Exterior Frames: Fabricated from metallic-coated steel sheet.

1. Fabricate frames with mitered or coped and welded face corners and seamless face joints. Galvanealed steel finish.
2. Frames shall be thermally-broken
3. Frames for Level 3 Steel Doors: 14 gauge.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

C. Interior Frames: Fabricated from cold-rolled steel sheet, unless otherwise indicated to comply with exterior frame requirements.

1. Fabricate frames with mitered or coped and welded face corners and seamless face joints.
2. Frames for Level 2 Steel Doors: 14 gauge.

D. Hardware Reinforcement: Fabricate reinforcement plates from same material as frames to comply with the following minimum sizes:

1. Hinges: Minimum 7 gage mortised for 4 ½" or 5" longer than hinge, secured by not less than 6 spot welds. Drilled and tapped for fasteners in accordance with ANSI A156.7. Alternately, provide 14 gauge continuous hinge rail.
2. Pivots: Minimum 0.167 inch (4.2 mm) thick by 1-1/2 inches (38 mm) wide by 6 inches (152 mm) longer than hinge, secured by not less than 6 spot welds.
3. Lock Face, Closers, and Concealed Holders: Minimum 0.067 inch (1.7 mm) thick.
4. All Other Surface-Mounted Hardware: Minimum 0.067 inch (1.7 mm) thick.

E. Supports and Anchors: Fabricated from electrolytic zinc-coated or metallic-coated steel sheet.

F. Jamb Anchors:

1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch (1.0 mm) thick, with corrugated or perforated straps not less than 2 inches (50 mm) wide by 10 inches (250 mm) long; or wire anchors not less than 0.177 inch (4.5 mm) thick.
2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch (1.0 mm) thick.
3. Compression Type for Slip-on Frames: Adjustable compression anchors.
4. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch- (9.5-mm-) diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.

G. Floor Anchors: Formed from same material as frames, not less than 0.042 inch (1.0 mm) thick, and as follows:

1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
2. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than 2-inch (50-mm) height adjustment. Terminate bottom of frames at finish floor surface.

H. Fabricate concealed stiffeners and hardware reinforcement from either cold- or hot-rolled steel sheet.

I. Plaster Guards: Formed from same material as frames, not less than 0.016-inch (0.4-mm) thick.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

2.5 STOPS AND MOLDINGS

A. Moldings for Glazed Lites in Doors: Minimum 0.032 inch (0.8 mm) thick, fabricated from same material as door face sheet in which they are installed.

B. Fixed Frame Moldings: Formed integral with standard steel frames, minimum 5/8 inch (16 mm) high, unless otherwise indicated.

C. Loose Stops for Glazed Lites in Frames: Minimum 0.032 inch (0.8 mm) thick, fabricated from same material as frames in which they are installed.

2.6 FABRICATION

A. General: Fabricate standard steel doors and frames to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.

B. Standard Steel Doors:

1. Exterior Doors: Provide weep-hole openings in bottom of exterior doors to permit moisture to escape. Provide flush top caps and seal joints in top edges of doors against water penetration. Thresholds at exterior doors shall also be thermally broken (by Pemko or approved equal)
2. Glazed Lites: Factory cut openings in doors.

C. Standard Steel Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.

1. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
2. Sidelight and Transom Frames: Provide closed tubular members with no visible face seams or joints; fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
3. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners, unless otherwise indicated.
4. Plaster Guards: Weld guards to frame at back of hardware mortises in frames installed in concrete or masonry.
5. Where installed in masonry, leave vertical mullions in frames open at top for grouting.
6. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
7. Jamb Anchors: Provide number and spacing of anchors as follows:

a. Masonry Type: Locate anchors not more than 18 inches (457 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c. and as follows:

1) Two anchors per jamb up to 60 inches (1524 mm) in height.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

2) Three anchors per jamb from 60 to 90 inches (1524 to 2286 mm) in height.
3) Four anchors per jamb from 90 to 120 inches (2286 to 3048 mm) in height.
4) Four anchors per jamb plus 1 additional anchor per jamb for each 24 inches (610 mm) or fraction thereof more than 120 inches (3048 mm) in height.

b. Stud-Wall Type: Locate anchors not more than 18 inches (457 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c. and as follows:

1) Three anchors per jamb up to 60 inches (1524 mm) in height.
2) Four anchors per jamb from 60 to 90 inches (1524 to 2286 mm) in height.
3) Five anchors per jamb from 90 to 96 inches (2286 to 2438 mm) in height.
4) Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches (610 mm) or fraction thereof more than 96 inches (2438 mm) in height.
5) Two anchors per head for frames more than 42 inches (1066 mm) wide and mounted in metal-stud partitions.

c. Compression Type: Not less than two anchors in each jamb.
d. Postinstalled Expansion Type: Locate anchors not more than 6 inches (152 mm) from top and bottom of frame. Space anchors not more than 26 inches (660 mm) o.c.

8. Door Silencers: Except on weather-stripped doors, drill stops to receive door silencers as follows. Provide plastic plugs to keep holes clear during construction.

a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

D. Hardware Preparation: Factory prepare standard steel doors and frames to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping, according to the Door Hardware Schedule and templates furnished as specified in Division 8 Section "Door Hardware."

1. Reinforce doors and frames to receive nontemplated mortised and surface-mounted door hardware.
2. Comply with applicable requirements in ANSI A250.6 and ANSI/DHI A115 Series specifications for door and frame preparation for hardware. Locate hardware as indicated on Shop Drawings or, if not indicated, according to ANSI A250.8.

E. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of door or frame.
2. Multiple Glazed Lites: Provide fixed and removable stops and moldings such that each glazed lite is capable of being removed independently.
3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
4. Provide loose stops and moldings on inside of doors and frames.
5. Coordinate rabbet width between fixed and removable stops with type of glazing and type of installation indicated.

2.7 STEEL FINISHES

A. General: Comply with ANSI A250.10 "Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames" for recommendations for applying and designating finishes.

1. Finish standard steel door and frames after assembly.

B. Metallic-Coated Steel Surface Preparation: Clean surfaces with nonpetroleum solvent so surfaces are free of oil and other contaminants. After cleaning, apply a conversion coating suited to the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas, and apply galvanizing repair paint specified below to comply with ASTM A 780.

1. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.

C. Steel Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning"; remove dirt, oil, grease, or other contaminants that could impair paint bond. Remove mill scale and rust, if present, from uncoated steel; comply with SSPC-SP 3, "Power Tool Cleaning," or SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

D. Factory Priming for Field-Painted Finish: Apply shop primer specified below immediately after surface preparation and pretreatment. Apply a smooth coat of even consistency to provide a uniform dry film thickness of not less than 0.7 mils (0.018 mm).

1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied finish paint system indicated; and providing a sound foundation for field-applied topcoats despite prolonged exposure.

2. Apply electrostatically primer coat on all exterior doors prior to arrival at the site.

3. **All** frames and doors shall be painted prior to installation of glass inserts in order to eliminate exposed unpainted finishes visible through the glass.

E. **All** exterior steel doors and hollow metal frames shall be Galvanealled Steel.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of standard steel doors and frames.

1. Examine roughing-in for embedded and built-in anchors to verify actual locations of standard steel frame connections before frame installation.
2. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove welded-in shipping spreaders installed at factory.

B. Prior to installation and with installation spreaders in place, adjust and securely brace standard steel door frames for squareness, alignment, twist, and plumb to the following tolerances:

1. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
2. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
3. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
4. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a perpendicular line from head to floor.

C. Drill and tap doors and frames to receive nontemplated mortised and surface-mounted door hardware.

3.3 INSTALLATION

A. General: Provide doors and frames of sizes, thicknesses, and designs indicated. Install standard steel doors and frames plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.

B. Standard Steel Frames: Install standard steel frames for doors and other openings, of size and profile indicated. Comply with SDI 105.

1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.

a. At fire-protection-rated openings, install frames according to NFPA 80.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

b. Where frames are fabricated in sections due to shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
c. Install frames with removable glazing stops located on secure side of opening.
d. Install door silencers in frames before grouting.
e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
f. Check plumb, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
g. Apply bituminous coating to backs of frames that are filled with mortar, grout, and plaster containing antifreezing agents.

2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor and secure with postinstalled expansion anchors.

   a. Floor anchors may be set with powder-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.

3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation behind frames.
4. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with mortar as specified in Division 4 Section "Unit Masonry Assemblies."
5. Concrete Walls: Solidly fill space between frames and concrete with grout. Install grout in lifts and take precautions, including bracing frames, to ensure that frames are not deformed or damaged by grout forces.
6. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
7. In-Place Gypsum Board Partitions: Secure frames in place with postinstalled expansion anchors through floor anchors at each jamb. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
8. Ceiling Struts: Extend struts vertically from top of frame at each jamb to supporting construction above, unless frame is anchored to masonry or to other structural support at each jamb. Bend top of struts to provide flush contact for securing to supporting construction above. Provide adjustable wedged or bolted anchorage to frame jamb members.
9. Installation Tolerances: Adjust standard steel door frames for squareness, alignment, twist, and plumb to the following tolerances:

   a. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
   b. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
   c. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
   d. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs at floor.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

C. Standard Steel Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.

1. Non-Fire-Rated Standard Steel Doors:

a. Jambs and Head: 1/8 inch (3 mm) plus or minus 1/16 inch (1.6 mm).
b. Between Edges of Pairs of Doors: 1/8 inch (3 mm) plus or minus 1/16 inch (1.6 mm).
c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch (9.5 mm).
d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch (19 mm).

2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
3. Smoke-Control Doors: Install doors according to NFPA 105.

D. Glazing: Comply with installation requirements in Division 8 Section "Glazing" and with standard steel door and frame manufacturer's written instructions.

1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches (230 mm) o.c., and not more than 2 inches (50 mm) o.c. from each corner.

3.4 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including standard steel doors or frames that are warped, bowed, or otherwise unacceptable.

B. Clean grout and other bonding material off standard steel doors and frames immediately after installation.

C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying primer.

D. Galvannealed Surfaces: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION 081110

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

084413 GLAZED ALUMINUM CURTAIN WALL

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes: Aluminum Curtain Wall Systems:
   1. YKK AP Series YHC 300 OG (Outside Glazed) Impact Resistant Aluminum Curtain Wall System (basis of design

B. Related Sections:
   1. Sealants: Dow Corning® 995 Structural Silicone Sealant.
   2. Glass and Glazing: Refer to Division 8 Glass and Glazing Section for glass and glazing requirements.
   3. Single Source Requirement: All products listed below shall be by the same manufacturer.
      a. Section 08 32 13 Sliding Aluminum - Framed Glass Doors.
      b. Section 08 41 13 Aluminum - Framed Entrances and Storefronts.
      c. Section 08 51 13 Aluminum Windows.
      d. Section 08 44 33 Sloped Glazing Assemblies.

1.02 SYSTEM PERFORMANCE DESCRIPTION

A. All test unit sizes and configurations shall conform to the minimum sizes in accordance with; Florida High Velocity Hurricane Zone (HVHZ) Protocols, ASTM E 1886, ASTM E 1996, and meet all requirements of TAS 201, TAS 202, and TAS 203. They shall also comply with the following specific performance requirements indicated.

   1. Air Infiltration: Completed curtain wall systems shall have 0.06 CFM/FT² (1.10 m³/h·m²) maximum allowable Infiltration when tested in accordance with ASTM E 283 at differential static pressure of 6.24 PSF (299 Pa).
   2. Water Infiltration: No uncontrolled water, other than condensation, on indoor face of any component when tested in accordance with ASTM E 331 at test pressure differential of 20 PSF (958 Pa). Water test to be performed immediately after design pressure test.
   3. Wind Loads: Completed curtain wall system shall withstand wind pressure loads normal to wall plane indicated:
      a. Structural Performance:
         1) Positive Pressure: ___ psf.
         2) Negative Pressure: ___ psf.
   4. Deflection: Maximum allowable deflection in any member when tested in accordance with ASTM E 330 with allowable stress in accordance with AA Specifications for Aluminum Structures:
      a. Without Horizontals: L/175 or 3/4" (19.1mm) maximum.
      b. With Horizontals: L/175 or L/240 + 1/4" (6.4mm) for spans greater than 13'-6" (4.1m) but less than 40'-0" (12.2m).
   5. Thermal Movement: Provide for thermal movement caused by 180 degrees F. (82.2 degrees C.) surface temperature, without causing buckling stresses on glass, joint seal failure, undue stress on structural elements, damaging loads on fasteners, reduction of performance, or detrimental effects.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

6. Thermal Performance: When tested in accordance with AAMA 1503.1 and NFRC 102:
   a. Condensation Resistance Factor (CRF_f): A minimum of 72.
   b. Thermal Transmittance U Value: .42 BTU/HR/FT²/ºF or less.
   Note: The CRF for the glazed system as a whole will be affected by the characteristics of the glass specified.
7. Acoustical Performance: Acoustical Performance: When tested in accordance with ASTM E 1425:
   a. Sound Transmission Class (STC) shall not be less than 37.
   b. Outdoor–Indoor Transmission Class (OITC) shall not be less than 32.

1.03 SUBMITTALS

A. General: Prepare, review, approve, and submit specified submittals in accordance with "Conditions of the Contract" and Division 1 Submittals Sections. Product data, shop drawings, samples, and similar submittals are defined in “Conditions of the Contract."

B. Product Data: Submit product data for each type curtain wall series specified.

C. Substitutions: Whenever substitute products are to be considered, supporting technical data, samples and test reports must be submitted ten (10) working days prior to bid date in order to make a valid comparison.

D. Shop Drawings: Submit shop drawings showing layout, profiles, and product components, including anchorage, accessories, finish colors and textures.

E. Samples: Submit verification samples for colors on actual aluminum substrates indicating full color range expected in installed system.

F. Quality Assurance / Control Submittals:
   1. Test Reports: Submit certified test reports showing compliance with specified performance characteristics and physical properties.
   2. Installer Qualification Data: Submit installer qualification data.

G. Closeout Submittals:
   1. Warranty: Submit warranty documents specified herein.
   2. Project Record Documents: Submit project record documents for installed materials in accordance with Division 1 Project Closeout (Project Record Documents) Section.

1.04 QUALITY ASSURANCE

A. Qualifications:
   1. Installer Qualifications: Installer experienced (as determined by contractor) to perform work of this section who has specialized in the installation of work similar to that required for this project. If requested by Owner, submit reference list of completed projects.
   2. Manufacturer Qualifications: Manufacturer capable of providing field service representation during construction process.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

B. Mock-Ups (Field Constructed): Install at project site a job mock-up using acceptable products and manufacturer approved installation methods. Obtain Owner's and Architect's acceptance of finish color, and workmanship standard.
   1. Mock-Up Size:
   2. Maintenance: Maintain mock-up during construction for workmanship comparison; remove and legally dispose of mock-up when no longer required.
   3. Incorporation: Mock-up may be incorporated into final construction upon Owner's approval.

C. Pre-Installation Meetings: Conduct pre-installation meeting to verify project requirements, substrate conditions, manufacturer's installation instructions, and manufacturer's warranty requirements.

1.05 PROJECT CONDITIONS / SITE CONDITIONS

A. Field Measurements: Verify actual measurements/openings by field measurements before fabrication; show recorded measurements on shop drawings. Coordinate field measurements, fabrication schedule with construction progress to avoid construction delays.

1.06 WARRANTY

A. Project Warranty: Refer to "Conditions of the Contract" for project warranty provisions.

B. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by an authorized company official.
   1. Warranty Period: Manufacturer’s one (1) year standard warranty commencing on the substantial date of completion for the project provided that the warranty, in no event, shall start later than six (6) months from the date of shipment by YKK AP America Inc.

PART 2 PRODUCTS

2.01 MANUFACTURERS (Acceptable Manufacturers/Products)

A. Acceptable Manufacturers:

1. YKK AP America Inc.
   270 Riverside Parkway, Suite 100
   Austell, GA 30168
   Telephone: (678) 838-6000; Fax: (678) 838-6001
2. Kawneer Company, Inc. 2” x 4-1/2” “Trifab 451T for Exterior Doors, Entrances and
3. EFCO Corporation
4. Butler Manufacturing Company; Vistawall Architectural Products.
5. TRACO

B . Curtain Wall Framing System: YKK AP YHC 300 OG Curtain Wall System. (basis of design)
   1. Description: Framing System shall be thermally improved. Horizontal and vertical members shall have a nominal face dimension of 3 inches, depth as indicated on the shop drawings. Framing system shall provide a flush glazed appearance on all sides with no protruding glass

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

stops.

2. Glazing: Manufacturer's standard silicone compatible EPDM glazing gaskets to inhibit water infiltration at the exterior and Dow Corning® 995 Structural Silicone Sealant with fixed stops at the interior; interior spacers are to be silicone.

2.02 MATERIALS

A. Extrusions: ASTM B 221 (ASTM B 221M), 6063-T5 Aluminum Alloy.

B. Aluminum Sheet:

1. Finish: Color AAMA 612-02 Combined Coatings Color Anodic Finish. Coating thickness of no less than .7 mill (18 microns) Color uniformity shall not differ more than 5 Delta E, in accordance with ASTM D 2244. Color to be selected by Architect from the full range of colors.

2.03 ACCESSORIES

A. Manufacturer's Standard Accessories:

1. Fasteners: Zinc plated steel concealed fasteners; Hardened aluminum alloys or AISI 300 series stainless steel fasteners. Joint fasteners may be concealed.
2. Sealant: Non-skinning type, AAMA 803.3
3. Glazing: Setting blocks, edge blocks, and spacers in accordance with ASTM C 864, shore durometer hardness as recommended by manufacturer; exterior glazing silicone compatible EPDM gaskets, in accordance with ASTM C 864, designed to lock into gasket reglet, interior by means of silicone spacer and structural silicone adhesive.
4. Glazing Adhesive: Dow Corning® 995 Structural Silicone.

2.04 RELATED MATERIALS (Specified In Other Sections)

A. Glass: Refer to Division 8 Glass and Glazing Section for glass materials.

2.05 FABRICATION

A. Shop Assembly: Fabricate and assemble units with joints only at intersection of aluminum members with uniform hairline joints; rigidly secure, and sealed in accordance with manufacturer's recommendations.

1. Hardware: Drill and cut to template for hardware. Reinforce frames and door stiles to receive hardware in accordance with manufacturer's recommendations.
2. Welding: Conceal welds on aluminum members in accordance with AWS recommendations or methods recommended by manufacturer. Members showing welding bloom or discoloration on finish or material distortion will be rejected.

2.06 FINISHES AND COLORS

A. YKK AP America Anodized Plus® Finish:

YB5N* Dark Bronze Anodized Plus®

B. Anodized Finishing: Prepare aluminum surfaces for specified finish; apply shop finish in accordance with the following:

1. Anodic Coating: Electrolytic color coating followed by an organic seal applied in accordance

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

with the requirements of AAMA 612. Aluminum extrusions shall be produced from quality controlled billets meeting AA-6063-T5.

a. Exposed Surfaces shall be free of scratches and other serious blemishes.

b. Extrusions shall be given a caustic etch followed by an anodic oxide treatment and then sealed with an organic coating applied with an electrodeposition process.

c.The anodized coating shall comply with all of the requirements of AAMA 612: Voluntary Specifications, Performance Requirements and Test Procedures for Combined Coatings of Anodic Oxide and Transparent Organic Coatings on Architectural Aluminum. Testing shall demonstrate the ability of the finish to resist damage from mortar, salt spray, and chemicals commonly found on construction sites, and to resist the loss of color and gloss.

d.Overall coating thickness for finishes shall be a minimum of 0.7 mils.

PART 3 EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS / RECOMMENDATIONS

A. Compliance: Comply with manufacturer's product data, including product technical bulletins, installation instructions, and product carton instructions. The latest Installation Manual can be found at www.ykkap.com.

3.02 EXAMINATION

A. Site Verification of Conditions: Verify conditions (which have been previously installed under other sections) are acceptable for product installation in accordance with manufacturer's instructions.

3.03 PREPARATION

A. Adjacent Surfaces Protection: Protect adjacent work areas and finish surfaces from damage during product installation.

3.04 INSTALLATION

A. General: Install manufacturer's system in accordance with shop drawings, and within specified tolerances.

1. Protect aluminum members in contact with masonry, steel, concrete, or dissimilar materials Using nylon pads or bituminous coating.
2. Shim and brace aluminum system before anchoring to structure.
3. Verify curtain wall system allows water entering system to be collected in gutters and wept to exterior. Verify weep holes are open, and metal joints are sealed in accordance with manufacturers installation instructions.
4. Seal metal to metal curtain wall system joints using sealant recommended by system manufacturer.

3.05 FIELD QUALITY CONTROL

A. Manufacturer's Field Services: Upon request, provide manufacturer's field service consisting of site visit for inspection of product installation in accordance with manufacturer's instructions.

B. Field Test: Conduct field test to determine watertightness of curtain wall system. Conduct test in

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

accordance with AAMA 501.2.

3.06 ADJUSTING AND CLEANING

A. Adjusting: Adjust swing doors for operation in accordance with manufacturer's recommendations.

B. Cleaning: The General Contractor shall clean installed products in accordance with manufacturer's instructions prior to owner's acceptance, and remove construction debris from project site. Legally dispose of debris.

C. Protection: The General Contractor shall protect the installed product's finish surfaces from damage during construction.

END OF SECTION

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

SECTION 08710 - DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Commercial door hardware for the following:

a. Swinging doors.

B. Related Sections include the following:

1. Division 8 Section "Standard Steel Doors and Frames".

1.3 SUBMITTALS

A. Product Data: Include construction and installation details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: Details of electrified door hardware, indicating the following:

1. Wiring Diagrams: Power, signal, and control wiring. Include the following:

a. System schematic.
b. Point-to-point wiring diagram.
c. Riser diagram.
d. Elevation of each door.

2. Detail interface between electrified door hardware and fire alarm, access control, and intrusion detection system.
3. Operation Narrative: Describe the operation of doors controlled by electrified door hardware.

C. Samples for Initial Selection: For each finish, color, and texture required for each type of door hardware indicated.

D. Samples for Verification: For exposed door hardware of each type, in specified finish, full size. Tag with full description for coordination with the door hardware sets. Submit Samples before, or concurrent with, submission of the final door hardware sets.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

1. Samples will be returned to Contractor. Units that are acceptable and remain undamaged through submittal, review, and field comparison process may, after final check of operation, be incorporated into the Work, within limitations of keying requirements.

E. Product Certificates: For electrified door hardware, signed by product manufacturer.

1. Certify that door hardware approved for use on types and sizes of labeled fire doors complies with listed fire door assemblies.

F. Maintenance Data: For each type of door hardware to include in maintenance manuals. Include final hardware and keying schedules.

G. Warranty: Special warranty specified in this Section.

H. Other Action Submittals:

1. Door Hardware Sets: Prepared by or under the supervision of an Architectural Hardware Consultant, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final door hardware sets with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

a. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule." Double space entries, and number and date each page.
b. Format: Use same scheduling sequence and format and use same door numbers as in the Contract Documents.
c. Content: Include the following information:

1) Identification number, location, hand, fire rating, and material of each door and frame.
2) Type, style, function, size, quantity, and finish of each door hardware item.
3) Complete designations of every item required for each door or opening including name and manufacturer.
4) Fastenings and other pertinent information.
5) Location of each door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
6) Explanation of abbreviations, symbols, and codes contained in schedule.
7) Mounting locations for door hardware.
8) Door and frame sizes and materials.
9) Description of each electrified door hardware function, including location, sequence of operation, and interface with other building control systems.

a) Sequence of Operation: Include description of component functions that occur in the following situations: authorized person wants to enter; authorized person wants to exit;

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

unauthorized person wants to enter; unauthorized person wants to exit.

10) List of related door devices specified in other Sections for each door and frame.

d. Submittal Sequence: Submit the final door hardware sets at earliest possible date, particularly where approval of the door hardware sets must precede fabrication of other work that is critical in Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the door hardware sets.

e. Submittal Sequence: Submit initial draft of final schedule along with essential Product Data to facilitate the fabrication of other work that is critical in Project construction schedule. Submit the final door hardware sets after Samples, Product Data, coordination with Shop Drawings of other work, delivery schedules, and similar information has been completed and accepted.

2. Keying Schedule: Prepared by or under the supervision of an Architectural Hardware Consultant, detailing Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by lock manufacturer.

1. Installer's responsibilities include supplying and installing door hardware and providing a qualified Architectural Hardware Consultant available during the course of the Work to consult with Contractor, Architect, and Owner about door hardware and keying.
2. Installer shall have warehousing facilities in Project's vicinity.
3. Scheduling Responsibility: Preparation of door hardware and keying schedules.
4. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

B. Supplier Qualifications: Door hardware supplier with warehousing facilities in Project's vicinity and who is or employs a qualified Architectural Hardware Consultant, available during the course of the Work to consult with Contractor, Architect, and Owner about door hardware and keying.

1. Electrified Door Hardware Supplier Qualifications: An experienced door hardware supplier who has completed projects with electrified door hardware similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance, and who is acceptable to manufacturer of primary materials.

a. Engineering Responsibility: Prepare data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

2. Scheduling Responsibility: Preparation of door hardware and keying schedules.

C. Architectural Hardware Consultant Qualifications: A person who is currently certified by DHI as an Architectural Hardware Consultant and who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project.

D. Source Limitations: Obtain each type and variety of door hardware from a single manufacturer, unless otherwise indicated.

1. Provide electrified door hardware from same manufacturer as mechanical door hardware, unless otherwise indicated. Manufacturers that perform electrical modifications and that are listed by a testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.

E. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NPFA252 and UL10C.

1. Test Pressure: After 5 minutes into the test, neutral pressure level in furnace shall be established at 40 inches (1016 mm) or less above the sill.

F. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

G. Keying Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination." In addition to Owner, Contractor, and Architect, conference participants shall also include supplier's Architectural Hardware Consultant and Owner's security consultant. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including, but not limited to, the following:

1. Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
2. Preliminary key system schematic diagram.
3. Requirements for key control system.
4. Address for delivery of keys.

H. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

I. Electrical pre-installation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination." Review methods and procedures related to electrified door hardware including, but not limited to, the following:

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

1. Inspect and discuss electrical roughing-in and other preparatory work performed by other trades.
2. Review sequence of operation for each type of electrified door hardware.
3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review required testing, inspecting, and certifying procedures.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.

B. Tag each item or package separately with identification related to the final door hardware sets, and include basic installation instructions, templates, and necessary fasteners with each item or package.

C. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.

D. Deliver keys and/or permanent cores to Owner by registered mail or overnight package service.

1.6 COORDINATION

A. Coordinate layout and installation of recessed pivots and floor closers with floor construction. Cast anchoring inserts into concrete. Concrete, reinforcement, and formwork requirements are specified in Division 3.

B. Templates: Distribute door hardware templates for doors, frames, and other work specified to be factory prepared for installing door hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

C. Electrical System Roughing-in: Coordinate layout and installation of electrified door hardware with connections to power supplies, fire alarm system, access control system and security system.

D. Existing Openings: Where new hardware components are scheduled for application to existing construction or where modifications to existing door hardware are required, field verify existing conditions and coordinate installation of door hardware to suit opening conditions and to provide for proper operation.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

a. Structural failures including excessive deflection, cracking, or breakage.
b. Faulty operation of operators and door hardware.
c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.

2. Warranty Period: One year from date of Substantial Completion, except as follows:

a. Exit Devices: Five years from date of Substantial Completion.
b. Manual Closers: Twenty Five years from date of Substantial Completion.
c. Mortise Locks: Five years from date of Substantial Completion

1.8 MAINTENANCE SERVICE

A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

B. Maintenance Service: Beginning at Substantial Completion, provide six months' full maintenance by skilled employees of door hardware Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door hardware operation. Provide parts and supplies same as those used in the manufacture and installation of original products.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

A. General: Provide door hardware for each door to comply with requirements in this Section and door hardware sets indicated in Part 3 "Door Hardware Sets".

1. Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and named manufacturers' product.
2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.

B. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of door hardware are indicated in Part 3 "Door Hardware Sets" Article. Products are identified by using door hardware designations, as follows:

1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum requirements. Manufacturers' names are abbreviated in Part 3 "Door Hardware Sets" Article.
2. References to BHMA Standards: Provide products complying with these standards and requirements for description, quality, and function.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

C. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 HINGES, GENERAL

A. Quantity: Provide the following, unless otherwise indicated:

1. Two Hinges: For doors with heights up to 60 inches (1524 mm).
2. Three Hinges: For doors with heights 61 to 90 inches (1549 to 2286 mm).
3. Four Hinges: For doors with heights 91 to 120 inches (2311 to 3048 mm).
4. For doors with heights more than 120 inches (3048 mm), provide 4 hinges, plus 1 hinge for every 30 inches (750 mm) of door height greater than 120 inches (3048 mm).

B. Template Requirements: Except for hinges and pivots to be installed entirely (both leaves) into wood doors and frames, provide only template-produced units.

C. Hinge Weight: Provide the following:

1. ALL DOORS: Antifriction-bearing heavy-weight hinges.

D. Hinge Base Metal: Unless otherwise indicated, provide the following:

1. Exterior Hinges: Stainless Steel with non-removable pin and & security stud.
2. Interior Hinges: Steel

2.3 HINGES

A. Template Hinge Dimensions: BHMA A156.7.

B. Manufacturers:
1. Bommer.
2. Hager.
3. McKinney.
4. Stanley

2.4 LOCKS AND LATCHES, GENERAL

A. Accessibility Requirements: Comply with ANSI A117.1

B. Latches and Locks for Means of Egress Doors: Comply with NFPA 101.

C. Lock Trim: Provide as shown in the hardware sets.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

D. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors.

E. Backset: 2-3/4 inches (70 mm), unless otherwise indicated.

F. Where required by Local Code, provide abrasive coating on lock trim to satisfy "Tactile Warning" requirements.

2.5 MECHANICAL LOCKS AND LATCHES

A. Lock Functions: Function numbers and descriptions indicated in door hardware sets.

B. Mortise Locks:

1. Manufacturers:

a. Schlage - L9000 with Vandlguard (LV)

2.6 DOOR BOLTS

A. Bolt Throw: Comply with testing requirements for length of bolts required for labeled fire doors.

B. Flush and Surface Bolts: BHMA A156.16.

1. Manufacturers:
   a. Door Controls International.
   b. Hiawatha.
   c. Rockwood.
   d. Trimco.

2.7 EXIT DEVICES

A. Accessibility Requirements: Comply with ANSI A117.1.

B. Exit Devices for Means of Egress Doors: Comply with NFPA 101.

C. Removable Mullions: BHMA A156.3.

D. Outside Trim: As shown in the hardware sets.

E. Manufacturers:

1. Von Duprin – 99 series

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

2.8 LOCK CYLINDERS

A. Cylinders: Manufacturer's standard tumbler type, constructed from brass or bronze, stainless steel, or nickel silver, and complying with the following:

1. Number of Pins: Match Existing School Schlage Primus System.
2. Mortise Type: Threaded cylinders with rings and straight- or clover-type cam.
3. Rim Type: Cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
4. Bored-Lock Type: Cylinders with tailpieces to suit locks.
5. All cylinders – Schalge Full Size Interchangeable Core “FSIC” less core. Owner to provide and key FSIC cores.

B. Construction Keying: Comply with the following:

1. Construction Cores: Provide construction cores that are replaceable by permanent cores. Provide 10 construction master keys.
   a. Furnish permanent cores to Owner for installation. Cores must be REMOVABLE.

C. Manufacturer: Schlage Primus – NO SUBSTITUTION.

2.9 KEYING

A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, Appendix A. Incorporate decisions made in keying conference, and as follows:

1. Great-Grand Master Key System: Cylinders are operated by a change key, a master key, a grand master key, and a great-grand master key.
2. Existing System: Master key or grand master key locks to Owner's existing system.

B. Keys: Nickel silver.

1. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:

   a. Notation: "DO NOT DUPLICATE.".

2. Quantity: In addition to one extra key blank for each lock, provide the following:

   a. Cylinder Change Keys: Three.
   b. Master Keys: Ten.
   c. Grand Master Keys: Five.
   d. Great-Grand Master Keys: Five.
   e. Control Keys (Construction and Permanent): Two.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

2.10 KEY CONTROL SYSTEM

A. Key Control Cabinet: BHMA A156.5, Grade 1; metal cabinet with baked-enamel finish; containing key-holding hooks, labels, 2 sets of key tags with self-locking key holders, key-gathering envelopes, and temporary and permanent markers; with key capacity of 150 percent of the number of locks.

1. Manufacturers:

a. Key Control Systems.
b. Lund Equipment Co.
c. MMF Industries.

2.11 OPERATING TRIM

A. Materials: Fabricate from stainless steel, unless otherwise indicated.

B. Manufacturers:

1. Burns.
2. Hiawatha.
3. Rockwood.
4. Trimco.

2.12 CLOSERS

A. Accessibility Requirements: Comply with ANSI A117.1

B. Door Closers for Means of Egress Doors: Comply with NFPA 101.

C. 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.

D. Surface Closers: BHMA A156.4 Grade 1. Provide type of arm required for closer to be located on non-public side of door, unless otherwise indicated. Provide plates, brackets and spacers as necessary to suit door and frame conditions. Unitrol type heavy duty spring stop arms are a no substitution item. Similar arms are not acceptable.

1. Manufacturers:

a. LCN 4040 Series with SCUSH Arms

2.13 PROTECTIVE TRIM UNITS

A. Size: 2 inches (38 mm) less than door width on push side and 1” (13 mm) less than door width on pull side, by height specified in door hardware sets.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

1. Material: 0.050-inch- (1.3-mm-) thick Stainless Steel
2. Manufacturers:

    a. Burns.
    b. Hiawatha.
    c. Rockwood.
    d. Trimco.

2.14 STOPS AND HOLDERS

A. Stops and Bumpers:

1. Provide floor stops for doors unless wall or other type stops are scheduled or indicated. Do not mount floor stops where they will impede traffic. Where floor or wall stops are not appropriate, provide overhead holders.

B. Silencers for Metal Door Frames: BHMA A156.16, Grade 1; neoprene or rubber, minimum diameter 1/2 inch (13 mm); fabricated for drilled-in application to frame.

C. Manufacturers:

1. Burns.
2. Hiawatha.
3. Rockwood.
4. Trimco.

2.15 THRESHOLDS AND DOOR GASKETING

A. Standard: BHMA A156.22.

B. General: Provide continuous weather-strip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated or scheduled. Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

1. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
2. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
3. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

C. Air Leakage: Not to exceed 0.50 cfm per foot (0.000774 cu. m/s per m) of crack length for gasketing other than for smoke control, as tested according to ASTM E 283.

D. Manufacturers:

1. National Guard Products.
2. Pemko.
3. Reese.
4. Zero International.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

2.16 MISCELLANEOUS DOOR HARDWARE

A. Boxed Power Supplies: Modular unit in NEMA ICS 6, Type 4 enclosure; filtered and regulated; voltage rating and type matching requirements of door hardware served; and listed and labeled for use with fire alarm systems.

2.17 FABRICATION

A. Manufacturer's Nameplate: Do not provide products that have manufacturer's name or trade name displayed in a visible location except in conjunction with required fire-rated labels and as otherwise approved by Architect.

1. Manufacturer's identification is permitted on rim of lock cylinders only.

B. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.

2.18 FINISHES

A. Standard: BHMA A156.18, as indicated in door hardware sets.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.

B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

3.2 PREPARATION

A. Steel Doors and Frames: Comply with DHI A115 Series.

1. Surface-Applied Door Hardware: Drill and tap doors and frames according to ANSI A250.6.

B. Wood Doors: Comply with DHI A115-W Series.

3.3 INSTALLATION

A. Mounting Heights: Mount door hardware units at heights indicated on drawings unless otherwise indicated or required to comply with governing regulations.

1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."

B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.

1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

C. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.

D. Boxed Power Supplies: Locate power supplies as indicated or, if not indicated, verify location with Architect.

1. Configuration: Provide one power supply for each door opening.

E. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."

3.4 FIELD QUALITY CONTROL

A. Independent Architectural Hardware Consultant: Owner will engage a qualified independent Architectural Hardware Consultant to perform inspections and to prepare inspection reports.

1. Independent Architectural Hardware Consultant will inspect door hardware and state in each report whether installed work complies with or deviates from requirements, including whether door hardware is properly installed and adjusted.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

3.5 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

1. Spring Hinges: Adjust to achieve positive latching when door is allowed to close freely from an open position of 30 degrees.
2. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.
3. Door Closers: Unless otherwise required by authorities having jurisdiction, adjust sweep period so that, from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches (75 mm) from the latch, measured to the leading edge of the door.

B. Occupancy Adjustment: Approximately three months after date of Substantial Completion, Installer's Architectural Hardware Consultant shall examine and readjust, including adjusting operating forces, each item of door hardware as necessary to ensure function of doors, door hardware, and electrified door hardware.

3.6 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by door hardware installation.

B. Clean operating items as necessary to restore proper function and finish.

C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain door hardware and door hardware finishes. Refer to Division 1 Section "Demonstration and Training."

3.8 DOOR HARDWARE SETS

Manufacturer List

1. MK - McKinney
2. RO - Rockwood
3. SC - Schlage
4. HS - HES
5. PE - Pemko
6 VON – Von Duprin

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

Set: 1.0
Provide each SGL door(s) with the following:

3	Hinge (heavy weight)	T4A3386 4-1/2" x 4-1/2"	US32D	MK
1	Panic Hardware	CD-99-NL-OP	630	VON
1	Primus Core	20-740	626	SC
1	Rim Cylinder Housing	20-079	626	SC
1	Mortise Cylinder Housing	26-064 x Length / Cam as Req.	626	SC
1	Surface Closer	4040XP	689	LCN
1	Kick Plate	K1050 24" high 4BE CSK	US32D	RO
1	Threshold	2009APK MSES25SS x LAR		PE
1	Gasketing	2891APK (Head)		PE
2	Gasketing	290APK (Jambs)		PE
1	Sweep	3452CNB x LAR		PE

END OF SECTION 08710

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

SECTION 088000 – GENERAL GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:

1. Windows.

B. Related Sections include the following:

1. Division 8 Section "Aluminum Windows”
2. Division 8 Section "Steel Doors and Frames."

1.3 DEFINITIONS

A. Glass Manufacturers: Firms that produce primary glass or fabricated glass as defined in referenced glazing publications.

B. Glazing Fabricators: Firms that produce fabricated glass products from primary glass as defined in referenced glazing publications.

C. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.

D. Interspace: Space between lites of an insulating-glass unit that contains dehydrated air or a specified gas.

E. Deterioration of Coated Glass: Defects developed from normal use that are attributed to the fabricating process and not to causes other than glass breakage and practices for maintaining and cleaning coated glass contrary to fabricator’s written instructions. Defects include peeling, cracking, and other indications of deterioration in metallic coating.

F. Deterioration of Laminated Glass: Defects developed from normal use that are attributed to the fabricating process and not to causes other than glass breakage and practices for maintaining and cleaning laminated glass contrary to fabricator’s written instructions. Defects include edge separation, delamination materially obstructing

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.

G. Deterioration of Insulating Glass: Failure of the hermetic seal under normal use that is attributed to the fabricating process and not to causes other than glass breakage and practices for maintaining and cleaning insulating glass contrary to fabricator's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.

1.4 PERFORMANCE REQUIREMENTS

A. General: Provide glazing systems capable of withstanding normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

B. Glass Design: Glass thicknesses indicated are minimums and are for detailing only. Confirm glass thicknesses by analyzing Project loads and in-service conditions. Provide glass lites for various size openings in nominal thicknesses indicated, but not less than thicknesses and in strengths (annealed or heat treated) required to meet or exceed the following criteria:

1. Glass Thicknesses: Select minimum glass thicknesses to comply with ASTM E 1300 and ICC's 2006 International Building Code according to the following requirements:

a. Specified Design Wind Loads: Determine design wind loads applicable to Project from basic wind speed indicated in miles per hour at 200 feet above grade, according to ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 6.4.2, "Analytic Procedure," based on mean roof heights above grade indicated on Drawings.

1) Wind Design Data: Minimum hurricane force for 130mph pressure and airborne debris.
2) Importance Factor: 1.15
3) Exposure Category: C

b. Specified Design Snow Loads: As indicated on Drawings, but not less than snow loads applicable to Project, required by ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 7, "Snow Loads".

c. Probability of Breakage for Vertical Glazing: 8 lites per 1000 for lites set vertically or not more than 15 degrees off vertical and under wind action.

1) Load Duration: 60 seconds or less.

d. Probability of Breakage for Sloped Glazing: For glass surfaces sloped more than 15 degrees from vertical, design glass for a probability of breakage not greater than 0.001.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

e. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 1 inch, whichever is less.
f. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.
g. Minimum Glass Thickness for Exterior Lites:

1) Manufacturer's standard to meet wind load criteria, but not less than 6 mm.

C. Thermal Movements: Provide glazing that allows for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures acting on glass framing members and glazing components. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

D. Performance Characteristics: Provide glass with performance properties specified based on manufacturer's published test data, as determined according to procedures indicated below:

1. For monolithic-glass lites, properties are based on units with lites 6 mm thick.
2. For insulating-glass units, properties are based on units with lites 6 mm thick and a nominal ½-inch-wide interspace.
3. Center-of-Glass thermal and optical performance properties shall be based on data and calculations from the current LBNL Windows 5.2 computer program expressed as Btu/sq. ft. x h x deg F.
4. Fenestration Performance: Performance values that take into account the total fenestration (Center-of-Glass and framing members) normally identified with building energy codes such as ASHRAE-IESNA 90.1 and the IECC. Values can also be tested and certified by the National Fenestration Rating Council (NFRC).

1.5 SUBMITTALS

A. Product Data: For each glass product and glazing material indicated.

B. Samples: Provide 12-inch-square samples of each glass product specified.

C. Glazing Schedule: Use same designations indicated on Drawings for glazed openings in preparing a schedule listing glass types and thicknesses for each size opening and location.

D. Product Certificates: Signed by manufacturers of glass and glazing products certifying that products furnished comply with requirements.

1. For solar-control low-e-coated glass, provide documentation demonstrating that manufacturer of coated glass is certified by coating manufacturer.

E. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

project names and addresses, names and addresses of architects and owners, and other information specified.

F. Adhesion and Compatibility Test Report: From glazing sealant manufacturer indicating glazing sealants were tested for adhesion to glass and glazing channel substrates and for compatibility with glass and other glazing materials.

G. Product Test Reports: From a qualified testing agency, indicating the specified products comply with requirements based on comprehensive testing of standard products. Provide product test reports for each glass product.

H. Warranties: Special warranties specified in this Section.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed glazing similar in material, design, and extent to that indicated for Project and whose work has resulted in construction with a record of successful in-service performance.

B. Source Limitations for Monolithic Float Glass: Obtain all monolithic float glass from one source from a single manufacturer.

C. Source Limitations for Insulating Glass: Obtain all insulating-glass units from one source from a single fabricator using the same type of glass and other components for each type of unit indicated.

D. Source Limitations for Laminated Glass: Obtain all laminated glass units from one source from a single fabricator using the same type of glass and other components for each type of unit indicated.

E. Source Limitations for Glazing Accessories: Obtain all glazing accessories from one source from a single manufacturer for each product and installation method indicated.

F. Safety Glass: Category II materials complying with testing requirements in 16 CFR 1201 and ANSI Z97.1.

1. Subject to compliance with requirements, permanently mark safety glass with certification label of Safety Glazing Certification Council or another certification agency acceptable to authorities having jurisdiction.

G. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to the following publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. GANA Publications: GANA's “Glazing Manual", “Sealant Manual” and “Laminated Glass Design Guide.”
2. SIGMA Publications: SIGMA TM-3000, “Vertical Glazing Guidelines.”
3. IGMA Publication for Insulating Glass: SIGNA TM-3000, “North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use.”

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

4. IGMA Publication for Sloped Glazing: IGMA TB-3001, “Guidelines for Sloped Glazing.”

H. Preinstallation Conference: Conduct conference at Project site.

1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review temporary protection requirements for glazing during and after installation.

I. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of the following inspecting and testing agency:

1. Insulated Glass Certification Council (IGCC)

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials according to manufacturer's written instructions and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

B. For insulating-glass units that will be exposed to substantial altitude changes, comply with insulating-glass manufacturer's written recommendations for venting and sealing to avoid hermetic seal ruptures.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.

1.9 WARRANTY

A. General Warranty: Special warranties specified in this Article shall not deprive Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Manufacturer's Special Warranty on Insulating Glass: Written warranty, made out to Owner and signed by insulating-glass fabricator agreeing to furnish replacements for insulating-glass units that deteriorate as defined in “Definitions” Article within specified warranty period indicated below.

1. Warranty Period: 10 years from date of Substantial Completion.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

C. Manufacturer's Special Warranty on Laminated Glass: Written warranty, made out to Owner and signed by laminated-glass fabricator agreeing to furnish replacements for laminated-glass units that deteriorate as defined in “Definitions” Article within specified warranty period indicated below

1. Warranty Period: 5 years from date of Substantial Completion.

D. Manufacturer's Special Warranty for Coated-Glass Products: Written warranty, made out to Owner and signed by coated-glass fabricator agreeing to furnish replacements for coated-glass that deteriorates as defined in “Definitions” Article within specified warranty period indicated below. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer’s written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.

1. Warranty Period: 5 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GLASS PRODUCTS, GENERAL

A. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass lites in thicknesses as needed to comply with requirements indicated.

1. Minimum Glass Thickness for Exterior Lites: Not less than 6.0 mm.

B. Strength: Where float glass is indicated, provide annealed float glass, Kind HS heat-treated float glass, or Kind FT heat-treated float glass as required by applicable glazing code.

C. Windborne-Debris-Impact Resistance: Provide exterior glazing that passes basic-protection testing requirements in ASTM E 1996 for wind gusts of 130mph when tested according to ASTM E 1886. Test specimens shall be no smaller in width and length than glazing indicated for use on the Project and shall be installed in same manner as glazing indicated for use on the Project.

2.2 MANUFACTURERS AND FABRICATION

A. Available Products: Subject to compliance with requirements, manufacturers of products that may be incorporated into the Work include, but are not limited to, the following:

1. Monolithic Float Glass

a. PPG Industries, Inc.
b. Guardian Industries, Inc.
c. Pilkington, Inc.
d. ACH (formerly Visteon).

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

B. Available Fabricators: Subject to compliance with requirements, fabricators of the products specified include, but are not limited to, the following:

1. J. E. Berkowitz, L.P. (800) 257-7827
2. Viracon, Inc.
3. Arch Aluminum, Inc.
4. Oldcastle Glass

2.3 MONOLITHIC FLOAT GLASS

A. Float Glass: ASTM C 1036, Type 1, Class 1 (clear), Class 2 (tinted) transparent glass, flat, Quality q3 (glazing select); class, kind and condition indicated.

2.4 HEAT-TREATED FLOAT GLASS

A. Heat-Treated Float Glass: ASTM C 1048; Type I; Class I (clear), Class 2 (tinted) transparent glass, flat, Quality q3 (glazing select); class, kind, and condition as required by the applicable glazing code.

B. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed, unless otherwise indicated.

1. Flatness Tolerances

a. Roller-Wave or Ripple: Deviation from flatness at any peak shall be targeted not to exceed 0.003” as measured per peak to valley for ¼” (6 mm) thick glass.
b. Bow and Warp: The bow and warp tolerances targeted shall not exceed 1/32” per linear foot.

2.5 INSULATING GLASS

A. Insulating Glass Units – General: Preassembled units consisting of sealed lites of glass separated by a dehydrated interspace, and complying with ASTM E 2190 for Class CBA units and with requirements specified in this Article.

1. Type IG-1 Insulated Glass: Insulated glass units consisting of two lites of clear, annealed glass, separated by a ½-inch sealed air space. Provide insulated units with low “E” coating. For use in the buildings perimeter openings primarily facing North and East. Refer to Schedules for applied use.

a. Basis-of-Design Product: Subject to compliance with requirements, provide units fabricated with “PPG Solarban 60 Clear” with the following characteristics or comparable product:

1) Ultra Violet: 18%
2) Visible Light Transmittance: 70%
3) Total Solar Energy Transmittance: 33%
4) Winter Night-time U Value: .29

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

5) Summer Day-time U Value: .28
6) Shading Co-efficient: .43
7) Solar Heat Gain Co-efficient: .38
8) Light to Solar Gain: 1.84

b. Insulating Glass Unit Make-up

1) Outboard Lite: "PPG Solarban 60 Clear", ¼-inch thick.
2) Low "E" coating on 2nd. surface.
3) ½-inch thick desiccant filled aluminum spacer.
4) Inboard Lite: ¼-inch thick clear glass.
5) Overall Thickness: 1-inch

TYPE 2 INSULATED GLASS IS THE CRA STANDARD FOR SOUTH AND WEST FACING WALLS.

2. Type IG-2 Insulated Glass: Insulated glass units consisting of two lites of clear, annealed glass, separated by a ½-inch sealed air space. Provide insulated units with low "E" coating. For use in the buildings perimeter openings primarily facing South and West. Refer to Schedules for applied use.

a. Basis-of-Design Product: Subject to compliance with requirements, provide "PPG Solarban 70 Clear" with the following characteristics or comparable product:

1) Ultra Violet: 4%
2) Visible Light Transmittance: 64%
3) Total Solar Energy Transmittance: 23%
4) Winter Night-time U Value: .28
5) Summer Day-time U Value: .27
6) Shading Co-efficient: .31
7) Solar Heat Gain Co-efficient: .27
8) Light to Solar Gain: 2.33

b. Insulating Glass Unit Make-up

1) Outboard Lite: "PPG Solarban 70 Clear", ¼-inch thick.
2) Low "E" coating on 2nd surface.
3) ½-inch thick desiccant filled aluminum spacer.
4) Inboard Lite: ¼-inch thick clear glass.
5) Overall Thickness: 1-inch.

2.6 LAMINATED GLASS

A. Laminated Glass – General: ASTM C 1172, and complying with testing requirements in 16 CFR 1201 for Category II materials, and with other requirements specified. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.

1. Construction: Laminate glass with a polyvinylbutyral interlayer to comply with interlayer manufacturer's written recommendations unless otherwise noted.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

2. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.

B. Laminated Glass:

1. Type LG-1 Laminated Glass: Laminated glass units consisting of two lites of clear, tempered glass laminated with an interlayer. For use at the main decorative glass entrance canopy.

a. Basis-of-Design Product: Subject to compliance with requirements, provide "Invisiwall Point Supported Canopy System" by J.E. Berkowitz, L.P., fabricated with an interlayer of "SentryGlas Plus" by DuPont with the following characteristics or comparable product:

1) Ultra Violet: 99%.
2) Visible Light Transmittance: 57%.
3) Total Solar Energy Transmittance: 36%.
4) Winter Night-time U-Value: .89
5) Summer Day-time U-Value: .81
6) Shading Co-efficient: .59
7) Solar Heat Gain Co-efficient: .51
8) Light to Solar Gain: 1.11

b. Laminated Glass Unit Make-up

1) Outboard Lite: Clear tempered glass, ½-inch thick.
2) Interlayer: "SentryGlas Plus" by DuPont, .060-thick.
3) Silk Screen Pattern: 60% negative white dots on 3rd. surface.
4) Inboard Lite: Clear tempered glass, ½-inch thick.
5) Overall Thickness: 1-inch.

2.7 GLAZING GASKETS

A. Dense Compression Gaskets: Molded or extruded gaskets of material indicated below, complying with standards referenced with name of elastomer indicated below, and of profile and hardness required to maintain watertight seal:

1. Neoprene, ASTM C 864.
2. EPDM, ASTM C 864.
3. Silicone, ASTM C 1115.
4. Thermoplastic polyolefin rubber, ASTM C 1115.
5. Any material indicated above.

2.8 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tape: Preformed, butyl-based elastomeric tape with a solids content of 100 percent; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rods as recommended in writing by tape and glass manufacturers for application indicated; packaged on rolls with a release paper backing; and complying with ASTM C 1281 and AAMA 800.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

2.9 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. VOC Content: For Sealants used inside weatherproofing system, not more than 250 g/L when calculated according to 40 CFR 59, subpart D.

C. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

D. Setting Blocks: Elastomeric material with a Shore A durometer hardness of 85, plus or minus 5.

E. Spacers: Elastomeric blocks or continuous extrusions with a Shore A durometer hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

F. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

2.10 FABRICATION OF GLASS AND OTHER GLAZING PRODUCTS

A. Fabricate glass and other glazing products in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing standard, to comply with system performance requirements.

B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites in a manner that produces square edges with slight kerfs at junctions with outdoor and indoor faces.

C. Grind smooth and polish exposed glass edges and corners.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine framing glazing, with Installer present, for compliance with the following:

1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
2. Presence and functioning of weep system.
3. Minimum required face or edge clearances.
4. Effective sealing between joints of glass-framing members.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

3.2 PREPARATION

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

3.3 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Glazing channel dimensions, as indicated on Drawings, provide necessary bite on glass, minimum edge and face clearances, with reasonable tolerances. Adjust as required by Project conditions during installation.

C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.

D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

F. Provide spacers for glass lites where the length plus width is larger than 50 inches as follows:

1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
2. Provide 1/8-inch minimum bite of spacers on glass.

G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

H. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

3.4 GASKET GLAZING (DRY)

A. Fabricate compression gaskets in lengths recommended by gasket manufacturer to fit openings exactly, with stretch allowance during installation.

B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

C. Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

D. Install gaskets so they protrude past face of glazing stops.

3.5 CLEANING AND PROTECTION

A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels, and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations, including weld splatter. If, despite such protection, contaminating substances do come into contact with glass, remove them immediately as recommended by glass manufacturer.

C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for build-up of dirt, scum, alkaline deposits, or stains; remove as recommended by glass manufacturer.

D. Remove and replace glass that is broken, chipped, cracked, abraded, or damaged in any way, including natural causes, accidents, and vandalism, during construction period.

E. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended by glass manufacturer.

END OF SECTION 088000

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

SECTION 095113 - ACOUSTICAL PANEL CEILINGS

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 ceilings consisting of acoustical panels (ACT) and exposed suspension systems.

B. This Section includes ceilings consisting of fiberglass reinforced plastic (FRP) and exposed suspension systems.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Suspended ceiling components.
2. Structural members to which suspension systems will be attached.
3. Size and location of initial access modules for acoustical panels.
4. Items penetrating finished ceiling including, but not limited to, the following:

    a. Lighting fixtures.
    b. Air outlets and inlets.
    c. Speakers.
    d. Sprinklers.
    e. Access panels.

5. Perimeter moldings.

B. Qualification Data: For testing agency.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

C. Product Test Reports: For each acoustical panel ceiling, for tests performed by a qualified testing agency.

D. Evaluation Reports: For each acoustical panel ceiling suspension system and anchor and fastener type, from ICC-ES.

E. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For finishes to include in maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Acoustical Ceiling and FRP Panels: Full-size panels equal to 2 percent of quantity installed.
2. Suspension-System Components: Quantity of each exposed component equal 2 percent of quantity installed.

1.8 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to NVLAP for testing indicated.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical panels, suspension-system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical panels, permit them to reach room temperature and stabilized moisture content.

C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.10 FIELD CONDITIONS

A. Environmental Limitations: Do not install acoustical panel or FRP ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Acoustical ceiling shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: Comply with ASTM E 1264 for Class A materials.
2. Smoke-Developed Index: 50 or less.

C. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.2 ACOUSTICAL PANELS, GENERAL

A. Low-Emitting Materials: Acoustical panel ceilings 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."

B. Source Limitations: Obtain each type of acoustical ceiling panel and supporting suspension system from single source from single manufacturer.

C. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances unless otherwise indicated.

D. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.

1. Where appearance characteristics of acoustical panels are indicated by referencing pattern designations in ASTM E 1264 and not manufacturers' proprietary product designations, provide products selected by Architect from each manufacturer's full range that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.

2.3 ACOUSTICAL PANELS TYPE (Operator Room)

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. Armstrong World Industries, Inc. Fine Fissured High NRC No.1755

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

2. USG Interiors, Inc.; Radar ClimaPlus Open Plan, No.22325

B. Classification: Provide panels complying with ASTM E 1264 for type, form, and pattern as follows:

1. Type and Form: Type III, mineral base with painted finish.
2. Color: White.
3. LR: .86
4. NRC: Not less than .75
5. CAC: Not less than 35
6. AC: Not less than 170
7. Edge Detail: Square
8. Thickness: 7/8 inch
9. Modular Size: 24 by 48 inches

C. Broad Spectrum Antimicrobial Fungicide and Bactericide Treatment: Provide acoustical panels treated with manufacturer's standard antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D 3273 and evaluated according to ASTM D 3274 or ASTM G 21.

D. Suspension System Type: As specified in Part 2.7.B. and 2.9 for cloud applications.

2.4 ACOUSTICAL PANELS TYPE (FRP – Toilet Room)

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. Alpha San Composite, as distributed by Ceisco, Inc.
2. Nudo, equal to Alpha San Composite

B. Panel Characteristics: Antimicrobial Alpha San Composite with aluminum top core and LDPE base finish; composite clean room ceiling tile; Item No. AK3383. Class C.

1. Color: White.
2. Finish: Crackled Ice.
3. Thickness: 3/4 inch
4. Modular Size: 24 by 48 inches
5. Edge: Lay-In

C. Installation: Use clear super silicone sealant on top of flange with a nominal 1/8 inch bead to secure panel, 100% coverage on top of all flanges including wall angle.

D. Component Materials:Alpha San MB 8142 highly concentrated with RC500 contain silver ions. Provide microbiological and analytic test as follows (or also required by the architect prior to approval):Aluminum substrate to be 3mm +/- 0.01 (DIN 1784),Section Modulus W to be 1.25 +/- 0.01 (DIN 53293),Rigidity to be .14 (DIN 53293),Modulus of elasticity to be 70000 (EN 19991-1),Tensile Strength (EN 485-2),Elongation % A50>2 (EN 485-2),Polyethylene, type LDPE G/cm .935,Thickness of coating to be

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

>16,Pencil Hardness -2H (ECCAT4),Thermal Resistance R 0.0069 (DIN 52612), Thermal Transition coefficient U 5.65 (DIN 4108), Temperature Range to be 32-125

E. Warranty: Provide 10 year warranty for product installed.

F. Suspension System Type: As specified in Part 2.7.C.

2.5 METAL SUSPENSION SYSTEMS, GENERAL

A. Metal Suspension-System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635.

1. High-Humidity Finish: Comply with ASTM C 635 requirements for "Coating Classification for Severe Environment Performance" where high-humidity finishes are indicated.

B. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:

2. Zinc-Coated, Carbon-Steel Wire: ASTM A 641, Class 1 zinc coating, soft temper.
3. Stainless-Steel Wire: ASTM A 580, Type 304, nonmagnetic.
4. Nickel-Copper-Alloy Wire: ASTM B 164, nickel-copper-alloy UNS No. N04400.
5. Size: Select wire diameter so its stress at three times hanger design load (ASTM C 635/C, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106-inch diameter wire.

C. Hanger Rods Mild steel, zinc coated or protected with rust-inhibitive paint.

D. Angle Hangers: Angles with legs not less than 7/8 inch wide; formed with 0.04-inch-thick, galvanized-steel sheet complying with ASTM A 653/A 653M, G90 coating designation; with bolted connections and 5/16-inch diameter bolts.

E. Hold-Down Clips: Provide for all vestibule applications, provide manufacturer's standard hold-down clips spaced 24 inches o.c. on all cross tees.

2.6 METAL SUSPENSION SYSTEM

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Armstrong World Industries, Inc.
2. USG Interiors, Inc.; Subsidiary of USG Corporation.

B. Wide-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; prepainted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A 653/A 653M, not less than G30 (Z90) coating designation; with prefinished 15/16-inch- (24-mm-) wide metal caps on flanges.

1. Structural Classification: Intermediate duty system.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

2. End Condition of Cross Runners: butt-edge type.
3. Face Design: Flat, flush.
4. Cap Material: aluminum cold-rolled sheet.
5. Cap Finish: Painted white

C. Metal Suspension System Standard for FRP Panels and Ceramaguard Ceiling Panels: Provide manufacturer's

1. Structural Classification: Heavy-duty system.
2. Finish: paint white or black to match other ceiling components.
3. Suspension system to be manufacturer's standard and to be supplied by the same manufacturer as the acoustical panels.
4. Grid to be USG ZXLA26 Heavy Duty for main runners, 4' Tees to be USG ZXLA424, 2' Tees USG ZXLA224 and Wall angle USG M7Z.
5. Aluminum Cap Suspension System for use with FRP Panels: Formed from 15/16 inch wide flanges; other characteristics as follows:

   a. Structural Classification: Heavy Duty System
   b. Finish: Baked Polyester paint white or black to match other ceiling components.

2.7 METAL EDGE MOLDINGS AND TRIM

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Armstrong World Industries, Inc.
2. USG Interiors, Inc.; Subsidiary of USG Corporation.

B. Extruded-Aluminum Edge Moldings and Trim: Where indicated, provide manufacturer's extruded-aluminum edge moldings and trim of profile indicated or referenced by manufacturer's designations, including splice plates, corner pieces, and attachment and other clips, complying with seismic design requirements and the following:

1. Aluminum Alloy: Alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than the strength and durability properties of aluminum extrusions complying with ASTM B 221 for Alloy and Temper 6063-T5.
2. Baked-Enamel or Powder-Coat Finish: Minimum dry film thickness of 1.5 mils . Comply with ASTM C 635 and coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.

B. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

3.3 INSTALLATION

A. General: Install acoustical panel ceilings to comply with ASTM C 636/C 636M and seismic design requirements indicated, according to manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."

1. Fire-Rated Assembly: Install fire-rated ceiling systems according to tested fire-rated design.

B. Suspend ceiling hangers from building's structural members and as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
2. Splay hangers only where required and, if permitted with fire-resistance-rated ceilings, to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
4. Secure wire hangers to ceiling-suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both the structure to which hangers are attached and the type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
6. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

7. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
8. Do not attach hangers to steel deck tabs.
9. Do not attach hangers to steel roof deck. Attach hangers to structural members.
10. Space hangers not more than 48 inches o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.
11. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.

C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.

D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.

1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
2. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet Miter corners accurately and connect securely.
3. Do not use exposed fasteners, including pop rivets, on moldings and trim.

E. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

F. Install acoustical panels with undamaged edges and fit accurately into suspension-system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.

1. Arrange directionally patterned acoustical panels as follows:

   a. As indicated on reflected ceiling plans.

2. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension-system runners and moldings.
3. For reveal-edged panels on suspension-system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
4. For reveal-edged panels on suspension-system members with box-shaped flanges, install panels with reveal surfaces in firm contact with suspension-system surfaces and panel faces flush with bottom face of runners.
5. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
6. Install hold-down clips for all vestibule applications and in areas required by authorities having jurisdiction, and for fire-resistance ratings; space as recommended by panel manufacturer's written instructions unless otherwise indicated.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

7. Protect lighting fixtures and air ducts to comply with requirements indicated for fire-resistance-rated assembly.

3.4 CLEANING

A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension-system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 095113

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

SECTION 096513 - RESILIENT BASE AND ACCESSORIES

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. Rubber Wall Base

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified, not less than 12 inches long.

C. Samples for Initial Selection: For each type of product indicated.

D. Product Schedule: For resilient base and accessory products.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Furnish not less than 10 linear feet for every 500 linear feet or fraction thereof, of each type, color, pattern, and size of resilient product installed.

1.5 QUALITY ASSURANCE

A. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Coordinate mockups in this Section with mockups specified in other Sections.

1.6 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.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

1.7 FIELD 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. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.

C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. FloorScore Compliance: Resilient base and stair accessories shall comply with requirements of FloorScore certification.

B. Low-Emitting Materials: Flooring system shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.2 RUBBER WALL BASE: (RB) Where this designation is indicated, provide rubber wall base complying with the following:

1. Products: As follows:

   a. Johnsonite Traditional Wall Base
   b. Roppe Wall Base

2. Color and Pattern: As selected by Architect from manufacturer's full range of colors and patterns produced for vinyl wall base complying with requirements indicated. Provide a minimum of 90 color selections.
3. Style: Cove with top-set toe.
4. Minimum Thickness: 1/8 inch.
5. Height: Provide 4" high base in all other areas indicated as RB on the room finish schedule.
6. Lengths: Lengths standard with manufacturer, but not less than 96 feet.
7. Outside Corners: Created in field.
8. Inside Corners: Created in field
9. Surface: Smooth.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

2.3 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.

1. Adhesives shall have a VOC content of 50 g/L or less
2. Adhesives shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

1. 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.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

1. Installation of resilient products indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

B. Concrete Substrates for Resilient Stair Accessories: Prepare horizontal surfaces according to ASTM F 710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9pH.
4. Moisture Testing: Proceed with installation only after substrates pass testing according to manufacturer's written recommendations, but not less stringent than the following:

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

a. Perform anhydrous calcium chloride test according to ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
b. Perform relative humidity test using in situ probes according to ASTM F 2170. Proceed with installation only after substrates have maximum 75 percent relative humidity level.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install resilient products until they are the same temperature as the space where they are to be installed.

1. At least 48 hours in advance of installation, move resilient products and installation materials into spaces where they will be installed.

E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

3.3 RESILIENT BASE INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient base.

B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.

D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

E. Do not stretch resilient base during installation.

F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.

G. Preformed Corners: Install preformed corners before installing straight pieces.

H. Job-Formed Corners:

1. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.

a. Form without producing discoloration (whitening) at bends.

2. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.

a. Miter corners to minimize open joints.

END OF SECTION 096513

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

SECTION 096519 - RESILIENT TILE FLOORING

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. Vinyl composition floor tile. (VCT)

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For each type of floor tile. Include floor tile layouts, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.

1. Show details of special patterns.

C. Samples: Full-size units of each color and pattern of floor tile required.

D. Samples for Initial Selection: For each type of floor tile indicated.

E. Product Schedule: For floor tile. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of floor tile to include in maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

1. Floor Tile: Furnish one box for every 60 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in techniques required by manufacturer for floor tile installation and seaming method indicated.

1. Engage an installer who employs workers for this Project who are trained or certified by floor tile manufacturer for installation techniques required.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F Store floor tiles on flat surfaces.

1.9 FIELD CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F in spaces to receive floor tile during the following time periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. After installation and 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. Close spaces to traffic during floor tile installation.

D. Close spaces to traffic for 48 hours after floor tile installation.

E. Install floor tile after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For resilient tile flooring, as determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

2.2 VINYL COMPOSITION FLOOR TILE (VCT)

A. Products: Subject to compliance with requirements, provide one of the following:

1. Armstrong

B. Tile Standard: ASTM F 1066, Class 2, through-pattern.

C. Wearing Surface: Smooth

D. Thickness: 0.125 inch

E. Size: 12 by 12 inches

F. Colors: full range of colors (one color installed) to be selected by the Architect

2.3 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by floor tile manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by floor tile and adhesive manufacturers to suit floor tile and substrate conditions indicated.

1. Adhesives shall comply with the following limits for VOC content:

a. Vinyl Composition Tile Adhesives: 50 g/L or less.
b. Rubber Floor Adhesives: 60 g/L or less.

2. Adhesives shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

C. Floor Polish: Provide protective, liquid floor-polish products recommended by floor tile manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor tile.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. Receive Resilient Tile Floor Manufacturer's written approval of substrate required before installation of any tile flooring. The Carpet and Resilient Tile Contractor is responsible for obtaining the Resilient Tile Flooring Manufacturer's written approval of the floor as an acceptable substrate for the installation of manufacturer's tile product specified. If the floor is not acceptable to the manufacturer, the general contractor is responsible for preparing the floor to receive the new tile, as specified in order paragraphs of this specification, including an underlayment or leveling compound where necessary to meet all requirements for a manufacturer's approval of the substrate.

3.2 PREPARATION

A. Prepare substrates according to floor tile manufacturer's written instructions to ensure adhesion of resilient products.

B. Concrete Substrates: Prepare according to ASTM F 710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by floor tile manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by floor tile manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 10 pH.
4. Moisture Testing: Proceed with installation only after substrates pass testing according to floor tile manufacturer's written recommendations, but not less stringent than the following:

   a. Perform anhydrous calcium chloride test according to ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
   b. Perform relative humidity test using in situ probes according to ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install floor tiles until they are the same temperature as the space where they are to be installed.

1. At least 48 hours in advance of installation, move resilient floor tile and installation materials into spaces where they will be installed.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile.

3.3 FLOOR TILE INSTALLATION

A. Comply with manufacturer's written instructions for installing floor tile.

B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.

1. Lay tiles in pattern indicated

C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.

1. Lay tiles with grain running in one direction.

D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.

E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent marking device.

G. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in finished floor areas. Maintain overall continuity of color and pattern between pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.

H. Adhere floor tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.4 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protecting floor tile.

B. Perform the following operations immediately after completing floor tile installation:

1. Remove adhesive and other blemishes from exposed surfaces.
2. Sweep and vacuum surfaces thoroughly.
3. Damp-mop surfaces to remove marks and soil.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

C. Protect floor tile from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Floor Polish: Remove soil, adhesive, and blemishes from floor tile surfaces before applying liquid floor polish.

E. Joint Sealant: Apply sealant to resilient terrazzo floor tile perimeter and around columns, at door frames, and at other joints and penetrations.

F. Sealers and Finish Coats: Remove soil, visible adhesive, and surface blemishes from resilient floor tile surfaces before applying liquid cleaners, sealers, and finish products.
   1. Finish: Apply 3 coats of liquid floor polish.

G. Cover floor tile until Substantial Completion.

END OF SECTION 096519

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

Copyright 1999, The American Institute of Architects (AIA)

SECTION 099123 – PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes surface preparation and field painting of exposed exterior and interior items and surfaces.

1. Surface preparation, priming, and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections.

B. Paint exposed surfaces, except where these Specifications indicate that the surface or material is not to be painted or is to remain natural. If an item or a surface is not specifically mentioned, paint the item or surface the same as similar adjacent materials or surfaces. If a color of finish is not indicated, Architect will supply a color selection.

1. Painting includes field painting of exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron supports, and surfaces of mechanical and electrical equipment that do not have a factory-applied final finish.

C. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels.

1. Prefinished items include the following factory-finished components:

a. Architectural woodwork.
b. Acoustical wall panels.
c. Metal toilet enclosures.
d. Metal lockers.
e. Unit kitchens.
f. Elevator entrance doors and frames.
g. Elevator equipment.
h. Light fixtures.

2. Concealed surfaces include walls or ceilings in the following generally inaccessible spaces:

a. Foundation spaces.
b. Furred areas.
c. Ceiling plenums.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

d. Utility tunnels.
e. Pipe spaces.
f. Duct shafts.
g. Elevator shafts.

3. Finished metal surfaces include the following:

a. Anodized aluminum.
b. Stainless steel.
c. Chromium plate.
d. Copper and copper alloys.
e. Bronze and brass.

4. Operating parts include moving parts of operating equipment and the following:

a. Valve and damper operators.
b. Linkages.
c. Sensing devices.
d. Motor and fan shafts.

5. Labels: Do not paint over UL, FMG, or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.

D. Related Sections include the following:

1. Division 5 Sections for shop priming of metal substrates with primers specified in this Section.
2. Division 2 Section "Cement Concrete Pavement" for traffic-marking paint.
3. Division 5 Section "Structural Steel" for shop priming structural steel.
4. Division 5 Section "Metal Fabrications" for shop priming ferrous metal.
5. Division 6 Section "Architectural Woodwork" for shop priming interior architectural woodwork.
6. Division 8 Section "Steel Doors and Frames" for factory priming steel doors and frames.
7. Division 9 Section "Gypsum Board Assemblies" for surface preparation of gypsum board.

1.3 DEFINITIONS

A. General: Standard coating terms defined in ASTM D 16 apply to this Section.

1. Flat refers to a lusterless or matte finish with a gloss range below 15 when measured at an 85-degree meter.
2. Eggshell refers to low-sheen finish with a gloss range between 20 and 35 when measured at a 60-degree meter.
3. Semigloss refers to medium-sheen finish with a gloss range between 35 and 70 when measured at a 60-degree meter.
4. Full gloss refers to high-sheen finish with a gloss range more than 70 when measured at a 60-degree meter.

1.4 SUBMITTALS

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

A. Product Data: For each paint system indicated. Include block fillers and primers.

1. Material List: An inclusive list of required coating materials. Indicate each material and cross-reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification. Submit in same format as specification.
2. Manufacturer's Information: Manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material.
3. Certification by the manufacturer that products supplied comply with local regulations controlling use of volatile organic compounds (VOC's).

B. Colors: Match Architect's color selections.

C. Samples for Verification: For each color and material to be applied, with texture to simulate actual conditions, on representative Samples of the actual substrate.

1. Submit 4 sets of samples of each final color and finish.

D. Qualification Data: For firms and persons specified in the "Quality Assurance" Article to be 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.

E. Certifications:
1. Furnish a letter from the paint manufacturer or their factory representative certifying that the paint system proposed for this project are equal to or better than the specified systems in appearance and performance levels. Submit proof of equivalency for approval including generic type, descriptive information, VOC content, performance data, solids by volume, and recommended film thickness. Submittals not accompanied by this certification will be returned, "REJECTED."

F. Coating Maintenance Manual: Upon conclusion of the project, the Contractor or paint manufacturer/supplier shall furnish a coating maintenance manual, such as Sherwin-Williams "Custodian Project Color and Product Information" report or equal. Manual shall include an Area Summary with finish schedule, Area Detail designating where each product/color/finish was used, product data pages, Material Safety Data Sheets, care and cleaning instructions, touch-up procedures, and color samples of each color and finish used.

1.5 QUALITY ASSURANCE

A. Applicator Qualifications: A firm or individual experienced in applying paints and coatings similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.

B. Source Limitations: Obtain block fillers and primers for each coating system from the same manufacturer as the finish coats.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

C. Benchmark Samples (Mockups): Provide a full-coat benchmark finish sample for each type of coating and substrate required. Comply with procedures specified in PDCA P5. Duplicate finish of approved sample Submittals.

1. Architect will select one room or surface to represent surfaces and conditions for application of each type of coating and substrate.

   a. Provide mock up of first and second coats of block filler or primer for approval of application.

   b. Wall Surfaces: Provide samples on at least 100 sq. ft.
   c. Small Areas and Items: Architect will designate items or areas required.

D. Apply benchmark samples, according to requirements for the completed Work, after permanent lighting and other environmental services have been activated. Provide required sheen, color, and texture on each surface. Where materials are being applied over previously painted surfaces, apply mock up samples and perform field testing to check for compatibility, adhesion, and film integrity of the new materials to existing painted surfaces. Report in writing any condition that may affect application, appearance, or performance of the specified coating system.

   a. After finishes are accepted, Architect will use the room or surface to evaluate coating systems of a similar nature.

2. Final approval of colors will be from benchmark samples.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label and the following information:

1. Product name or title of material.
2. Product description (generic classification or binder type).
3. Manufacturer's stock number and date of manufacture.
4. Contents by volume, for pigment and vehicle constituents.
5. Thinning instructions.
6. Application instructions.
7. Color name and number.
8. VOC content.

B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F. Maintain storage containers in a clean condition, free of foreign materials and residue.

1. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily.

C. Take necessary measures to ensure that workers and work areas are protected from fire and health hazards resulting from handling, mixing, and application.

1.7 PROJECT CONDITIONS

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

A. Apply waterborne paints only when temperatures of surfaces to be painted and surrounding air are between 50 and 90 deg F.

B. Apply solvent-thinned paints only when temperatures of surfaces to be painted and surrounding air are between 45 and 95 deg F.

C. Do not apply paint in snow, rain, fog, or mist; or when relative humidity exceeds 85 percent; or at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by manufacturer during application and drying periods.

1.8 EXTRA MATERIALS

A. Furnish extra paint materials from the same production run as the materials applied and in the quantities described below. Package with protective covering for storage and identify with labels describing contents. Deliver left-over paint materials to Owner.

1. Quantity: Furnish Owner with extra paint materials in quantities indicated below:

a. Exterior: 2 gallons of each color applied.
b. Interior: 1 case of each color applied.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, provide products from one of the following manufacturers. Sherwin-Williams is the basis of design and establishes the standard of quality required.

B. Manufacturers' Names:

1. Sherwin Williams. (SW)

2. Duron

3. MAB

4. Glidden

2.2 PAINT MATERIALS, GENERAL

A. Material Compatibility: Provide block fillers, primers, and finish-coat materials that are compatible with one another and with the substrates indicated under conditions of

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

service and application, as demonstrated by manufacturer based on testing and field experience. Each system should be from the same manufacturer.

B. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified that are factory formulated and recommended by manufacturer for application indicated. Paint-material containers not displaying manufacturer's product identification will not be acceptable.

1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish manufacturer's material data and certificates of performance for proposed substitutions.

C. Colors: Match Architect's samples.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for paint application. Comply with procedures specified in PDCA P4.

1. Proceed with paint application only after unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.
2. Start of painting will be construed as Applicator's acceptance of surfaces and conditions within a particular area.

B. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.

1. Notify Architect about anticipated problems when using the materials specified over substrates primed by others.

C. Where materials are being applied over previously painted surfaces, apply mock up samples and perform field testing to check for compatibility, adhesion, and film integrity of the new materials to existing painted surfaces. Report in writing any condition that may affect application, appearance, or performance of the specified coating system.

3.2 PREPARATION

A. General: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of size or weight of the item, provide surface-applied protection before surface preparation and painting.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

1. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.

B. Cleaning: Before applying paint or other surface treatments, clean substrates of substances that could impair bond of the various coatings. Remove oil and grease before cleaning. All surfaces must be clean, dry, and free of all oil, grease, surface contaminants, and substances that could impair adhesion.

1. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.

C. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified.

1. Provide barrier coats over incompatible primers or remove and reprime.
2. Cementitious Materials: Prepare concrete, concrete unit masonry, cement plaster, and mineral-fiber-reinforced cement panel surfaces to be painted. Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.

    a. Use abrasive blast-cleaning methods if recommended by paint manufacturer.
    b. Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct this condition before application. Do not paint surfaces if moisture content exceeds that permitted in manufacturer's written instructions.
3. For Concrete Floors:
    a. Surface must be clean, dry, and in sound condition. Remove stains, oil, dust, grease, dirt, rust, release agents, curing compounds and hardeners, salts, efflorescence, laitance, and other contaminants and foreign material to ensure adequate adhesion.
    b. Follow recommendations as listed in the Sherwin Williams / General Polymers G-1 Surface Preparation Guide and ICRI Guideline #310-2-1997 for surface preparation.
    c. Provide Concrete Surface Profile (CSP) as recommended by manufacturer for specified systems.
    d. Determine alkalinity and moisture content of surfaces by performing appropriate tests. Document results in writing to GC and architect.
4. Wood: Clean surfaces of dirt, oil, and other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sand surfaces exposed to view smooth and dust off.

    a. Scrape and clean small, dry, seasoned knots, and apply a thin coat of white shellac or other recommended knot sealer before applying primer. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sand smooth when dried.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

b. Prime, stain, or seal wood to be painted immediately on delivery. Prime edges, ends, faces, undersides, and back sides of wood, including cabinets, counters, cases, and paneling.
c. If transparent finish is required, backprime with spar varnish.
d. Backprime paneling on interior partitions where masonry, plaster, or other wet wall construction occurs on back side.
e. Seal tops, bottoms, and cutouts of unprimed wood doors with a heavy coat of varnish or sealer immediately on delivery.

5. Ferrous Metals: Clean ungalvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with SSPC's recommendations.

a. Power Tool Clean surfaces clean as recommended by paint system manufacturer and according to SSPC-SP3.
b. Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.
c. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by paint manufacturer, and touch up with same primer as the shop coat.

6. Galvanized Surfaces: Clean galvanized surfaces with nonpetroleum-based solvents so surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.

7. Interior Grilles, Louvers and Sprinkler Escutcheons shall be painted in the field to match adjacent material color. Contractor shall prep and prime factory finished items to receive new paint finish in the field.

D. Material Preparation: Mix and prepare paint materials according to manufacturer's written instructions.

1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
3. Use only thinners approved by paint manufacturer and only within recommended limits.

E. Tinting: Tint each undercoat a lighter shade to simplify identification of each coat when multiple coats of same material are applied. Tint undercoats to match the color of the finish coat, but provide sufficient differences in shade of undercoats to distinguish each separate coat.

3.3 APPLICATION

A. General: Apply paint according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

1. Paint colors, surface treatments, and finishes are indicated in the paint schedules.
2. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
3. Provide finish coats that are compatible with primers used.
4. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, grilles, convector covers, covers for finned-tube radiation, and similar components are in place. Extend coatings in these areas, as required, to maintain system integrity and provide desired protection.
5. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
6. Paint interior surfaces of ducts with a flat, nonspecular black paint where visible through registers or grilles.
7. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
8. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.
9. Finish interior of wall and base cabinets and similar field-finished casework to match exterior.
10. Sand lightly between each succeeding enamel or varnish coat.

B. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.

1. The number of coats and film thickness required are the same regardless of application method. Do not apply succeeding coats until previous coat has cured as recommended by manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.
2. Omit primer over metal surfaces that have been shop primed and touchup painted.
3. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure that edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
4. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, and does not deform or feel sticky under moderate thumb pressure, and until application of another coat of paint does not cause undercoat to lift or lose adhesion.

C. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.

1. Brushes: Use brushes best suited for type of material applied. Use brush of appropriate size for surface or item being painted.
2. Rollers: Use rollers of carpet, velvet-back, or high-pile sheep's wool as recommended by manufacturer for material and texture required.
3. Spray Equipment: Use airless spray equipment with orifice size as recommended by manufacturer for material and texture required.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

D. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate to achieve dry film thickness indicated. Provide total dry film thickness of the entire system as recommended by manufacturer.

E. Mechanical and Electrical Work: Painting of mechanical and electrical work is limited to items exposed in equipment rooms and occupied spaces.

F. Mechanical items to be painted include, but are not limited to, the following:

1. Exposed uninsulated metal piping.
2. Exposed uninsulated plastic piping.
3. Exposed pipe hangers and supports.
4. Tanks that do not have factory-applied final finishes.
5. Visible portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets.
6. Duct, equipment, and pipe insulation having "all-service jacket" or other paintable jacket material.
7. Mechanical equipment that is indicated to have a factory-primed finish for field painting.

G. Electrical items to be painted include, but are not limited to, the following:

1. Switchgear.
2. Panelboards.
3. Electrical equipment that is indicated to have a factory-primed finish for field painting.

H. All interior and exterior exposed gypsum wallboard, including any bulkheads and soffits to be painted.

I. All interior and exterior ferrous metal to be painted including any lintels, railings, grilles, and louvers (does not include factory or pre-finished items).

J. All hollow metal doors and frames, interior and exterior, to be painted.

K. Block Fillers: Apply block fillers to concrete masonry block at a rate to ensure complete coverage with pores filled.

L. Prime Coats: Before applying finish coats, apply a prime coat, as recommended by manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn-through or other defects due to insufficient sealing.

M. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.

N. Transparent (Clear) Finishes: Use multiple coats to produce a glass-smooth surface film of even luster. Provide a finish free of laps, runs, cloudiness, color irregularity, brush marks, orange peel, nail holes, or other surface imperfections.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

1. Provide satin finish for final coats.

O. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.

P. Marking and Identification: Fire walls, fire barriers, fire partitions, smoke barriers and smoke partitions or any other wall required to have protected openings or penetrations shall be effectively and permanently identified with signs or stenciling. Such identification shall:
1. Be located in accessible concealed floor, floor-ceiling or attic spaces;
2. Be repeated at intervals not exceeding 30 feet measured horizontally along the wall or partition; and
3. Include lettering not less than 0.5 inch in height, incorporating the suggested wording: "FIRE AND/OR SMOKE BARRIER-PROTECT ALL OPENINGS," or other wording.
   a. Exception: Walls in Group R-2 occupancies that do not have a removable decorative ceiling allowing access to the concealed space.

3.4 FIELD QUALITY CONTROL

A. Owner reserves the right to invoke the following test procedure at any time and as often as Owner deems necessary during the period when paint is being applied:

1. Owner will engage a qualified independent testing agency to sample paint material being used. Samples of material delivered to Project will be taken, identified, sealed, and certified in the presence of Contractor.
2. Testing agency will perform appropriate tests for the following characteristics as required by Owner:

   a. Quantitative material analysis.
   b. Abrasion resistance.
   c. Apparent reflectivity.
   d. Flexibility.
   e. Washability.
   f. Absorption.
   g. Accelerated weathering.
   h. Dry opacity.
   i. Accelerated yellowness.
   j. Recoating.
   k. Skinning.
   l. Color retention.
   m. Alkali and mildew resistance.

3. Owner may direct Contractor to stop painting if test results show material being used does not comply with specified requirements. Contractor shall remove noncomplying paint from Project site, pay for testing, and repaint surfaces previously coated with the noncomplying paint. If necessary, Contractor may be required to remove noncomplying paint from previously painted surfaces if, on repainting with specified paint, the two coatings are incompatible.

B. Pre-installation Meetings:

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

1. Schedule a conference and inspection to be held on-site before field application of coating systems begins.
2. Conference shall be attended by Contractor, Owner's representative, Engineer, Construction Manager, coating applicators, and a representative of coating material manufacturer.
3. Topics to be discussed at meeting shall include:

    a. A review of Contract Documents and accepted shop drawings shall be made and deviations or differences shall be resolved.
    b. Review items such as environmental conditions, surface conditions, surface preparation, application procedures, and protection following application.
    c. Establish which areas on-site will be available for use as storage areas and working area

4. Pre-construction conference and inspection shall serve to clarify Contract Documents, application requirements and what work should be completed before coating application can begin.
5. Prepare and submit, to parties in attendance, a written report of pre-installation conference report shall be submitted with 3 days following conference.
6. Field Samples:

    a. Provide a full coating system to the required sheen, color, texture, and recommended coverage rates. Simulate finished lighting conditions for reviewing in-place work.

7. The Architect, Construction Manager or Owners Representative will select one room, area, or combination of areas and surfaces and conditions for each type of coating and substrate to be coated. Apply coatings in this room, area, combination of areas and surfaces according to the schedule, or as specified. After finishes are accepted, this room, area or combination of areas and surfaces will serve as the standard of quality and for evaluation of coating systems of similar nature.
8. A manufacturer’s representative shall be available upon request by the General Contractor or Painting subcontractor, to advise applicator on proper application technique and procedures.

3.5 CLEANING

A. Cleanup: At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from Project site.

1. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping without scratching or damaging adjacent finished surfaces.

3.6 PROTECTION

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

A. Protect work of other trades, whether being painted or not, against damage from painting. Correct damage by cleaning, repairing or replacing, and repainting, as approved by Architect.

B. Provide "Wet Paint" signs to protect newly painted finishes. After completing painting operations, remove temporary protective wrappings provided by others to protect their work.

1. After work of other trades is complete, touch up and restore damaged or defaced painted surfaces. Comply with procedures specified in PDCA P1.

3.7 EXTERIOR PAINT SCHEDULE

A. Ferrous Metal: Provide the following finish systems over exterior ferrous metal. Primer is not required on shop-primed items.

1. Semi-Gloss Acrylic-Enamel Finish: two finish coats over a rust-inhibitive primer.

a. Primer: Pro Industrial Pro-Cryl Universal Metal Primer, B66-310 series
b. 1st Coat: Waterbased Acrolon 100 Waterbased Urethane Gloss
c. 2nd Coat: Waterbased Acrolon 100 Waterbased Urethane Gloss

B. Galvanized Metal: Provide the following finish systems over exterior ferrous metal. Primer is not required on shop-primed items.

1. Semi-Gloss Acrylic-Enamel Finish: two finish coats over a rust-inhibitive primer.

a. Primer: Pro Industrial Pro-Cryl Universal Metal Primer, B66-310 series
b. 1st Coat: Waterbased Acrolon 100 Waterbased Urethane Gloss
c. 2nd Coat: Waterbased Acrolon 100 Waterbased Urethane Gloss

C. Concrete Masonry Units (CMU): Provide the following finish systems over exterior CMU/Block.

1. Semi-Gloss Acrylic-Enamel Finish: two finish coats over a block filler.

a. Filler: PrepRite Block Filler, B25W25
b. 1st Coat: A-100 Exterior 100% Acrylic Gloss, A8 series
c. 2nd Coat: A-100 Exterior 100% Acrylic Gloss, A8 series

D. Poured Concrete/Masonry: Provide the following finish systems over exterior concrete/masonry.

1. Semi-Gloss Acrylic-Enamel Finish: two finish coats over a masonry primer.

a. Primer: Loxon Concrete & Masonry Primer, A24W8300
b. 1st Coat: A-100 Exterior 100% Acrylic Gloss, A8 series
c. 2nd Coat: A-100 Exterior 100% Acrylic Gloss, A8 series

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

E. Exterior Wood (Painted Finish): Provide the following finish systems over exterior wood surfaces.

1. Semi-Gloss Acrylic-Enamel Finish: two finish coats over a wood primer.

   a. Primer: Exterior Latex Wood Primer, B42W8041
   b. 1st Coat: Solo 100% Acrylic Int./Ext. Semi-Gloss, A76 series
   c. 2nd Coat: Solo 100% Acrylic Int./Ext. Semi-Gloss, A76 series

F. Exterior Wood Semi-Transparent (Stained Finish): Provide the following finish systems over exterior wood surfaces.

1. Semi-Transparent Finish: two finish coats over a rust-inhibitive primer.
   a. 1st Coat: Woodscapes Exterior Polyurethane Semi-Transparent Stain, A15 series
   b. 2nd Coat: Woodscapes Exterior Polyurethane Semi-Transparent Stain, A15 series

3.8 INTERIOR PAINT SCHEDULE

A. Gypsum Board: Provide the following finish systems over interior gypsum board surfaces:

1. Flat Acrylic Finish: - Two finish coats over a primer.

   a. Primer: ProMar 200 Zero VOC Latex Primer, B28W600.
   b. 1st Coat: ProMar 200 Zero VOC Latex Flat, B30W2650 series
   c. 2nd Coat: ProMar 200 Zero VOC Latex Flat, B30W2650 series

2. Low Luster Acrylic-Enamel Finish for administration areas: two finish coats over a primer.

   a. Primer: ProMar 200 Zero VOC Latex Primer, B28W600.
   b. 1st Coat: ProMar 200 Zero VOC Latex Eg-Shel, B20W2650 series
   c. 2nd Coat: ProMar 200 Zero VOC Latex Eg-Shel, B20W2650 series

3. Low Luster Acrylic-Enamel Finish for administration areas: two finish coats over an adhesion promoting primer.

   a. Primer: Multi-Purpose Interior/Exterior Latex Primer/Sealer, B51-450 series
   b. 1st Coat: ProMar 200 Zero VOC Latex Eg-Shel, B20W2650 series
   c. 2nd Coat: ProMar 200 Zero VOC Latex Eg-Shel, B20W2650 series

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

B. Ferrous Metal: Provide the following finish systems over ferrous metal:

1. Semi-Gloss Finish: two finish coats over a primer.

   a. Primer: Pro Industrial Pro-Cryl Universal Metal Primer, B66-310 series
   b. 1st Coat: Waterbased Acrolon 100 Waterbased Urethane Gloss
   c. 2nd Coat: Waterbased Acrolon 100 Waterbased Urethane Gloss

C. Galvanized Metal: Provide the following finish systems over galvanized metal:

1. Semi-Gloss Finish: two finish coats over a primer.

   a. Primer: Pro Industrial Pro-Cryl Universal Metal Primer, B66-310 series
   b. 1st Coat: Waterbased Acrolon 100 Waterbased Urethane Gloss
   c. 2nd Coat: Waterbased Acrolon 100 Waterbased Urethane Gloss

END OF SECTION 099123

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

SECTION 101550 TOILET COMPARTMENTS

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. Solid-polymer toilet compartments configured as toilet enclosures

B. Related Sections:
   1. Division 10 Section "Toilet Accessories" for grab bars and similar accessories.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For toilet compartments. Include plans, elevations, sections, details, and attachments to other work.

   1. Show locations of cutouts for compartment-mounted toilet accessories.
   2. Show locations of reinforcements for compartment-mounted grab bars.
   3. Show locations of centerlines of toilet fixtures, except where minimum clear stall dimensions are required.

C. Samples for Initial Selection: For each type of unit indicated. Include Samples of hardware and accessories involving material and color selection.

D. Samples for Verification: For the following products, in manufacturer's standard sizes unless otherwise indicated:

   1. Each type of material, color, and finish required for units, prepared on 6-inch-square Samples of same thickness and material indicated for Work.
   2. Each type of hardware and accessory.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of toilet compartment, from manufacturer.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For toilet compartments to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Comply with requirements in GSA's CID-A-A-60003, "Partitions, Toilets, Complete."

B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84, or another standard acceptable to authorities having jurisdiction, by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 450 or less.

C. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities" and ICC/ANSI A117.1 for toilet compartments designated as accessible.

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Aluminum Castings: ASTM B 26.

B. Aluminum Extrusions: ASTM B 221.

C. Stainless-Steel Sheet: ASTM A 666, Type 304, stretcher-leveled standard of flatness.

D. Zamac: ASTM B 86, commercial zinc-alloy die castings.

2.2 SOLID-POLYMER UNITS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Scranton Products Hiny Hiders or comparable product by one of the following:

1. Partition Systems Incorporated of South Carolina.
2. Sanymetal; a Crane Plumbing company.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

B. Toilet-Enclosure Style: Floor mounted & overhead braced.

C. Door, Panel, and Pilaster Construction: Solid, high-density polyethylene (HDPE) panel material, not less than 1 inch thick, seamless, with eased edges, and with homogenous color and pattern throughout thickness of material.

1. Color and Pattern: One color and pattern in each as selected by Architect from manufacturer's full range.

D. Pilaster Shoes and Sleeves (Caps): Manufacturer's standard design; stainless steel.

E. Brackets (Fittings):

1. Stirrup Type: Ear or U-brackets, chrome-plated zamac.

2.3 ACCESSORIES

A. Hardware and Accessories: Manufacturer's standard design, heavy-duty operating hardware and accessories.

1. Material: Clear-anodized aluminum.
2. Hinges: Manufacturer's standard wrap-around paired, self-closing type that can be adjusted to hold doors open at any angle up to 90 degrees.
3. Latch and Keeper: Manufacturer's standard surface-mounted latch unit designed for emergency access and with combination rubber-faced door strike and keeper. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible.
4. Coat Hook: Manufacturer's standard combination hook and rubber-tipped bumper, sized to prevent in-swinging door from hitting compartment-mounted accessories.
5. Door Bumper: Manufacturer's standard rubber-tipped bumper at out-swinging doors.
6. Door Pull: Manufacturer's standard unit at out-swinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible.

B. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with antigrip profile and in manufacturer's standard finish.

C. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel or chrome-plated steel or brass, finished to match the items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless steel, hot-dip galvanized steel, or other rust-resistant, protective-coated steel.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

2.4 FABRICATION

A. Floor Mounted & Overhead-Braced Units: Provide manufacturer's standard corrosion-resistant supports, leveling mechanism, and anchors at pilasters to suit floor conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.

B. Door Size and Swings: Unless otherwise indicated, provide 24-inch- wide, in-swinging doors for standard toilet compartments and 36-inch- wide, out-swinging doors with a minimum 32-inch- wide, clear opening for compartments designated as accessible.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.

1. Maximum Clearances:

a. Pilasters and Panels: 1/2 inch.
b. Panels and Walls: 1 inch.

2. Stirrup Brackets: Secure panels to walls and to pilasters with no fewer than two brackets attached near top and bottom of panel.

a. Locate wall brackets so holes for wall anchors occur in masonry or tile joints.
b. Align brackets at pilasters with brackets at walls.

B. Overhead-Braced Units: Secure pilasters to floor and level, plumb, and tighten. Set pilasters with anchors penetrating not less than 1-3/4 inches into structural floor unless otherwise indicated in manufacturer's written instructions. Secure continuous head rail to each pilaster with no fewer than two fasteners. Hang doors to align tops of doors with tops of panels, and adjust so tops of doors are parallel with overhead brace when doors are in closed position.

3.2 ADJUSTING

A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

SECTION 108000 TOILET ACCESSORIES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Work of this Section includes the following:

1. Supply and install Toilet and Bath Accessory items as scheduled.

2. Installation of Owner supplied Toilet and Bath accessories as scheduled.

B. Toilet compartments and related accessories are specified in another Division 10 Section.

1.3 SUBMITTALS

A. General: Submit the following according to Conditions of the Contract and Division 1 Specification Sections.

B. Product data for each toilet accessory item specified, including construction details relative to materials, dimensions, gages, profiles, mounting method, specified options, and finishes.

C. Schedule indicating types, quantities, sizes, and installation locations (by room) for each toilet accessory item to be provided for project.

D. Setting drawings where cutouts are required in other work, including templates, substrate preparation instructions, and directions for preparing cutouts and installing anchorage devices.

E. Maintenance instructions including replaceable parts and service recommendations.

1.4 QUALITY ASSURANCE

A. Inserts and Anchorages: Furnish accessory manufacturers' standard inserts and anchoring devices that must be set in concrete or built into masonry. Coordinate delivery with other work to avoid delay.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

B. Single-Source Responsibility: Provide products of same manufacturer for each type of accessory unit and for units exposed to view in same areas, unless otherwise acceptable to Architect.

1.5 PROJECT CONDITIONS

A. Coordination: Coordinate accessory locations, installation, and sequencing with other work to avoid interference with and ensure proper installation, operation, adjustment, cleaning, and servicing of toilet accessory items.

1.6 WARRANTY

A. Warranty: Submit a written warranty executed by mirror manufacturer, agreeing to replace any mirrors that develop visible silver spoilage defects within warranty period.

B. Warranty Period: 5 years from date of Substantial Completion.

C. The warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under requirements of the Contract Documents.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering toilet accessories that may be incorporated in the Work include, but are not limited to, the following:

1. Toilet Accessories

a. Bobrick Washroom Equipment, Inc.
b. American Specialties, Inc.
c. Bradley Corporation

2.2 MATERIALS, GENERAL

A. Stainless Steel: AISI Type 302/304, with polished No. 4 finish, 0.034-inch (22-gage) minimum thickness.

B. Sheet Steel: Cold-rolled, commercial quality ASTM A366, 0.04-inch (20-gage) minimum. Surface preparation and metal pretreatment as required for applied finish.

C. Galvanized Steel Sheet: ASTM A 527, G60.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

D. Chromium Plating: Nickel and chromium electro-deposited on base metal, ASTM B 456, Type SC 2.

E. Mirror Glass: Nominal 6.0-mm (0.23-inch) thick, conforming to ASTM C 1036, Type I, Class 1, Quality q2, and with silvering, electro-plated copper coating, and protective organic coating.

F. Galvanized Steel mounting Devices: ASTM A 153, hot-dip galvanized after fabrication.

G. Fasteners: Screws, bolts, and other devices of same material as accessory unit, or of galvanized steel where concealed.

2.3 TOILET ACCESSORY SCHEDULE

A. A Toilet Accessory Schedule on the drawings lists the types of accessories required. The schedule includes model numbers of specific items as manufactured by Bobrick. The inclusion of these model numbers is to provide a guide as to the quality, function, size, and materials of the intended products, not to be exclusionary or proprietary. Equal products by other manufacturers specified are acceptable.

2.4 FABRICATION

A. General: Only a maximum 1-1/2-inch-diameter, unobtrusive stamped manufacturer logo, as approved by Architect, is permitted on exposed face of toilet or bath accessory units. On either interior surface not exposed to view or back surface, provide additional identification by either a printed, waterproof label or a stamped nameplate, indicating manufacturer's name and product model number.

B. Surface-Mounted Toilet Accessories, General: Except where otherwise indicated, fabricate units with tight seams and joints, exposed edges rolled. Hang doors or access panels with continuous stainless steel piano hinge. Provide concealed anchorage wherever possible.

C. Framed Mirror Units, General: Fabricate frames for glass mirror units to accommodate wood, felt, plastic, or other glass edge protection material. Provide mirror backing and support system that will permit rigid, tamperproof glass installation and prevent moisture accumulation.

D. Mirror Unit Hangers: Provide system for mounting mirror units that will permit rigid, tamperproof, and theftproof installation, as follows:

1. One-piece, galvanized-steel, wall-hanger device with spring-action locking mechanism to hold mirror unit in position with no exposed screws or bolts.

PART 3 - EXECUTION

3.1 INSTALLATION

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

A. Install toilet accessory units according to manufacturers' instructions, using fasteners appropriate to substrate as recommended by unit manufacturer. Install units plumb and level, firmly anchored in locations and at heights indicated.

B. Secure mirrors to walls in concealed, tamperproof manner with special hangers, toggle bolts, or screws. Set units plumb, level, and square at locations indicated, according to manufacturer's instructions for type of substrate involved.

C. Install grab bars to withstand a downward load of at least 250 lbf, complying with ASTM F 446.

3.2 ADJUSTING AND CLEANING

A. Adjust toilet accessories for proper operation and verify that mechanisms function smoothly. Replace damaged or defective items.

B. Clean and polish all exposed surfaces strictly according to manufacturer's recommendations after removing temporary labels and protective coatings.

END OF SECTION 108000

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

SECTION 122413 - ROLLER WINDOW SHADES

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:

a. Manually operated roller shades and blackout shades to be applied to **ALL** exterior window applications.

B. Related Requirements:

1. Division 6 Section "Miscellaneous Rough Carpentry" for wood blocking and grounds for mounting roller shades and accessories.
2. Division 7 Section "Joint Sealants" for sealing the perimeters of installation accessories for light-blocking shades with a sealant.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include styles, material descriptions, construction details, dimensions of individual components and profiles, features, finishes, and operating instructions for roller shades.

B. Shop Drawings: Show fabrication and installation details for roller shades, including shadeband materials, their orientation to rollers, and their seam and batten locations.

C. Samples: For each exposed product and for each color and texture specified, 10 inches long.

D. Samples for Initial Selection: For each type and color of shadeband material.

1. Include Samples of accessories involving color selection.

E. Roller-Shade Schedule: Use same designations indicated on Drawings.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Certificates: For each type of shadeband material, signed by product manufacturer.

C. Product Test Reports: For each type of shadeband material, for tests performed by manufacturer and witnessed by a qualified testing agency.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roller shades to include in maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Roller Shades: Full-size units equal to 5 percent of quantity installed for each size, color, and shadeband material indicated, but no fewer than 2 units.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver roller shades in factory packages, marked with manufacturer, product name, and location of installation using same designations indicated on Drawings.

1.9 FIELD CONDITIONS

A. Environmental Limitations: Do not install roller shades until construction and finish work in spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operating hardware of operable glazed units through entire operating range. Notify Architect of installation conditions that vary from Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following and not limited to:

1. Draper Inc. Manual Flexshade
2. Hunter Douglas Contract. (Equal to Draper)
3. MechoShade Systems, Inc. (Equal to Draper)
4. Jacksons Window Shoppe

B. Source Limitations: Obtain roller shades from single source from single manufacturer.

2.2 MANUALLY OPERATED SHADES WITH SINGLE ROLLERS

A. Chain-and-Clutch Operating Mechanisms: With continuous-loop bead chain and clutch that stops shade movement when bead chain is released; permanently adjusted and lubricated.

1. Bead Chains: Manufacturer's standard.

a. Loop Length: Full length of roller shade.
b. Limit Stops: Provide upper and lower ball stops.
c. Chain-Retainer Type: Chain tensioner, jamb mounted

B. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.

1. Roller Drive-End Location: Right side of inside face of shade
2. Direction of Shadeband Roll: Regular, from back of roller.
3. Shadeband-to-Roller Attachment: Manufacturer's standard method.

C. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated.

D. Roller-Coupling Assemblies: Coordinated with operating mechanism and designed to join up to three inline rollers into a multiband shade that is operated by one roller drive-end assembly.

E. Shadebands:

1. Shadeband Material: Light-filtering Series
2. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.

a. Type: Enclosed in sealed pocket of shadeband material

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

b. Color and Finish: As selected by Architect from manufacturer's full range

F. Installation Accessories:

1. Front Fascia: Aluminum extrusion that conceals front and underside of roller and operating mechanism and attaches to roller endcaps without exposed fasteners.

   a. Shape: L-shaped
   b. Height: Manufacturer's standard height required to conceal roller and shadeband when shade is fully open, but not less than 3 inches.

2. Exposed Headbox: Rectangular, extruded-aluminum enclosure including front fascia, top and back covers, endcaps, and removable bottom closure.

   a. Height: Manufacturer's standard height required to enclose roller and shadeband when shade is fully open, but not less than 3 inches

3. Endcap Covers: To cover exposed endcaps.
4. Installation Accessories Color and Finish: As selected from manufacturer's full range.

2.3 SHADEBAND MATERIALS

A. Shadeband Material Flame-Resistance Rating: Comply with NFPA 701 Testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

B. Light-Filtering Fabric: Woven fabric, stain and fade resistant.

1. Source: SheerWeave 2300
2. Type: Vinyl Coated polyester
3. Weight: 13.9 oz per yard.
4. Openness Factor: 3 percent.
5. Color: As selected by Architect from manufacturer's full range.

D. Installation Accessories:

1. Front Fascia: Aluminum extrusion that conceals front and underside of roller and operating mechanism and attaches to roller endcaps without exposed fasteners.

   a. Shape: L-shaped

   b. Height: Manufacturer's standard height required to conceal roller and shadeband when shade is fully open, but not less than 3 inches.

   c. Exposed Headbox: Rectangular, extruded-aluminum enclosure including front fascia, top and back covers, endcaps, and removable bottom closure.

   d. Height: Manufacturer's standard height required to enclose roller and shadeband when shade is fully open, but not less than 3 inches

   e. Endcap Covers: To cover exposed endcaps.

   f. Installation Accessories Color and Finish: As selected from manufacturer's full range.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

2.4 ROLLER-SHADE FABRICATION

A. Product Safety Standard: Fabricate roller shades to comply with WCMA A 100.1, including requirements for flexible, chain-loop devices; lead content of components; and warning labels.

B. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at 74 deg F.

1. Between (Inside) Jamb Installation: Width equal to jamb-to-jamb dimension of opening in which shade is installed less 1/4 inch per side or 1/2-inch total, plus or minus 1/8 inchLength equal to head-to-sill or -floor dimension of opening in which shade is installed less 1/4 inch plus or minus 1/8 inch.

C. Shadeband Fabrication: Fabricate shadebands without battens or seams to extent possible except as follows:

1. Vertical Shades: Where width-to-length ratio of shadeband is equal to or greater than 1:4 provide battens and seams at uniform spacings along shadeband length to ensure shadeband tracking and alignment through its full range of movement without distortion of the material.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 ROLLER-SHADE INSTALLATION

A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions.

3.3 ADJUSTING

A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

3.4 CLEANING AND PROTECTION

A. Clean roller-shade surfaces after installation, according to manufacturer's written instructions.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that roller shades are without damage or deterioration at time of Substantial Completion.

C. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

END OF SECTION 122413

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

SECTION 220500 - COMMON WORK RESULTS FOR PLUMBING

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. Piping materials and installation instructions common to most piping systems.
2. Equipment installation requirements common to equipment sections.
3. Painting and finishing.
4. Concrete bases.
5. Supports and anchorages.

1.3 DEFINITIONS

A. Basis of Design Products:

1. The "basis of design" products named on the contract drawings and throughout the project manual constitute the engineers design.
2. The phrase "or comparable product by one of the following" throughout the project manual implies that the comparable products are accepted as equal; however, the conditions of AIA document A201-2007 regarding shop drawings, product data and samples apply with regards to deviations from the contract documents.
3. If products other than the "basis of design" differ from the engineers design to the extent that modifications to structural, mechanical, electrical, or any other affected discipline's design is required to install the product properly, then all such modifications shall be done at the expense of the Contractor.

B. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

C. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

D. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

E. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.

F. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

G. The following are industry abbreviations for plastic materials:

1. CPVC: Chlorinated polyvinyl chloride plastic.
2. PE: Polyethylene plastic.
3. PVC: Polyvinyl chloride plastic.

H. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Welding certificates.

1.5 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for PLUMBING Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

D. Pennsylvania Department of Labor and Industry: Installing Contractor shall submit appropriate forms to Pennsylvania Department of Labor and Industry – Boiler Division for approval of water heater, unfired pressure vessel, or any other equipment under their jurisdiction before installation of equipment. Contractor shall also submit appropriate fees. Contractor shall arrange for inspection and obtain approval for installation. If installation fails inspection, Contractor shall arrange for re-inspection until approval is granted.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

E. Installing Contractor shall submit appropriate forms to Pennsylvania Department of Labor and Industry – Boiler Division for approval of water heater, unfired pressure vessels, or other equipment under their jurisdiction before installation of equipment. Contractor shall also submit appropriate fees. Contractor shall arrange for inspection and obtain approval for installation. If installation fails inspection, Contractor shall arrange for re-inspection until approval is granted.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for PLUMBING installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for PLUMBING items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

2.3 JOINING MATERIALS

A. Refer to individual Division 22 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

F. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

G. Solvent Cements for Joining Plastic Piping:

1. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.

M. Verify final equipment locations for roughing-in.

N. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. PVC Non-pressure Piping: Join according to ASTM D 2855.

3.3 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install PLUMBING equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

3.5 PAINTING

A. Painting of PLUMBING systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.6 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions.

1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete."

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor PLUMBING materials and equipment.

C. Field Welding: Comply with AWS D1.1.

END OF SECTION 220500

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

SECTION 220516 - EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

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. Flexible-hose packless expansion joints.
2. Metal-bellows packless expansion joints.
3. Rubber packless expansion joints.
4. Grooved-joint expansion joints.
5. Pipe loops and swing connections.
6. Alignment guides and anchors.

1.3 PERFORMANCE REQUIREMENTS

A. Compatibility: Products shall be suitable for piping service fluids, materials, working pressures, and temperatures.

B. Capability: Products to absorb 200 percent of maximum axial movement between anchors.

1.4 ACTION SUBMITTALS

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

B. Delegated-Design Submittal: For each anchor and alignment guide indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Design Calculations: Calculate requirements for thermal expansion of piping systems and for selecting and designing expansion joints, loops, and swing connections.
2. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.
3. Alignment Guide Details: Detail field assembly and attachment to building structure.
4. Schedule: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

1.5 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Product Certificates: For each type of expansion joint, from manufacturer.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For expansion joints to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

2.1 PACKLESS EXPANSION JOINTS

A. Flexible-Hose Packless Expansion Joints:

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. Flex Pression Ltd.
b. Flex-Hose Co., Inc.
c. Flexicraft Industries.
d. Mason Industries, Inc.
e. Metraflex Company (The).
f. Unisource Manufacturing, Inc.

2. Description: Manufactured assembly with inlet and outlet elbow fittings and two flexible-metal-hose legs joined by long-radius, 180-degree return bend or center section of flexible hose.
3. Flexible Hose: Corrugated-metal inner hoses and braided outer sheaths.
4. Expansion Joints for Copper Tubing NPS 2 and Smaller: Copper-alloy fittings with solder-joint end connections.

a. Bronze hoses and single-braid bronze sheaths with 450 psig at 70 deg F and 340 psig at 450 deg F ratings.
b. Bronze hoses and double-braid bronze sheaths with 700 psig at 70 deg F and 500 psig at 450 deg F ratings.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

5. Expansion Joints for Copper Tubing NPS 2-1/2 to NPS 4: Copper-alloy fittings with threaded end connections.

    a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 300 psig at 70 deg F and 225 psig at 450 deg F ratings.
    b. Stainless-steel hoses and double-braid, stainless-steel sheaths with 420 psig at 70 deg F and 315 psig at 450 deg F ratings.

6. Expansion Joints for Steel Piping NPS 2 and Smaller: Stainless-steel fittings with threaded end connections.

    a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 450 psig at 70 deg F and 325 psig at 600 deg F ratings.
    b. Stainless-steel hoses and double-braid, stainless-steel sheaths with 700 psig at 70 deg F and 515 psig at 600 deg F ratings.

7. Expansion Joints for Steel Piping NPS 2-1/2 to NPS 6: Stainless-steel fittings with flanged end connections.

    a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 200 psig at 70 deg F and 145 psig at 600 deg F ratings.
    b. Stainless-steel hoses and double-braid, stainless-steel sheaths with 275 psig at 70 deg F and 200 psig at 600 deg F ratings.

8. Expansion Joints for Steel Piping NPS 8 to NPS 12: Stainless-steel fittings with flanged end connections.

    a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 125 psig at 70 deg F and 90 psig at 600 deg F ratings.
    b. Stainless-steel hoses and double-braid, stainless-steel sheaths with 165 psig at 70 deg F and 120 psig at 600 deg F ratings.

B. Metal-Bellows Packless Expansion Joints:

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. Adsco Manufacturing LLC.
    b. American BOA, Inc.
    c. Badger Industries, Inc.
    d. Expansion Joint Systems, Inc.
    e. Flex Pression Ltd.
    f. Flex-Hose Co., Inc.
    g. Flex-Weld, Inc.
    h. Flexicraft Industries.
    i. Flo Fab inc.
    j. Hyspan Precision Products, Inc.
    k. Mason Industries, Inc.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

l. Metraflex Company (The).
m. Proco Products, Inc.
n. Senior Flexonics Pathway.
o. Tozen Corporation.
p. U.S. Bellows, Inc.
q. Unaflex.
r. Unisource Manufacturing, Inc.
s. Universal Metal Hose.
t. WahlcoMetroflex.

2. Standards: ASTM F 1120 and EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."
3. Type: Circular, corrugated bellows with external tie rods.
4. Minimum Pressure Rating: 150 psig unless otherwise indicated.
5. Configuration: Single joint with base and double joint with base class(es) unless otherwise indicated.
6. Expansion Joints for Copper Tubing: Single- or multi-ply phosphor-bronze bellows, copper pipe ends, and brass shrouds.

a. End Connections for Copper Tubing NPS 2 and Smaller: Solder joint or threaded.
b. End Connections for Copper Tubing NPS 2-1/2 to NPS 4: Solder joint or threaded.
c. End Connections for Copper Tubing NPS 5 and Larger: Flanged.

C. Rubber Packless Expansion Joints:

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. Amber/Booth Company, Inc.
b. Flex-Hose Co., Inc.
c. Flex-Weld, Inc.
d. Flexicraft Industries.
e. Garlock Sealing Technologies.
f. General Rubber Corporation.
g. Mason Industries, Inc.
h. Metraflex Company (The).
i. Proco Products, Inc.
j. Red Valve Company, Inc.
k. Tozen Corporation.
l. Unaflex.
m. Unisource Manufacturing, Inc.

2. Standards: ASTM F 1123 and FSA's "Technical Handbook: Non-Metallic Expansion Joints and Flexible Pipe Connectors."
3. Material: Fabric-reinforced rubber complying with FSA-NMEJ-703.
4. Arch Type: Single or multiple arches with external control rods.
5. Spherical Type: Single or multiple spheres with external control rods.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

6. Minimum Pressure Rating for NPS 1-1/2 to NPS 4: 150 psig at 220 deg F.
7. Minimum Pressure Rating for NPS 5 and NPS 6: 140 psig at 200 deg F.
8. Minimum Pressure Rating for NPS 8 to NPS 12: 140 psig at 180 deg F.
9. Material for Fluids Containing Acids, Alkalies, or Chemicals: EPDM.
10. Material for Fluids Containing Gas, Hydrocarbons, or Oil: Buna-N.
11. Material for Water: EPDM.
12. End Connections: Full-faced, integral steel flanges with steel retaining rings.

2.2 GROOVED-JOINT EXPANSION JOINTS

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. Anvil International, Inc.
2. Shurjoint Piping Products.
3. Victaulic Company.

B. Description: Factory-assembled expansion joint made of several grooved-end pipe nipples, couplings, and grooved joints.

C. Standard: AWWA C606, for grooved joints.

D. Nipples: Galvanized, ASTM A 53/A 53M, Schedule 40, Type E or S, steel pipe with grooved ends.

E. Couplings: Five, flexible type for steel-pipe dimensions. Include ferrous housing sections, EPDM gasket suitable for cold and hot water, and bolts and nuts.

2.3 ALIGNMENT GUIDES AND ANCHORS

A. Alignment Guides:

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. Adsco Manufacturing LLC.
b. Advanced Thermal Systems, Inc.
c. Flex-Hose Co., Inc.
d. Flex-Weld, Inc.
e. Flexicraft Industries.
f. Hyspan Precision Products, Inc.
g. Mason Industries, Inc.
h. Metraflex Company (The).
i. Senior Flexonics Pathway.
j. U.S. Bellows, Inc.
k. Unisource Manufacturing, Inc.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

2. Description: Steel, factory-fabricated alignment guide, with bolted two-section outer cylinder and base for attaching to structure; with two-section guiding spider for bolting to pipe.

B. Anchor Materials:

1. Steel Shapes and Plates: ASTM A 36/A 36M.
2. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel hex head.
3. Washers: ASTM F 844, steel, plain, flat washers.
4. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, with tension and shear capacities appropriate for application.

    a. Stud: Threaded, zinc-coated carbon steel.
    b. Expansion Plug: Zinc-coated steel.
    c. Washer and Nut: Zinc-coated steel.

5. Chemical Fasteners: Insert-type-stud, bonding-system anchor for use with hardened portland cement concrete, with tension and shear capacities appropriate for application.

    a. Bonding Material: ASTM C 881/C 881M, Type IV, Grade 3, two-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.
    b. Stud: ASTM A 307, zinc-coated carbon steel with continuous thread on stud unless otherwise indicated.
    c. Washer and Nut: Zinc-coated steel.

PART 3 - EXECUTION

3.1 EXPANSION-JOINT INSTALLATION

A. Install expansion joints of sizes matching sizes of piping in which they are installed.

B. Install metal-bellows expansion joints according to EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."

C. Install rubber packless expansion joints according to FSA-NMEJ-702.

D. Install grooved-joint expansion joints to grooved-end steel piping

3.2 PIPE LOOP AND SWING CONNECTION INSTALLATION

A. Install pipe loops cold-sprung in tension or compression as required to partly absorb tension or compression produced during anticipated change in temperature.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

B. Connect risers and branch connections to mains with at least five pipe fittings including tee in main.

C. Connect risers and branch connections to terminal units with at least four pipe fittings including tee in riser.

D. Connect mains and branch connections to terminal units with at least four pipe fittings including tee in main.

3.3 ALIGNMENT-GUIDE AND ANCHOR INSTALLATION

A. Install alignment guides to guide expansion and to avoid end-loading and torsional stress.

B. Install one guide(s) on each side of pipe expansion fittings and loops. Install guides nearest to expansion joint not more than four pipe diameters from expansion joint.

C. Attach guides to pipe and secure guides to building structure.

D. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.

E. Anchor Attachments:

1. Anchor Attachment to Black-Steel Pipe: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
2. Anchor Attachment to Galvanized-Steel Pipe: Attach with pipe hangers. Use MSS SP-69, Type 42, riser clamp welded to anchor.
3. Anchor Attachment to Copper Tubing: Attach with pipe hangers. Use MSS SP-69, Type 24, U-bolts bolted to anchor.

F. Fabricate and install steel anchors by welding steel shapes, plates, and bars. Comply with ASME B31.9 and AWS D1.1/D1.1M.

1. Anchor Attachment to Steel Structural Members: Attach by welding.
2. Anchor Attachment to Concrete Structural Members: Attach by fasteners. Follow fastener manufacturer's written instructions.

G. Use grout to form flat bearing surfaces for guides and anchors attached to concrete.

END OF SECTION 220516

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

SECTION 220517 - SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

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. Sleeves.
2. Stack-sleeve fittings.
3. Sleeve-seal systems.
4. Sleeve-seal fittings.
5. Grout.

1.3 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 SLEEVES

A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.

C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.

D. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.

E. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

F. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

G. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

2.2 STACK-SLEEVE FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Smith, Jay R. Mfg. Co.
2. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.

B. Description: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring, bolts, and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with setscrews.

2.3 SLEEVE-SEAL SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Advance Products & Systems, Inc.
2. CALPICO, Inc.
3. Metraflex Company (The).
4. Pipeline Seal and Insulator, Inc.
5. Proco Products, Inc.

B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.

1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Stainless steel.
3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.4 SLEEVE-SEAL FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Pre-sealed Systems.

B. Description: Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall. Unit has plastic or rubber waterstop collar with center opening to match piping OD.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

2.5 GROUT

A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Non-shrink; recommended for interior and exterior applications.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.

1. Sleeves are not required for core-drilled holes.

C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

1. Cut sleeves to length for mounting flush with both surfaces.

a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.

2. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

D. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.
2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Section 079200 "Joint Sealants."

E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078413 "Through-Penetration Firestop Systems."

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

3.2 STACK-SLEEVE-FITTING INSTALLATION

A. Install stack-sleeve fittings in new slabs as slabs are constructed.

1. Install fittings that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 076200 "Sheet Metal Flashing and Trim."
3. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.
4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
5. Using grout, seal the space around outside of stack-sleeve fittings.

B. Fire-Barrier Penetrations: Maintain indicated fire rating of floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078413 "Through-Penetration Firestop Systems."

3.3 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.4 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

3.5 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above Grade:

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

a. Piping Smaller Than NPS 6: Cast-iron wall sleeves.
b. Piping NPS 6 and Larger: Cast-iron wall sleeves.

2. Exterior Concrete Walls below Grade:

a. Piping Smaller Than NPS 6: Cast-iron wall sleeves with sleeve-seal system.

1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

b. Piping NPS 6 and Larger: Cast-iron wall sleeves with sleeve-seal system.

1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

3. Concrete Slabs-on-Grade:

a. Piping Smaller Than NPS 6: Cast-iron wall sleeves with sleeve-seal system.

1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

b. Piping NPS 6 and Larger: Cast-iron wall sleeves with sleeve-seal system.

1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

4. Interior Partitions:

a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.
b. Piping NPS 6] and Larger: Galvanized-steel-sheet sleeves.

END OF SECTION 220517

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

SECTION 220518 - ESCUTCHEONS FOR PLUMBING PIPING

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. Escutcheons.
2. Floor plates.

1.3 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

A. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.

C. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.

2.2 FLOOR PLATES

A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.

1. Escutcheons for New Piping:

a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
b. Chrome-Plated Piping: One-piece, cast-brass type with polished, chrome-plated finish.
c. Insulated Piping: One-piece, stamped-steel type.
d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
f. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
g. Bare Piping in Equipment Rooms: One-piece, cast-brass type with polished, chrome-plated finish.

C. Install floor plates for piping penetrations of equipment-room floors.

D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

1. New Piping: One-piece, floor-plate type.

3.2 FIELD QUALITY CONTROL

A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION 220518

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

SECTION 220523 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

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. Brass ball valves.
2. Bronze ball valves.
3. Iron, single-flange butterfly valves.
4. Bronze lift check valves.
5. Bronze swing check valves.

B. Related Sections:

1. Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.
2. Section 221116 "Domestic Water Piping" for valves applicable only to this piping.
3. Section 221319 "Sanitary Waste Piping Specialties" for valves applicable only to this piping.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene copolymer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

D. NRS: Non-rising stem.

E. OS&Y: Outside screw and yoke.

F. RS: Rising stem.

G. SWP: Steam working pressure.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

1.4 ACTION SUBMITTALS

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

1.5 QUALITY ASSURANCE

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
2. ASME B31.1 for power piping valves.
3. ASME B31.9 for building services piping valves.

C. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set angle, gate, and globe valves closed to prevent rattling.
4. Set ball and plug valves open to minimize exposure of functional surfaces.
5. Set butterfly valves closed or slightly open.
6. Block check valves in either closed or open position.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Refer to valve schedule articles for applications of valves.

B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

C. Valve Sizes: Same as upstream piping unless otherwise indicated.

D. Valve Actuator Types:

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

1. Gear Actuator: For quarter-turn valves NPS 8 and larger.
2. Handwheel: For valves other than quarter-turn types.
3. Handlever: For quarter-turn valves NPS 6 and smaller.
4. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 10 plug valves, for each size square plug-valve head.
5. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.

E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
1. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
2. Butterfly Valves: With extended neck.

F. Valve-End Connections:

1. Flanged: With flanges according to ASME B16.1 for iron valves.
2. Solder Joint: With sockets according to ASME B16.18.
3. Threaded: With threads according to ASME B1.20.1.

G. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRASS BALL VALVES

A. Two-Piece, Full-Port, Brass Ball Valves with Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Hammond Valve.
d. Milwaukee Valve Company.

2. Description:

a. Standard: MSS SP-110.
b. SWP Rating: 150 psig.
c. CWP Rating: 600 psig.
d. Body Design: Two piece.
e. Body Material: Forged brass.
f. Ends: Threaded.
g. Seats: PTFE or TFE.
h. Stem: Stainless steel.
i. Ball: Stainless steel, vented.
j. Port: Full.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

2.3 BRONZE BALL VALVES

A. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Conbraco Industries, Inc.; Apollo Valves.
   b. Crane Co.; Crane Valve Group; Crane Valves.
   c. Hammond Valve.
   d. Milwaukee Valve Company.
   e. NIBCO INC.
   f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

   a. Standard: MSS SP-110.
   b. SWP Rating: 150 psig.
   c. CWP Rating: 600 psig.
   d. Body Design: Two piece.
   e. Body Material: Bronze.
   f. Ends: Threaded.
   g. Seats: PTFE or TFE.
   h. Stem: Stainless steel.
   i. Ball: Stainless steel, vented.
   j. Port: Full.

2.4 IRON, SINGLE-FLANGE BUTTERFLY VALVES

A. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Stainless-Steel Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Conbraco Industries, Inc.; Apollo Valves.
   b. Crane Co.; Crane Valve Group; Jenkins Valves.
   c. Crane Co.; Crane Valve Group; Stockham Division.
   d. Hammond Valve.
   e. Milwaukee Valve Company.
   f. NIBCO INC.
   g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

   a. Standard: MSS SP-67, Type I.
   b. CWP Rating: 200 psig.
   c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
e. Seat: EPDM.
f. Stem: One- or two-piece stainless steel.
g. Disc: Stainless steel.

2.5 BRONZE LIFT CHECK VALVES

A. Class 125, Lift Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Crane Co.; Crane Valve Group; Stockham Division.

2. Description:

a. Standard: MSS SP-80, Type 1.
b. CWP Rating: 200 psig.
c. Body Design: Vertical flow.
d. Body Material: ASTM B 61 or ASTM B 62, bronze.
e. Ends: Threaded.
f. Disc: Bronze.

B. Class 125, Lift Check Valves with Nonmetallic Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Hammond Valve.
b. Kitz Corporation.
c. NIBCO INC.
d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-80, Type 2.
b. CWP Rating: 200 psig.
c. Body Design: Vertical flow.
d. Body Material: ASTM B 61 or ASTM B 62, bronze.
e. Ends: Threaded.
f. Disc: NBR, PTFE, or TFE.

2.6 BRONZE SWING CHECK VALVES

A. Class 125, Bronze Swing Check Valves with Bronze Disc:

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Crane Co.; Crane Valve Group; Crane Valves.
    b. Crane Co.; Crane Valve Group; Jenkins Valves.
    c. Crane Co.; Crane Valve Group; Stockham Division.
    d. Hammond Valve.
    e. Milwaukee Valve Company.
    f. NIBCO INC.

2. Description:

    a. Standard: MSS SP-80, Type 3.
    b. CWP Rating: 200 psig.
    c. Body Design: Horizontal flow.
    d. Body Material: ASTM B 62, bronze.
    e. Ends: Threaded.
    f. Disc: Bronze.

B. Class 125, Bronze Swing Check Valves with Nonmetallic Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Crane Co.; Crane Valve Group; Crane Valves.
    b. Crane Co.; Crane Valve Group; Jenkins Valves.
    c. Crane Co.; Crane Valve Group; Stockham Division.
    d. Hammond Valve.
    e. Milwaukee Valve Company.
    f. NIBCO INC.

2. Description:

    a. Standard: MSS SP-80, Type 4.
    b. CWP Rating: 200 psig.
    c. Body Design: Horizontal flow.
    d. Body Material: ASTM B 62, bronze.
    e. Ends: Threaded.
    f. Disc: PTFE or TFE.

C. Class 150, Bronze Swing Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Crane Co.; Crane Valve Group; Crane Valves.
    b. Crane Co.; Crane Valve Group; Jenkins Valves.
    c. Crane Co.; Crane Valve Group; Stockham Division.
    d. Milwaukee Valve Company.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

e. NIBCO INC.

2. Description:

a. Standard: MSS SP-80, Type 3.
b. CWP Rating: 300 psig.
c. Body Design: Horizontal flow.
d. Body Material: ASTM B 62, bronze.
e. Ends: Threaded.
f. Disc: Bronze.

D. Class 150, Bronze Swing Check Valves with Nonmetallic Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Hammond Valve.
d. NIBCO INC.
e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-80, Type 4.
b. CWP Rating: 300 psig.
c. Body Design: Horizontal flow.
d. Body Material: ASTM B 62, bronze.
e. Ends: Threaded.
f. Disc: PTFE or TFE.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem or handle movement.

E. Install check valves for proper direction of flow and as follows:

1. Swing Check Valves: In horizontal position with hinge pin level.
2. Lift Check Valves: With stem upright and plumb.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:

1. Shutoff Service: Ball or butterfly valves.
2. Butterfly Valve Dead-End Service: Single-flange (lug) type.
3. Throttling Service: ball, or butterfly valves.
4. Pump-Discharge Check Valves:

a. NPS 2 and Smaller: Bronze swing check valves with bronze or nonmetallic disc.
b. NPS 2-1/2 and Larger for Domestic Water: Iron swing check valves with lever and weight or with spring or iron, center-guided, metal or resilient-seat check valves.
c. NPS 2-1/2 and Larger for Sanitary Waste and Storm Drainage: Iron swing check valves with lever and weight or spring.

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.

C. Select valves, except wafer types, with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
6. For Steel Piping, NPS 5 and Larger: Flanged ends.

3.5 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
2. Ball Valves: Two piece, full port, brass or bronze with stainless-steel trim.
3. Bronze Swing Check Valves: Class 125, bronze disc.

B. Pipe NPS 2-1/2 and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
2. Iron, Single-Flange Butterfly Valves: 200 CWP, EPDM seat, stainless-steel disc.
3. Iron Swing Check Valves: Class 125, metal seats.

END OF SECTION 220523

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Thermal-hanger shield inserts.
5. Fastener systems.
6. Pipe stands.
7. Pipe positioning systems.
8. Equipment supports.

B. Related Sections:

1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

1.5 ACTION SUBMITTALS

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

B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following; include Product Data for components:

1. Trapeze pipe hangers.
2. Metal framing systems.
3. Fiberglass strut systems.
4. Pipe stands.
5. Equipment supports.

C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail fabrication and assembly of trapeze hangers.
2. Design Calculations: Calculate requirements for designing trapeze hangers.

1.6 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.7 QUALITY ASSURANCE

A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

2. Galvanized Metallic Coatings: Pre-galvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

B. Stainless-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

C. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

2.2 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Cooper B-Line, Inc.
   b. Flex-Strut Inc.
   c. Thomas & Betts Corporation.
   d. Unistrut Corporation; Tyco International, Ltd.

2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
3. Standard: MFMA-4.
4. Channels: Continuous slotted steel channel with inturned lips.
5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
7. Metallic Coating: Hot-dipped galvanized.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

2.4 THERMAL-HANGER SHIELD INSERTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ERICO International Corporation.
2. National Pipe Hanger Corporation.
3. PHS Industries, Inc.

B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.

C. Insulation-Insert Material for Hot Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength.

D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.5 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

B. Mechanical-Expansion Anchors: Insert-wedge-type, stainless- steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.6 PIPE STANDS

A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.

C. Low-Type, Single-Pipe Stand: One-piece plastic base unit with plastic roller, for roof installation without membrane penetration.

D. High-Type, Single-Pipe Stand:

1. Description: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

2. Base: Plastic.
3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.

E. High-Type, Multiple-Pipe Stand:

1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
2. Bases: One or more; plastic.
3. Vertical Members: Two or more protective-coated-steel channels.
4. Horizontal Member: Protective-coated-steel channel.
5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.

F. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

G. Protective Pad: Provide and install a protective pad under all roof mounded pipe stands. Protective padding shall be "Yellow Spaghetti" roof walkway pads and rolls as manufactured by Greenstreak, Inc. 3400 Tree Court Industrial Blvd. St. Louis, Mo 63122. Contractor may purchase padding from roof contractor JJD Urethane Co. Inc. This padding is required to maintain any and all warranties the owner may have on existing roof surfaces.

2.7 PIPE POSITIONING SYSTEMS

A. Description: IAPMO PS 42, positioning system of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

2.8 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.9 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, non-shrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Non-staining, non-corrosive, and non-gaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.

D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

E. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

F. Pipe Stand Installation:

1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Section 077200 "Roof Accessories" for curbs.

G. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.

H. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

I. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

J. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

K. Install lateral bracing with pipe hangers and supports to prevent swaying.

L. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

M. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

N. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

O. Insulated Piping:

1. Attach clamps and spacers to piping.

    a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
    b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
    c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

    a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

    a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:

    a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
    b. NPS 4: 12 inches long and 0.06 inch thick.
    c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
    d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
    e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and 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. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.5 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers and supports, metal trapeze pipe hangers and metal framing systems and attachments for general service applications.

F. Use stainless-steel pipe hangers and fiberglass pipe hangers and stainless-steel or corrosion-resistant attachments for hostile environment applications.

G. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.

H. Use padded hangers for piping that is subject to scratching.

I. Use thermal-hanger shield inserts for insulated piping and tubing.

J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of non-insulated or insulated, stationary pipes NPS 1/2 to NPS 30.
2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of non-insulated, stationary pipes NPS 3/4 to NPS 8.
7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of non-insulated, stationary pipes NPS 1/2 to NPS 8.
8. Adjustable Band Hangers (MSS Type 9): For suspension of non-insulated, stationary pipes NPS 1/2 to NPS 8.
9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of non-insulated, stationary pipes NPS 1/2 to NPS 8.
10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of non-insulated, stationary pipes NPS 3/8 to NPS 8.
11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of non-insulated, stationary pipes NPS 3/8 to NPS 3.
12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.
19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:

    a. Light (MSS Type 31): 750 lb.
    b. Medium (MSS Type 32): 1500 lb.
    c. Heavy (MSS Type 33): 3000 lb.

13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:

    a. Horizontal (MSS Type 54): Mounted horizontally.
    b. Vertical (MSS Type 55): Mounted vertically.
    c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

P. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

Q. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

R. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

S. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 220529

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

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. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Valve tags.
5. Warning tags.

1.3 ACTION SUBMITTALS

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

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

D. Valve numbering scheme.

E. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Brass, 0.032-inch minimum thickness, and having pre-drilled or stamped holes for attachment hardware.
2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
4. Fasteners: Stainless-steel rivets or self-tapping screws.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
2. Letter Color: Black.
3. Background Color: White.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless-steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

B. Letter Color: Red.

C. Background Color: White.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Pre-tensioned Pipe Labels: Pre-coiled, semi-rigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches high.

2.4 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.

1. Tag Material: Brass, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass wire-link or beaded chain; or S-hook.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

2.5 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.

1. Size: 3 by 5-1/4 inches minimum.
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

A. Piping Color-Coding: Painting of piping is specified in Section 099123 "Interior Painting."

B. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

C. Pipe Label Color Schedule:

1. Domestic Water Piping:
   a. Color shall comply with ASTM A13.1

2. Sanitary Waste and Storm Drainage Piping:
   a. Color shall comply with ASTM A13.1

3. Gas Piping
   a. Color shall comply with ASTM A13.1

3.4 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

1. Valve-Tag Size and Shape:

   a. Cold Water: 2 inches, round.
   b. Hot Water: 2 inches, round.
   c. Gas: 2 inches, round.

2. Valve-Tag Color:

   a. Cold Water: Natural.
   b. Hot Water: Natural.
   c. Gas: Natural.

3. Letter Color:

   a. Cold Water: Black.
   b. Hot Water: Black.
   c. Gas: Black.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

3.5 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 220553

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

SECTION 220719 - PLUMBING PIPING INSULATION

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 insulating the following plumbing piping services:

1. Domestic cold-water piping.
2. Domestic hot-water piping.
3. Domestic re-circulating hot-water piping.
4. Sanitary waste piping exposed to freezing conditions.
5. Storm-water piping exposed to freezing conditions.
6. Roof drains and rainwater leaders.
7. Supplies and drains for handicap-accessible lavatories and sinks.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied, if any).

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail attachment and covering of heat tracing inside insulation.
3. Detail insulation application at pipe expansion joints for each type of insulation.
4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
5. Detail removable insulation at piping specialties, equipment connections, and access panels.
6. Detail application of field-applied jackets.
7. Detail application at linkages of control devices.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

C. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

C. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

1.8 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. When material to be in contact with austenitic stainless steel is tested according to ASTM C795 (which includes ASTM C692 and ASTM C871), the pH of the leach water from the specific material supplied shall be greater than 7.0 but not greater than 11.7 at 77 degrees F. An acceptable proportion of sodium plus silicate ions to the chloride ions as found by leaching from the insulation is shown in the “plot point” of Figure 1 in ASTM C795.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Aeroflex USA, Inc.; Aerocel.
b. Armacell LLC; AP Armaflex.
c. K-Flex USA; Insul-Lock, Insul-Tube, and K-FLEX LS.

G. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type I. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the following:

a. CertainTeed Corp.; SoftTouch Duct Wrap.
b. Johns Manville; Microlite.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

c. Knauf Insulation; Friendly Feel Duct Wrap.
d. Manson Insulation Inc.; Alley Wrap.
e. Owens Corning; SOFTR All-Service Duct Wrap.

H. Mineral-Fiber, Preformed Pipe Insulation:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Fibrex Insulations Inc.; Coreplus 1200.
b. Johns Manville; Micro-Lok HP.
c. Knauf Insulation; 1000-Degree Pipe Insulation.
d. Manson Insulation Inc.; Alley-K.
e. Owens Corning; Fiberglas Pipe Insulation.

2. Type I, 850 Deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.2 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Ramco Insulation, Inc.; Super-Stik.

B. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Ramco Insulation, Inc.; Ramcote 1200 and Quik-Cote.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Aeroflex USA, Inc.; Aeroseal.
b. Armacell LLC; Armaflex 520 Adhesive.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.
d. K-Flex USA; R-373 Contact Adhesive.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive 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."

C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
   b. Eagle Bridges - Marathon Industries; 225.
   c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
   d. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive 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."

D. ASJ Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
   b. Eagle Bridges - Marathon Industries; 225.
   c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-20.
   d. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive 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."

2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
   b. Vimasco Corporation; 749.

2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
5. Color: White.

C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below-ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-30.
   b. Eagle Bridges - Marathon Industries; 501.
   c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-35.
   d. Mon-Eco Industries, Inc.; 55-10.

2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 35-mil dry film thickness.
3. Service Temperature Range: 0 to 180 deg F.
4. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
5. Color: White.

D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below-ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Encacel.
   b. Eagle Bridges - Marathon Industries; 570.
   c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 60-95/60-96.

2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
3. Service Temperature Range: Minus 50 to plus 220 deg F.
4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
5. Color: White.

E. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
b. Eagle Bridges - Marathon Industries; 550.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
d. Mon-Eco Industries, Inc.; 55-50.
e. Vimasco Corporation; WC-1/WC-5.

2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: 60 percent by volume and 66 percent by weight.
5. Color: White.

2.5 SEALANTS

A. Joint Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Permanently flexible, elastomeric sealant.
3. Service Temperature Range: Minus 100 to plus 300 deg F.
4. Color: White or gray.
5. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
6. Sealants 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."

B. ASJ Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: White.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants 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."

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

2.6 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.

2.7 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. Metal Jacket:

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Metal Jacketing Systems.
   b. ITW Insulation Systems; Aluminum and Stainless Steel Jacketing.
   c. RPR Products, Inc.; Insul-Mate.

2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.

   a. Sheet and roll stock ready for shop or field sizing.
   b. Finish and thickness are indicated in field-applied jacket schedules.
   c. Moisture Barrier for Indoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
   d. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
   e. Factory-Fabricated Fitting Covers:

      1) Same material, finish, and thickness as jacket.
      2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
      3) Tee covers.
      4) Flange and union covers.
      5) End caps.
      6) Beveled collars.
      7) Valve covers.
      8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

2.8 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following:

a. ABI, Ideal Tape Division; 428 AWF ASJ.
b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
c. Compac Corporation; 104 and 105.
d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.

2. Width: 3 inches.
3. Thickness: 11.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

2.9 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements, provide one of the following:

a. ITW Insulation Systems; Gerrard Strapping and Seals.
b. RPR Products, Inc.; Insul-Mate Strapping and Seals.

2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide with wing seal or closed seal.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

C. Wire: 0.062-inch soft-annealed, stainless steel.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. C & F Wire.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:

1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches on center.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches on center.

    a. For below-ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 25 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. For above-ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Cleanouts.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

1. Comply with requirements in Section 078413 "Through-Penetration Firestop Systems" for firestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Through-Penetration Firestop Systems."

3.5 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.7 INSTALLATION OF MINERAL-FIBER INSULATION

A. Insulation Installation on Straight Pipes and Tubes:
1. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
2. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward clinched staples at 6 inches on center.
3. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

3.8 FIELD-APPLIED JACKET INSTALLATION

A. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches on center and at end joints.

3.9 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.10 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Drainage piping located in crawl spaces.
2. Underground piping.
3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.11 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Cold Water:

1. All Pipe Sizes: Insulation shall be one of the following:
   a. Flexible Elastomeric: 1 inch thick.
   b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

B. Domestic Hot and Re-circulated Hot Water:

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

1. All Pipe Sizes: Insulation shall be one of the following:
   a. Flexible Elastomeric: 1 inch thick.
   b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

C. Stormwater and Overflow:

1. All Pipe Sizes: Insulation shall be one of the following:
   a. Flexible Elastomeric: 1 inch thick.
   b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

D. Roof Drain and Overflow Drain Bodies:

1. All Pipe Sizes: Insulation shall be one of the following:
   a. Flexible Elastomeric: 1 inch thick.
   b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

E. Sanitary Waste Piping Where Heat Tracing Is Installed:

1. All Pipe Sizes: Insulation shall be the following:
   a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inches thick.

F. Floor Drains, Traps, and Sanitary Drain Piping within 10 Feet of Drain Receiving Condensate and Equipment Drain Water below 60 Deg F:

1. All Pipe Sizes: Insulation shall be the following:
   a. Flexible Elastomeric: 1 inch thick.
   b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

G. Hot Service Drains:

1. All Pipe Sizes: Insulation shall be the following:
   a. Mineral-Fiber, Preformed Pipe, Type I or II: 1 inch thick.

H. Hot Service Vents:

1. All Pipe Sizes: Insulation shall be the following:
   a. Mineral-Fiber, Preformed Pipe, Type I or II: 1 inch thick.

3.12 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Domestic Water Piping:

1. All Pipe Sizes: Insulation shall be one of the following:
   a. Flexible Elastomeric: 2 inches thick.
   b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.

B. Domestic Hot and Re-circulated Hot Water:

1. All Pipe Sizes: Insulation shall be one of the following:

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

a. Flexible Elastomeric: 2 inches thick.
b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.

C. Sanitary Waste Piping Where Heat Tracing Is Installed:

1. All Pipe Sizes: Insulation shall be the following:
a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.

D. Hot Service Drains:

1. All Pipe Sizes: Insulation shall be the following:
a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

E. Hot Service Vents:

1. All Pipe Sizes: Insulation shall be the following:
a. Mineral-Fiber, Preformed Pipe Insulation, Type II: 1 inch thick.

3.13 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Concealed:

1. None.

D. Piping, Exposed within 8 Feet of finished floor:
1. Aluminum, Smooth: 0.020 inch thick.

3.14 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Concealed:

1. None.

D. Piping, Exposed:
1. Aluminum, Smooth: 0.020 inch thick.

END OF SECTION 220719

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

SECTION 221116 - DOMESTIC WATER PIPING

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. Under-building-slab and aboveground domestic water pipes, tubes, and fittings inside buildings.
2. Encasement for piping.

B. Related Requirements:

1. Section 220519 "Meters and Gages for Plumbing Piping" for thermometers, pressure gages, and flow meters in domestic water piping.
2. Section 221116 "Domestic Water Piping" for water meters.
3. Section 224200 Plumbing Fixtures" for plumbing fixtures.

1.3 ACTION SUBMITTALS

A. Product Data: For transition fittings and dielectric fittings.

1.4 INFORMATIONAL SUBMITTALS

A. System purging and disinfecting activities report.

B. Field quality-control reports.

1.5 FIELD CONDITIONS

A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:

1. Notify Architect no fewer than seven days in advance of proposed interruption of water service.
2. Do not interrupt water service without Architect's written permission.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

B. Potable-water piping and components shall comply with NSF 14 and NSF 61. Plastic piping components shall be marked with "NSF-pw."

2.2 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.

B. Soft Copper Tube: ASTM B 88, Type L water tube, annealed temper.

C. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.

D. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.

E. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.

F. Copper Unions:

1. MSS SP-123.
2. Cast-copper-alloy, hexagonal-stock body.
3. Ball-and-socket, metal-to-metal seating surfaces.
4. Solder-joint or threaded ends.

2.3 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials:

1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
2. Full-face or ring type unless otherwise indicated.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Solder Filler Metals: ASTM B 32, lead-free alloys.

D. Flux: ASTM B 813, water flushable.

E. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

2.4 ENCASEMENT FOR PIPING

A. Standard: ASTM A 674 or AWWA C105/A21.5.

B. Form: Sheet or tube.

C. Color: Black or natural.

2.5 TRANSITION FITTINGS

A. General Requirements:

1. Same size as pipes to be joined.
2. Pressure rating at least equal to pipes to be joined.
3. End connections compatible with pipes to be joined.

B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

C. Sleeve-Type Transition Coupling: AWWA C219.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Cascade Waterworks Manufacturing.
b. Dresser, Inc.; Piping Specialties Products.
c. Ford Meter Box Company, Inc. (The).
d. JCM Industries.
e. Romac Industries, Inc.
f. Smith-Blair, Inc.; a Sensus company.
g. Viking Johnson.

2.6 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Capitol Manufacturing Company; member of the Phoenix Forge Group.
b. Central Plastics Company.
c. Hart Industries International, Inc.
d. Jomar International.
e. Matco-Norca.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

f. McDonald, A. Y. Mfg. Co.
g. Watts; a division of Watts Water Technologies, Inc.
h. Wilkins; a Zurn company.

2. Standard: ASSE 1079.
3. Pressure Rating: 125 psig minimum at 180 deg F.
4. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Capitol Manufacturing Company; member of the Phoenix Forge Group.
b. Central Plastics Company.
c. Matco-Norca.
d. Watts; a division of Watts Water Technologies, Inc.
e. Wilkins; a Zurn company.

2. Standard: ASSE 1079.
3. Factory-fabricated, bolted, companion-flange assembly.
4. Pressure Rating: 125 psig minimum at 180 deg F.
5. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Central Plastics Company.
d. Pipeline Seal and Insulator, Inc.

2. Non-conducting materials for field assembly of companion flanges.
3. Pressure Rating: 150 psig.
4. Gasket: Neoprene or phenolic.
5. Bolt Sleeves: Phenolic or polyethylene.
6. Washers: Phenolic with steel backing washers.

E. Dielectric Nipples:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Elster Perfection Corporation.
b. Grinnell Mechanical Products; Tyco Fire Products LP.
c. Matco-Norca.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

d. Precision Plumbing Products, Inc.

2. Standard: IAPMO PS 66.
3. Electroplated steel nipple complying with ASTM F 1545.
4. Pressure Rating and Temperature: 300 psig at 225 deg F.
5. End Connections: Male threaded or grooved.
6. Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Comply with requirements in Section 312000 "Earthwork" for excavating, trenching, and backfilling.

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."

C. Install underground copper tube in PE encasement according to ASTM A 674 or AWWA C105/A21.5.

D. Install shutoff valve immediately upstream of each dielectric fitting.

E. Install domestic water piping level with 0.25 percent slope downward toward drain and plumb.

F. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

G. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

H. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

I. Install piping to permit valve servicing.

J. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.

K. Install piping free of sags and bends.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

L. Install fittings for changes in direction and branch connections.

M. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

N. Install pressure gages on suction and discharge piping for each plumbing pump and packaged booster pump. Comply with requirements for pressure gages in Section 220519 "Meters and Gages for Plumbing Piping."

O. Install thermostats in hot-water circulation piping. Comply with requirements for thermostats in Section 221123 "Domestic Water Pumps."

P. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements for thermometers in Section 220519 "Meters and Gages for Plumbing Piping."

Q. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

R. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

S. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

T. Contractor shall clean all aerators after cleaning and flushing domestic water system.

3.3 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

D. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Brazed Joints" chapter.

E. Soldered Joints for Copper Tubing: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

F. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.

G. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.4 TRANSITION FITTING INSTALLATION

A. Install transition couplings at joints of dissimilar piping.

B. Transition Fittings in Underground Domestic Water Piping:

1. Fittings for NPS 1-1/2 and Smaller: Fitting-type coupling.
2. Fittings for NPS 2 and Larger: Sleeve-type coupling.

3.5 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings or nipples.

C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flange kits.

D. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.6 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hanger, support products, and installation in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

1. Vertical Piping: MSS Type 8 or 42, clamps.
2. Individual, Straight, Horizontal Piping Runs:

a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Support vertical piping and tubing at base and at each floor.

C. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

D. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
4. NPS 2-1/2: 108 inches with 1/2-inch rod.
5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
6. NPS 6: 10 feet with 5/8-inch rod.
7. NPS 8: 10 feet with 3/4-inch rod.

E. Install supports for vertical copper tubing every 10 feet.

F. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.7 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.

C. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:

1. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
2. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
3. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.8 IDENTIFICATION

A. Identify system components. Comply with requirements for identification materials and installation in Section 220553 "Identification for Plumbing Piping and Equipment."

B. Label pressure piping with system operating pressure.

3.9 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Piping Inspections:

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:

1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.

c. Re-inspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for re-inspection.
d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

2. Piping Tests:

a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
f. Prepare reports for tests and for corrective action required.

B. Domestic water piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.10 ADJUSTING

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
b. Adjust calibrated balancing valves to flows indicated.

5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.11 CLEANING

A. Clean and disinfect potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:

a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
b. Fill and isolate system according to either of the following:

1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.

c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
d. Repeat procedures if biological examination shows contamination.
e. Submit water samples in sterile bottles to authorities having jurisdiction.

B. Clean non-potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:

a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

C. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.

D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.12 PIPING SCHEDULE

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.

C. Under-building-slab, domestic water piping, NPS 2 and smaller, shall be the following:

1. soft copper tube, ASTM B 88, Type L; wrought-copper, solder-joint fittings; and brazed joints.

D. Aboveground domestic water piping, NPS 2 and smaller, shall be the following:

1. Hard copper tube, ASTM B 88, Type L; cast- or wrought-copper, solder-joint fittings; and soldered joints.

E. Aboveground domestic water piping, NPS 2-1/2 to NPS 4, shall be the following:

1. Hard copper tube, ASTM B 88, Type L; cast- or wrought-copper, solder-joint fittings; and soldered joints.

F. Aboveground domestic water piping, NPS 5 to NPS 8, shall be the following:

1. Hard copper tube, ASTM B 88, Type L; cast- or wrought-copper, solder-joint fittings; and soldered joints.

3.13 VALVE SCHEDULE

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Shutoff Duty: Use ball or gate valves for piping NPS 2 and smaller. Use butterfly, ball, or gate valves with flanged ends for piping NPS 2-1/2 and larger.
2. Throttling Duty: Use ball or globe valves for piping NPS 2 and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 and larger.
3. Hot-Water Circulation Piping, Balancing Duty: Calibrated balancing valves.
4. Drain Duty: Hose-end drain valves.

B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

END OF SECTION 221116

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

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. Vacuum breakers.
2. Backflow preventers.
3. Strainers.
4. Hose bibbs.
5. Drain valves.
6. Water-hammer arresters.
7. Air vents.

B. Related Requirements:

1. Section 220519 "Meters and Gages for Plumbing Piping" for thermometers, pressure gages, and flow meters in domestic water piping.
2. Section 221116 "Domestic Water Piping" for water meters.
3. Section 224200 Plumbing Fixtures" for plumbing fixtures.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For domestic water piping specialties.

1. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

2.2 VACUUM BREAKERS

A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

   a. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.
   b. Conbraco Industries, Inc.
   c. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
   d. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.

2. Standard: ASSE 1001.
3. Size: NPS 1/4 to NPS 3, as required to match connected piping.
4. Body: Bronze.
5. Inlet and Outlet Connections: Threaded.
6. Finish: Rough bronze.

B. Hose-Connection Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
   a. Conbraco Industries, Inc.
   b. MIFAB, Inc.
   c. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
   d. Woodford Manufacturing Company; a division of WCM Industries, Inc.
   e. Zurn Industries, LLC; Plumbing Products Group; Light Commercial Products.
   f. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.

2. Standard: ASSE 1011.
3. Body: Bronze, non-removable, with manual drain.
4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
5. Finish: Rough bronze.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

2.3 BACKFLOW PREVENTERS

A. Reduced-Pressure-Principle Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
   a. Conbraco Industries, Inc.
   b. FEBCO; a division of Watts Water Technologies, Inc.
   c. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
   d. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.

2. Standard: ASSE 1013.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 12 psig maximum, through middle third of flow range.
5. Size: See drawings.
6. Design Flow Rate: See drawings.
7. Selected Unit Flow Range Limits: See drawings.
8. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
9. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
10. Configuration: Designed for horizontal, straight-through flow.
11. Accessories:

    a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
    b. Valves NPS 2-1/2 and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
    c. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

B. Backflow-Preventer Test Kits:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

   a. Conbraco Industries, Inc.
   b. FEBCO; a division of Watts Water Technologies, Inc.
   c. Flomatic Corporation.
   d. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
   e. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.

2. Description: Factory calibrated, with gages, fittings, hoses, and carrying case with test-procedure instructions.

2.4 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

1. Pressure Rating: 125 psig minimum unless otherwise indicated.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved, epoxy coated and for NPS 2-1/2 and larger.
3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
4. Screen: Stainless steel with round perforations unless otherwise indicated.
5. Perforation Size:

    a. Strainers NPS 2 and Smaller: 0.033 inch.
    b. Strainers NPS 2-1/2 to NPS 4: 0.062 inch.
    c. Strainers NPS 5 and Larger: 0.125 inch.

6. Drain: Factory-installed, hose-end drain valve.

2.5 HOSE BIBBS

A. Hose Bibbs: HB

1. Standard: ASME A112.18.1 for sediment faucets.
2. Body Material: Bronze.
3. Seat: Bronze, replaceable.
4. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.
5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
6. Pressure Rating: 125 psig.
7. Vacuum Breaker: Integral non-removable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
8. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
9. Finish for Service Areas: Chrome or nickel plated.
10. Finish for Finished Rooms: Chrome or nickel plated.
11. Operation for Equipment Rooms: Wheel handle or operating key.
12. Operation for Service Areas: Wheel handle.
13. Operation for Finished Rooms: Operating key.
14. Include operating key with each operating-key hose bibb.
15. Include integral wall flange with each chrome- or nickel-plated hose bibb.

2.6 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 3/4.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

B. Stop-and-Waste Drain Valves:

1. Standard: MSS SP-110 for ball valves or MSS SP-80 for gate valves.
2. Pressure Rating: 200-psig minimum CWP or Class 125.
3. Size: NPS 3/4.
4. Body: Copper alloy or ASTM B 62 bronze.
5. Drain: NPS 1/8 side outlet with cap.

2.7 WATER-HAMMER ARRESTERS

A. Water-Hammer Arresters: WHA

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

   a. AMTROL, Inc.
   b. Josam Company.
   c. MIFAB, Inc.
   d. Precision Plumbing Products, Inc.
   e. Sioux Chief Manufacturing Company, Inc.
   f. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
   g. Tyler Pipe; Wade Div.
   h. Watts Drainage Products.
   i. Zurn Industries, LLC; Plumbing Products Group; Specification Drainage Products.

2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Metal bellows or Copper tube with piston.
4. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

2.8 AIR VENTS

A. Welded-Construction Automatic Air Vents:

1. Body: Stainless steel.
2. Pressure Rating: 150-psig minimum pressure rating.
3. Float: Replaceable, corrosion-resistant metal.
4. Mechanism and Seat: Stainless steel.
5. Size: NPS 3/8 minimum inlet.
6. Inlet and Vent Outlet End Connections: Threaded.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.

1. Locate backflow preventers in same room as connected equipment or system.
2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe-to-floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are unacceptable for this application.
3. Do not install bypass piping around backflow preventers.

B. Install water regulators with inlet and outlet shutoff valves. Install pressure gages on inlet and outlet.

C. Install water-control valves with inlet and outlet shutoff valves. Install pressure gages on inlet and outlet.

D. Install balancing valves in locations where they can easily be adjusted.

E. Install temperature-actuated, water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet. Piping configuration shall meet requirements of the manufacturer. If a difference manufacturer is provided than the basis of design, the piping configuration on the drawing shall be modified to meet the requirements of the manufacturer.

F. Install Y-pattern strainers for water on supply side of each control valve, water pressure-reducing valve, solenoid valve, and pump.

G. Install water-hammer arresters in water piping according to PDI-WH 201.

H. Install air vents at high points of water piping. Install drain piping and discharge onto floor drain.

3.2 CONNECTIONS

A. Comply with requirements for ground equipment in Section 260526 "Grounding and Bonding."

B. Fire-retardant-treated-wood blocking is specified in Section 260519 "Conductors and Cables" for electrical connections.

3.3 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

1. Pressure vacuum breakers.
2. Intermediate atmospheric-vent backflow preventers.
3. Reduced-pressure-principle backflow preventers.
4. Double-check, backflow-prevention assemblies.
5. Dual-check-valve backflow preventers.
6. Water pressure-reducing valves.
7. Calibrated balancing valves.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Test each pressure vacuum breaker, reduced-pressure-principle, backflow preventer, double-check, backflow-prevention assembly and double-check, detector-assembly backflow preventer according to authorities having jurisdiction and the device's reference standard.

B. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.5 ADJUSTING

A. Set field-adjustable pressure set points of water pressure-reducing valves.

B. Set field-adjustable flow set points of balancing valves.

C. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.

END OF SECTION 221119

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

SECTION 221316 - SANITARY WASTE AND VENT PIPING

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. Pipe, tube, and fittings.
2. Specialty pipe fittings.

B. Related Sections:

1. Section 221319 "Sanitary Waste Piping Specialties".
2. Section 220529 " Hangers and Supports for Plumbing Piping and Equipment.

1.3 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:

1. Soil, Waste, and Vent Piping: 10-foot head of water.

1.4 ACTION SUBMITTALS

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

1.5 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF/ANSI 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping and "NSF-sewer" for plastic sewer piping.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

1.6 PROJECT CONDITIONS

A. Interruption of Existing Sanitary Waste Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify Architect Construction Manager Owner no fewer than seven days in advance of proposed interruption of sanitary waste service.
2. Do not proceed with interruption of sanitary waste service without Architect's written permission.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 74, Service class(es).

B. Gaskets: ASTM C 564, rubber.

C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

D. All cast iron soil pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute (CISPI) and be listed by NSF International.

2.3 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. CISPI, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ANACO-Husky.
b. Dallas Specialty & Mfg. Co.
c. Fernco Inc.
d. Matco-Norca, Inc.
e. MIFAB, Inc.
f. Mission Rubber Company; a division of MCP Industries, Inc.
g. Stant.
h. Tyler Pipe.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

2. Standards: ASTM C 1277 and CISPI 310.
3. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

C. Cast-Iron, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. MG Piping Products Company.

2. Standard: ASTM C 1277.
3. Description: Two-piece ASTM A 48/A 48M, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve with integral, center pipe stop.

D. All cast iron soil pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute (CISPI) and be listed by NSF International.

2.4 PVC PIPE AND FITTINGS

A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.

B. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

C. Adhesive Primer: ASTM F 656.

1. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesive primer 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."

D. Solvent Cement: ASTM D 2564.

1. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Solvent cement 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."

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

GALVANIZED-STEEL PIPE AND FITTINGS

A. Galvanized-Steel Pipe: ASTM A 53/A 53M, Type E, Standard Weight class. Include square-cut-grooved or threaded ends matching joining method.

B. Cast-Iron Drainage Fittings: ASME B16.12, threaded.

C. Steel Pipe Pressure Fittings:

1. Galvanized-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106/A 106M, Schedule 40, seamless steel pipe. Include ends matching joining method.
2. Malleable-Iron Unions: ASME B16.39; Class 150; hexagonal-stock body with ball-and-socket, metal-to-metal, bronze seating surface; and female threaded ends.
3. Galvanized-Gray-Iron, Threaded Fittings: ASME B16.4, Class 125, standard pattern.

D. Cast-Iron Flanges: ASME B16.1, Class 125.

1. Flange Gasket Materials: ASME B16.21, full-face, flat, nonmetallic, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

2.5 SPECIALTY PIPE FITTINGS

A. Transition Couplings:

1. General Requirements: Fitting or device for joining piping with small differences in OD's or of different materials. Include end connections same size as and compatible with pipes to be joined.
2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
3. Unshielded, Non-pressure Transition Couplings:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Dallas Specialty & Mfg. Co.
2) Fernco Inc.
3) Mission Rubber Company; a division of MCP Industries, Inc.
4) Plastic Oddities; a division of Diverse Corporate Technologies, Inc.

b. Standard: ASTM C 1173.
c. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
d. Sleeve Materials:

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

1) For Cast-Iron Soil Pipes: ASTM C 564, rubber.
2) For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
3) For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

4. Shielded, Non-pressure Transition Couplings:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Cascade Waterworks Mfg. Co.
2) Mission Rubber Company; a division of MCP Industries, Inc.

b. Standard: ASTM C 1460.
c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

5. Pressure Transition Couplings:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Cascade Waterworks Mfg. Co.
2) Dresser, Inc.
3) EBAA Iron, Inc.
4) JCM Industries, Inc.
5) Romac Industries, Inc.
6) Smith-Blair, Inc.; a Sensus company.
7) The Ford Meter Box Company, Inc.
8) Viking Johnson.

b. Standard: AWWA C219.
c. Description: Metal, sleeve-type same size as, with pressure rating at least equal to, and ends compatible with, pipes to be joined.
d. Center-Sleeve Material: Manufacturer's standard.
e. Gasket Material: Natural or synthetic rubber.
f. Metal Component Finish: Corrosion-resistant coating or material.

B. Dielectric Fittings:

1. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
2. Dielectric Unions:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

1) Capitol Manufacturing Company.
2) Central Plastics Company.
3) Hart Industries International, Inc.
4) Jomar International Ltd.
5) Matco-Norca, Inc.
6) McDonald, A. Y. Mfg. Co.
7) Watts Regulator Co.; a division of Watts Water Technologies, Inc.
8) Wilkins; a Zurn company.

b. Description:

1) Standard: ASSE 1079.
2) Pressure Rating: 125 psig minimum at 180 deg F.
3) End Connections: Solder-joint copper alloy and threaded ferrous.

3. Dielectric Flanges:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Capitol Manufacturing Company.
2) Central Plastics Company.
3) Matco-Norca, Inc.
4) Watts Regulator Co.; a division of Watts Water Technologies, Inc.
5) Wilkins; a Zurn company.

b. Description:

1) Standard: ASSE 1079.
2) Factory-fabricated, bolted, companion-flange assembly.
3) Pressure Rating: 125 psig minimum at 180 deg F.
4) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

4. Dielectric-Flange Insulating Kits:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Advance Products & Systems, Inc.
2) Calpico, Inc.
3) Central Plastics Company.
4) Pipeline Seal and Insulator, Inc.

b. Description:

1) Non-conducting materials for field assembly of companion flanges.
2) Pressure Rating: 150 psig.
3) Gasket: Neoprene or phenolic.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

4) Bolt Sleeves: Phenolic or polyethylene.
5) Washers: Phenolic with steel backing washers.

5. Dielectric Nipples:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Elster Perfection.
2) Grinnell Mechanical Products.
3) Matco-Norca, Inc.
4) Precision Plumbing Products, Inc.
5) Victaulic Company.

b. Description:

1) Standard: IAPMO PS 66
2) Electroplated steel nipple.
3) Pressure Rating: 300 psig at 225 deg F.
4) End Connections: Male threaded or grooved.
5) Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 EARTH MOVING

A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earthwork."

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

K. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

L. Install soil and waste drainage and vent piping at the following minimum slopes unless otherwise indicated:

1. Building Sanitary Drain: ¼” per foot downward in direction of flow for piping NPS 2.5 and smaller; 1/8” per foot downward in direction of flow for piping NPS 3 and larger.
2. Horizontal Sanitary Drainage Piping: 1 percent downward in direction of flow.
3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

M. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

N. Install aboveground PVC piping according to ASTM D 2665.

O. Install underground PVC piping according to ASTM D 2321.

P. Plumbing Specialties:

1. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary drainage gravity-flow piping. Install cleanout fitting with closure plug inside the building in sanitary drainage force-main piping. Comply with requirements for cleanouts specified in Section 221319 "Sanitary Waste Piping Specialties."
2. Install drains in sanitary drainage gravity-flow piping. Comply with requirements for drains specified in Section 221319 "Sanitary Waste Piping Specialties."

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

Q. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

R. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

S. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

T. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

A. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

B. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead-and-oakum calked joints.

C. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

E. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Torque bolts in cross pattern.

F. Plastic, Non-pressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
3. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 Appendixes.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

3.4 SPECIALTY PIPE FITTING INSTALLATION

A. Transition Couplings:

1. Install transition couplings at joints of piping with small differences in OD's.
2. In Drainage Piping: Shielded, non-pressure transition couplings.

B. Dielectric Fittings:

1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
2. Dielectric Fittings for NPS 2 and Smaller: Use dielectric unions.
3. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flange kits.
4. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.5 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
2. Install stainless-steel pipe hangers for horizontal piping in corrosive environments.
3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
5. Vertical Piping: MSS Type 8 or Type 42, clamps.
6. Install individual, straight, horizontal piping runs:

   a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
   b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
   c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.

7. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
8. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Support horizontal piping and tubing within 12 inches of each fitting, valve, and coupling.

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.

E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
2. NPS 3: 60 inches with 1/2-inch rod.
3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
4. NPS 6 and NPS 8: 60 inches with 3/4-inch rod.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

5. NPS 10 and NPS 12: 60 inches with 7/8-inch rod.
6. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.

F. Install supports for vertical cast-iron soil piping every 15 feet.

G. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2: 48 inches with 3/8-inch rod.
2. NPS 3: 48 inches with 1/2-inch rod.
3. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
4. NPS 6 and NPS 8: 48 inches with 3/4-inch rod.
5. NPS 10 and NPS 12: 48 inches with 7/8-inch rod.

H. Install supports for vertical PVC piping every 48 inches.

I. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.6 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

C. Connect drainage and vent piping to the following:

1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
5. Comply with requirements for cleanouts and drains specified in Section 221319 "Sanitary Waste Piping Specialties."
6. Equipment: Connect drainage piping as indicated. Provide shutoff valve if indicated and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.

D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

E. Make connections according to the following unless otherwise indicated:

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.7 IDENTIFICATION

A. Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.8 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Re-inspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for re-inspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping except outside leaders on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

3.9 CLEANING AND PROTECTION

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

D. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

3.10 PIPING SCHEDULE

A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.

B. Aboveground, soil and waste piping shall be any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.
3. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
4. Dissimilar Pipe-Material Couplings: Shielded, non-pressure transition couplings.

C. Aboveground, vent piping shall be any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.
3. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
4. Dissimilar Pipe-Material Couplings: Shielded, non-pressure transition couplings.

D. Underground, soil, waste, and vent piping shall be any of the following:

1. Service class, cast-iron soil piping; gaskets; and gasketed joints.
2. Solid wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
3. Dissimilar Pipe-Material Couplings: Shielded, non-pressure transition couplings.

END OF SECTION 221316

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

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. Floor drains.
2. Air-admittance valves.
3. Roof flashing assemblies.
4. Through-penetration firestop assemblies.
5. Miscellaneous sanitary drainage piping specialties.
6. Flashing materials.

B. Related Requirements:

1. Section 334100 "Storm Drainage" for storm drainage piping and piping specialties outside the building.
2. Section 221423 "Storm Drainage Piping Specialties" for storm drainage piping inside the building, drainage piping specialties, and drains.

1.3 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. FOG: Fats, oils, and greases.

C. FRP: Fiberglass-reinforced plastic.

D. HDPE: High-density polyethylene plastic.

E. PE: Polyethylene plastic.

F. PP: Polypropylene plastic.

G. PVC: Polyvinyl chloride plastic.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories for the following:

1. Floor drains.

2. Air-admittance valves

3. Drainage specialties.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary piping specialty components.

1.7 COORDINATION

A. Coordinate size and location of roof penetrations.

PART 2 - PRODUCTS

2.1 CLEANOUTS

A. Exposed Metal Cleanouts: CO

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Josam Company; Josam Div.
b. MIFAB, Inc.
c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
d. Tyler Pipe; Wade Div.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

e. Watts Drainage Products Inc.
f. Zurn Plumbing Products Group; Specification Drainage Operation.
g. Josam Company; Blucher-Josam Div.

2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
3. Size: Same as connected drainage piping
4. Body Material: Hub-and-spigot, cast-iron soil pipe T-branch as required to match connected piping.
5. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
6. Closure: Stainless-steel plug with seal.

B. Metal Floor Cleanouts: FCO

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Josam Company; Josam Div.
b. Sioux Chief Manufacturing Company, Inc.
c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
d. Watts Drainage Products Inc.
e. Zurn Plumbing Products Group; Light Commercial Operation.
f. Zurn Plumbing Products Group; Specification Drainage Operation.
g. Josam Company; Josam Div.
h. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
i. Josam Company; Blucher-Josam Div.

2. Adjustable floor cleanout, coated cast iron body, with gas and watertight ABS tapered thread plug, and round scoriated secured top adjustable to finished floor.

C. Cast-Iron Wall Cleanouts: WCO

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Josam Company; Josam Div.
b. MIFAB, Inc.
c. Smith, Jay R. Mfg. Co.; d of Smith Industries, Inc.
d. Tyler Pipe; Wade Div.
e. Watts Drainage Products Inc.
f. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Coated cast iron body, gas and watertight ABS tapered thread plug, and round, smooth stainless steel access cover with securing screw.

2.2 FLOOR DRAINS

A. Cast-Iron Floor Drains: FD-1

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

1. Basis-of-Design Product: Subject to compliance with requirements, provide Josam 30000-A series or a comparable product by one of the following:
   a. Josam Company; Josam Div.
   b. MIFAB, Inc.
   c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
   d. Watts Drainage Products Inc.
2. Coated cast iron floor drain, two-piece body with double drainage flange, invertible non-puncturing flashing collar, weepholes, bottom outlet and adjustable satin Nikaloy round Super-Flo strainer.

2.3 AIR-ADMITTANCE VALVES

A. Fixture Air-Admittance Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      a. Ayrlett, LLC.
      b. Durgo, Inc.
      c. Oatey.
      d. ProSet Systems Inc.
      e. RectorSeal.
      f. Studor, Inc.

   2. Standard: ASSE 1051, Type A for single fixture or Type B for branch piping.
   3. Housing: Plastic.
   4. Operation: Mechanical sealing diaphragm.
   5. Size: Same as connected fixture or branch vent piping.

B. Stack Air-Admittance Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      a. Durgo, Inc.
      b. Oatey.
      c. Studor, Inc.

   2. Standard: ASSE 1050 for vent stacks.
   3. Housing: Plastic.
   4. Operation: Mechanical sealing diaphragm.
   5. Size: Same as connected stack vent or vent stack.

C. Wall Box:

   1. Manufacturers: Subject to compliance with requirements, provide products by the following:

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

a. Durgo, Inc.
b. Oatey.
c. RectorSeal.
d. Studor, Inc.

2. Description: White plastic housing with white plastic grille, made for recessed installation. Include bottom pipe connection and space to contain one air-admittance valve.
3. Size: About 9 inches wide by 8 inches high by 4 inches deep.

2.4 ROOF FLASHING ASSEMBLIES

A. Roof Flashing Assemblies:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Acorn Engineering Company; Elmdor/Stoneman Div.
b. Thaler Metal Industries Ltd.

B. Description: Manufactured assembly made of 4.0-lb/sq. ft., 0.0625-inch- thick, lead flashing collar and skirt extending at least 8 inches from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.

1. Open-Top Vent Cap: Without cap.

2.5 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ProSet Systems Inc.

2. Standard: UL 1479 assembly of sleeve and stack fitting with fire-stopping plug.
3. Size: Same as connected soil, waste, or vent stack.
4. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
5. Stack Fitting: ASTM A 48/A 48M, gray-iron, hub-less-pattern, wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.
6. Special Coating: Corrosion resistant on interior of fittings.

2.6 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Open Drains:

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

1. Description: Shop or field fabricate from ASTM A 74, Service class, hub-and-spigot, cast-iron, soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C 564, rubber gaskets.
2. Size: Same as connected waste piping.

B. Deep-Seal Traps:

1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
2. Size: Same as connected waste piping.

   a. NPS 2: 4-inch- minimum water seal.
   b. NPS 2-1/2 and Larger: 5-inch- minimum water seal.

C. Air-Gap Fittings:

1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
2. Body: Bronze or cast iron.
3. Inlet: Opening in top of body.
4. Outlet: Larger than inlet.
5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

D. Sleeve Flashing Device:

1. Description: Manufactured, cast-iron fitting, with clamping device, that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 2 inches above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
2. Size: As required for close fit to riser or stack piping.

E. Stack Flashing Fittings:

1. Description: Counter-flashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
2. Size: Same as connected stack vent or vent stack.

F. Vent Caps:

1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.
2. Size: Same as connected stack vent or vent stack.

G. Frost-Resistant Vent Terminals:

1. Description: Manufactured or shop-fabricated assembly constructed of copper, lead-coated copper, or galvanized steel.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

2. Design: To provide 1-inch enclosed air space between outside of pipe and inside of flashing collar extension, with counterflashing.

H. Expansion Joints:

1. Standard: ASME A112.21.2M.
2. Body: Cast iron with bronze sleeve, packing, and gland.
3. End Connections: Matching connected piping.
4. Size: Same as connected soil, waste, or vent piping.

2.7 FLASHING MATERIALS

A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:

1. General Use: 4.0-lb/sq. ft., 0.0625-inch thickness.
2. Vent Pipe Flashing: 3.0-lb/sq. ft., 0.0469-inch thickness.
3. Burning: 6-lb/sq. ft., 0.0938-inch thickness.

B. Copper Sheet: ASTM B 152/B 152M, of the following minimum weights and thicknesses, unless otherwise indicated:

1. General Applications: 12 oz./sq. ft..
2. Vent Pipe Flashing: 8 oz./sq. ft..

C. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch minimum thickness, unless otherwise indicated. Include G90 hot-dip galvanized, mill-phosphatized finish for painting if indicated.

D. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.

E. Fasteners: Metal compatible with material and substrate being fastened.

F. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

G. Solder: ASTM B 32, lead-free alloy.

H. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Equipment Mounting: Comply with requirements for equipment bases specified in Section 033053 "Miscellaneous Cast-in-Place Concrete."

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

1. Coordinate sizes and locations of concrete bases with actual equipment provided.
2. Construct bases to withstand, without damage to equipment, seismic force required by code.
3. Construct concrete bases high and extend base not less than 6 inches in all directions beyond the maximum dimensions of, unless otherwise indicated or unless required for seismic anchor support.
4. Minimum Compressive Strength: 3000 psi at 28 days.
5. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
6. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base, and anchor into structural concrete floor.
7. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
8. Install anchor bolts to elevations required for proper attachment to supported equipment.

B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:

1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
2. Locate at each change in direction of piping greater than 45 degrees.
3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
4. Locate at base of each vertical soil and waste stack.

C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

E. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.

1. Position floor drains for easy access and maintenance.
2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:

    a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
    b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
    c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.

3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

F. Install fixture air-admittance valves on fixture drain piping.

G. Install stack air-admittance valves at top of stack vent and vent stack piping.

H. Install air-admittance-valve wall boxes recessed in wall.

I. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.

J. Install through-penetration firestop assemblies in plastic conductors and stacks at floor penetrations.

K. Assemble open drain fittings and install with top of hub 1 inch above floor.

L. Install deep-seal traps on floor drains and other waste outlets, if indicated.

M. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

N. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.

O. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.

P. Install wood-blocking reinforcement for wall-mounting-type specialties.

Q. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

3.2 CONNECTIONS

A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

C. Grease Interceptors: Connect inlet and outlet to unit, and connect flow-control fitting and vent to unit inlet piping.

3.3 FLASHING INSTALLATION

A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.
2. Copper Sheets: Solder joints of copper sheets.

B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.

1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.

C. Set flashing on floors and roofs in solid coating of bituminous cement.

D. Secure flashing into sleeve and specialty clamping ring or device.

E. Install flashing for piping passing through roofs with counter-flashing or commercially made flashing fittings, according to Section 076200 "Sheet Metal Flashing and Trim."

F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

G. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.4 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:

1. Grease interceptors.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.5 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

3.6 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221319

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

SECTION 221413 - STORM DRAINAGE PIPING

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. Pipe, tube, and fittings.
2. Specialty pipe fittings.
3. Encasement for underground metal piping.

B. Related Sections:

1. Section 334100 "Storm Drainage" for storm drainage piping outside the building.

1.3 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:

1. Storm Drainage Piping: 10-foot head of water.

1.4 ACTION SUBMITTALS

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

1.5 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF/ANSI 14, "Plastics Piping System Components and Related Materials," for plastic piping components. Include marking with "NSF-drain" for plastic drain piping and "NSF-sewer" for plastic sewer piping.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

1.6 PROJECT CONDITIONS

A. Interruption of Existing Storm-Drainage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify Architect no fewer than seven days in advance of proposed interruption of storm-drainage service.
2. Do not proceed with interruption of storm-drainage service without Architect's written permission.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 74, Service classes.

B. Gaskets: ASTM C 564, rubber.

C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

D. All cast iron soil pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute (CISPI) and be listed by NSF International.

2.3 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. CISPI, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ANACO-Husky.
b. Dallas Specialty & Mfg. Co.
c. Fernco Inc.
d. Matco-Norca, Inc.
e. MIFAB, Inc.
f. Mission Rubber Company; a division of MCP Industries, Inc.
g. Stant.
h. Tyler Pipe.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

2. Standards: ASTM C 1277 and CISPI 310.
3. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

C. Cast-Iron, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. MG Piping Products Company.

2. Standard: ASTM C 1277.
3. Description: Two-piece ASTM A 48/A 48M, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve with integral, center pipe stop.

D. All cast iron soil pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute (CISPI) and be listed by NSF International.

2.4 PVC PIPE AND FITTINGS

A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.

B. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

C. Adhesive Primer: ASTM F 656.

1. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesive primer 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."

D. Solvent Cement: ASTM D 2564.

1. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Solvent cement 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."

2.5 SPECIALTY PIPE FITTINGS

A. Transition Couplings:

1. General Requirements: Fitting or device for joining piping with small differences in OD's or of different materials. Include end connections same size as and compatible with pipes to be joined.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified-piping-system fitting.

3. Shielded, Non-pressure Transition Couplings:

   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      1) Cascade Waterworks Mfg. Co.
      2) Mission Rubber Company; a division of MCP Industries, Inc.

   b. Standard: ASTM C 1460.
   c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

4. Pressure Transition Couplings:

   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      1) Cascade Waterworks Mfg. Co.
      2) Dresser, Inc.
      3) EBAA Iron, Inc.
      4) Ford Meter Box Company, Inc. (The)
      5) JCM Industries, Inc.
      6) Romac Industries, Inc.
      7) Smith-Blair, Inc.; a Sensus company.
      8) Viking Johnson; c/o Mueller Co.

   b. Standard: AWWA C219.
   c. Description: Metal, sleeve-type couplings same size as, with pressure rating at least equal to and ends compatible with, pipes to be joined.
   d. Center-Sleeve Material: Manufacturer's standard.
   e. Gasket Material: Natural or synthetic rubber.
   f. Metal Component Finish: Corrosion-resistant coating or material.

B. Dielectric Fittings:

1. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
2. Dielectric Unions:

   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      1) Capitol Manufacturing Company.
      2) Central Plastics Company.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

3) Hart Industries International, Inc.
4) Jomar International Ltd.
5) Matco-Norca, Inc.
6) McDonald, A. Y. Mfg. Co.
7) Watts Regulator Co.; a division of Watts Water Technologies, Inc.
8) Wilkins; a Zurn company.

b. Description:

1) Standard: ASSE 1079.
2) Pressure Rating: 150 psig at 180 deg F.
3) End Connections: Solder-joint copper alloy and threaded ferrous.

3. Dielectric Flanges:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Capitol Manufacturing Company.
2) Central Plastics Company.
3) Matco-Norca, Inc.
4) Watts Regulator Co.; a division of Watts Water Technologies, Inc.
5) Wilkins; a Zurn company.

b. Description:

1) Standard: ASSE 1079.
2) Factory-fabricated, bolted, companion-flange assembly.
3) Pressure Rating: 150 psig.
4) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

4. Dielectric-Flange Insulating Kits:

a. M Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Advance Products & Systems, Inc.
2) Calpico, Inc.
3) Central Plastics Company.
4) Pipeline Seal and Insulator, Inc.

b. Description:

1) Non-conducting materials for field assembly of companion flanges.
2) Pressure Rating: 150 psig.
3) Gasket: Neoprene or phenolic.
4) Bolt Sleeves: Phenolic or polyethylene.
5) Washers: Phenolic with steel-backing washers.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

5. Dielectric Nipples:

   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      1) Elster Perfection.
      2) Matco-Norca, Inc.
      3) Precision Plumbing Products, Inc.

   b. Description:

      1) Electroplated steel nipple complying with ASTM F 1545.
      2) Pressure Rating: 300 psig at 225 deg F.
      3) End Connections: Male threaded or grooved.
      4) Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 EARTH MOVING

A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earthwork."

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations from layout are approved on coordination drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

I. Install piping to allow application of insulation.

J. Make changes in direction for storm drainage piping using appropriate branches, bends, and long-sweep bends. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

K. Lay buried building storm drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

L. Install storm drainage piping at the following minimum slopes unless otherwise indicated:

1. Building Storm Drain: 1/8” per foot downward in direction of flow.
2. Horizontal Storm-Drainage Piping: 1/8” per foot downward in direction of flow.

M. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

N. Install aboveground PVC piping according to ASTM D 2665.

O. Install underground PVC piping according to ASTM D 2321.

P. Plumbing Specialties:

1. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers in storm drainage gravity-flow piping. Install cleanout fitting with closure plug inside the building in storm drainage force-main piping. Comply with requirements for cleanouts specified in Section 221423 "Storm Drainage Piping Specialties."
2. Install drains in storm drainage gravity-flow piping. Comply with requirements for drains specified in Section 221423 "Storm Drainage Piping Specialties."

Q. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

R. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

S. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

T. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

3.3 JOINT CONSTRUCTION

A. Hub-and-Spigot, Cast-Iron Soil Piping Gasketed Joints: Join according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

B. Hubless, Cast-Iron Soil Piping Coupled Joints: Join according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

D. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Torque bolts in cross pattern.

E. Plastic, Non-pressure-Piping, Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
3. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 Appendixes.

3.4 SPECIALTY PIPE FITTING INSTALLATION

A. Transition Couplings:

1. Install transition couplings at joints of piping with small differences in OD's.
2. In Drainage Piping: Shielded, non-pressure transition couplings.
3. In Aboveground Force-Main Piping: Fitting-type transition couplings.
4. In Underground Force-Main Piping:

a. NPS 1-1/2 and Smaller: Fitting-type transition couplings.
b. NPS 2 and Larger: Pressure transition couplings.

B. Dielectric Fittings:

1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
2. Dielectric Fittings for NPS 2 and Smaller: Use dielectric nipples.
3. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flange kits.
4. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

3.5 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
2. Install stainless-steel pipe hangers for horizontal piping in corrosive environments.
3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
5. Vertical Piping: MSS Type 8 or Type 42, clamps.
6. Individual, Straight, Horizontal Piping Runs:

   a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
   b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
   c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.

7. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
8. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Support horizontal piping and tubing within 12 inches of each fitting, valve, and coupling.

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.

E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
2. NPS 3: 60 inches with 1/2-inch rod.
3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
4. NPS 6 and NPS 8: 60 inches with 3/4-inch rod.
5. NPS 10 and NPS 12: 60 inches with 7/8-inch rod.
6. Spacing for 10-foot pipe lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.

F. Install supports for vertical cast-iron soil piping every 15 feet.

G. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2: 48 inches with 3/8-inch rod.
2. NPS 3: 48 inches with 1/2-inch rod.
3. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
4. NPS 6 and NPS 8: 48 inches with 3/4-inch rod.
5. NPS 10 and NPS 12: 48 inches with 7/8-inch rod.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

H. Install supports for vertical PVC piping every 48 inches.

I. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.6 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.

C. Connect storm drainage piping to roof drains and storm drainage specialties.

1. Install test tees (wall cleanouts) in conductors near floor, and floor cleanouts with cover flush with floor.

D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

E. Make connections according to the following unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.7 IDENTIFICATION

A. Identify exposed storm drainage piping. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.8 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Re-inspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for re-inspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

D. Test storm drainage piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Test Procedure: Test storm drainage piping on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts until completion of inspection, water level must not drop. Inspect joints for leaks.
4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
5. Prepare reports for tests and required corrective action.

3.9 CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

3.10 PIPING SCHEDULE

A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.

B. Aboveground storm drainage piping shall be any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings; CISPI, hubless-piping couplings; and coupled joints.
3. Galvanized-steel pipe, drainage fittings, and threaded joints.
4. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
5. Dissimilar Pipe-Material Couplings: Shielded, non-pressure transition couplings.

C. Underground storm drainage piping shall be the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
3. Dissimilar Pipe-Material Couplings: Shielded, non-pressure transition couplings.

END OF SECTION 221413

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

SECTION 221423 - STORM DRAINAGE PIPING SPECIALTIES

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. Roof drains.
2. Cleanouts.
3. Through-penetration firestop assemblies.
4. Flashing materials.

1.3 ACTION SUBMITTALS

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

1.4 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 METAL ROOF DRAINS

A. Cast-Iron, Medium-Sump, General-Purpose Roof Drains: RD-1

1. Basis-of-Design Product: Subject to compliance with requirements, provide Josam 21504-22 or comparable product by one of the following:

a. Josam Company.
b. MIFAB, Inc.
c. Smith, Jay R. Mfg. Co.
d. Tyler Pipe.
e. Watts Water Technologies, Inc.
f. Zurn

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

2. 15" diameter roof drain. Cast iron body with combination membrane flashing clamp/gravel guard and low silhouette cast iron dome.

2.2 CLEANOUTS

A. Metal Floor Cleanouts: FCO
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Josam Company; Josam Div.
   b. Sioux Chief Manufacturing Company, Inc.
   c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
   d. Watts Drainage Products Inc.
   e. Zurn Plumbing Products Group; Light Commercial Operation.
   f. Zurn Plumbing Products Group; Specification Drainage Operation.
   g. Josam Company; Josam Div.
   h. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
   i. Josam Company; Blucher-Josam Div.
2. Adjustable floor cleanout, coated cast iron body, with gas and watertight ABS tapered thread plug, and round scoriated secured top adjustable to finished floor.

B. Cast-Iron Wall Cleanouts: WCO
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Josam Company; Josam Div.
   b. MIFAB, Inc.
   c. Smith, Jay R. Mfg. Co.; d of Smith Industries, Inc.
   d. Tyler Pipe; Wade Div.
   e. Watts Drainage Products Inc.
   f. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Coated cast iron body, gas and watertight ABS tapered thread plug, and round, smooth stainless steel access cover with securing screw.

2.3 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. ProSet Systems Inc.

2. Standard: ASTM E 814, for through-penetration firestop assemblies.
3. Certification and Listing: Intertek Testing Service NA for through-penetration firestop assemblies.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

4. Size: Same as connected pipe.
5. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
6. Stack Fitting: ASTM A 48/A 48M, gray-iron, hubless-pattern, wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.

2.4 FLASHING MATERIALS

A. Copper Sheet: ASTM B 152/B 152M,12 oz./sq. ft..

B. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch minimum thickness unless otherwise indicated. Include G90 hot-dip galvanized, mill-phosphatized finish for painting if indicated.

C. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.

D. Fasteners: Metal compatible with material and substrate being fastened.

E. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

F. Solder: ASTM B 32, lead-free alloy.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions.

1. Install flashing collar or flange of roof drain to prevent leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
2. Install expansion joints, if indicated, in roof drain outlets.
3. Position roof drains for easy access and maintenance.

B. Install cleanouts in aboveground piping and building drain piping according to the following instructions unless otherwise indicated:

1. Use cleanouts the same size as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
2. Locate cleanouts at each change in direction of piping greater than 45 degrees.
3. Locate cleanouts at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
4. Locate cleanouts at base of each vertical stack.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

E. Install test tees in vertical conductors and near floor.

F. Install wall cleanouts in vertical conductors. Install access door in wall if indicated.

G. Install through-penetration firestop assemblies in plastic conductors at concrete floor penetrations.

H. Install sleeve flashing device with each conductor passing through floors with waterproof membrane.

3.2 CONNECTIONS

A. Comply with requirements for piping specified in Section 221413 "Storm Drainage Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

3.3 FLASHING INSTALLATION

A. Fabricate flashing from single piece of metal unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:

1. Lead Sheets: Burn joints of 6.0-lb/sq. ft. lead sheets, 0.0938-inch thickness or thicker. Solder joints of 4.0-lb/sq. ft. lead sheets, 0.0625-inch thickness or thinner.
2. Copper Sheets: Solder joints of copper sheets.

B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.

1. Pipe Flashing: Sleeve type, matching the pipe size, with a minimum length of 10 inches and with skirt or flange extending at least 8 inches around pipe.
2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.

C. Set flashing on floors and roofs in solid coating of bituminous cement.

D. Secure flashing into sleeve and specialty clamping ring or device.

E. Fabricate and install flashing and pans, sumps, and other drainage shapes.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

3.4 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221423

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

SECTION 230500 - COMMON WORK RESULTS FOR HVAC

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. HVAC demolition.
2. Equipment installation requirements common to equipment sections.
3. Painting and finishing.
4. Supports and anchorages.

1.3 DEFINITIONS

A. Basis of Design Products:

1. The "basis of design" products named on the contract drawings and throughout the project manual constitute the engineers design.
2. The phrase "or comparable product by one of the following" throughout the project manual implies that the comparable products are accepted as equal; however, the conditions of AIA document A201-2007 regarding shop drawings, product data and samples apply with regards to deviations from the contract documents.
3. If products other than the "basis of design" differ from the engineers design to the extent that modifications to structural, mechanical, electrical, or any other affected discipline's design is required to install the product properly, then all such modifications shall be done at the expense of the Contractor.

B. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

C. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

D. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

E. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

F. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

G. The following are industry abbreviations for plastic materials:

1. CPVC: Chlorinated polyvinyl chloride plastic.
2. PE: Polyethylene plastic.
3. PVC: Polyvinyl chloride plastic.

H. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.4 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

D. Installing Contractor shall submit appropriate forms to Pennsylvania Department of Labor and Industry – Boiler Division for approval of boilers, unfired pressure vessels, or other equipment under their jurisdiction before installation of equipment. Contractor shall also submit appropriate fees. Contractor shall arrange for inspection and obtain approval for installation. If installation fails inspection, Contractor shall arrange for re-inspection until approval is granted.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

1.6 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 HVAC DEMOLITION

A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.

B. Disconnect, demolish, and remove HVAC systems, equipment, and components indicated to be removed.

1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
2. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
3. Equipment to Be Removed: Disconnect and cap services and remove equipment.
4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
5. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

C. Patching: The mechanical contractor is responsible for patching floor, wall, ceiling, and roof penetrations in existing construction to remain after selective demolition of HVAC equipment. The extent of such patching shall be to restore the substrate materials to the extent that new finishes can be installed.

D. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 15 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.

M. Verify final equipment locations for roughing-in.

N. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 15 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

F. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

G. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.4 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.5 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

D. Install equipment to allow right of way for piping installed at required slope.

3.6 PAINTING

A. Painting of HVAC systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.

C. Field Welding: Comply with AWS D1.1.

END OF SECTION 230500

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

SECTION 230517 - SLEEVES AND SLEEVE SEALS FOR HVAC PIPING

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. Sleeves.
2. Stack-sleeve fittings.
3. Sleeve-seal systems.
4. Sleeve-seal fittings.
5. Grout.

1.3 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 SLEEVES

A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.

C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.

D. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

2.2 STACK-SLEEVE FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Smith, Jay R. Mfg. Co.
2. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.

B. Description: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring, bolts, and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with setscrews.

2.3 SLEEVE-SEAL SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Advance Products & Systems, Inc.
2. CALPICO, Inc.
3. Metraflex Company (The).
4. Pipeline Seal and Insulator, Inc.
5. Proco Products, Inc.

B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.

1. Sealing Elements: NBR interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Stainless steel.
3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.4 SLEEVE-SEAL FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Presealed Systems.

B. Description: Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall. Unit has plastic or rubber waterstop collar with center opening to match piping OD.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

2.5 GROUT

A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Nonshrink; recommended for interior and exterior applications.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.

1. Sleeves are not required for core-drilled holes.

C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
2. Cut sleeves to length for mounting flush with both surfaces.

a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.

3. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

D. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.
2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Section 079200 "Joint Sealants."

E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

3.2 STACK-SLEEVE-FITTING INSTALLATION

A. Install stack-sleeve fittings in new slabs as slabs are constructed.

1. Install fittings that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 076200 "Sheet Metal Flashing and Trim."
3. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.
4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
5. Using grout, seal the space around outside of stack-sleeve fittings.

B. Fire-Barrier Penetrations: Maintain indicated fire rating of floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

3.3 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.4 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

3.5 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above Grade:

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

a. Piping Smaller Than NPS 6: Cast-iron wall sleeves.

2. Exterior Concrete Walls below Grade:

a. Piping Smaller Than NPS 6: Cast-iron wall sleeves with sleeve-seal system.

1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

3. Concrete Slabs-on-Grade:

a. Piping Smaller Than NPS 6: Cast-iron wall sleeves with sleeve-seal system.

1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

4. Concrete Slabs above Grade:

a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.

5. Interior Partitions:

a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.

END OF SECTION 230517

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

SECTION 230518 - ESCUTCHEONS FOR HVAC PIPING

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. Escutcheons.
2. Floor plates.

1.3 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

A. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.

C. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.

D. Split-Casting Brass Type: With polished, chrome-plated finish and with concealed hinge and setscrew.

E. Split-Plate, Stamped-Steel Type: With chrome-plated finish, concealed hinge, and spring-clip fasteners.

2.2 FLOOR PLATES

A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.

B. Split-Casting Floor Plates: Cast brass with concealed hinge.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

1. Escutcheons for New Piping:

a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
b. Chrome-Plated Piping: One-piece, cast-brass type with polished, chrome-plated finish.
c. Insulated Piping: One-piece, stamped-steel type.
d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type.
f. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
g. Bare Piping in Equipment Rooms: One-piece, cast-brass type with polished, chrome-plated finish.

C. Install floor plates for piping penetrations of equipment-room floors.

D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

1. New Piping: One-piece, floor-plate type.
2. Existing Piping: Split-casting, floor-plate type.

3.2 FIELD QUALITY CONTROL

A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION 230518

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Thermal-hanger shield inserts.
5. Fastener systems.
6. Pipe stands.
7. Equipment supports.

B. Related Sections:

1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Section 230516 "Expansion Fittings and Loops for HVAC Piping" for pipe guides and anchors.
3. Section 233113 "Metal Ducts" and Section 233116 "Nonmetal Ducts" for duct hangers and supports.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

1.5 ACTION SUBMITTALS

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

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following; include Product Data for components:

1. Trapeze pipe hangers.
2. Metal framing systems.
3. Pipe stands.
4. Equipment supports.

1.6 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.7 QUALITY ASSURANCE

A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

B. Stainless-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

C. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

2.2 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Allied Tube & Conduit.
   b. Cooper B-Line, Inc.
   c. Flex-Strut Inc.
   d. GS Metals Corp.
   e. Thomas & Betts Corporation.
   f. Unistrut Corporation; Tyco International, Ltd.
   g. Wesanco, Inc.

2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
3. Standard: MFMA-4.
4. Channels: Continuous slotted steel channel with inturned lips.
5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.
7. Metallic Coating: Galvanized.
8. Paint Coating: Epoxy.

B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.

C. Insulation-Insert Material for Hot Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength.

D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

2.4 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

B. Mechanical-Expansion Anchors: Insert-wedge-type, stainless- steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.5 PIPE STANDS

A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.

C. Low-Type, Single-Pipe Stand: One-piece plastic base unit with plastic roller, for roof installation without membrane penetration.

D. Curb-Mounted-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.6 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.7 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.

D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

E. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

F. Pipe Stand Installation:

1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Section 077200 "Roof Accessories" for curbs.

G. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

H. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

I. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

J. Install lateral bracing with pipe hangers and supports to prevent swaying.

K. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

L. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

M. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

N. Insulated Piping:

1. Attach clamps and spacers to piping.

    a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
    b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
    c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

    a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

    a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:

    a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
    b. NPS 4: 12 inches long and 0.06 inch thick.
    c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
    d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
    e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.

5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

3.2 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and 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. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

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 a minimum dry film thickness of 2.0 mils.

B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Section 099113 "Exterior Painting", Section 099123 "Interior Painting", and Section 099600 "High-Performance Coatings."

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers and supports metal trapeze pipe hangers and metal framing systems and attachments for general service applications.

F. Use copper-plated pipe hangers and stainless-steel attachments for copper piping and tubing.

G. Use padded hangers for piping that is subject to scratching.

H. Use thermal-hanger shield inserts for insulated piping and tubing.

I. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.
19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

K. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

L. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:

    a. Light (MSS Type 31): 750 lb.
    b. Medium (MSS Type 32): 1500 lb.
    c. Heavy (MSS Type 33): 3000 lb.

13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

M. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

N. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:

    a. Horizontal (MSS Type 54): Mounted horizontally.
    b. Vertical (MSS Type 55): Mounted vertically.
    c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

O. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

P. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

Q. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 230529

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

SECTION 230548 - VIBRATION CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Isolation pads.
2. Isolation mounts.
3. Restrained elastomeric isolation mounts.
4. Freestanding spring isolators.
5. Elastomeric hangers.
6. Spring hangers.
7. Pipe riser resilient supports.
8. Resilient pipe guides.
9. Vibration isolation equipment bases.

1.3 DEFINITIONS

A. IBC: International Building Code.

B. ICC-ES: ICC-Evaluation Service.

C. OSHPD: Office of Statewide Health Planning and Development for the State of California.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For professional engineer and testing agency.

B. Welding certificates.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

C. Field quality-control test reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air-mounting systems to include in operation and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

B. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ace Mountings Co., Inc.
2. Amber/Booth Company, Inc.
3. California Dynamics Corporation.
4. Isolation Technology, Inc.
5. Kinetics Noise Control.
6. Mason Industries.
7. Vibration Eliminator Co., Inc.
8. Vibration Isolation.
9. Vibration Mountings & Controls, Inc.

B. Pads: Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.

1. Resilient Material: Oil- and water-resistant neoprene.

C. Mounts: Double-deflection type, with molded, oil-resistant rubber, hermetically sealed compressed fiberglass, or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Color-code or otherwise identify to indicate capacity range.

1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

element and attachment hardware from contacting the housing during normal operation.

2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.

D. Spring Isolators: Freestanding, laterally stable, open-spring isolators.

1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
5. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch- thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 500 psig.
6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

E. Elastomeric Hangers: Single or double-deflection type, fitted with molded, oil-resistant elastomeric isolator elements bonded to steel housings with threaded connections for hanger rods. Color-code or otherwise identify to indicate capacity range.

F. Spring Hangers: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.

1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the 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.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
7. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

G. Pipe Riser Resilient Support: All-directional, acoustical pipe anchor consisting of 2 steel tubes separated by a minimum of 1/2-inch- thick neoprene. Include steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions. Design support for a maximum load on the isolation material of 500 psig and for equal resistance in all directions.

H. Resilient Pipe Guides: Telescopic arrangement of 2 steel tubes or post and sleeve arrangement separated by a minimum of 1/2-inch- thick neoprene. Where clearances are not readily visible, a factory-set guide height with a shear pin to allow vertical motion due to pipe expansion and contraction shall be fitted. Shear pin shall be removable and reinsertable to

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.2 VIBRATION ISOLATION EQUIPMENT BASES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Amber/Booth Company, Inc.
2. California Dynamics Corporation.
3. Isolation Technology, Inc.
4. Kinetics Noise Control.
5. Mason Industries.
6. Vibration Eliminator Co., Inc.
7. Vibration Isolation.
8. Vibration Mountings & Controls, Inc.

B. Steel Base: Factory-fabricated, welded, structural-steel bases and rails.

1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.

   a. Include supports for suction and discharge elbows for pumps.

2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

C. Inertia Base: Factory-fabricated, welded, structural-steel bases and rails ready for placement of cast-in-place concrete.

1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.

   a. Include supports for suction and discharge elbows for pumps.

2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
4. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

2.3 FACTORY FINISHES

A. Finish: Manufacturer's standard prime-coat finish ready for field painting.

B. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.

1. Powder coating on springs and housings.
2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.
3. Baked enamel or powder coat for metal components on isolators for interior use.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation control devices for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.

3.3 VIBRATION-CONTROL DEVICE INSTALLATION

A. Comply with requirements in Section 077200 "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.

B. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

C. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
5. Test to 90 percent of rated proof load of device.
6. Measure isolator restraint clearance.
7. Measure isolator deflection.
8. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

3.5 ADJUSTING

A. Adjust isolators after piping system is at operating weight.

B. Adjust active height of spring isolators.

C. Adjust restraints to permit free movement of equipment within normal mode of operation.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

END OF SECTION 230548

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Valve tags.
5. Warning tags.

1.3 ACTION SUBMITTALS

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

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

D. Valve numbering scheme.

E. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
4. Fasteners: Stainless-steel rivets or self-tapping screws.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
2. Letter Color: Black.
3. Background Color: White.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless-steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

B. Letter Color: Red.

C. Background Color: White.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches high.

2.4 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.

1. Tag Material: Brass, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass wire-link or beaded chain; or S-hook.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

2.5 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.

1. Size: 3 by 5-1/4 inches minimum.
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

A. Piping Color-Coding: Painting of piping is specified in Section 099600 "High Performance Coatings."

B. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

C. Pipe Label Color Schedule:

1. Refrigerant Piping:
   a. Color shall comply with ASTM A13.1

3.4 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

1. Valve-Tag Size and Shape:

   a. Refrigerant: 2 inches, round.

2. Valve-Tag Color:

   a. Refrigerant: Natural.

3. Letter Color:

   a. Refrigerant: Black.

3.5 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 230553

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

SECTION 230719 - HVAC PIPING INSULATION

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 insulating the following HVAC piping systems:

1. Condensate drain piping, indoors.
2. Refrigerant suction and hot-gas piping, indoors and outdoors.

B. Related Sections:

1. Section 336313 "Steam Distribution" for loose-fill pipe insulation in underground piping outside the building.
2. Section 230713 "Duct Insulation."
3. Section 230716 "HVAC Equipment Insulation."

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail attachment and covering of heat tracing inside insulation.
3. Detail insulation application at pipe expansion joints for each type of insulation.
4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
5. Detail removable insulation at piping specialties.
6. Detail application of field-applied jackets.
7. Detail application at linkages of control devices.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

C. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.8 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Aeroflex USA, Inc.; Aerocel.
b. Armacell LLC; AP Armaflex.
c. K-Flex USA; Insul-Lock, Insul-Tube, and K-FLEX LS.

2.2 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Aeroflex USA, Inc.; Aeroseal.
b. Armacell LLC; Armaflex 520 Adhesive.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.
d. K-Flex USA; R-373 Contact Adhesive.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive 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 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
b. Vimasco Corporation; 749.

2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
5. Color: White.

C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below-ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-30.
b. Eagle Bridges - Marathon Industries; 501.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-35.
d. Mon-Eco Industries, Inc.; 55-10.

2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 35-mil dry film thickness.
3. Service Temperature Range: 0 to 180 deg F.
4. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
5. Color: White.

D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below-ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Encacel.
b. Eagle Bridges - Marathon Industries; 570.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 60-95/60-96.

2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
3. Service Temperature Range: Minus 50 to plus 220 deg F.
4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
5. Color: White.

E. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
b. Eagle Bridges - Marathon Industries; 550.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
d. Mon-Eco Industries, Inc.; 55-50.
e. Vimasco Corporation; WC-1/WC-5.

2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: 60 percent by volume and 66 percent by weight.
5. Color: White.

2.4 SEALANTS

A. Joint Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Permanently flexible, elastomeric sealant.
3. Service Temperature Range: Minus 100 to plus 300 deg F.
4. Color: White or gray.
5. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
6. Sealants 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."

B. ASJ Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: White.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants 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."

2.5 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
   1. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.

2.6 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. Metal Jacket:

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Metal Jacketing Systems.
   b. ITW Insulation Systems; Aluminum and Stainless Steel Jacketing.
   c. RPR Products, Inc.; Insul-Mate.

2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.

   a. Sheet and roll stock ready for shop or field sizing.
   b. Finish and thickness are indicated in field-applied jacket schedules.
   c. Moisture Barrier for Indoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
   d. Moisture Barrier for Outdoor Applications: 2.5-mil- thick polysurlyn.
   e. Factory-Fabricated Fitting Covers:

      1) Same material, finish, and thickness as jacket.
      2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
      3) Tee covers.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

4) Flange and union covers.
5) End caps.
6) Beveled collars.
7) Valve covers.
8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.7 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following:

a. ABI, Ideal Tape Division; 428 AWF ASJ.
b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
c. Compac Corporation; 104 and 105.
d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.

2. Width: 3 inches.
3. Thickness: 11.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, provide one of the following:

a. ABI, Ideal Tape Division; 488 AWF.
b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
c. Compac Corporation; 120.
d. Venture Tape; 3520 CW.

2. Width: 2 inches.
3. Thickness: 3.7 mils.
4. Adhesion: 100 ounces force/inch in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

2.8 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements, provide one of the following:

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

a. ITW Insulation Systems; Gerrard Strapping and Seals.
b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.

2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide with wing seal or closed seal.
3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal or closed seal.
4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

C. Wire: 0.080-inch nickel-copper alloy.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. C & F Wire.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:

1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.

    a. For below-ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. For above-ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Manholes.
5. Handholes.
6. Cleanouts.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.

5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.7 FIELD-APPLIED JACKET INSTALLATION

A. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.8 FINISHES

A. Pipe Insulation with ASJ, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.9 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Tests and Inspections:

1. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.10 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

1. Drainage piping located in crawl spaces.
2. Underground piping.
3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.11 INDOOR PIPING INSULATION SCHEDULE

A. Condensate and Equipment Drain Water below 60 Deg F:

1. All Pipe Sizes: Insulation shall be one of the following:
   a. Flexible Elastomeric: 1-1/2 inch thick.

B. Refrigerant Suction and Hot-Gas Piping:

1. All Pipe Sizes: Insulation shall be one of the following:

   a. Flexible Elastomeric: 1-1/2 inch thick.

C. Refrigerant Suction and Hot-Gas Flexible Tubing:

1. All Pipe Sizes: Insulation shall be the following:

   a. Flexible Elastomeric: 1-1/2 inch thick.

3.12 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Refrigerant Suction and Hot-Gas Piping:

1. All Pipe Sizes: Insulation shall be one of the following:
   a. Flexible Elastomeric: 2 inches thick.
   b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.

B. Refrigerant Suction and Hot-Gas Flexible Tubing:

1. All Pipe Sizes: Insulation shall be the following:

   a. Flexible Elastomeric: 2 inches thick.

3.13 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Concealed:

1. None.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

D. Piping, Exposed (within 6' of the floor):
   1. Aluminum, Smooth: 0.024 inch thick.

3.14 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Concealed:

   1. None.

D. Piping, Exposed:
   1. Aluminum, Smooth: 0.024 inch thick.

3.15 UNDERGROUND, FIELD-INSTALLED INSULATION JACKET

A. For underground direct-buried piping applications, install underground direct-buried jacket over insulation material.

END OF SECTION 230719

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

SECTION 232300 - REFRIGERANT PIPING

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 refrigerant piping used for air-conditioning applications.

1.3 PERFORMANCE REQUIREMENTS

A. Line Test Pressure for Refrigerant R-410A:

1. Suction Lines for Air-Conditioning Applications: 300 psig.
2. Suction Lines for Heat-Pump Applications: 535 psig.
3. Hot-Gas and Liquid Lines: 535 psig.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of valve and refrigerant piping specialty indicated. Include pressure drop, based on manufacturer's test data, for the following:

1. Thermostatic expansion valves.
2. Solenoid valves.
3. Hot-gas bypass valves.
4. Filter dryers.
5. Strainers.
6. Pressure-regulating valves.

B. Shop Drawings: Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes, flow capacities, valve arrangements and locations, slopes of horizontal runs, oil traps, double risers, wall and floor penetrations, and equipment connection details. Show interface and spatial relationships between piping and equipment.

1. Shop Drawing Scale: 1/4 inch equals 1 foot.
2. Refrigerant piping indicated on Drawings is schematic only. Size piping and design actual piping layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

1.5 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Field quality-control test reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

B. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."

C. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

1.8 PRODUCT STORAGE AND HANDLING

A. Store piping in a clean and protected area with end caps in place to ensure that piping interior and exterior are clean when installed.

1.9 COORDINATION

A. Coordinate size and location of roof curbs, equipment supports, and roof penetrations. These items are specified in Section 077200 "Roof Accessories."

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

A. Copper Tube: ASTM B 88, Type L.

B. Wrought-Copper Fittings: ASME B16.22.

C. Wrought-Copper Unions: ASME B16.22.

D. Brazing Filler Metals: AWS A5.8.

E. Flexible Connectors:

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
2. End Connections: Socket ends.
3. Offset Performance: Capable of minimum 3/4-inch misalignment in minimum 7-inch-long assembly.
4. Pressure Rating: Factory test at minimum 500 psig.
5. Maximum Operating Temperature: 250 deg F.

2.2 VALVES AND SPECIALTIES

A. Diaphragm Packless Valves:

1. Body and Bonnet: Forged brass or cast bronze; globe design with straight-through or angle pattern.
2. Diaphragm: Phosphor bronze and stainless steel with stainless-steel spring.
3. Operator: Rising stem and hand wheel.
4. Seat: Nylon.
5. End Connections: Socket, union, or flanged.
6. Working Pressure Rating: 500 psig.
7. Maximum Operating Temperature: 275 deg F.

B. Check Valves:

1. Body: Ductile iron, forged brass, or cast bronze; globe pattern.
2. Bonnet: Bolted ductile iron, forged brass, or cast bronze; or brass hex plug.
3. Piston: Removable polytetrafluoroethylene seat.
4. Closing Spring: Stainless steel.
5. Manual Opening Stem: Seal cap, plated-steel stem, and graphite seal.
6. End Connections: Socket, union, threaded, or flanged.
7. Maximum Opening Pressure: 0.50 psig.
8. Working Pressure Rating: 500 psig.
9. Maximum Operating Temperature: 275 deg F.

C. Service Valves:

1. Body: Forged brass with brass cap including key end to remove core.
2. Core: Removable ball-type check valve with stainless-steel spring.
3. Seat: Polytetrafluoroethylene.
4. End Connections: Copper spring.
5. Working Pressure Rating: 500 psig.

D. Solenoid Valves: Comply with ARI 760 and UL 429; listed and labeled by an NRTL.

1. Body and Bonnet: Plated steel.
2. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
3. Seat: Polytetrafluoroethylene.
4. End Connections: Threaded.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

5. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch conduit adapter, and 24-V ac coil.
6. Working Pressure Rating: 400 psig.
7. Maximum Operating Temperature: 240 deg F.
8. Manual operator.

E. Safety Relief Valves: Comply with ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.

1. Body and Bonnet: Ductile iron and steel, with neoprene O-ring seal.
2. Piston, Closing Spring, and Seat Insert: Stainless steel.
3. Seat Disc: Polytetrafluoroethylene.
4. End Connections: Threaded.
5. Working Pressure Rating: 400 psig.
6. Maximum Operating Temperature: 240 deg F.

F. Thermostatic Expansion Valves: Comply with ARI 750.

1. Body, Bonnet, and Seal Cap: Forged brass or steel.
2. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
3. Packing and Gaskets: Non-asbestos.
4. Capillary and Bulb: Copper tubing filled with refrigerant charge.
5. Suction Temperature: 40 deg F.
6. Superheat: Adjustable.
7. Reverse-flow option (for heat-pump applications).
8. End Connections: Socket, flare, or threaded union.
9. Working Pressure Rating: 450 psig.

G. Hot-Gas Bypass Valves: Comply with UL 429; listed and labeled by an NRTL.

1. Body, Bonnet, and Seal Cap: Ductile iron or steel.
2. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
3. Packing and Gaskets: Non-asbestos.
4. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
5. Seat: Polytetrafluoroethylene.
6. Equalizer: Internal.
7. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch conduit adapter, and 24-V ac coil.
8. End Connections: Socket.
9. Throttling Range: Maximum 5 psig.
10. Working Pressure Rating: 500 psig.
11. Maximum Operating Temperature: 240 deg F.

H. Straight-Type Strainers:

1. Body: Welded steel with corrosion-resistant coating.
2. Screen: 100-mesh stainless steel.
3. End Connections: Socket or flare.
4. Working Pressure Rating: 500 psig.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

5. Maximum Operating Temperature: 275 deg F.

I. Angle-Type Strainers:

1. Body: Forged brass or cast bronze.
2. Drain Plug: Brass hex plug.
3. Screen: 100-mesh monel.
4. End Connections: Socket or flare.
5. Working Pressure Rating: 500 psig.
6. Maximum Operating Temperature: 275 deg F.

J. Moisture/Liquid Indicators:

1. Body: Forged brass.
2. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
3. Indicator: Color coded to show moisture content in ppm.
4. Minimum Moisture Indicator Sensitivity: Indicate moisture above 60 ppm.
5. End Connections: Socket or flare.
6. Working Pressure Rating: 500 psig.
7. Maximum Operating Temperature: 240 deg F.

K. Replaceable-Core Filter Dryers: Comply with ARI 730.

1. Body and Cover: Painted-steel shell with ductile-iron cover, stainless-steel screws, and neoprene gaskets.
2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
3. Desiccant Media: Activated charcoal.
4. Designed for reverse flow (for heat-pump applications).
5. End Connections: Socket.
6. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
7. Maximum Pressure Loss: 2 psig.
8. Working Pressure Rating: 500 psig.
9. Maximum Operating Temperature: 240 deg F.

L. Permanent Filter Dryers: Comply with ARI 730.

1. Body and Cover: Painted-steel shell.
2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
3. Desiccant Media: Activated charcoal.
4. Designed for reverse flow (for heat-pump applications).
5. End Connections: Socket.
6. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
7. Maximum Pressure Loss: 2 psig.
8. Working Pressure Rating: 500 psig.
9. Maximum Operating Temperature: 240 deg F.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

M. Mufflers:

1. Body: Welded steel with corrosion-resistant coating.
2. End Connections: Socket or flare.
3. Working Pressure Rating: 500 psig.
4. Maximum Operating Temperature: 275 deg F.

N. Receivers: Comply with ARI 495.

1. Comply with ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.
2. Comply with UL 207; listed and labeled by an NRTL.
3. Body: Welded steel with corrosion-resistant coating.
4. Tappings: Inlet, outlet, liquid level indicator, and safety relief valve.
5. End Connections: Socket or threaded.
6. Working Pressure Rating: 500 psig.
7. Maximum Operating Temperature: 275 deg F.

O. Liquid Accumulators: Comply with ARI 495.

1. Body: Welded steel with corrosion-resistant coating.
2. End Connections: Socket or threaded.
3. Working Pressure Rating: 500 psig.
4. Maximum Operating Temperature: 275 deg F.

2.3 REFRIGERANTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Atofina Chemicals, Inc.
2. DuPont Company; Fluorochemicals Div.
3. Honeywell, Inc.; Genetron Refrigerants.
4. INEOS Fluor Americas LLC.

B. ASHRAE 34, R-410A: Pentafluoroethane/Difluoromethane.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS FOR REFRIGERANT R-410A

A. Suction Lines NPS 4 and Smaller for Conventional Air-Conditioning Applications: Copper, Type L, drawn-temper tubing and wrought-copper fittings with soldered joints.

B. Hot-Gas and Liquid Lines: Copper, Type L, annealed- or drawn-temper tubing and wrought-copper fittings with brazed joints.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

C. Safety-Relief-Valve Discharge Piping: Copper, Type L, annealed- or drawn-temper tubing and wrought-copper fittings with brazed joints.

3.2 VALVE AND SPECIALTY APPLICATIONS

A. Install diaphragm packless valves in suction and discharge lines of compressor.

B. Install service valves for gage taps at inlet and outlet of hot-gas bypass valves and strainers if they are not an integral part of valves and strainers.

C. Install a check valve at the compressor discharge and a liquid accumulator at the compressor suction connection.

D. Except as otherwise indicated, install diaphragm packless valves on inlet and outlet side of filter dryers.

E. Install a full-sized, three-valve bypass around filter dryers.

F. Install solenoid valves upstream from each expansion valve and hot-gas bypass valve. Install solenoid valves in horizontal lines with coil at top.

G. Install thermostatic expansion valves as close as possible to distributors on evaporators.

1. Install valve so diaphragm case is warmer than bulb.
2. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
3. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.

H. Install safety relief valves where required by ASME Boiler and Pressure Vessel Code. Pipe safety-relief-valve discharge line to outside according to ASHRAE 15.

I. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.

J. Install strainers upstream from and adjacent to the following unless they are furnished as an integral assembly for device being protected:

1. Solenoid valves.
2. Thermostatic expansion valves.
3. Hot-gas bypass valves.
4. Compressor.

K. Install filter dryers in liquid line between compressor and thermostatic expansion valve, and in the suction line at the compressor.

L. Install receivers sized to accommodate pump-down charge.

M. Install flexible connectors at compressors.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

3.3 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.

B. Install refrigerant piping according to ASHRAE 15.

C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping adjacent to machines to allow service and maintenance.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Select system components with pressure rating equal to or greater than system operating pressure.

J. Refer to Section 230900 "HVAC Instrumentation and Controls" and Section 230993 "Sequence of Operation" for solenoid valve controllers, control wiring, and sequence of operation.

K. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.

L. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Section 083113 "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.

M. Install refrigerant piping in protective conduit where installed belowground.

N. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.

O. Slope refrigerant piping as follows:

1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
2. Install horizontal suction lines with a uniform slope downward to compressor.
3. Install traps and double risers to entrain oil in vertical runs.
4. Liquid lines may be installed level.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

P. When brazing, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.

Q. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.

R. Identify refrigerant piping and valves according to Section 230553 "Identification for HVAC Piping and Equipment."

S. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."

T. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."

U. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."

3.4 PIPE JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Fill pipe and fittings with an inert gas (nitrogen or carbon dioxide), during brazing or welding, to prevent scale formation.

D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."

1. Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper pipe.
2. Use Type BAg, cadmium-free silver alloy for joining copper with bronze or steel.

3.5 HANGERS AND SUPPORTS

A. Hanger, support, and anchor products are specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

B. Install the following pipe attachments:

1. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
2. Spring hangers to support vertical runs.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

3. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.

C. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes:

1. NPS 1/2: Maximum span, 60 inches; minimum rod size, 1/4 inch.
2. NPS 5/8: Maximum span, 60 inches; minimum rod size, 1/4 inch.
3. NPS 1: Maximum span, 72 inches; minimum rod size, 1/4 inch.
4. NPS 1-1/4: Maximum span, 96 inches; minimum rod size, 3/8 inch.
5. NPS 1-1/2: Maximum span, 96 inches; minimum rod size, 3/8 inch.
6. NPS 2: Maximum span, 96 inches; minimum rod size, 3/8 inch.
7. NPS 2-1/2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
8. NPS 3: Maximum span, 10 feet; minimum rod size, 3/8 inch.
9. NPS 4: Maximum span, 12 feet; minimum rod size, 1/2 inch.

D. Support multifloor vertical runs at least at each floor.

3.6 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:

1. Comply with ASME B31.5, Chapter VI.
2. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in Part 1 "Performance Requirements" Article.

    a. Fill system with nitrogen to the required test pressure.
    b. System shall maintain test pressure at the manifold gage throughout duration of test.
    c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
    d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

3.7 SYSTEM CHARGING

A. Charge system using the following procedures:

1. Install core in filter dryers after leak test but before evacuation.
2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers. If vacuum holds for 12 hours, system is ready for charging.
3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.
4. Charge system with a new filter-dryer core in charging line.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

3.8 ADJUSTING

A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.

B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.

C. Adjust set-point temperature of air-conditioning or chilled-water controllers to the system design temperature.

D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:

1. Open shutoff valves in condenser water circuit.
2. Verify that compressor oil level is correct.
3. Open compressor suction and discharge valves.
4. Open refrigerant valves except bypass valves that are used for other purposes.
5. Check open compressor-motor alignment and verify lubrication for motors and bearings.

E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

END OF SECTION 232300

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

SECTION 233113 - METAL DUCTS

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. Single-wall round ducts and fittings.
2. Sheet metal materials.
3. Sealants and gaskets.
4. Hangers and supports.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of the following products:

1. Liners and adhesives.
2. Sealants and gaskets.

1.4 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports, AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports, AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

B. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."

D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

PART 2 - PRODUCTS

2.1 SINGLE-WALL ROUND DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Lindab Inc.
b. McGill AirFlow LLC.
c. SEMCO Incorporated.
d. Sheet Metal Connectors, Inc.
e. Spiral Manufacturing Co., Inc.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
2. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.

2.2 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G90.
2. Finishes for Surfaces Exposed to View: Mill phosphatized.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

2.3 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Two-Part Tape Sealing System:

1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
2. Tape Width: 4 inches.
3. Sealant: Modified styrene acrylic.
4. Water resistant.
5. Mold and mildew resistant.
6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
7. Service: Indoor and outdoor.
8. Service Temperature: Minus 40 to plus 200 deg F.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
10. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
11. Sealant 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."

C. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

2.4 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

C. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

D. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

E. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install round ducts in maximum practical lengths.

D. Install ducts with fewest possible joints.

E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.

K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Section 15820 "Duct Accessories" for fire and smoke dampers.

L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

3.2 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.

D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 DUCT SEALING

A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

B. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":

1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
2. Outdoor, Supply-Air Ducts: Seal Class A.
3. Outdoor, Exhaust Ducts: Seal Class C.
4. Outdoor, Return-Air Ducts: Seal Class C.
5. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class B.
6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class A.
7. Unconditioned Space, Exhaust Ducts: Seal Class C.
8. Unconditioned Space, Return-Air Ducts: Seal Class B.
9. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class C.
10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class B.
11. Conditioned Space, Exhaust Ducts: Seal Class B.
12. Conditioned Space, Return-Air Ducts: Seal Class C.

3.4 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Where practical, install concrete inserts before placing concrete.
2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
5. Do not use powder-actuated concrete fasteners for seismic restraints.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

D. Hangers Exposed to View: Threaded rod and angle or channel supports.

E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.

F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.5 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Section 233300 "Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.6 PAINTING

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

3.7 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Leakage Tests:

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

1. Perform Leakage testing on 25% of ductwork constructed to 3” or more pressure classification standards.
2. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
4. Test for leaks before applying external insulation.
5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
6. Give seven days' advance notice for testing.

C. Duct System Cleanliness Tests:

1. Visually inspect duct system to ensure that no visible contaminants are present.
2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."

   a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.

D. Duct system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.8 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel.

B. Elbow Configuration:

1. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."

   a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.

      1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
      2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
      3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
      4) Radius-to Diameter Ratio: 1.5.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam.

C. Branch Configuration:

1. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.

a. Velocity 1000 fpm or Lower: 90-degree tap.
b. Velocity 1000 to 1500 fpm: Conical tap.
c. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION 233113

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

SECTION 233300 - DUCT ACCESSORIES

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. Backdraft and pressure relief dampers.

1.3 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

2.2 MATERIALS

A. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

1. Galvanized Coating Designation: G60.
2. Exposed-Surface Finish: Mill phosphatized.

2.3 BACKDRAFT AND PRESSURE RELIEF DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Air Balance Inc.; a division of Mestek, Inc.
2. Greenheck Fan Corporation.
3. Nailor Industries Inc.
4. Pottorff.
5. Ruskin Company.

B. Description: Gravity balanced.

C. Maximum Air Velocity: 1000 fpm.

D. Maximum System Pressure: 3-inch wg.

E. Frame: Hat-shaped, 0.094-inch- thick, galvanized sheet steel, with welded corners or mechanically attached and mounting flange.

F. Blades: Multiple single-piece blades, center pivoted, maximum 6-inch width, 0.025-inch- thick, roll-formed aluminum with sealed edges.

G. Blade Action: Parallel.

H. Blade Seals: Felt.

I. Blade Axles:

1. Material: Stainless steel.
2. Diameter: 0.20 inch.

J. Tie Bars and Brackets: Aluminum.

K. Return Spring: Adjustable tension.

L. Bearings: Steel ball or synthetic pivot bushings.

M. Accessories:

1. Adjustment device to permit setting for varying differential static pressure.
2. Counterweights and spring-assist kits for vertical airflow installations.
3. Electric actuators.
4. Chain pulls.
5. Screen Mounting: Front mounted in sleeve.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

a. Sleeve Thickness: 20 gage minimum.
b. Sleeve Length: 6 inches minimum.

6. Screen Mounting: Rear mounted.
7. Screen Material: Aluminum.
8. Screen Type: Bird.
9. 90-degree stops.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

C. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.

D. Set dampers to fully open position before testing, adjusting, and balancing.

E. Install test holes at fan inlets and outlets and elsewhere as indicated.

F. Install fire and smoke dampers according to UL listing.

G. Install flexible connectors to connect ducts to equipment.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors and verify that purpose of access door can be performed.
3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation.
5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION 233300

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

SECTION 233423 - POWER VENTILATORS

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. Ceiling-mounted ventilators.

1.3 PERFORMANCE REQUIREMENTS

A. Project Altitude: Base fan-performance ratings on sea level.

B. Operating Limits: Classify according to AMCA 99.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Also include the following:

1. Certified fan performance curves with system operating conditions indicated.
2. Certified fan sound-power ratings.
3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
4. Material thickness and finishes, including color charts.
5. Dampers, including housings, linkages, and operators.
6. Roof curbs.
7. Fan speed controllers.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:

1. Roof framing and support members relative to duct penetrations.
2. Ceiling suspension assembly members.
3. Size and location of initial access modules for acoustical tile.
4. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

B. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For power ventilators to include in emergency, operation, and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Belts: One set(s) for each belt-driven unit.

1.8 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. AMCA Compliance: Fans shall have AMCA-Certified performance ratings and shall bear the AMCA-Certified Ratings Seal.

C. UL Standards: Power ventilators shall comply with UL 705. Power ventilators for use for restaurant kitchen exhaust shall also comply with UL 762.

1.9 COORDINATION

A. Coordinate size and location of structural-steel support members.

B. Coordinate sizes and locations of concrete bases with actual equipment provided.

C. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

PART 2 - PRODUCTS

2.1 CEILING-MOUNTED VENTILATORS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Carnes Company.
2. Loren Cook Company.
3. Soler & Palau, S&P USA Ventilation Systems, LLC

B. General Description:

1. Ceiling mounted applications
2. Maximum operating temperatures is 130 Fahrenheit
3. UL/cUL listed for above bathtub exhaust
4. Fans are UL/cUL listed 507 - Electric Fans
5. Each fan shall bear a permanently affixed manufacture's nameplate containing the model number and individual serial number

C. Wheel:

1. Forward curved centrifugal wheel
2. Constructed of calcium carbonate filled polypropylene
3. Statically and dynamically balanced in accordance to AMCA Standard 204-05

D. Motors:

1. Motor enclosures shall be open driproof (ODP), opening in the frame body and or end brackets
2. Motors are permanently lubricated sleeve bearing type to match with the fan load and furnished at the specific voltage and phase
3. Motors shall be mounted on vibration isolators and be accessible for maintenance
4. Compatible for use with speed controls
5. Thermal overload protection

E. Housing:

1. Constructed of heavy gauge galvanized steel
2. Profile as low as 6 15/16 inches

F. Aluminum Backdraft Damper:

1. Prevents air from entering back into the building when fan is off
2. Eliminates rattling or unwanted backdrafts

G. Outlet:

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

1. Steel duct collar shall be six or four inches in diameter to accept a six or four inch round duct work.
2. Shall include a backdraft damper

H. Grille:

1. Types: Designer
2. Constructed of high impact polystyrene plastic shall be factory standard on all units
3. Attached to the housing with screws

I. Mounting Brackets:

1. Fully adjustable for multiple installation conditions

J. Options/Accessories:

1. Disconnect Switches:

a. NEMA rated: 1
b. Positive electrical shut-off
c. Access for wiring shall be external

K. Roof Discharge:

1. Type: Pitched Roof Cap

2.2 SOURCE QUALITY CONTROL

A. Certify sound-power level ratings according to AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.

B. Certify fan performance ratings, including flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating." Label fans with the AMCA-Certified Ratings Seal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install power ventilators level and plumb.

B. Ceiling Units: Suspend units from structure; use steel wire or metal straps.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

C. Support suspended units from structure using threaded steel rods and elastomeric hangers having a static deflection of 1 inch. Vibration-control devices are specified in Section 230548 "Vibration Controls for HVAC Piping and Equipment."

D. Install units with clearances for service and maintenance.

E. Label units according to requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."

3.2 CONNECTIONS

A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Section 233300 "Duct Accessories."

B. Install ducts adjacent to power ventilators to allow service and maintenance.

C. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.3 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. Verify that shipping, blocking, and bracing are removed.
2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
3. Verify that cleaning and adjusting are complete.
4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
5. Adjust belt tension.
6. Adjust damper linkages for proper damper operation.
7. Verify lubrication for bearings and other moving parts.
8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

9. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
10. Shut unit down and reconnect automatic temperature-control operators.
11. Remove and replace malfunctioning units and retest as specified above.

C. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Prepare test and inspection reports.

END OF SECTION 233423

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

SECTION 238126 - SPLIT-SYSTEM AIR-CONDITIONING UNITS

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 split-system air-conditioning and heat-pump units consisting of separate evaporator-fan and compressor-condenser components.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.

C. Samples for Initial Selection: For units with factory-applied color finishes.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Filters: One set(s) for each air-handling unit.
2. Gaskets: One set(s) for each access door.
3. Fan Belts: One set(s) for each air-handling unit fan.

1.7 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. ASHRAE Compliance:

1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."
2. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - " Procedures," and Section 7 - "Construction and System Start-up."

C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

1.8 COORDINATION

A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.

1. Warranty Period:

a. For Compressor: Five year(s) from date of Substantial Completion.
b. For Parts: Five year(s) from date of Substantial Completion.
c. For Labor: Five year(s) from date of Substantial Completion.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

PART 2 - PRODUCTS

2.1 SINGLE-ZONE SPLIT-SYSTEMS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Carrier
2. Samsung
3. Trane

B. The outdoor unit shall be capable of the following operating ambient range.

1. Cooling: 0°F DB to 118°F DB
2. Heating: -4°F WB to 75°F WB

C. General

1. The air-conditioning system shall use R410A refrigerant.
2. The system shall have one air source outdoor unit.
3. The refrigerant circuit shall be field piped to a single matching indoor unit to effectively and efficiently control the heating or cooling operation of the system.
4. All refrigerant piping from outdoor unit to indoor unit shall be field insulated.
5. Factory installed microprocessor controls in the outdoor unit and indoor unit shall perform functions to efficiently operate the single zone system and communicate via four conductor power/transmission cable.
6. The outdoor unit shall be internally assembled, wired and piped from the factory.
7. The factory assembled system shall have the outdoor unit fitted with refrigerant strainer, check valves, oil separator, accumulator, 4-way reversing valve, electronic expansion valve, high side and low side refrigerant charging ports, and a service port.

D. Piping Capabilities

1. The outdoor unit shall be capable of operating at an elevation of 75 feet above the indoor units.

E. Defrost Operations

1. The outdoor unit shall be capable of auto defrost operation to melt accumulated ice off the outdoor unit heat exchanger. The defrost cycle control shall be based on outdoor ambient temperatures and outdoor unit heat exchanger temperatures.

F. Oil Management

1. The outdoor unit shall have an oil injection mechanism to ensure a consistent film of oil on all moving compressor parts at low speed.
2. The outdoor unit shall have an oil separator to separate oil mixed with the refrigerant gas during compression and return oil to the compressor.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

G. Cabinet

1. The outdoor unit cabinet shall be made of pre-coated metal (PCM).
2. The front/side panels of the outdoor unit shall be removable type for access to internal components.
3. Outdoor unit cabinet shall be tested in accordance with ASTM B-117 salt spray test procedure for a minimum of 1000 hours.

H. Fan Assembly

1. The outdoor unit shall be equipped with one direct drive variable speed propeller fan with Brushless Digitally Controlled (BLDC) motor with a horizontal air discharge.
2. The fan blades shall be made of Acrylonitrile Butadiene Styrene (ABS) material.
3. The fan shall be equipped with permanently lubricated bearings.
4. The fan motor shall have variable speed to a maximum of 950 RPM.
5. The fan shall have a raised guard to help prevent contact with moving parts.

I. Outdoor Coil

1. The outdoor unit shall have a factory built coil comprised of aluminum fins mechanically bonded on copper tubing.
2. The aluminum fins shall have factory applied corrosion resistant GoldFin™ material.
3. Coil coating shall be tested in accordance with ASTM B-117 salt spray test procedure for a minimum of 1000 hours.
4. The outdoor unit coil shall be factory tested to a pressure of 600 psig.
5. The coil for each outdoor unit shall have a minimum of 14 Fins per Inch (FPI).
6. The coil for each outdoor unit shall have a 2 row heat exchanger.
7. The outdoor unit cabinet shall have a coil guard.

J. Compressor

1. Each 3/4 to 1 ton outdoor unit shall be equipped with one hermetically sealed, digitally controlled, inverter driven single-rotary compressor with vibration isolation.
2. Each 1.5 to 3 ton outdoor unit shall be equipped with one hermetically sealed, digitally controlled, inverter driven twin-rotary compressor.
3. The compressor shall be mounted on vibration attenuating rubber grommets.
4. The compressor shall use a factory charge of Polyvinyl Ether (PVE) oil.
5. The compressor bearing(s) shall have Teflon™ coating.
6. The compressor shall be equipped with over-current protection.

K. Sound Levels

1. The outdoor unit shall have sound levels not exceeding 55 dB(A) tested in an anechoic chamber under ISO1996 standard.

L. Sensors

1. The outdoor unit shall have

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

a. Suction temperature sensor
b. Discharge temperature sensor
c. High pressure sensor
d. Low Pressure sensor
e. Outdoor temperature sensor
f. Outdoor unit heat exchanger temperature sensor

2.2 SINGLE ZONE CASSETTE (HEAT PUMP OUTDOOR UNIT)

A. The outdoor unit shall be capable of the following operating ambient range.

1. Cooling: 5°F DB to 118°F DB
2. Heating: 0°F WB to 64°F WB

B. General

1. The air-conditioning system shall use R410A refrigerant.
2. Each system shall have one air source outdoor unit.
3. The refrigerant circuit shall be field piped to a single matching indoor unit to effectively and efficiently control the heating or cooling operation of the system.
4. All refrigerant piping from outdoor unit to indoor unit shall be field insulated.
5. Factory installed microprocessor controls in the outdoor unit and indoor unit shall perform functions to efficiently operate the single zone system and communicate via four conductor power/transmission cable.
6. The outdoor unit shall be internally assembled, wired and piped from the factory.
7. The factory assembled system shall have the outdoor unit fitted with refrigerant strainer, check valves, oil separator, accumulator, 4-way reversing valve, electronic expansion valve, high side and low side refrigerant charging ports, and a service port.

C. Piping capabilities

1. The outdoor unit shall be capable of operating at an elevation of 75 feet above the indoor unit.

D. Defrost Operations

1. The outdoor unit shall be capable of auto defrost operation to melt accumulated ice off the outdoor unit heat exchanger. The defrost cycle control shall be based on outdoor ambient temperatures and outdoor unit heat exchanger temperatures.

E. Oil Management

1. The outdoor unit shall have an oil injection mechanism to ensure a consistent film of oil on all moving compressor parts at low speed.
2. The outdoor unit shall have an oil separator to separate oil mixed with the refrigerant gas during compression and return oil to the compressor.

F. Cabinet

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

1. The outdoor unit cabinet shall be made of pre-coated metal (PCM).
2. The front/side panels of the outdoor unit shall be removable type for access to internal components.
3. Outdoor unit cabinet shall be tested in accordance with ASTM B-117 salt spray test procedure for a minimum of 1000 hours.

G. Fan Assembly

1. Each 1.5 to 2 ton outdoor unit shall be equipped with one direct drive variable speed propeller fan with Brushless Digitally Controlled (BLDC) motor with a horizontal air discharge.
2. Each 3 to 3.5 ton outdoor unit shall be equipped with two direct drive variable speed propeller fans with BLDC motors with a horizontal air discharge.

    a. The fan blades shall be made of Acrylonitrile Butadiene Styrene (ABS) material.
    b. The fan(s) shall be equipped with permanently lubricated bearings.
    c. The fan motor(s) shall have variable speed to a maximum of 950 RPM.
    d. The fan(s) shall have a raised guard to help prevent contact with moving parts.

H. Outdoor Coil

1. The outdoor unit shall have a factory built coil comprised of aluminum fins mechanically bonded on copper tubing.
2. The aluminum fins shall have factory applied corrosion resistant GoldFin™ material.
3. Coil coating shall be tested in accordance with ASTM B-117 salt spray test procedure for a minimum of 1000 hours.
4. The outdoor unit coil shall be factory tested to a pressure of 600 psig.
5. The coil for each outdoor unit shall have a minimum of 14 Fins per Inch (FPI).
6. The coil for each outdoor unit shall have a 2 row heat exchanger.
7. The outdoor unit cabinet shall have a coil guard.

I. Compressor

1. The outdoor unit shall be equipped with one hermetically sealed, digitally controlled, inverter driven twin-rotary compressor.
2. The inverter driven, digitally controlled compressor shall be capable of operating in a frequency range from 20 Hz to 100 Hz with control in 1 Hz increments.
3. The compressor shall be mounted on vibration attenuating rubber grommets.
4. The compressor shall use a factory charge of Polyvinyl Ether (PVE) oil.
5. The compressor bearing(s) shall have Teflon™ coating.
6. The compressor shall be equipped with over-current protection.

J. Sound Levels

1. The outdoor unit shall have sound levels not exceeding 54 dB(A) tested in an anechoic chamber under ISO1996 standard.

K. Sensors

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

1. The outdoor unit shall have

    a. Suction temperature sensor
    b. Discharge temperature sensor
    c. High pressure sensor
    d. Low Pressure sensor
    e. Outdoor temperature sensor
    f. Outdoor unit heat exchanger temperature sensor

2.3 INDOOR UNITS

A. Wall Mounted – Standard

1. General

    a. Unit shall be factory assembled, wired, piped and run tested.
    b. Unit shall be designed to be installed for indoor application.
    c. Unit shall be attached to an installation plate/bracket that secures unit to the wall.
    d. The depth of the unit shall not exceed 10-1/2 inches.

2. Casing/Panel

    a. Unit case shall be manufactured of heavy duty Acrylonitrile Butadiene Styrene (ABS) and High Impact Polystyrene (HIPS) plastic.
    b. Unit case shall have a pearl white finish.
    c. The front surface of the unit shall have an architectural curved panel with pearl white finish.

3. Cabinet Assembly

    a. Unit shall have one supply air outlet and one return air inlet.
    b. Unit shall be equipped with factory installed temperature thermistors for

        1) Return air
        2) Refrigerant entering coil
        3) Refrigerant leaving coil

    c. Unit shall have a built-in control panel to communicate with the outdoor unit.
    d. Unit shall have the following functions as standard

        1) Self-diagnostic function
        2) Auto restart function
        3) Auto changeover function
        4) Auto clean function
        5) Dehumidifying function
        6) Hot Start
        7) Sleep mode

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

e. Unit shall be capable of refrigerant piping in 4 different directions.
f. Unit shall be capable of drain piping in 2 different directions.

4. Fan Assembly

a. The unit shall have a direct drive, cross flow fan made of high strength ABS plastic.
b. The fan motor is Brushless Digitally controlled (BLDC) with permanently lubricated and sealed ball bearings.
c. The fan/motor assembly shall be mounted on vibration attenuating rubber grommets.
d. The fan speed shall be controlled using microprocessor based direct digitally controlled algorithm.
e. In cooling mode, the indoor fan shall have the following settings: Low, Med, High, Power Cool, and Auto.
f. In heating mode, the indoor fan shall have the following settings: Low, Med, High, Power Heat, and Auto.
g. The Auto fan setting shall adjust the fan speed to most effectively achieve the set-point.
h. Unit shall have factory installed motorized louver to provide flow of air in up and down direction for uniform airflow.
i. Unit shall have factory installed motorized guide vane to control the direction of flow of air from side to side.

5. Filter Assembly

a. The return air inlet shall have a factory supplied primary removable, washable filter.
b. The filter access shall be from the front of the unit.

6. Coil Assembly

a. Unit shall have a factory built coil comprised of aluminum fins mechanically bonded on copper tubing.
b. Unit shall have minimum of 2 rows of coils.
c. Unit shall have a factory supplied condensate drain pan below the coil.
d. Unit shall be designed for gravity drain.
e. Unit shall have a factory insulated drain hose to handle condensate.
f. Unit shall have provision of 45° flare refrigerant pipe connections
g. The coil shall be factory pressure tested at a minimum of 551 psig.
h. All refrigerant piping from outdoor unit to indoor unit shall be field insulated.

7. Condensate Sensor Connection

a. The unit shall include a factory installed condensate sensor connection.

8. Microprocessor Control

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

a. The unit shall have a factory installed microprocessor controller capable of performing functions necessary to operate the system.
b. The unit shall be able to communicate with the outdoor unit using a field supplied minimum of 18 AWG, 4 core, stranded and shielded power/communication cable.
c. The unit shall be capable of setting Cooling Only operation.
d. The unit controls shall operate the indoor unit using one of the five operating modes:

1) Auto changeover
2) Heating
3) Cooling
4) Dry
5) Fan only

9. Electrical

a. The unit electrical power shall be 208-230/1/60 (V/Ph/Hz)
b. The unit shall be capable of operating within voltage limits of +/- 10% of the rated voltage.

10. Controls

a. The indoor unit shall be supplied with a wireless handheld controller.
b. An optional wired controller shall be available as an additional accessory.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install units level and plumb.

B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.

C. Install ground-mounted, compressor-condenser components on 4-inch- thick, reinforced concrete base that is 4 inches larger, on each side, than unit. Concrete, reinforcement, and formwork are specified in Section 033000 "Cast-in-Place Concrete." Coordinate anchor installation with concrete base.

D. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

1. Water Coil Connections: Comply with requirements specified in Section 232113 "Hydronic Piping." Connect hydronic piping to supply and return coil connections with shutoff-duty valve and union or flange on the supply connection and with throttling-duty valve and union or flange on the return connection.
2. Remote, Water-Cooled Condenser Connections: Comply with requirements specified in Section 232113 "Hydronic Piping." Connect hydronic piping to supply and return connections with shutoff-duty valve and union or flange on the supply connection and with throttling-duty valve and union or flange on the return connection.

B. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.

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.

B. 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.

C. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

3.4 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

END OF SECTION 238126

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Building wires and cables rated 600 V and less.
2. Connectors, splices, and terminations rated 600 V and less.

1.3 DEFINITIONS

A. VFC: Variable frequency controller.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Alcan Products Corporation; Alcan Cable Division.
2. Alpha Wire.
3. Belden Inc.
4. Encore Wire Corporation.
5. General Cable Technologies Corporation.
6. Southwire Incorporated.

B. Copper Conductors: Comply with NEMA WC 70/ICEA S-95-658.

C. Conductor Insulation: Comply with NEMA WC 70/ICEA S-95-658 for Type THW-2, Type THHN-2-THWN-2, Type XHHW-2, Type UF, Type USE and Type SO.

D. Multiconductor Cable: Comply with NEMA WC 70/ICEA S-95-658 for armored cable, Type AC, metal-clad cable, Type MC, nonmetallic-sheathed cable, Type NM, Type SO and Type USE with ground wire.

2.2 CONNECTORS AND SPLICES

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. AFC Cable Systems, Inc.
2. Gardner Bender.
3. Hubbell Power Systems, Inc.
4. Ideal Industries, Inc.
5. Ilsco; a branch of Bardes Corporation.
6. NSi Industries LLC.
7. O-Z/Gedney; a brand of the EGS Electrical Group.
8. 3M; Electrical Markets Division.
9. Tyco Electronics.

B. 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.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

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, except VFC cable, which shall be extra flexible stranded.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Exposed Feeders: Type THHN-2-THWN-2, single conductors in raceway.

B. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN-2-THWN-2, single conductors in raceway.

C. Exposed Branch Circuits, Including in Crawlspaces: Type THHN-2-THWN-2, single conductors in raceway.

D. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-2-THWN-2, single conductors in raceway, Metal-clad cable, Type MC.

E. 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.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

G. Complete cable tray systems installation according to Section 260536 "Cable Trays for Electrical Systems" prior to installing conductors and cables.

3.4 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches 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.

3.8 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

C. Perform the following tests and inspections:

1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.

2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

D. 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.

E. Cables will be considered defective if they do not pass tests and inspections.

END OF SECTION 260519

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes grounding and bonding systems and equipment.

B. Section includes grounding and bonding systems and equipment.
   1. Connect to existing building ground system.
      a. Provide modifications as required to correct deficiencies in existing system.

1.3 ACTION SUBMITTALS

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

1.4 INFORMATIONAL SUBMITTALS

A. As-Built Data: Plans showing dimensioned as-built locations of grounding features specified in "Field Quality Control" Article, including the following:
   1. Grounding arrangements and connections for separately derived systems.

B. Qualification Data: For testing agency and testing agency's field supervisor.

C. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.

   1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

      a. Instructions for periodic testing and inspection of grounding features ground rings, grounding connections for separately derived systems based on NETA MTS and/or NFPA 70B.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

1) Tests shall determine if ground-resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if values do not.
2) Include recommended testing intervals.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Burndy; Part of Hubbell Electrical Systems.
2. Dossert; AFL Telecommunications LLC.
3. ERICO International Corporation.
4. Fushi Copperweld Inc.
5. Galvan Industries, Inc.; Electrical Products Division, LLC.
6. Harger Lightning and Grounding.
7. ILSCO.
8. O-Z/Gedney; A Brand of the EGS Electrical Group.
9. Robbins Lightning, Inc.
10. Siemens Power Transmission & Distribution, Inc.

2.2 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with UL 467 for grounding and bonding materials and equipment.

2.3 CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

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 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 wide and 1/16 inch thick.
7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches in cross section, with 9/32-inch holes spaced 1-1/8 inches apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V.

2.4 CONNECTORS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy.

C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

D. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless exothermic-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.

B. 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.

C. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

2. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING AT THE SERVICE

A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

3.3 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

B. 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. Flexible raceway runs.
5. Armored and metal-clad cable runs.

C. 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.

D. Water Heater, Heat-Tracing: 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.

E. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.

F. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.

3.4 INSTALLATION

A. In addition to new work requirements, if the existing grounding system is found to be deficient, utilize the following systems as required to correct.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

B. 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.

C. 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.

D. Grounding and Bonding for Piping:

1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

E. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install tinned bonding jumper to bond across flexible duct connections to achieve continuity.

F. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet apart.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. 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.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

D. Tests and Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.

E. Grounding system will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

G. 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 Distribution Units or Panelboards Serving Electronic Equipment: 1 ohm.

H. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect and Engineer promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Hangers and supports for electrical equipment and systems.
2. Construction requirements for concrete bases.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. IMC: Intermediate metal conduit.

C. RMC: Rigid metal conduit.

1.4 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.

1.5 ACTION SUBMITTALS

A. Product Data: For the following:

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

1. Steel slotted support systems.
2. Nonmetallic slotted support systems.

B. Shop Drawings: 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. Nonmetallic slotted channel systems. Include Product Data for components.
4. Equipment supports.

1.6 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.7 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Comply with NFPA 70.

1.8 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified together with concrete Specifications.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Section 077200 "Roof Accessories."

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. Manufacturers: Subject to compliance with requirements, provide products by one of 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.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

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. Nonmetallic Slotted Support Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with 9/16-inch- diameter holes at a maximum of 8 inches o.c., in at least 1 surface.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allied Tube & Conduit.
b. Cooper B-Line, Inc.; a division of Cooper Industries.
c. Fabco Plastics Wholesale Limited.
d. Seasafe, Inc.

2. Fittings and Accessories: Products of channel and angle manufacturer and designed for use with those items.
3. Fitting and Accessory Materials: Same as channels and angles**, except metal items may be stainless steel**.
4. Rated Strength: Selected to suit applicable load criteria.

C. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

D. Conduit and Cable Support Devices: **Steel** hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

E. 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.

F. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

G. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

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, **stainless** 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. Manufacturers: Subject to compliance with requirements, provide products by one of 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 required by NFPA 70. Minimum rod size shall be 1/4 inch 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.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

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 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.

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.
3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. To Existing Concrete: Expansion anchor fasteners.
5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
6. To Steel: **Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69** or **Spring-tension clamps**.
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 .

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.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

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 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.

B. Touchup: Comply with requirements in **Section 099113 "Exterior Painting"**, **Section 099123 "Interior Painting" and Section 099600 "High Performance Coatings** 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

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Metal conduits, tubing, and fittings.
2. Nonmetal conduits, tubing, and fittings.
3. Metal wireways and auxiliary gutters.
4. Surface raceways.
5. Boxes, enclosures, and cabinets.

B. Related Requirements:
1. Section 283111 "Digital. Addressable Fire-Alarm system" for conduits, surface pathways, innerduct, boxes, and faceplate adapters serving electronic fire alarm.

1.3 DEFINITIONS

A. ARC: Aluminum rigid conduit.

B. GRC: Galvanized rigid steel conduit.

C. IMC: Intermediate metal conduit.

1.4 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.

1.5 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:

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

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. Qualification Data: For professional engineer.

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AFC Cable Systems, Inc.
2. Allied Tube & Conduit.
3. Anamet Electrical, Inc.
4. Electri-Flex Company.
5. O-Z/Gedney.
6. Picoma Industries.
7. Republic Conduit.
8. Robroy Industries.
9. Southwire Company.
10. Thomas & Betts Corporation.
11. Western Tube and Conduit Corporation.
12. Wheatland Tube Company.

B. 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.

C. GRC: Comply with ANSI C80.1 and UL 6.

D. ARC: Comply with ANSI C80.5 and UL 6A.

E. IMC: Comply with ANSI C80.6 and UL 1242.

F. EMT: Comply with ANSI C80.3 and UL 797.

G. FMC: Comply with UL 1; zinc-coated steel.

H. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

I. 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.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

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, with overlapping sleeves protecting threaded joints.

J. 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. Manufacturers: Subject to compliance with requirements provide products by one of the following:

1. AFC Cable Systems, Inc.
2. Anamet Electrical, Inc.
3. Arnco Corporation.
4. CANTEX Inc.
5. CertainTeed Corporation.
6. Condux International, Inc.
7. Electri-Flex Company.
8. Kraloy.
9. Lamson & Sessions; Carlon Electrical Products.
10. Niedax-Kleinhuis USA, Inc.
11. RACO; Hubbell.
12. Thomas & Betts Corporation.

B. 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.

C. ENT: Comply with NEMA TC 13 and UL 1653.

D. RNC: Type EPC-40-PVC complying with NEMA TC 2 and UL 651 unless otherwise indicated.

E. LFNC: Comply with UL 1660.

F. Rigid HDPE: Comply with UL 651A.

G. Continuous HDPE: Comply with UL 651B.

H. Coilable HDPE: Preassembled with conductors or cables, and complying with ASTM D 3485.

I. RTRC: Comply with UL 1684A and NEMA TC 14.

J. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

K. Fittings for LFNC: Comply with UL 514B.

L. 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).

M. 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper B-Line, Inc.
2. Hoffman.
3. Mono-Systems, Inc.
4. Square D.

B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1, Type 3R, unless otherwise indicated, and sized according to NFPA 70.

1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Wireway Covers: Screw-cover type unless otherwise indicated.

E. Finish: Manufacturer's standard enamel finish.

2.4 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. Manufacturer's standard enamel finish in color selected by Architect.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Mono-Systems, Inc.
b. Panduit Corp.
c. Wiremold / Legrand.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

C. Surface Nonmetallic Raceways: Two- or three-piece construction, complying with UL 5A, and manufactured of rigid PVC with texture and color selected by Architect from manufacturer's standard colors. Product shall comply with UL 94 V-0 requirements for self-extinguishing characteristics.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Hubbell Incorporated.
b. Mono-Systems, Inc.
c. Panduit Corp.
d. Wiremold / Legrand.

2.5 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers: Subject to compliance with requirements provide products by one of the following:

1. Adalet.
2. Cooper Technologies Company; Cooper Crouse-Hinds.
3. EGS/Appleton Electric.
4. Erickson Electrical Equipment Company.
5. Hoffman.
6. Hubbell Incorporated.
7. O-Z/Gedney.
8. RACO; Hubbell.
9. Thomas & Betts Corporation.
10. Wiremold / Legrand.

B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.

E. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.

F. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lb shall be listed and marked for the maximum allowable weight.

G. Paddle Fan Outlet Boxes: Nonadjustable, designed for attachment of paddle fan weighing 70 lb.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

1. Listing and Labeling: Paddle fan outlet boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

H. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

I. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.

J. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

K. Device Box Dimensions: 4 inches square by 2-1/8 inches deep, 4 inches by 2-1/8 inches by 2-1/8 inches deep.

L. Gangable boxes are allowed.

M. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1, Type 3R, Type 4 with continuous-hinge cover with flush latch unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
2. Nonmetallic Enclosures: Plastic.
3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

N. Cabinets:

1. NEMA 250, Type 1, Type 3R 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.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed Conduit: GRC, IMC, RNC, Type EPC-40-PVC, RNC, Type EPC-80-PVC.
2. Concealed Conduit, Aboveground: GRC, IMC, EMT, RNC, Type EPC-40-PVC.
3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
4. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R, Type 4.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

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, IMC.
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, IMC.
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: 3/4-inch trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
2. 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 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. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.

F. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

G. Install surface raceways only where indicated on Drawings.

H. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg.

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 away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

C. Complete raceway installation before starting conductor installation.

D. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.

E. Arrange stub-ups so curved portions of bends are not visible above finished slab.

F. 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 of changes in direction.

G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

H. Support conduit within 12 inches of enclosures to which attached.

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 trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

N. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

O. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

P. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

Q. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

R. Surface Raceways:

1. Install surface raceway with a minimum 2-inch 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.

S. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.

T. 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.

U. Comply with manufacturer's written instructions for solvent welding RNC and fittings.

V. Expansion-Joint Fittings:

1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F and that has straight-run length that exceeds 25 feet . Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.
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 temperature change.
    b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
    c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
    d. Attics: 135 deg F 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 deg of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg of temperature change for metal conduits.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

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.

W. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations subject to severe physical damage.
2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.

X. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.

Y. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

Z. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

AA. Locate boxes so that cover or plate will not span different building finishes.

BB. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

CC. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

DD. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 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."

3.4 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

3.5 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

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Identification for raceways.
2. Identification of power and control cables.
3. Identification for conductors.
4. Warning labels and signs.
5. Instruction signs.
6. Equipment identification labels.
7. Miscellaneous identification products.

1.3 ACTION SUBMITTALS

A. Product Data: For each electrical identification product indicated.

B. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.

1.4 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.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

1.5 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with location of access panels and doors.

D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 POWER AND CONTROL 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.

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 cable size.

B. Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.

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 cable size.

B. Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.

2.4 CONDUCTOR IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.

B. 2-inch- wide, 5-mil pressure-sensitive vinyl tape, with black and white stripes and clear vinyl overlay.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

2.5 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 grommets in corners for mounting.
3. Nominal size, 7 by 10 inches.

D. 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."

2.6 INSTRUCTION SIGNS

A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. inches and 1/8 inch 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.

2.7 EQUIPMENT IDENTIFICATION LABELS

A. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch.

2.8 CABLE TIES

A. General-Purpose Cable Ties: Fungus inert, self extinguishing, one piece, self locking, Type 6/6 nylon.

1. Minimum Width: 3/16 inch .
2. Tensile Strength at 73 deg F , According to ASTM D 638: 12,000 psi .
3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: Black except where used for color-coding.

B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self extinguishing, one piece, self locking, Type 6/6 nylon.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.
3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: Black.

C. Plenum-Rated Cable Ties: Self extinguishing, UV stabilized, one piece, self locking.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 deg F, According to ASTM D 638: 7000 psi.
3. UL 94 Flame Rating: 94V-0.
4. Temperature Range: Minus 50 to plus 284 deg F.
5. Color: Black.

2.9 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. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Apply identification devices to surfaces that require finish after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

F. Attach plastic raceway and cable labels that are not self-adhesive type with clear vinyl tape with adhesive appropriate to the location and substrate.

G. 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 maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

H. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.

I. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

J. 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 30A, and 120V to ground: Identify with self-adhesive vinyl label. Install labels at 10-foot 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.

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.

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 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.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

D. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.

E. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use adhesive vinyl labels with the conductor or cable designation, origin, and destination.

F. Control-Circuit Conductor Termination Identification: For identification at terminations provide self-adhesive vinyl labels with the conductor designation.

G. Conductors to Be Extended in the Future: Attach marker tape to conductors and list source.

H. 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.

I. 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.

J. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Baked-enamel warning signs.

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.

K. 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.

L. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch- high letters for emergency instructions at equipment used for power transfer and/or load shedding.

M. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

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- high letters on 1-1/2-inch- high label; where two lines of text are required, use labels 2 inches high.
    b. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
    c. 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.

2. Equipment to Be Labeled:
    a. Enclosures and electrical cabinets.
    b. Access doors and panels for concealed electrical items.
    c. Emergency system boxes and enclosures.
    d. Enclosed switches.
    e. Enclosed circuit breakers.
    f. Enclosed controllers.
    g. Push-button stations.
    h. Contactors.
    i. Remote-controlled switches, dimmer modules, and control devices.
    j. Battery-inverter units.
    k. Monitoring and control equipment.

END OF SECTION 260553

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Snap switches and wall-box dimmers.
   2. Wall-switch occupancy sensors.

1.3 DEFINITIONS

A. EMI: Electromagnetic interference.

B. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

C. RFI: Radio-frequency interference.

D. UTP: Unshielded twisted pair.

1.4 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.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Poke-Through, Fire-Rated Closure Plugs: One for every five floor service outlets installed, but no fewer than two.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers

   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 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 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, provide one of the following]:

      1) Single Pole:

      2) Cooper; AH1221.
      3) Hubbell; HBL1221.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

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, provide one of 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."

2.4 WALL SWITCH SENSOR LIGHT SWITCH, DUAL TECHNOLOGY

A. Provide one of the following:
1. Legrand Wattstopper – DW-100
2. Cooper Greengate – OSW-DT
3. Hubbell -

B. Description: Switchbox-mounted, combination lighting-control sensor and conventional switch lighting-control unit using dual technology.
1. Connections: Hard wired.
2. Connections: Wireless.
3. Rated 960 W at 120-V ac for tungsten lighting, 10 A at 120-V ac or 10 A at 277-V ac for fluorescent or LED lighting, and 1/4 hp at 120-V ac.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

4. Integral relay for connection to BAS.
5. Adjustable time delay of 4-30 minutes.
6. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc (21.5 to 2152 lux).
7. Comply with NEMA WD 1, UL 20, and FS W-S-896.

2.5 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: As selected by Architect.
3. Material for Unfinished Spaces: Smooth, high-impact thermoplastic. Color to match device body.
4. Material for Damp Locations: Thermoplastic with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.

B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, thermoplastic with lockable cover.

2.6 FINISHES

A. Device Color:

1. Wiring Devices Connected to Normal Power System: As selected by Architect unless otherwise indicated or required by NFPA 70 or device listing.
2. Wiring Devices Connected to Emergency Power System: Red

B. Wall Plate Color: As selected by Architect. 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.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

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 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. 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.

F. 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.

G. .

3.2 IDENTIFICATION

A. Comply with Section 260553 "Identification for Electrical Systems."

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

B. Identify each receptacle with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

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. Wiring device will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION 262726

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

SECTION 265119 - LED INTERIOR LIGHTING

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 the following types of LED luminaires:
   1. Linear industrial.
   2. Recessed linear.
   3. Strip light.
   4. Surface mount, linear.
   5. Surface mount, nonlinear.
   6. Suspended, linear.
   7. Suspended, nonlinear.
   8. Materials.
   9. Finishes.
   10. Luminaire support.

1.3 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color Rendering Index.

C. Fixture: See "Luminaire."

D. IP: International Protection or Ingress Protection Rating.

E. LED: Light-emitting diode.

F. Lumen: Measured output of lamp and luminaire, or both.

G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

   1. Arrange in order of luminaire designation.
   2. Include data on features, accessories, and finishes.
   3. Include physical description and dimensions of luminaires.
   4. Include emergency lighting units, including batteries and chargers.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

5. Include life, output (lumens, CCT, and CRI), and energy efficiency data.
6. Photometric data and adjustment factors based on laboratory tests, complying with IES Lighting Measurements Testing and Calculation Guides, of each luminaire type. The adjustment factors shall be for lamps and accessories identical to those indicated for the luminaire as applied in this Project.

    a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
    b. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.

B. Shop Drawings: For nonstandard or custom luminaires.

1. Include plans, elevations, sections, and mounting and attachment details.
2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

C. Product Schedule: For luminaires and lamps.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Luminaires.
2. Suspended ceiling components.
3. Partitions and millwork that penetrate the ceiling or extend to within 12 inches of the plane of the luminaires.
4. Structural members to which equipment and or luminaires will be attached.
5. Initial access modules for acoustical tile, including size and locations.
6. Items penetrating finished ceiling, including the following:

    a. Other luminaires.
    b. Air outlets and inlets.
    c. Piping.
    d. Ductwork.
    e. Access panels.
    f. Ceiling-mounted cable tray.
    g. All other existing condition installations.

B. Qualification Data: For testing laboratory providing photometric data for luminaires.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

C. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Product Certificates: For each type of luminaire.

E. Sample warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.

1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Lamps: Ten for every 100 of each type and rating installed. Furnish at least one of each type.
2. Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.
3. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.

1.8 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.

B. Provide luminaires from a single manufacturer for each luminaire type.

C. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

D. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.9 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

B. Warranty Period: Five year(s) from date of Substantial Completion.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

PART 2 - PRODUCTS

2.1 LUMINAIRE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Standards:

1. ENERGY STAR certified.
2. California Title 24 compliant.
3. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.
4. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.
5. UL Listing: Listed for damp location.
6. Recessed luminaires shall comply with NEMA LE 4.
7. User Replaceable Lamps:

a. Bulb shape complying with ANSI C78.79.
b. Lamp base complying with ANSI C81.61.

C. CRI of minimum 80, CCT as noted in Lighting Fixture Schedule.

D. Rated lamp life of minimum 50,000 hours to L70.

E. Lamps dimmable from 100 percent to 0 percent of maximum light output.

F. Internal driver.

G. Nominal Operating Voltage: as noted on Lighting Fixture Schedule.

1. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless otherwise indicated.

H. Housings:

1. Extruded-aluminum housing and heat sink.
2. Clear, or colored, powder-coat or painted finish.

2.2 LINEAR INDUSTRIAL

A. Manufacturers: As noted in Lighting Fixture Schedule or approved equal.

B. Minimum 3000 lumens. Minimum allowable efficacy of 80 lumens per watt.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

2.3 RECESSED LINEAR

A. Manufacturers: As noted in Lighting Fixture Schedule or approved equal.

B. Minimum 1000 lumens. Minimum allowable efficacy of 85 lumens per watt.

C. Integral junction box with conduit fittings.

2.4 STRIP LIGHT

A. Manufacturers: As noted in Lighting Fixture Schedule or approved equal.

B. Minimum 500 lumens. Minimum allowable efficacy of 80 lumens per watt.

C. Integral junction box with conduit fittings.

2.5 SURFACE MOUNT, LINEAR

A. Manufacturers: As noted in Lighting Fixture Schedule or approved equal.

B. Minimum 500 lumens. Minimum allowable efficacy of 80 lumens per watt.

C. Integral junction box with conduit fittings.

2.6 SURFACE MOUNT, NONLINEAR

A. Manufacturers: As noted in Lighting Fixture Schedule or approved equal.

B. Minimum 500 lumens. Minimum allowable efficacy of 80 lumens per watt.

C. Integral junction box with conduit fittings.

2.7 SUSPENDED, LINEAR

A. Manufacturers: As noted in Lighting Fixture Schedule or approved equal.

B. Minimum 1500 lumens. Minimum allowable efficacy of 85 lumens per watt.

2.8 SUSPENDED, NONLINEAR

A. Manufacturers: As noted in Lighting Fixture Schedule or approved equal.

B. Minimum 1500> lumens. Minimum allowable efficacy of 85 lumens per watt.

C. Integral junction box with conduit fittings.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

2.9 MATERIALS

A. Metal Parts:

1. Free of burrs and sharp corners and edges.
2. Sheet metal components shall be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging.

B. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

C. Diffusers and Globes:

1. Tempered Fresnel glass, prismatic glass, diffuse glass, clear glass, prismatic acrylic, or clear, UV-stabilized acrylic.
2. Acrylic Diffusers: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
3. Glass: Annealed crystal glass unless otherwise indicated.
4. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless otherwise indicated.

D. Housings:

1. Extruded-aluminum housing and heat sink.
2. Clear or colored, powder-coat or painted finish.

E. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp characteristics:

a. "USE ONLY" and include specific lamp type.
b. Lamp diameter, shape, size, wattage, and coating.
c. CCT and CRI for all luminaires.

2.10 METAL FINISHES

A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.11 LUMINAIRE SUPPORT

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.

C. Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12 gage.

D. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 TEMPORARY LIGHTING

A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is sufficiently complete, clean luminaires used for temporary lighting and install new lamps.

3.3 INSTALLATION

A. Comply with NECA 1.

B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

C. Install lamps in each luminaire.

D. Supports:

1. Sized and rated for luminaire weight.
2. Able to maintain luminaire position after cleaning and relamping.
3. Provide support for luminaire without causing deflection of ceiling or wall.
4. Luminaire mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and vertical force of 400 percent of luminaire weight.

E. Flush-Mounted Luminaire Support:

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

1. Secured to outlet box.
2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
3. Trim ring flush with finished surface.

F. Wall-Mounted Luminaire Support:

1. Attached to structural members in walls, attached to a minimum 20 gauge backing plate attached to wall structural members, or attached using through bolts and backing plates on either side of wall.
2. Do not attach luminaires directly to gypsum board.

G. Ceiling-Mounted Luminaire Support:

1. Ceiling mount with two 5/32-inch- diameter aircraft cable supports adjustable to 120 inches in length.
2. Ceiling mount with pendant mount with 5/32-inch- diameter aircraft cable supports adjustable to 120 inches in length.
3. Ceiling mount with hook mount.

H. Suspended Luminaire Support:

1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
3. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and wire support for suspension for each unit length of luminaire chassis, including one at each end.
4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

I. Ceiling-Grid-Mounted Luminaires:

1. Secure to any required outlet box.
2. Secure luminaire to the luminaire opening using approved fasteners in a minimum of four locations, spaced near corners of luminaire.
3. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.

J. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

3.4 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Prepare test and inspection reports.

3.6 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.

1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
3. Adjust the aim of luminaires in the presence of the Architect.

END OF SECTION 265119

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

SECTION 283111 - DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Fire-alarm control unit.
2. Manual fire-alarm boxes.
3. System smoke detectors.
4. Heat detectors.
5. Notification appliances.
6. Remote annunciator.
7. Addressable interface device.
8. Digital alarm communicator transmitter.
9. Network communications.

1.3 DEFINITIONS

A. EMT: Electrical Metallic Tubing.

B. FACP: Fire Alarm Control Panel.

C. HLI: High Level Interface.

D. NICET: National Institute for Certification in Engineering Technologies.

E. PC: Personal computer.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product, including furnished options and accessories.

1. Include construction details, material descriptions, dimensions, profiles, and finishes.
2. Include rated capacities, operating characteristics, and electrical characteristics.

B. Shop Drawings: For fire-alarm system.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

1. Comply with recommendations and requirements in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
2. Include plans, elevations, sections, details, and attachments to other work.
3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations. Indicate conductor sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.
4. Detail assembly and support requirements.
5. Include voltage drop calculations for notification-appliance circuits.
6. Include battery-size calculations.
7. Include input/output matrix.
8. Include statement from manufacturer that all equipment and components have been tested as a system and meet all requirements in this Specification and in NFPA 72.
9. Include performance parameters and installation details for each detector.
10. Verify that each duct detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
11. Provide program report showing that air-sampling detector pipe layout balances pneumatically within the airflow range of the air-sampling detector.
12. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale; coordinate location of duct smoke detectors and access to them.

    a. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators.
    b. Show field wiring required for HVAC unit shutdown on alarm.
    c. Show field wiring and equipment required for HVAC unit shutdown on alarm and override by firefighters' control system.
    d. Show field wiring and equipment required for HVAC unit shutdown on alarm and override by firefighters' smoke-evacuation system.
    e. Locate detectors according to manufacturer's written recommendations.
    f. Show air-sampling detector pipe routing.
13. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits and point-to-point wiring diagrams.

C. General Submittal Requirements:

1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Architect.
2. Shop Drawings shall be prepared by persons with the following qualifications:

    a. Trained and certified by manufacturer in fire-alarm system design.
    b. NICET-certified, fire-alarm technician; Level III minimum.
    c. Licensed or certified by authorities having jurisdiction.

D. Delegated-Design Submittal: For notification appliances and smoke and heat detectors, in addition to submittals listed above, indicate compliance with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

1. Drawings showing the location of each notification appliance and smoke and heat detector, ratings of each, and installation details as needed to comply with listing conditions of the device.
2. Design Calculations: Calculate requirements for selecting the spacing and sensitivity of detection, complying with NFPA 72. Calculate spacing and intensities for strobe signals and sound-pressure levels for audible appliances.
3. Indicate audible appliances required to produce square wave signal per NFPA 72.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Seismic Qualification Certificates: For fire-alarm control unit, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field quality-control reports.

1.6 Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following and deliver copies to authorities having jurisdiction:

a. Comply with the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
b. Provide "Fire Alarm and Emergency Communications System Record of Completion Documents" according to the "Completion Documents" Article in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
c. Complete wiring diagrams showing connections between all devices and equipment. Each conductor shall be numbered at every junction point with indication of origination and termination points.
d. Riser diagram.
e. Device addresses.
f. Record copy of site-specific software.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

g. Provide "Inspection and Testing Form" according to the "Inspection, Testing and Maintenance" chapter in NFPA 72, and include the following:

1) Equipment tested.
2) Frequency of testing of installed components.
3) Frequency of inspection of installed components.
4) Requirements and recommendations related to results of maintenance.
5) Manufacturer's user training manuals.

h. Manufacturer's required maintenance related to system warranty requirements.
i. Abbreviated operating instructions for mounting at fire-alarm control unit and each annunciator unit.

B. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.
2. Program Software Backup: On magnetic media or compact disk, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Lamps for Remote Indicating Lamp Units: Quantity equal to 10 percent of amount installed, but no fewer than one unit.
2. Lamps for Strobe Units: Quantity equal to 10 percent of amount installed, but no fewer than one unit.
3. Smoke Detectors, Fire Detectors: Quantity equal to 10 percent of amount of each type installed, but no fewer than one unit of each type.
4. Detector Bases: Quantity equal to five percent of amount of each type installed, but no fewer than one unit of each type.
5. Keys and Tools: One extra set for access to locked or tamperproofed components.
6. Audible and Visual Notification Appliances: One of each type installed.
7. Fuses: Two of each type installed in the system. Provide in a box or cabinet with compartments marked with fuse types and sizes.

1.9 QUALITY ASSURANCE

A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.

B. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm Level II, minimum, technician.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

C. NFPA Certification: Obtain certification according to NFPA 72 by an NRTL (nationally recognized testing laboratory).

1.10 PROJECT CONDITIONS

A. Use of Devices during Construction: Protect devices during construction unless devices are placed in service to protect the facility during construction.

1.11 SEQUENCING AND SCHEDULING

A. Existing Fire-Alarm Equipment: Maintain existing equipment fully operational until new equipment has been tested and accepted. As new equipment is installed, label it "NOT IN SERVICE" until it is accepted. Remove labels from new equipment when put into service, and label existing fire-alarm equipment "NOT IN SERVICE" until removed from the building.

B. Equipment Removal: After acceptance of new fire-alarm system, remove existing disconnected fire-alarm equipment and wiring.

1.12 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace fire-alarm system equipment and components that fail in materials or workmanship within specified warranty period.

1. Warranty Extent: All equipment and components not covered in the Maintenance Service Agreement.
2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Source Limitations for Fire-Alarm System and Components: Components shall be compatible with, and operate as a system. Provide system manufacturer's certification that all components provided have been tested as, and will operate as, a system.

B. Noncoded, UL-certified addressable system, with multiplexed signal transmission and horn/strobe evacuation.

C. Automatic sensitivity control of certain smoke detectors.

D. All components provided shall be listed for use with the selected system.

E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

2.2 SYSTEMS OPERATIONAL DESCRIPTION

A. Fire-alarm signal initiation shall be by one or more of the following devices and systems:

1. Manual stations.
2. Heat detectors.
3. Flame detectors.
4. Smoke detectors.
5. Duct smoke detectors.
6. Carbon monoxide detectors.

B. Fire-alarm signal shall initiate the following actions:

1. Continuously operate alarm notification appliances.
2. Identify alarm and specific initiating device at fire-alarm control unit, connected network control panels, and remote annunciators.
3. Transmit an alarm signal to the remote alarm receiving station.
4. Activate voice/alarm communication system.
5. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
6. Recall elevators to primary or alternate recall floors (if required and equipped).
7. Activate elevator power shunt trip (if required and equipped).
8. Record events in the system memory.

C. Supervisory signal initiation shall be by one or more of the following devices and actions:
1. Elevator shunt-trip supervision.
2. Independent fire-detection and -suppression systems.
3. User disabling of zones or individual devices.
4. Loss of communication with any panel on the network.

D. System trouble signal initiation shall be by one or more of the following devices and actions:

1. Open circuits, shorts, and grounds in designated circuits.
2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
3. Loss of communication with any addressable sensor, input module, relay, control module, remote annunciator, or Ethernet module.
4. Loss of primary power at fire-alarm control unit.
5. Ground or a single break in internal circuits of fire-alarm control unit.
6. Abnormal ac voltage at fire-alarm control unit.
7. Break in standby battery circuitry.
8. Failure of battery charging.
9. Abnormal position of any switch at fire-alarm control unit or annunciator.
10. Hose cabinet door open.

E. System Supervisory Signal Actions:

1. Initiate notification appliances.
2. Identify specific device initiating the event at fire-alarm control unit, connected network control panels, and remote annunciators.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

3. After a time delay of 200 seconds transmit a trouble or supervisory signal to the remote alarm receiving station.
4. Transmit system status to building management system.

2.3 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Fire-alarm control unit and raceways shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2.4 FIRE-ALARM CONTROL UNIT

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. GAMEWELL.
2. GE UTC Fire & Security; A United Technologies Company.
3. Honeywell-Notifier.
4. Siemens Industry, Inc.; Fire Safety Division.
5. Silent Knight.
6. SimplexGrinnell LP.

B. General Requirements for Fire-Alarm Control Unit:

1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864.

   a. System software and programs shall be held in nonvolatile flash, electrically erasable, programmable, read-only memory, retaining the information through failure of primary and secondary power supplies.
   b. Include a real-time clock for time annotation of events on the event recorder.
   c. Provide communication between the FACP and remote circuit interface panels, annunciators, and displays.
   d. The FACP shall be listed for connection to a central-station signaling system service.
   e. Provide nonvolatile memory for system database, logic, and operating system and event history. The system shall require no manual input to initialize in the event of a complete power down condition. The FACP shall provide a minimum 500-event history log.

2. Addressable Initiation Device Circuits: The FACP shall indicate which communication zones have been silenced and shall provide selective silencing of alarm notification appliance by building communication zone.
3. Addressable Control Circuits for Operation of Notification Appliances and Mechanical Equipment: The FACP shall be listed for releasing service.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

C. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.

1. Annunciator and Display: Liquid-crystal type, 80 characters, minimum.
2. Keypad: Arranged to permit entry and execution of programming, display, and control commands.

D. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.

1. Annunciator and Display: Liquid-crystal type, three line(s) of 80 characters, minimum.
2. Keypad: Arranged to permit entry and execution of programming, display, and control commands.

E. Initiating-Device, Notification-Appliance, and Signaling-Line Circuits:

1. Pathway Class Designations: NFPA 72, Class B.
2. Pathway Survivability: Level 1.
3. Install no more than 50 addressable devices on each signaling-line circuit.
4. Serial Interfaces:

   a. One dedicated RS 485 port for central-station operation using point ID DACT.
   b. One RS 485 port for remote annunciators or Ethernet.
   c. One USB port for PC configuration.

F. Smoke-Alarm Verification:

1. Initiate audible and visible indication of an "alarm-verification" signal at fire-alarm control unit.
2. Activate an approved "alarm-verification" sequence at fire-alarm control unit and detector.
3. Sound general alarm if the alarm is verified.
4. Cancel fire-alarm control unit indication and system reset if the alarm is not verified.

G. Notification-Appliance Circuit:

1. Audible appliances shall sound in a three-pulse temporal pattern, as defined in NFPA 72.
2. Where notification appliances provide signals to sleeping areas, the alarm signal shall be a 520-Hz square wave with an intensity 15 dB above the average ambient sound level or 5 dB above the maximum sound level, or at least 75 dBA, whichever is greater, measured at the pillow.
3. Visual alarm appliances shall flash in synchronization where multiple appliances are in the same field of view, as defined in NFPA 72.

H. Elevator Recall:

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

1. Elevator recall shall be initiated only by one of the following alarm-initiating devices:

   a. Elevator lobby detectors except the lobby detector on the designated floor.
   b. Smoke detector in elevator machine room.
   c. Smoke detectors in elevator hoistway.

2. Elevator controller shall be programmed to move the cars to the alternate recall floor if lobby detectors located on the designated recall floors are activated.
3. Water-flow alarm connected to sprinkler in an elevator shaft and elevator machine room shall shut down elevators associated with the location without time delay.

   a. Water-flow switch associated with the sprinkler in the elevator pit may have a delay to allow elevators to move to the designated floor.

I. Door Controls: Door hold-open devices that are controlled by smoke detectors at doors in smoke-barrier walls shall be connected to fire-alarm system.

J. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.

K. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory signals, supervisory and digital alarm communicator transmitters shall be powered by 24-V dc source.

   1. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the power-supply module rating.

L. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.

   1. Batteries: Sealed lead calcium

M. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

2.5 SYSTEM SMOKE DETECTORS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   1. GAMEWELL.
   2. GE UTC Fire & Security; A United Technologies Company.
   3. Notifier.
   4. Siemens Industry, Inc.; Fire Safety Division.
   5. Silent Knight.
   6. SimplexGrinnell LP.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

B. General Requirements for System Smoke Detectors:

1. Comply with UL 268; operating at 24-V dc, nominal.
2. Detectors shall be four-wire type.
3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
4. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
5. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
6. Integral Visual-Indicating Light: LED type, indicating detector has operated and power-on status.
7. Remote Control: Unless otherwise indicated, detectors shall be digital-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit.

    a. Rate-of-rise temperature characteristic of combination smoke- and heat-detection units shall be selectable at fire-alarm control unit for 15 or 20 deg F per minute.
    b. Fixed-temperature sensing characteristic of combination smoke- and heat-detection units shall be independent of rate-of-rise sensing and shall be settable at fire-alarm control unit to operate at 135 or 155 deg F.
    c. Multiple levels of detection sensitivity for each sensor.
    d. Sensitivity levels based on time of day.

C. Photoelectric Smoke Detectors:

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:

    a. Primary status.
    b. Device type.
    c. Present average value.
    d. Present sensitivity selected.
    e. Sensor range (normal, dirty, etc.).

D. Ionization Smoke Detector:

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:

    a. Primary status.
    b. Device type.
    c. Present average value.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

d. Present sensitivity selected.
e. Sensor range (normal, dirty, etc.).

E. Duct Smoke Detectors: Photoelectric type complying with UL 268A.

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:

   a. Primary status.
   b. Device type.
   c. Present average value.
   d. Present sensitivity selected.
   e. Sensor range (normal, dirty, etc.).

3. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector for smoke detection in HVAC system ducts.
4. Each sensor shall have multiple levels of detection sensitivity.
5. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
6. Relay Fan Shutdown: Fully programmable relay rated to interrupt fan motor-control circuit.

2.6 CARBON MONOXIDE DETECTORS

A. General: Carbon monoxide detector listed for connection to fire-alarm system.

1. Mounting: Adapter plate for outlet box mounting.
2. Testable by introducing test carbon monoxide into the sensing cell.
3. Detector shall provide alarm contacts and trouble contacts.
4. Detector shall send trouble alarm when nearing end-of-life, power supply problems, or internal faults.
5. Comply with UL 2075.
6. Locate, mount, and wire according to manufacturer's written instructions.
7. Provide means for addressable connection to fire-alarm system.
8. Test button simulates an alarm condition.

2.7 MULTICRITERIA DETECTORS

A. Mounting: Adapter plate for outlet box mounting

B. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

C. Automatically adjusts its sensitivity by means of drift compensation and smoothing algorithms. The detector shall send trouble alarm if it is incapable of compensating for existing conditions.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

D. Test button tests all sensors in the detector.

E. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:

1. Primary status.
2. Device type.
3. Present sensitivity selected.
4. Sensor range (normal, dirty, etc.).

F. Sensors: The detector shall be comprised of four sensing elements including a smoke sensor, a carbon monoxide sensor, an infrared sensor, and a heat sensor.

1. Smoke sensor shall be photoelectric type as described in "System Smoke Detectors" Article.
2. Carbon monoxide sensor shall be as described in "Carbon Monoxide Detectors" Article.
3. Heat sensor shall be as described in "Heat Detectors" Article.
4. Each sensor shall be separately listed according to requirements for its detector type.

2.8 NONSYSTEM SMOKE DETECTORS

A. General Requirements for Nonsystem Smoke Detectors:

1. Nonsystem smoke detectors shall be listed as compatible with the fire-alarm equipment installed or shall have a contact closure interface listed for the connected load.
2. Nonsystem smoke detectors shall meet the monitoring for integrity requirements in NFPA 72.

B. Single-Station Duct Smoke Detectors:

1. Comply with UL 268A; operating at 120-V ac.
2. Sensor: LED or infrared light source with matching silicon-cell receiver.

   a. Detector Sensitivity: Smoke obscuration between 2.5 and 3.5 percent/foot (0.008 and 0.011 percent/mm) when tested according to UL 268A.

3. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. The fixed base shall be designed for mounting directly to air duct. Provide terminals in the fixed base for connection to building wiring.

   a. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; listed for use with the supplied detector.

4. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
5. Relay Fan Shutdown: Rated to interrupt fan motor-control circuit.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

2.9 HEAT DETECTORS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   1. GAMEWELL.
   2. Notifier.
   3. Siemens Industry, Inc.; Fire Safety Division.
   4. Silent Knight.
   5. SimplexGrinnell LP.

B. General Requirements for Heat Detectors: Comply with UL 521.

   1. Temperature sensors shall test for and communicate the sensitivity range of the device.

C. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F or a rate of rise that exceeds 15 deg F per minute unless otherwise indicated.

   1. Mounting: Adapter plate for outlet box mounting
   2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

D. Heat Detector, Fixed-Temperature Type: Actuated by temperature that exceeds a fixed temperature of 190 deg F.

   1. Mounting: Adapter plate for outlet box mounting
   2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

E. Continuous Linear Heat-Detector System:

   1. Detector Cable: Rated detection temperature 155 deg F Listed for "regular" service and a standard environment. Cable includes two steel actuator wires twisted together with spring pressure, wrapped with protective tape, and finished with PVC outer sheath. Each actuator wire is insulated with heat-sensitive material that reacts with heat to allow the cable twist pressure to short circuit wires at the location of elevated temperature.
   2. Control Unit: Two-zone or multizone unit as indicated. Provide same system power supply, supervision, and alarm features as specified for fire-alarm control unit.
   3. Signals to Fire-Alarm Control Unit: Any type of local system trouble shall be reported to fire-alarm control unit as a composite "trouble" signal. Alarms on each detection zone shall be individually reported to central fire-alarm control unit as separately identified zones.
   4. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

2.10 NOTIFICATION APPLIANCES

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Cooper Wheelock.
2. Federal Signal Corporation.
3. GE UTC Fire & Security; A United Technologies Company.
4. Siemens Industry, Inc.; Fire Safety Division.
5. SimplexGrinnell LP.

B. General Requirements for Notification Appliances: Connected to notification-appliance signal circuits, zoned as indicated, equipped for mounting as indicated, and with screw terminals for system connections.

1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated, and with screw terminals for system connections.

C. Chimes, High-Level Output: Vibrating type, 81-dBA minimum rated output.

D. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet from the horn, using the coded signal prescribed in UL 464 test protocol.

E. Visible Notification Appliances: Xenon strobe lights complying with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch high letters on the lens.

1. Rated Light Output:
   a. 15/30/75/110 cd, selectable in the field.

2. Mounting: Wall mounted unless otherwise indicated.
3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
4. Flashing shall be in a temporal pattern, synchronized with other units.
5. Strobe Leads: Factory connected to screw terminals.
6. Mounting Faceplate: Factory finished, red.

F. Tone Notification Appliances:

1. Comply with UL 1480.
2. Speakers for Voice Notification: Locate speakers for voice notification to provide the intelligibility requirements of the "Notification Appliances" and "Emergency Communications Systems" chapters in NFPA 72.
3. High-Range Units: Rated 2 to 15 W.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

4. Low-Range Units: Rated 1 to 2 W.
5. Mounting: surface mounted and bidirectional.
6. Matching Transformers: Tap range matched to acoustical environment of speaker location.

G. Exit Marking Audible Notification Appliance:

1. Exit marking audible notification appliances shall meet the audibility requirements in NFPA 72.
2. Provide exit marking audible notification appliances at the entrance to all building exits.
3. Provide exit marking audible notification appliances at the entrance to areas of refuge with audible signals distinct from those used for building exit marking.

2.11 REMOTE ANNUNCIATOR

A. Description: Annunciator functions shall match those of fire-alarm control unit for alarm, supervisory, and trouble indications. Manual switching functions shall match those of fire-alarm control unit, including acknowledging, silencing, resetting, and testing.

1. Mounting: Flush cabinet, NEMA 250, Type 1.

B. Display Type and Functional Performance: Alphanumeric display and LED indicating lights shall match those of fire-alarm control unit. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.

2.12 ADDRESSABLE INTERFACE DEVICE

A. General:

1. Include address-setting means on the module.
2. Store an internal identifying code for control panel use to identify the module type.
3. Listed for controlling HVAC fan motor controllers.

B. Monitor Module: Microelectronic module providing a system address for alarm-initiating devices for wired applications with normally open contacts.

C. Integral Relay: Capable of providing a direct signal to elevator controller to initiate elevator recall.

1. Allow the control panel to switch the relay contacts on command.
2. Have a minimum of two normally open and two normally closed contacts available for field wiring.

D. Control Module:

1. Operate notification devices.
2. Operate solenoids for use in sprinkler service.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

2.13 DIGITAL ALARM COMMUNICATOR TRANSMITTER

A. Digital alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL 632.

B. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit and automatically capture one telephone line(s) and dial a preset number for a remote central station. When contact is made with central station(s), signals shall be transmitted. If service on either line is interrupted for longer than 45 seconds, transmitter shall initiate a local trouble signal and transmit the signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. Transmitter shall automatically report telephone service restoration to the central station. If service is lost on both telephone lines, transmitter shall initiate the local trouble signal.

C. Local functions and display at the digital alarm communicator transmitter shall include the following:

1. Verification that both telephone lines are available.
2. Programming device.
3. LED display.
4. Manual test report function and manual transmission clear indication.
5. Communications failure with the central station or fire-alarm control unit.

D. Digital data transmission shall include the following:

1. Address of the alarm-initiating device.
2. Address of the supervisory signal.
3. Address of the trouble-initiating device.
4. Loss of ac supply.
5. Loss of power.
6. Low battery.
7. Abnormal test signal.
8. Communication bus failure.

E. Secondary Power: Integral rechargeable battery and automatic charger.

F. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

G. Provide network communications for fire-alarm system according to fire-alarm manufacturer's written requirements.

H. Provide network communications pathway per manufacturer's written requirements and requirements in NFPA 72 and NFPA 70.

I. Provide integration gateway using BACnet and/or LON for connection to building automation system.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements for ventilation, temperature, humidity, and other conditions affecting performance of the Work.

1. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment and wiring are installed, before installation begins.

B. Examine roughing-in for electrical connections to verify actual locations of connections before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EQUIPMENT INSTALLATION

A. Comply with NFPA 72, NFPA 101, and requirements of authorities having jurisdiction for installation and testing of fire-alarm equipment. Install all electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."

1. Devices placed in service before all other trades have completed cleanup shall be replaced.
2. Devices installed but not yet placed in service shall be protected from construction dust, debris, dirt, moisture, and damage according to manufacturer's written storage instructions.

B. Connecting to Existing Equipment: Verify that existing fire-alarm system is operational before making changes or connections.

1. Connect new equipment to existing control panel in existing part of the building.
2. Connect new equipment to existing monitoring equipment at the supervising station.
3. Expand, modify, and supplement existing control and monitoring equipment as necessary to extend existing control and monitoring functions to the new points. New components shall be capable of merging with existing configuration without degrading the performance of either system.

C. Install wall-mounted equipment, with tops of cabinets not more than 78 inches above the finished floor.

1. Comply with requirements for seismic-restraint devices specified in Section 260548 "Vibration and Seismic Controls for Electrical Systems."

D. Manual Fire-Alarm Boxes:

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

1. Install manual fire-alarm box in the normal path of egress within 60 inches of the exit doorway.
2. Mount manual fire-alarm box on a background of a contrasting color.
3. The operable part of manual fire-alarm box shall be between 42 inches and 48 inches above floor level. All devices shall be mounted at the same height unless otherwise indicated.

E. Smoke- or Heat-Detector Spacing:

1. Comply with the "Smoke-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for smoke-detector spacing.
2. Comply with the "Heat-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for heat-detector spacing.
3. Smooth ceiling spacing shall not exceed 30 feet.
4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Annex A in NFPA 72.
5. HVAC: Locate detectors not closer than 36 inches from air-supply diffuser or return-air opening.
6. Lighting Fixtures: Locate detectors not closer than 12 inches from any part of a lighting fixture and not directly above pendant mounted or indirect lighting.

F. Install a cover on each smoke detector that is not placed in service during construction. Cover shall remain in place except during system testing. Remove cover prior to system turnover.

G. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct. Tubes more than 36 inches long shall be supported at both ends.

1. Do not install smoke detector in duct smoke-detector housing during construction. Install detector only during system testing and prior to system turnover.

H. Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location. Do not install smoke detectors in sprinklered elevator shafts.

I. Single-Station Smoke Detectors: Where more than one smoke alarm is installed within a dwelling or suite, they shall be connected so that the operation of any smoke alarm causes the alarm in all smoke alarms to sound.

J. Remote Status and Alarm Indicators: Install in a visible location near each smoke detector, sprinkler water-flow switch, and valve-tamper switch that is not readily visible from normal viewing position.

K. Audible Alarm-Indicating Devices: Install not less than 6 inches below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille. Install all devices at the same height unless otherwise indicated.

L. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches below the ceiling. Install all devices at the same height unless otherwise indicated.

M. Device Location-Indicating Lights: Locate in public space near the device they monitor.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

3.3 PATHWAYS

A. Pathways above recessed ceilings and in non-accessible locations may be routed exposed.

1. Exposed pathways located less than 96 inches above the floor shall be installed in EMT.

B. Pathways shall be installed in EMT.

C. Exposed EMT shall be painted red enamel.

3.4 CONNECTIONS

A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Section 087100 "Door Hardware." Connect hardware and devices to fire-alarm system.

1. Verify that hardware and devices are listed for use with installed fire-alarm system before making connections.

B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 36 inches from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.
1. Smoke dampers in air ducts of designated HVAC duct systems.
2. Magnetically held-open doors.
3. Electronically locked doors and access gates.
4. Alarm-initiating connection to elevator recall system and components.
5. Alarm-initiating connection to activate emergency shutoffs for gas and fuel supplies.
6. Supervisory connections at valve supervisory switches.
7. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.
8. Supervisory connections at elevator shunt-trip breaker.
9. Data communication circuits for connection to building management system.
10. Supervisory connections at fire-extinguisher locations.

3.5 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

B. Install framed instructions in a location visible from fire-alarm control unit.

3.6 GROUNDING

A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

B. Ground shielded cables at the control panel location only. Insulate shield at device location.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

3.7 FIELD QUALITY CONTROL

A. Field tests shall be witnessed by authorities having jurisdiction.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

D. Perform the following tests and inspections:

1. Visual Inspection: Conduct visual inspection prior to testing.

   a. Inspection shall be based on completed record Drawings and system documentation that is required by the "Completion Documents, Preparation" table in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
   b. Comply with the "Visual Inspection Frequencies" table in the "Inspection" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.

2. System Testing: Comply with the "Test Methods" table in the "Testing" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
4. Test audible appliances for the private operating mode according to manufacturer's written instructions.
5. Test visible appliances for the public operating mode according to manufacturer's written instructions.
6. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" section of the "Fundamentals" chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

E. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.

F. Fire-alarm system will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

H. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.

I. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

DocuSign Envelope ID: FBF5061B-A6B0-4F9F-8BB2-5499CB380901

3.8 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of manufacturer's designated service organization. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

1. Include visual inspections according to the "Visual Inspection Frequencies" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
2. Perform tests in the "Test Methods" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
3. Perform tests per the "Testing Frequencies" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

3.9 SOFTWARE SERVICE AGREEMENT

A. Comply with UL 864.

B. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two years.

C. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.

1. Upgrade Notice: At least 30 days to allow Owner to schedule access to system and to upgrade computer equipment if necessary.

3.10 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

END OF SECTION 283111

County : New Hanover

Line #	Item Number	Sec #	Description	Quantity	Unit Cost	Amount
			ROADWAY ITEMS			
0001	0000100000-N	800	MOBILIZATION	Lump Sum	L.S.	
0002	0043000000-N	226	GRADING	Lump Sum	L.S.	
0003	0194000000-E	265	SELECT GRANULAR MATERIAL, CLASS III	7 CY		
0004	0196000000-E	270	GEOTEXTILE FOR SOIL STABILIZA-TION	711 SY		
0005	0344000000-E	310	18" SIDE DRAIN PIPE	37 LF		
0006	1220000000-E	545	INCIDENTAL STONE BASE	400 TON		
0007	4400000000-E	1110	WORK ZONE SIGNS (STATIONARY)	890 SF		
0008	4405000000-E	1110	WORK ZONE SIGNS (PORTABLE)	100 SF		
0009	4410000000-E	1110	WORK ZONE SIGNS (BARRICADE MOUNTED)	20 SF		
0010	4415000000-N	1115	FLASHING ARROW BOARD	1 EA		
0011	4420000000-N	1120	PORTABLE CHANGEABLE MESSAGE SIGN	8 EA		
0012	4430000000-N	1130	DRUMS	250 EA		
0013	4480000000-N	1165	TMA	1 EA		
0014	4695000000-E	1205	THERMOPLASTIC PAVEMENT MARKING LINES (8", 90 MILS)	415 LF		
0015	4710000000-E	1205	THERMOPLASTIC PAVEMENT MARKING LINES (24", 120 MILS)	110 LF		
0016	4721000000-E	1205	THERMOPLASTIC PAVEMENT MARKING CHARACTER (120 MILS)	4 EA		
0017	4725000000-E	1205	THERMOPLASTIC PAVEMENT MARKING SYMBOL (90 MILS)	6 EA		
0018	4770000000-E	1205	COLD APPLIED PLASTIC PAVEMENT MARKING LINES, TYPE ** (4") (IV)	6,430 LF		

County : New Hanover

Line #	Item Number	Sec #	Description	Quantity	Unit Cost	Amount
0019	4810000000-E	1205	PAINT PAVEMENT MARKING LINES (4")	3,188 LF		
0020	4820000000-E	1205	PAINT PAVEMENT MARKING LINES (8")	108 LF		
0021	4847010000-E	1205	POLYUREA PAVEMENT MARKING LINES (4", 20 MILS)	16,320 LF		
0022	4847050000-E	1205	POLYUREA PAVEMENT MARKING LINES (8", 20 MILS)	1,185 LF		
0023	4900000000-N	1251	PERMANENT RAISED PAVEMENT MARKERS	195 EA		
0024	6084000000-E	1660	SEEDING & MULCHING	0.06 ACR		
			STRUCTURE ITEMS			
0025	8065000000-N	SP	ASBESTOS ASSESSMENT	Lump Sum	L.S.	
0026	8296000000-N	442	POLLUTION CONTROL	Lump Sum	L.S.	
0027	8559000000-E	SP	CLASS II, SURFACE PREPARATION	1.11 SY		
0028	8660000000-E	SP	CONCRETE REPAIRS	207 CF		
0029	8664000000-E	SP	SHOTCRETE REPAIRS	1,240 CF		
0030	8678000000-E	SP	EPOXY RESIN INJECTION	12.5 LF		
0031	8860000000-N	SP	GENERIC STRUCTURE ITEM BIRD DETERRENT SCREENING	Lump Sum	L.S.	
0032	8860000000-N	SP	GENERIC STRUCTURE ITEM BRIDGE BACKUP GENERATOR	Lump Sum	L.S.	
0033	8860000000-N	SP	GENERIC STRUCTURE ITEM BRIDGE ELECTRICAL WORK	Lump Sum	L.S.	
0034	8860000000-N	SP	GENERIC STRUCTURE ITEM BRIDGE TENDER HOUSE SEWER LINE REPLACEMENT	Lump Sum	L.S.	

County : New Hanover

Line #	Item Number	Sec #	Description	Quantity	Unit Cost	Amount
0035	8860000000-N	SP	GENERIC STRUCTURE ITEM CLEANING AND REPAINTING OF BRIDGE #11	Lump Sum	L.S.	
0036	8860000000-N	SP	GENERIC STRUCTURE ITEM EXPANSION JOINT SEAL REPAIR	Lump Sum	L.S.	
0037	8860000000-N	SP	GENERIC STRUCTURE ITEM MECHANICAL OPERATING MACHINERY	Lump Sum	L.S.	
0038	8860000000-N	SP	GENERIC STRUCTURE ITEM OPERATOR HOUSE RENOVATION	Lump Sum	L.S.	
0039	8860000000-N	SP	GENERIC STRUCTURE ITEM PAINTING CONTAINMENT FOR BRIDGE #11	Lump Sum	L.S.	
0040	8860000000-N	SP	GENERIC STRUCTURE ITEM PLASTIC GLAZING PANELS	Lump Sum	L.S.	
0041	8860000000-N	SP	GENERIC STRUCTURE ITEM PLATFORM EXTENSIONS	Lump Sum	L.S.	
0042	8860000000-N	SP	GENERIC STRUCTURE ITEM REPLACEMENT OF FILLED STEEL GRID DECK	Lump Sum	L.S.	
0043	8860000000-N	SP	GENERIC STRUCTURE ITEM REPLACEMENT OF OPEN STEEL GRID DECK	Lump Sum	L.S.	
0044	8860000000-N	SP	GENERIC STRUCTURE ITEM SUBMARINE CABLES	Lump Sum	L.S.	
0045	8860000000-N	SP	GENERIC STRUCTURE ITEM TRAFFIC GATE RELOCATION	Lump Sum	L.S.	
0046	8860000000-N	SP	GENERIC STRUCTURE ITEM UNDER STRUCTURE WORK PLATFORM	Lump Sum	L.S.	
0047	8860000000-N	SP	GENERIC STRUCTURE ITEM VOLUMETRIC MIXER	Lump Sum	L.S.	
0048	8867000000-E	SP	GENERIC STRUCTURE ITEM FOAM JOINT SEALS FOR PRESERVA-TION	2,940 LF		
0049	8882000000-E	SP	GENERIC STRUCTURE ITEM CONCRETE FOR DECK REPAIR	3.3 CF		

County : New Hanover

Line #	Item Number	Sec #	Description	Quantity	Unit Cost	Amount
0050	8882000000-E	SP	GENERIC STRUCTURE ITEM ELASTOMERIC CONCRETE FOR PRESERVATION	290 CF		
0051	8882000000-E	SP	GENERIC STRUCTURE ITEM REPAIRS TO PRESTRESSED CONCRETE GIRDERS	154 CF		
0052	8889000000-E	SP	GENERIC STRUCTURE ITEM STRUCTURAL STEEL FOR REPAIRS	6,100 LB		
0053	8892000000-E	SP	GENERIC STRUCTURE ITEM BRIDGE JOINT DEMOLITION	1,160 SF		
0054	8892000000-E	SP	GENERIC STRUCTURE ITEM EPOXY PROTECTIVE COATING	1,280 SF		
0055	8892000000-E	SP	GENERIC STRUCTURE ITEM THERMAL SPRAYED ANODE	2,440 SF		
0056	8893000000-E	SP	GENERIC STRUCTURE ITEM SHOTBLASTING BRIDGE DECK	24,060 SY		
0057	8893000000-E	SP	GENERIC STRUCTURE ITEM SILANE DECK TREATMENT	24,060 SY		
0058	8897000000-N	SP	GENERIC STRUCTURE ITEM BACKPLATE	2 EA		
0059	8897000000-N	SP	GENERIC STRUCTURE ITEM EMBEDDED GALVANIC ANODE	2,370 EA		
0060	8897000000-N	SP	GENERIC STRUCTURE ITEM NEW ELECTRICAL SERVICE	1 EA		
0061	8897000000-N	SP	GENERIC STRUCTURE ITEM SPLICING OF PRESTRESSING STRAND	1 EA		
0062	8897000000-N	SP	GENERIC STRUCTURE ITEM TRAFFIC GATES	9 EA		
0063	8897000000-N	SP	GENERIC STRUCTURE ITEM VEHICLE SIGNAL HEAD (12", 3 SECTION)	2 EA		

COMBINED GOAL
SET 0.00%
COMBINED GOAL
ATTAINED 0.00%

Vendor 1 of 5: PCL CIVIL CONSTRUCTORS INC (3452)
Call Order 003 (Proposal: C204203)

Bid Information

Proposal County:	NEW HANOVER	**Bid Checksum:**	32083B2677
Vendor Address:		**Bid Total:**	$17,999,991.29
Signature Check:	Thomas Reed Spangler	**Items Total:**	$17,999,991.29
Time Bid Received:	February 19, 2019 01:48 PM	**Time Total:**	$0.00
Amendment Count:	1		

Bidding Errors:
None.

Vendor 1 of 5: PCL CIVIL CONSTRUCTORS INC (3452)
Call Order 003 (Proposal: C204203)

Bid Bond Information

Projects:		**Bond Maximum:**	
Counties:		**State of Incorporation:**	Maryland
Bond ID:	SNC19694247	**Agency Execution Date:**	1/29/2019 12
Paid by Check:	No	**Surety Name:**	Surety2000
Bond Percent:	5%	**Bond Agency Name:**	Fidelity and Deposit Company of Maryland

BondID: SNC19694247
Surety Registry Agency: Surety2000
Verified?: 1
Surety Agency: Fidelity and Deposit Company of Maryland
Bond Execution Date: 1/29/2019 12:22:30 PM

Line Number	Item Number	Quantity	Unit	Unit Price	Extension Price
Section 0001 ROADWAY ITEMS					
0001	0000100000-N	1.000	LS	$850,000.0000	$850,000.00
MOBILIZATION					
0002	0043000000-N	1.000	LS	$30,000.0000	$30,000.00
GRADING					
0003	0194000000-E	7.000	CY	$250.0000	$1,750.00
SELECT GRANULAR MATERIAL, CLASS III					
0004	0196000000-E	711.000	SY	$3.0000	$2,133.00
GEOTEXTILE FOR SOIL STABILIZA-TION					
0005	0344000000-E	37.000	LF	$80.0000	$2,960.00
18" SIDE DRAIN PIPE					
0006	1220000000-E	400.000	TON	$40.0000	$16,000.00
INCIDENTAL STONE BASE					
0007	4400000000-E	890.000	SF	$8.5000	$7,565.00
WORK ZONE SIGNS (STATIONARY)					
0008	4405000000-E	100.000	SF	$9.0000	$900.00
WORK ZONE SIGNS (PORTABLE)					
0009	4410000000-E	20.000	SF	$8.5000	$170.00
WORK ZONE SIGNS (BARRICADE MOUNTED)					
0010	4415000000-N	1.000	EA	$5,000.0000	$5,000.00
FLASHING ARROW BOARD					
0011	4420000000-N	8.000	EA	$9,500.0000	$76,000.00
PORTABLE CHANGEABLE MESSAGE SIGN					
0012	4430000000-N	250.000	EA	$70.0000	$17,500.00
DRUMS					
0013	4480000000-N	1.000	EA	$30,000.0000	$30,000.00
TMA					
0014	4695000000-E	415.000	LF	$4.0000	$1,660.00
THERMOPLASTIC PAVEMENT MARKINGLINES (8", 90 MILS)					
0015	4710000000-E	110.000	LF	$9.0000	$990.00
THERMOPLASTIC PAVEMENT MARKINGLINES (24", 120 MILS)					
0016	4721000000-E	4.000	EA	$200.0000	$800.00
THERMOPLASTIC PAVEMENT MARKINGCHARACTER (120 MILS)					
0017	4725000000-E	6.000	EA	$200.0000	$1,200.00
THERMOPLASTIC PAVEMENT MARKINGSYMBOL (90 MILS)					
0018	4770000000-E	6430.000	LF	$3.2000	$20,576.00
COLD APPLIED PLASTIC PAVEMENT MARKING LINES, TYPE ** (4") (IV)					
0019	4810000000-E	3188.000	LF	$0.7500	$2,391.00
PAINT PAVEMENT MARKING LINES (4")					
0020	4820000000-E	108.000	LF	$2.0000	$216.00
PAINT PAVEMENT MARKING LINES (8")					
0021	4847010000-E	16320.000	LF	$1.0000	$16,320.00
POLYUREA PAVEMENT MARKING LINES (4", 20 MILS)					
0022	4847050000-E	1185.000	LF	$2.0000	$2,370.00
POLYUREA PAVEMENT MARKING LINES (8", 20 MILS)					
0023	4900000000-N	195.000	EA	$7.0000	$1,365.00
PERMANENT RAISED PAVEMENT MARKERS					

0024	6084000000-E	0.060	ACR	$21,000.0000	$1,260.00
	SEEDING & MULCHING				

Section 0001 Total $1,089,126.00

Section 0004
STRUCTURE ITEMS

0025	8065000000-N	1.000	LS	$5,000.0000	$5,000.00
	ASBESTOS ASSESSMENT				
0026	8296000000-N	1.000	LS	$30,000.0000	$30,000.00
	POLLUTION CONTROL				
0027	8559000000-E	1.110	SY	$1,500.0000	$1,665.00
	CLASS II, SURFACE PREPARATION				
0028	8660000000-E	207.000	CF	$450.0000	$93,150.00
	CONCRETE REPAIRS				
0029	8664000000-E	1240.000	CF	$450.0000	$558,000.00
	SHOTCRETE REPAIRS				
0030	8678000000-E	12.500	LF	$500.0000	$6,250.00
	EPOXY RESIN INJECTION				
0031	8860000000-N	1.000	LS	$120,000.0000	$120,000.00
	GENERIC STRUCTURE ITEM BIRD DETERRENT SCREENING				
0032	8860000000-N	1.000	LS	$300,000.0000	$300,000.00
	GENERIC STRUCTURE ITEM BRIDGE BACKUP GENERATOR				
0033	8860000000-N	1.000	LS	$3,350,000.0000	$3,350,000.00
	GENERIC STRUCTURE ITEM BRIDGE ELECTRICAL WORK				
0034	8860000000-N	1.000	LS	$250,000.0000	$250,000.00
	GENERIC STRUCTURE ITEM BRIDGE TENDER HOUSE SEWER LINE REPLACEMENT				
0035	8860000000-N	1.000	LS	$1,500,000.0000	$1,500,000.00
	GENERIC STRUCTURE ITEM CLEANING AND REPAINTING OF BRIDGE #11				
0036	8860000000-N	1.000	LS	$6,000.0000	$6,000.00
	GENERIC STRUCTURE ITEM EXPANSION JOINT SEAL REPAIR				
0037	8860000000-N	1.000	LS	$1,650,000.0000	$1,650,000.00
	GENERIC STRUCTURE ITEM MECHANICAL OPERATING MACHINERY				
0038	8860000000-N	1.000	LS	$500,000.0000	$500,000.00
	GENERIC STRUCTURE ITEM OPERATOR HOUSE RENOVATION				
0039	8860000000-N	1.000	LS	$500,000.0000	$500,000.00
	GENERIC STRUCTURE ITEM PAINTING CONTAINMENT FOR BRIDGE #11				
0040	8860000000-N	1.000	LS	$80,000.0000	$80,000.00
	GENERIC STRUCTURE ITEM PLASTIC GLAZING PANELS				
0041	8860000000-N	1.000	LS	$55,000.0000	$55,000.00
	GENERIC STRUCTURE ITEM PLATFORM EXTENSIONS				
0042	8860000000-N	1.000	LS	$700,000.0000	$700,000.00
	GENERIC STRUCTURE ITEM REPLACEMENT OF FILLED STEEL GRID DECK				
0043	8860000000-N	1.000	LS	$2,250,000.0000	$2,250,000.00
	GENERIC STRUCTURE ITEM REPLACEMENT OF OPEN STEEL GRID DECK				
0044	8860000000-N	1.000	LS	$1,593,385.0000	$1,593,385.00
	GENERIC STRUCTURE ITEM SUBMARINE CABLES				
0045	8860000000-N	1.000	LS	$14,992.2900	$14,992.29
	GENERIC STRUCTURE ITEM TRAFFIC GATE RELOCATION				

0046	8860000000-N	1.000	LS	$950,000.0000	$950,000.00
	GENERIC STRUCTURE ITEM UNDER STRUCTURE WORK PLATFORM				
0047	8860000000-N	1.000	LS	$20,000.0000	$20,000.00
	GENERIC STRUCTURE ITEM VOLUMETRIC MIXER				
0048	8867000000-E	2940.000	LF	$32.0000	$94,080.00
	GENERIC STRUCTURE ITEM FOAM JOINT SEALS FOR PRESERVA-TION				
0049	8882000000-E	3.300	CF	$2,500.0000	$8,250.00
	GENERIC STRUCTURE ITEM CONCRETE FOR DECK REPAIR				
0050	8882000000-E	290.000	CF	$230.0000	$66,700.00
	GENERIC STRUCTURE ITEM ELASTOMERIC CONCRETE FOR PRESERVATION				
0051	8882000000-E	154.000	CF	$1,150.0000	$177,100.00
	GENERIC STRUCTURE ITEM REPAIRS TO PRESTRESSED CONCRETE GIRDERS				
0052	8889000000-E	6100.000	LB	$9.0000	$54,900.00
	GENERIC STRUCTURE ITEM STRUCTURAL STEEL FOR REPAIRS				
0053	8892000000-E	1160.000	SF	$31.0000	$35,960.00
	GENERIC STRUCTURE ITEM BRIDGE JOINT DEMOLITION				
0054	8892000000-E	1280.000	SF	$11.0000	$14,080.00
	GENERIC STRUCTURE ITEM EPOXY PROTECTIVE COATING				
0055	8892000000-E	2440.000	SF	$100.0000	$244,000.00
	GENERIC STRUCTURE ITEM THERMAL SPRAYED ANODE				
0056	8893000000-E	24060.000	SY	$3.6000	$86,616.00
	GENERIC STRUCTURE ITEM SHOTBLASTING BRIDGE DECK				
0057	8893000000-E	24060.000	SY	$2.1000	$50,526.00
	GENERIC STRUCTURE ITEM SILANE DECK TREATMENT				
0058	8897000000-N	2.000	EA	$1,000.0000	$2,000.00
	GENERIC STRUCTURE ITEM BACKPLATE				
0059	8897000000-N	2370.000	EA	$30.3000	$71,811.00
	GENERIC STRUCTURE ITEM EMBEDDED GALVANIC ANODE				
0060	8897000000-N	1.000	EA	$700,000.0000	$700,000.00
	GENERIC STRUCTURE ITEM NEW ELECTRICAL SERVICE				
0061	8897000000-N	1.000	EA	$4,500.0000	$4,500.00
	GENERIC STRUCTURE ITEM SPLICING OF PRESTRESSING STRAND				
0062	8897000000-N	9.000	EA	$85,000.0000	$765,000.00
	GENERIC STRUCTURE ITEM TRAFFIC GATES				
0063	8897000000-N	2.000	EA	$950.0000	$1,900.00
	GENERIC STRUCTURE ITEM VEHICLE SIGNAL HEAD (12", 3 SECTION)				

Section 0004 Total $16,910,865.29

Item Total $17,999,991.29

ELECTRONIC BID SUBMISSION

By submitting this bid electronically, I hereby acknowledge that all requirements included in the hard copy proposal, addendum, amendments, plans, standard specifications, supplemental specifications and special provisions are part of the bid and contract. Further, I acknowledge that I have read, understand, accept, acknowledge and agree to comply with all statements in this electronic bid.

==========

NON-COLLUSION, DEBARMENT AND GIFT BAN CERTIFICATION

The prequalified bidder declares (or certifies, verifies, or states) under penalty of perjury under the laws of the United States that neither he, nor any official, agent or employee has entered into any agreement, participated in any collusion, or otherwise taken any action which is in restraint of free competitive bidding in connection with any bid or contract, that the prequalified bidder has not been convicted of violating N.C.G.S. §133-24 within the last three years, and that the prequalified bidder intends to do the work with his own bonafide employees or subcontractors and will not bid for the benefit of another contractor.

By submitting this non-collusion, debarment and gift ban certification, the Contractor is attesting his status under penalty of perjury under the laws of the United States in accordance with the Debarment Certification attached, provided that the Debarment Certification also includes any required statements concerning exceptions that are applicable.

N.C.G.S. §133-32 and Executive Order 24 prohibit the offer to, or acceptance by, any State Employee of any gift from anyone with a contract with the State, or from any person seeking to do business with the State. By execution of any response in this procurement, you attest, for your entire organization and its employees or agents, that you are not aware that any such gift has been offered, accepted, or promised by any employees of your organization.

DEBARMENT CERTIFICATION OF PREQUALIFIED BIDDER

Conditions for certification:

1. The prequalified bidder shall provide immediate written notice to the Department if at any time the bidder learns that his certification was erroneous when he submitted his debarment certification or explanation that is file with the Department, or has become erroneous because of changed circumstances.

2. The terms covered transaction, debarred, suspended, ineligible, lower tier

covered transaction, participant, person, primary covered transaction, principal, proposal, and voluntarily excluded, as used in this provision, have the meanings set out in the Definitions and Coverage sections of the rules implementing Executive Order 12549. A copy of the Federal Rules requiring this certification and detailing the definitions and coverages may be obtained from the Contract Officer of the Department.

3. The prequalified bidder agrees by submitting this form, that he will not knowingly enter into any lower tier covered transaction with a person who is debarred, suspended, declared ineligible, or voluntarily excluded from participation in NCDOT contracts, unless authorized by the Department.

4. For Federal Aid projects, the prequalified bidder further agrees that by submitting this form he will include the Federal- Aid Provision titled Required Contract Provisions Federal-Aid Construction Contract (Form FHWA PR 1273) provided by the Department, without subsequent modification, in all lower tier covered transactions.

5. The prequalified bidder may rely upon a certification of a participant in a lower tier covered transaction that he is not debarred, suspended, ineligible, or voluntarily excluded from the covered transaction, unless he knows that the certification is erroneous. The bidder may decide the method and frequency by which he will determine the eligibility of his subcontractors.

6. Nothing contained in the foregoing shall be construed to require establishment of a system of records in order to render in good faith the certification required by this provision. The knowledge and information of a participant is not required to exceed that which is normally possessed by a prudent person in the ordinary course of business dealings.

7. Except as authorized in paragraph 6 herein, the Department may terminate any contract if the bidder knowingly enters into a lower tier covered transaction with a person who is suspended, debarred, ineligible, or voluntarily excluded from participation in this transaction, in addition to other remedies available by the Federal Government.

DEBARMENT CERTIFICATION

The prequalified bidder certifies to the best of his knowledge and belief, that he and his principals:

a. Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency;

b. Have not within a three-year period preceding this proposal been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State or local) transaction or contract under a public transaction; violation of Federal or State antitrust statutes or

commission of embezzlement, theft, forgery, bribery, falsification or destruction of records; making false statements; or receiving stolen property;

c. Are not presently indicted for or otherwise criminally or civilly charged by a governmental entity (Federal, State or local) with commission of any of the offenses enumerated in paragraph b. of this certification; and

d. Have not within a three-year period preceding this proposal had one or more public transactions (Federal, State or local) terminated for cause or default.

e. Will submit a revised Debarment Certification immediately if his status changes and will show in his bid proposal an explanation for the change in status.

If the prequalified bidder cannot certify that he is not debarred, he shall provide an explanation with this submittal. An explanation will not necessarily result in denial of participation in a contract.

Failure to submit a non-collusion and debarment certification will result in the prequalified bidder’s bid being considered non-responsive.

EXPLANATION:

==========

Award Limits on Multiple Projects

By answering YES to this statement, the bidder acknowleges that they are using the award limits on multiple projects? **Yes** ◯ **No** ◯

A bidder who desires to bid on more than one project on which bids are to be opened on the same date, and who also desires to avoid receiving an award of more projects than he is equipped to handle, may bid on any number of projects but may limit the total amount of work awarded to him on selected projects by completing the AWARD LIMITS ON MULTIPLE PROJECTS.

The Award Limits on Multiple Projects must be filled in on each project bid for which the Bidder desires protection.

It is the desire of the Bidder to be awarded contracts, the value of which

will not exceed a total of for those

projects indicated herein, for which bids will be opened on (MM/DD/YY)

The Award Limits shall apply to the following projects:

Contract Number
County

Contract Number
County

Contract Number
County

Contract Number
County

Contract Number
County

Contract Number
County

It is agreed that if I am (we are) the low Bidder(s) on indicated projects, the total value of which is more than the above stipulated award limits, the Board of Transportation will award me (us) projects from among those indicated

that have a total value not to exceed the award limit and will result in the lowest total bids to the Department of Transportation.

THIS PROPOSAL CONTAINS THE FOLLOWING ERRORS/WARNINGS (IF ANY)

This Bid contains 1 amendment files

000001 02/14/2019 MODIFY ITEM

Electronic Bid Submission

By submitting this bid electronically, I hereby acknowledge that all requirements included in the hard copy proposal, addendum, amendments, plans, standard specifications, supplemental specifications and special provisions are part of the bid and contract. Further, I acknowledge that I have read, understand, accept, acknowledge and agree to comply with all statements in this electronic bid.

I hereby certify that I have the authority to submit this bid.

Signature _____

Agency _____

Date _____

Signature _____

Agency _____

Date _____

Signature _____

Agency _____

Date _____

Contract Item Sheets For C204203

Line #	ItemNumber	Sec #	Description	Quantity Unit	Unit Bid Price	Amount Bid
			ROADWAY ITEMS			
0001	0000100000-N	800	MOBILIZATION	Lump Sum LS	850,000.00	850,000.00
0002	0043000000-N	226	GRADING	Lump Sum LS	30,000.00	30,000.00
0003	0194000000-E	265	SELECT GRANULAR MATERIAL, CLASS III	7 CY	250.00	1,750.00
0004	0196000000-E	270	GEOTEXTILE FOR SOIL STABILIZA-TION	711 SY	3.00	2,133.00
0005	0344000000-E	310	18" SIDE DRAIN PIPE	37 LF	80.00	2,960.00
0006	1220000000-E	545	INCIDENTAL STONE BASE	400 TON	40.00	16,000.00
0007	4400000000-E	1110	WORK ZONE SIGNS (STATIONARY)	890 SF	8.50	7,565.00
0008	4405000000-E	1110	WORK ZONE SIGNS (PORTABLE)	100 SF	9.00	900.00
0009	4410000000-E	1110	WORK ZONE SIGNS (BARRICADE MOUNTED)	20 SF	8.50	170.00
0010	4415000000-N	1115	FLASHING ARROW BOARD	1 EA	5,000.00	5,000.00
0011	4420000000-N	1120	PORTABLE CHANGEABLE MESSAGE SIGN	8 EA	9,500.00	76,000.00
0012	4430000000-N	1130	DRUMS	250 EA	70.00	17,500.00
0013	4480000000-N	1165	TMA	1 EA	30,000.00	30,000.00
0014	4695000000-E	1205	THERMOPLASTIC PAVEMENT MARKING LINES (8", 90 MILS)	415 LF	4.00	1,660.00
0015	4710000000-E	1205	THERMOPLASTIC PAVEMENT MARKING LINES (24", 120 MILS)	110 LF	9.00	990.00
0016	4721000000-E	1205	THERMOPLASTIC PAVEMENT MARKING CHARACTER (120 MILS)	4 EA	200.00	800.00
0017	4725000000-E	1205	THERMOPLASTIC PAVEMENT MARKING SYMBOL (90 MILS)	6 EA	200.00	1,200.00
0018	4770000000-E	1205	COLD APPLIED PLASTIC PAVEMENT MARKING LINES, TYPE ** (4") (IV)	6,430 LF	3.20	20,576.00

Contract Item Sheets For C204203

Line #	ItemNumber	Sec #	Description	Quantity Unit	Unit Bid Price	Amount Bid
0019	4810000000-E	1205	PAINT PAVEMENT MARKING LINES (4")	3,188 LF	0.75	2,391.00
0020	4820000000-E	1205	PAINT PAVEMENT MARKING LINES (8")	108 LF	2.00	216.00
0021	4847010000-E	1205	POLYUREA PAVEMENT MARKING LINES (4", 20 MILS)	16,320 LF	1.00	16,320.00
0022	4847050000-E	1205	POLYUREA PAVEMENT MARKING LINES (8", 20 MILS)	1,185 LF	2.00	2,370.00
0023	4900000000-N	1251	PERMANENT RAISED PAVEMENT MARKERS	195 EA	7.00	1,365.00
0024	6084000000-E	1660	SEEDING & MULCHING	0.06 ACR	21,000.00	1,260.00

Contract Item Sheets For C204203

Line #	ItemNumber	Sec #	Description	Quantity Unit	Unit Bid Price	Amount Bid
0025	8065000000-N	SP	ASBESTOS ASSESSMENT	Lump Sum LS	5,000.00	5,000.00
0026	8296000000-N	442	POLLUTION CONTROL	Lump Sum LS	30,000.00	30,000.00
0027	8559000000-E	SP	CLASS II, SURFACE PREPARATION	1.11 SY	1,500.00	1,665.00
0028	8660000000-E	SP	CONCRETE REPAIRS	207 CF	450.00	93,150.00
0029	8664000000-E	SP	SHOTCRETE REPAIRS	1,240 CF	450.00	558,000.00
0030	8678000000-E	SP	EPOXY RESIN INJECTION	12.5 LF	500.00	6,250.00
0031	8860000000-N	SP	GENERIC STRUCTURE ITEM BIRD DETERRENT SCREENING	Lump Sum LS	120,000.00	120,000.00
0032	8860000000-N	SP	GENERIC STRUCTURE ITEM BRIDGE BACKUP GENERATOR	Lump Sum LS	300,000.00	300,000.00
0033	8860000000-N	SP	GENERIC STRUCTURE ITEM BRIDGE ELECTRICAL WORK	Lump Sum LS	3,350,000.00	3,350,000.00
0034	8860000000-N	SP	GENERIC STRUCTURE ITEM BRIDGE TENDER HOUSE SEWER LINE REPLACEMENT	Lump Sum LS	250,000.00	250,000.00
0035	8860000000-N	SP	GENERIC STRUCTURE ITEM CLEANING AND REPAINTING OF BRIDGE #11	Lump Sum LS	1,500,000.00	1,500,000.00
0036	8860000000-N	SP	GENERIC STRUCTURE ITEM EXPANSION JOINT SEAL REPAIR	Lump Sum LS	6,000.00	6,000.00
0037	8860000000-N	SP	GENERIC STRUCTURE ITEM MECHANICAL OPERATING MACHINERY	Lump Sum LS	1,650,000.00	1,650,000.00
0038	8860000000-N	SP	GENERIC STRUCTURE ITEM OPERATOR HOUSE RENOVATION	Lump Sum LS	500,000.00	500,000.00
0039	8860000000-N	SP	GENERIC STRUCTURE ITEM PAINTING CONTAINMENT FOR BRIDGE #11	Lump Sum LS	500,000.00	500,000.00
0040	8860000000-N	SP	GENERIC STRUCTURE ITEM PLASTIC GLAZING PANELS	Lump Sum LS	80,000.00	80,000.00
0041	8860000000-N	SP	GENERIC STRUCTURE ITEM PLATFORM EXTENSIONS	Lump Sum LS	55,000.00	55,000.00

Contract Item Sheets For C204203

Line #	ItemNumber	Sec #	Description	Quantity Unit	Unit Bid Price	Amount Bid
0042	8860000000-N	SP	GENERIC STRUCTURE ITEM REPLACEMENT OF FILLED STEEL GRID DECK	Lump Sum LS	700,000.00	700,000.00
0043	8860000000-N	SP	GENERIC STRUCTURE ITEM REPLACEMENT OF OPEN STEEL GRID DECK	Lump Sum LS	2,250,000.00	2,250,000.00
0044	8860000000-N	SP	GENERIC STRUCTURE ITEM SUBMARINE CABLES	Lump Sum LS	1,593,385.00	1,593,385.00
0045	8860000000-N	SP	GENERIC STRUCTURE ITEM TRAFFIC GATE RELOCATION	Lump Sum LS	14,992.29	14,992.29
0046	8860000000-N	SP	GENERIC STRUCTURE ITEM UNDER STRUCTURE WORK PLATFORM	Lump Sum LS	950,000.00	950,000.00
0047	8860000000-N	SP	GENERIC STRUCTURE ITEM VOLUMETRIC MIXER	Lump Sum LS	20,000.00	20,000.00
0048	8867000000-E	SP	GENERIC STRUCTURE ITEM FOAM JOINT SEALS FOR PRESERVA-TION	2,940 LF	32.00	94,080.00
0049	8882000000-E	SP	GENERIC STRUCTURE ITEM CONCRETE FOR DECK REPAIR	3.3 CF	2,500.00	8,250.00
0050	8882000000-E	SP	GENERIC STRUCTURE ITEM ELASTOMERIC CONCRETE FOR PRESERVATION	290 CF	230.00	66,700.00
0051	8882000000-E	SP	GENERIC STRUCTURE ITEM REPAIRS TO PRESTRESSED CONCRETE GIRDERS	154 CF	1,150.00	177,100.00
0052	8889000000-E	SP	GENERIC STRUCTURE ITEM STRUCTURAL STEEL FOR REPAIRS	6,100 LB	9.00	54,900.00
0053	8892000000-E	SP	GENERIC STRUCTURE ITEM BRIDGE JOINT DEMOLITION	1,160 SF	31.00	35,960.00
0054	8892000000-E	SP	GENERIC STRUCTURE ITEM EPOXY PROTECTIVE COATING	1,280 SF	11.00	14,080.00
0055	8892000000-E	SP	GENERIC STRUCTURE ITEM THERMAL SPRAYED ANODE	2,440 SF	100.00	244,000.00
0056	8893000000-E	SP	GENERIC STRUCTURE ITEM SHOTBLASTING BRIDGE DECK	24,060 SY	3.60	86,616.00

Contract Item Sheets For C204203

Line #	ItemNumber	Sec #	Description	Quantity Unit	Unit Bid Price	Amount Bid
0057	8893000000-E	SP	GENERIC STRUCTURE ITEM SILANE DECK TREATMENT	24,060 SY	2.10	50,526.00
0058	8897000000-N	SP	GENERIC STRUCTURE ITEM BACKPLATE	2 EA	1,000.00	2,000.00
0059	8897000000-N	SP	GENERIC STRUCTURE ITEM EMBEDDED GALVANIC ANODE	2,370 EA	30.30	71,811.00
0060	8897000000-N	SP	GENERIC STRUCTURE ITEM NEW ELECTRICAL SERVICE	1 EA	700,000.00	700,000.00
0061	8897000000-N	SP	GENERIC STRUCTURE ITEM SPLICING OF PRESTRESSING STRAND	1 EA	4,500.00	4,500.00
0062	8897000000-N	SP	GENERIC STRUCTURE ITEM TRAFFIC GATES	9 EA	85,000.00	765,000.00
0063	8897000000-N	SP	GENERIC STRUCTURE ITEM VEHICLE SIGNAL HEAD (12", 3 SECTION)	2 EA	950.00	1,900.00

TOTAL AMOUNT OF BID FOR ENTIRE PROJECT **$17,999,991.29**

1022/Feb28/Q96739.97/D430674160000/E63

Contract No C204203

County NEW HANOVER

Rev. 1-16-18

EXECUTION OF CONTRACT
NON-COLLUSION, DEBARMENT AND GIFT BAN CERTIFICATION

CORPORATION

The Contractor declares (or certifies, verifies, or states) under penalty of perjury under the laws of the United States that neither he, nor any official, agent or employee has entered into any agreement, participated in any collusion, or otherwise taken any action which is in restraint of free competitive bidding in connection with this Contract, that the Contractor has not been convicted of violating *N.C.G.S. § 133-24* within the last three years, and that the Contractor intends to do the work with its own bonafide employees or subcontractors and did not bid for the benefit of another contractor.

By submitting this Execution of Contract, Non-Collusion and Debarment Certification, the Contractor is certifying his status under penalty of perjury under the laws of the United States in accordance with the Debarment Certification attached, provided that the Debarment Certification also includes any required statements concerning exceptions that are applicable.

N.C.G.S. § 133-32 and Executive Order 24 prohibit the offer to, or acceptance by, any State Employee of any gift from anyone with a contract with the State, or from any person seeking to do business with the State. By execution of any response in this procurement, you attest, for your entire organization and its employees or agents, that you are not aware that any such gift has been offered, accepted, or promised by any employees of your organization.

SIGNATURE OF CONTRACTOR

PCL CIVIL CONSTRUCTORS, INC.

Full name of Corporation

5440 WADE PARK BLVD STE 102, RALEIGH NC 27607

Address as Prequalified

Attest _____ By _____

Secretary/~~Assistant Secretary~~ — *Select appropriate title*

~~President/Vice President/Assistant Vice President~~ — *Select appropriate title* — Authorized Signer

THOMAS R. SPANGLER

Print or type Signer's name

CALEB J. LINN

Print or type Signer's name

CORPORATE SEAL

PCL CIVIL CONSTRUCTORS, INC. SEAL

Contract No C204203

County NEW HANOVER

Rev. 1-16-18

DEBARMENT CERTIFICATION

Conditions for certification:

1. The prequalified bidder shall provide immediate written notice to the Department if at any time the bidder learns that his certification was erroneous when he submitted his debarment certification or explanation filed with the Department, or has become erroneous because of changed circumstances.

2. The terms *covered transaction, debarred, suspended, ineligible, lower tier covered transaction, participant, person, primary covered transaction, principal, proposal,* and *voluntarily excluded,* as used in this provision, have the meanings set out in the Definitions and Coverage sections of the rules implementing Executive Order 12549. A copy of the Federal Rules requiring this certification and detailing the definitions and coverages may be obtained from the Contract Officer of the Department.

3. The prequalified bidder agrees by submitting this form, that he will not knowingly enter into any lower tier covered transaction with a person who is debarred, suspended, declared ineligible, or voluntarily excluded from participation in NCDOT contracts, unless authorized by the Department.

4. For Federal Aid projects, the prequalified bidder further agrees that by submitting this form he will include the Federal-Aid Provision titled *Required Contract Provisions Federal-Aid Construction Contract (Form FHWA PR* 1273) provided by the Department, without subsequent modification, in all lower tier covered transactions.

5. The prequalified bidder may rely upon a certification of a participant in a lower tier covered transaction that he is not debarred, suspended, ineligible, or voluntarily excluded from the covered transaction, unless he knows that the certification is erroneous. The bidder may decide the method and frequency by which he will determine the eligibility of his subcontractors.

6. Nothing contained in the foregoing shall be construed to require establishment of a system of records in order to render in good faith the certification required by this provision. The knowledge and information of a participant is not required to exceed that which is normally possessed by a prudent person in the ordinary course of business dealings.

7. Except as authorized in paragraph 6 herein, the Department may terminate any contract if the bidder knowingly enters into a lower tier covered transaction with a person who is suspended, debarred, ineligible, or voluntarily excluded from participation in this transaction, in addition to other remedies available by the Federal Government.

Contract No C204203

County NEW HANOVER

Rev 1-16-18

DEBARMENT CERTIFICATION

The prequalified bidder certifies to the best of his knowledge and belief, that he and his principals:

a. Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency;

b. Have not within a three-year period preceding this proposal been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State or local) transaction or contract under a public transaction; violation of Federal or State antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records; making false statements; or receiving stolen property;

c. Are not presently indicted for or otherwise criminally or civilly charged by a governmental entity (Federal, State or local) with commission of any of the offenses enumerated in paragraph b. of this certification; and

d. Have not within a three-year period preceding this proposal had one or more public transactions (Federal, State or local) terminated for cause or default.

e. Will submit a revised Debarment Certification immediately if his status changes and will show in his bid proposal an explanation for the change in status.

If the prequalified bidder cannot certify that he is not debarred, he shall provide an explanation with this submittal. An explanation will not necessarily result in denial of participation in a contract.

Failure to submit a non-collusion and debarment certification will result in the prequalified bidder's bid being considered non-responsive.

☐ Check here if an explanation is attached to this certification.

Contract No. **C204203**

County (ies): **New Hanover**

ACCEPTED BY THE
DEPARTMENT OF TRANSPORTATION

DocuSigned by:
Ronald E. Davenport, Jr.
F81B6038A47A442...
Contract Officer

3/12/2019
Date

Execution of Contract and Bonds
Approved as to Form:

DocuSigned by:
Steven A. Armstrong
5C738C23AF06459...
Attorney General

3/12/2019
Date

Signature Sheet (Bid - Acceptance by Department)

Bond No. 6352783, 106872873, 82521146

Contract No C204203
County New Hanover

Rev 5-17-11

CONTRACT PAYMENT BOND

Date of Payment Bond Execution	March 4, 2019
Name of Principal Contractor	PCL Civil Constructors, Inc.
Name of Surety:	Fidelity and Deposit Company of Maryland, Travelers Casualty and Surety Company of America, Federal Insurance Company
Name of Contracting Body:	**North Carolina Department of Transportation**
	Raleigh, North Carolina
Amount of Bond:	$17,999,991.29
Contract ID No.:	C204203
County Name:	New Hanover

KNOW ALL MEN BY THESE PRESENTS, That we, the PRINCIPAL CONTRACTOR (hereafter, PRINCIPAL) and SURETY above named, are held and firmly bound unto the above named Contracting Body, hereinafter called the Contracting Body, in the penal sum of the amount stated above for the payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators, and successors, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH, that whereas the principal entered into a certain contract with the Contracting Body, numbered as shown above and hereto attached:

NOW THEREFORE, if the principal shall promptly make payment to all persons supplying labor and material in the prosecution of the work provided for in said contract, and any and all duly authorized modifications of said contract that may hereafter be made, notice of which modifications to the surety being hereby waived, then this obligation to be void; otherwise to remain in full force and virtue.

IN WITNESS WHEREOF, the above-bound parties have executed this instrument under their several seals on the date indicated above, the name and corporate seal of each corporate party being hereto affixed and these presents duly signed by its undersigned representative, pursuant to authority of its governing body.

Contract No. C204203
County New Hanover

Rev 5-17-11

CONTRACT PAYMENT BOND

Affix Seal of Surety Company

Fidelity and Deposit Company of Maryland
Travelers Casualty and Surety Company of America
Federal Insurance Company
Print or type Surety Company Name

By Sandra M. Winsted
Print, stamp or type name of Attorney-in-Fact

Signature of Attorney-in-Fact

Signature of Witness

Judi Lucky-Eftimov
Print or type Signer's name

200 E. Randolph Street, Chicago, IL 60601
Address of Attorney-in-Fact

Contract No C204203
County New Hanover

Rev 5-17-11

CONTRACT PAYMENT BOND

CORPORATION

SIGNATURE OF CONTRACTOR (Principal)

PCL Civil Constructors, Inc.
Full name of Corporation

5440 Wade Park Blvd, Suite 102, Raleigh, NC 27607
Address as prequalified

By _____
Signature of ~~President, Vice President, Assistant Vice President~~
Select appropriate title Authorized Signer

Caleb J. Linn
Print or type Signer's name

Affix Corporate Seal

Attest _____
Signature of Secretary, Assistant Secretary
Select appropriate title

Thomas R. Spangler
Print or type Signer's name

Contract No. C204203
County New Hanover

Bond No. 6352783, 106872873, 82521146
Rev 5-17-11

CONTRACT PERFORMANCE BOND

Date of Performance Bond Execution:	March 4, 2019
Name of Principal Contractor:	PCL Civil Constructors, Inc.
Name of Surety:	Fidelity and Deposit Company of Maryland, Travelers Casualty and Surety Company of America, Federal Insurance Company
Name of Contracting Body:	**North Carolina Department of Transportation**
	Raleigh, North Carolina
Amount of Bond:	$17,999,991.29
Contract ID No.:	C204203
County Name:	New Hanover

KNOW ALL MEN BY THESE PRESENTS, That we, the PRINCIPAL CONTRACTOR (hereafter, PRINCIPAL) and SURETY above named, are held and firmly bound unto the above named Contracting Body, hereinafter called the Contracting Body, in the penal sum of the amount stated above for the payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators, and successors, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH, that whereas the principal entered into a certain contract with the Contracting Body, numbered as shown above and hereto attached:

NOW THEREFORE, if the principal shall well and truly perform and fulfill all the undertakings, covenants, terms, conditions, and agreements of said contract during the original term of said contract and any extensions thereof that may be granted by the Contracting Body, with or without notice to the Surety, and during the life of any guaranty required under the contract, and shall also well and truly perform and fulfill all the undertakings, covenants, terms, conditions, and agreements of any and all duly authorized modifications of said contract that may hereafter be made, notice of which modifications to the surety being hereby waived, then this obligation to be void; otherwise to remain in full force and virtue.

IN WITNESS WHEREOF, the above-bound parties have executed this instrument under their several seals on the date indicated above, the name and corporate seal of each corporate party being hereto affixed and these presents duly signed by its undersigned representative, pursuant to authority of its governing body.

Contract No. C204203
County New Hanover

Rev 5-17-11

CONTRACT PERFORMANCE BOND

Affix Seal of Surety Company

Fidelity and Deposit Company of Maryland
Travelers Casualty and Surety Company of America
Federal Insurance Company
Print or type Surety Company Name

By Sandra M. Winsted
Print, stamp or type name of Attorney-in-Fact

Signature of Attorney-in-Fact

Signature of Witness

Judi Lucky-Eftimov
Print or type Signer's name

200 E. Randolph Street, Chicago, IL 60601
Address of Attorney-in-Fact

Contract No. C204203
County New Hanover

Rev 5-17-11

CONTRACT PERFORMANCE BOND

CORPORATION

SIGNATURE OF CONTRACTOR (Principal)

PCL Civil Constructors, Inc.
Full name of Corporation

5440 Wade Park Blvd, Suite 102, Raleigh, NC 27607
Address as prequalified

By _____
Signature of ~~President, Vice President, Assistant Vice President~~
Select appropriate title Authorized Signer

Caleb J. Linn
Print or type Signer's name

Affix Corporate Seal

Attest _____
Signature of Secretary, Assistant Secretary
Select appropriate title

Thomas R. Spangler
Print or type Signer's name

ZURICH AMERICAN INSURANCE COMPANY
COLONIAL AMERICAN CASUALTY AND SURETY COMPANY
FIDELITY AND DEPOSIT COMPANY OF MARYLAND
POWER OF ATTORNEY

KNOW ALL MEN BY THESE PRESENTS: That the ZURICH AMERICAN INSURANCE COMPANY, a corporation of the State of New York, the COLONIAL AMERICAN CASUALTY AND SURETY COMPANY, a corporation of the State of Illinois, and the FIDELITY AND DEPOSIT COMPANY OF MARYLAND a corporation of the State of Illinois (herein collectively called the "Companies"), by **Robert D. Murray, Vice President**, in pursuance of authority granted by Article V, Section 8, of the By-Laws of said Companies, which are set forth on the reverse side hereof and are hereby certified to be in full force and effect on the date hereof, do hereby nominate, constitute, and appoint **Sandra M. WINSTED, Diane M. O'LEARY, Susan A. WELSH, Judith A. LUCKY-EFTIMOV, James B. McTAGGART, Debra J. DOYLE, Sandra M. NOWAK, Jessica B. DEMPSEY and Christina L. SANDOVAL, all of Chicago, Illinois, EACH** its true and lawful agent and Attorney-in-Fact, to make, execute, seal and deliver, for, and on its behalf as surety, and as its act and deed: **any and all bonds and undertakings**, and the execution of such bonds or undertakings in pursuance of these presents, shall be as binding upon said Companies, as fully and amply, to all intents and purposes, as if they had been duly executed and acknowledged by the regularly elected officers of the ZURICH AMERICAN INSURANCE COMPANY at its office in New York, New York., the regularly elected officers of the COLONIAL AMERICAN CASUALTY AND SURETY COMPANY at its office in Owings Mills, Maryland., and the regularly elected officers of the FIDELITY AND DEPOSIT COMPANY OF MARYLAND at its office in Owings Mills, Maryland., in their own proper persons.

The said Vice President does hereby certify that the extract set forth on the reverse side hereof is a true copy of Article V, Section 8, of the By-Laws of said Companies, and is now in force.

IN WITNESS WHEREOF, the said Vice-President has hereunto subscribed his/her names and affixed the Corporate Seals of the said **ZURICH AMERICAN INSURANCE COMPANY, COLONIAL AMERICAN CASUALTY AND SURETY COMPANY, and FIDELITY AND DEPOSIT COMPANY OF MARYLAND**, this 28th day of January, A.D. 2019.

ATTEST:
ZURICH AMERICAN INSURANCE COMPANY
COLONIAL AMERICAN CASUALTY AND SURETY COMPANY
FIDELITY AND DEPOSIT COMPANY OF MARYLAND

By: Robert D. Murray
Vice President

By: Dawn E. Brown
Secretary

State of Maryland
County of Baltimore

On this 28th day of January, A.D. 2019, before the subscriber, a Notary Public of the State of Maryland, duly commissioned and qualified, **Robert D. Murray, Vice President and Dawn E. Brown, Secretary** of the Companies, to me personally known to be the individuals and officers described in and who executed the preceding instrument, and acknowledged the execution of same, and being by me duly sworn, deposeth and saith, that he/she is the said officer of the Company aforesaid, and that the seals affixed to the preceding instrument are the Corporate Seals of said Companies, and that the said Corporate Seals and the signature as such officer were duly affixed and subscribed to the said instrument by the authority and direction of the said Corporations.

IN TESTIMONY WHEREOF, I have hereunto set my hand and affixed my Official Seal the day and year first above written.

Constance A. Dunn, Notary Public
My Commission Expires: July 9, 2019

TRAVELERS	Travelers Casualty and Surety Company of America Travelers Casualty and Surety Company St. Paul Fire and Marine Insurance Company

POWER OF ATTORNEY

KNOW ALL MEN BY THESE PRESENTS: That Travelers Casualty and Surety Company of America, Travelers Casualty and Surety Company, and St. Paul Fire and Marine Insurance Company are corporations duly organized under the laws of the State of Connecticut (herein collectively called the "Companies"), and that the Companies do hereby make, constitute and appoint **Sandra M. Winsted** of **Chicago** **Illinois**, their true and lawful Attorney-in-Fact to sign, execute, seal and acknowledge any and all bonds, recognizances, conditional undertakings and other writings obligatory in the nature thereof on behalf of the Companies in their business of guaranteeing the fidelity of persons, guaranteeing the performance of contracts and executing or guaranteeing bonds and undertakings required or permitted in any actions or proceedings allowed by law.

IN WITNESS WHEREOF, the Companies have caused this instrument to be signed, and their corporate seals to be hereto affixed, this **3rd** day of **February, 2017.**

State of Connecticut

City of Hartford ss.

By: _____
Robert L. Raney, Senior Vice President

On this the **3rd** day of **February, 2017**, before me personally appeared **Robert L. Raney**, who acknowledged himself to be the Senior Vice President of Travelers Casualty and Surety Company of America, Travelers Casualty and Surety Company, and St. Paul Fire and Marine Insurance Company, and that he, as such, being authorized so to do, executed the foregoing instrument for the purposes therein contained by signing on behalf of the corporations by himself as a duly authorized officer.

In Witness Whereof, I hereunto set my hand and official seal.

My Commission expires the **30th** day of **June, 2021**

Marie C Tetreault
Marie C. Tetreault, Notary Public

This Power of Attorney is granted under and by the authority of the following resolutions adopted by the Boards of Directors of Travelers Casualty and Surety Company of America, Travelers Casualty and Surety Company, and St. Paul Fire and Marine Insurance Company, which resolutions are now in full force and effect, reading as follows:

RESOLVED, that the Chairman, the President, any Vice Chairman, any Executive Vice President, any Senior Vice President, any Vice President, any Second Vice President, the Treasurer, any Assistant Treasurer, the Corporate Secretary or any Assistant Secretary may appoint Attorneys-in-Fact and Agents to act for and on behalf of the Company and may give such appointee such authority as his or her certificate of authority may prescribe to sign with the Company's name and seal with the Company's seal bonds, recognizances, contracts of indemnity, and other writings obligatory in the nature of a bond, recognizance, or conditional undertaking, and any of said officers or the Board of Directors at any time may remove any such appointee and revoke the power given him or her; and it is

FURTHER RESOLVED, that the Chairman, the President, any Vice Chairman, any Executive Vice President, any Senior Vice President or any Vice President may delegate all or any part of the foregoing authority to one or more officers or employees of this Company, provided that each such delegation is in writing and a copy thereof is filed in the office of the Secretary; and it is

FURTHER RESOLVED, that any bond, recognizance, contract of indemnity, or writing obligatory in the nature of a bond, recognizance, or conditional undertaking shall be valid and binding upon the Company when (a) signed by the President, any Vice Chairman, any Executive Vice President, any Senior Vice President or any Vice President, any Second Vice President, the Treasurer, any Assistant Treasurer, the Corporate Secretary or any Assistant Secretary and duly attested and sealed with the Company's seal by a Secretary or Assistant Secretary; or (b) duly executed (under seal, if required) by one or more Attorneys-in-Fact and Agents pursuant to the power prescribed in his or her certificate or their certificates of authority or by one or more Company officers pursuant to a written delegation of authority; and it is

FURTHER RESOLVED, that the signature of each of the following officers: President, any Executive Vice President, any Senior Vice President, any Vice President, any Assistant Vice President, any Secretary, any Assistant Secretary, and the seal of the Company may be affixed by facsimile to any Power of Attorney or to any certificate relating thereto appointing Resident Vice-Presidents, Resident Assistant Secretaries or Attorneys-in-Fact for purposes only of executing and attesting bonds and undertakings and other writings obligatory in the nature thereof, and any such Power of Attorney or certificate bearing such facsimile signature or facsimile seal shall be valid and binding upon the Company and any such power so executed and certified by such facsimile signature and facsimile seal shall be valid and binding on the Company in the future with respect to any bond or understanding to which it is attached.

I, **Kevin E. Hughes**, the undersigned, Assistant Secretary of Travelers Casualty and Surety Company of America, Travelers Casualty and Surety Company, and St. Paul Fire and Marine Insurance Company, do hereby certify that the above and foregoing is a true and correct copy of the Power of Attorney executed by said Companies, which remains in full force and effect.

Dated this 4 day of March 2019.

Kevin E. Hughes, Assistant Secretary

To verify the authenticity of this Power of Attorney, please call us at 1-800-421-3880.
Please refer to the above-named Attorney-in-Fact and the details of the bond to which the power is attached.

Minutes of a Meeting of
The Board of Directors of
PCL CIVIL CONSTRUCTORS, INC.

A meeting of the Board of Directors of PCL Civil Constructors, Inc., a Colorado corporation, was held at 8:05 a.m. MST on the 4th of February 2019 by telephone conference.

The undersigned, constituting all of the Directors of PCL Civil Constructors, Inc., a Colorado corporation, adopt the following resolutions pursuant to the authority of Colorado General Corporation Law:

Resolution: That the following persons be appointed officers and authorized signing authorities of the corporation. Such authority shall extend to the opening and closing of corporate bank accounts when two such signatures are present. The appointments shall be for the ensuing year or until their successors are designated:

Denver	J. D. Westphal	President
	G. L. Basher	Assistant Secretary
Phoenix	S. W. Britton	Senior Manager, Finance & Administration, Assistant Secretary
Raleigh	T. R. Spangler	Manager, Finance & Administration, Secretary/Treasurer
	C. J. Linn	Authorized Signer

Resolution: The financial statements of the corporation for the fiscal year ended October 31, 2018 and Management Letter, were reviewed and approved.

Resolution: That the following persons shall be appointed Authorized Banking Agents for the purposes of administering the controlled disbursement banking functions with Wells Fargo and UMB Bank, which the Company participates in, where two signatures are required for opening and closing bank accounts, account service changes, account disbursements, and other activities as more particularly described in the bank service agreements:

M. J. Kehoe
D. T. Morgan
T. E. Kijanka
J. S. Norton
K. L. Tartler

Resolution: M.J. Kehoe, G.L. Basher, and C. Thorkelsson, are hereby appointed Authorized Income Tax Agents for the purposes of administering, filing and signing income tax related documents on behalf of the corporation and its affiliates.

Resolution: The memo drafted by Steve Richards, General Counsel, titled Legal Obligations & Protections of Directors and Officers, was reviewed and accepted. The corporation will distribute this memo to all new officers and directors of the corporation.

Resolution: D. L. Brown is hereby appointed as the Chairman of the Board.

These resolutions are effective on February 4, 2019.

D. L. Brown, Director

J. D. Westphal, Director

D. T. Morgan, Director