

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

C204119

CONTRACT AND
CONTRACT BONDS

FOR CONTRACT NO. C204119

WBS 15BPR.15 STATE FUNDED

COUNTY OF NEW HANOVER
THIS IS THE STRUCTURE CONTRACT
ROUTE NUMBER US 76 LENGTH 0.575 MILES
LOCATION BRIDGE #13 OVER NE CAPE FEAR RIVER ON US-76/421.

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

BIDS OPENED FEBRUARY 20, 2018
CONTRACT EXECUTION 3/9/2018

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

PROPOSAL

INCLUDES ADDENDUM No. 2 DATED 02-14-2018
INCLUDES ADDENDUM No. 1 DATED 01-30-2018

DATE AND TIME OF BID OPENING: **FEBRUARY 20, 2018 AT 2:00 PM**

CONTRACT ID C204119
WBS 15BPR.15

FEDERAL-AID NO. STATE FUNDED
COUNTY NEW HANOVER
T.I.P. NO.
MILES 0.575
ROUTE NO. US 76
LOCATION BRIDGE #13 OVER NE CAPE FEAR RIVER ON US-76/421.

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 STRUCTURE PROPOSAL

5% BID BOND OR BID DEPOSIT REQUIRED

**PROPOSAL FOR THE CONSTRUCTION OF
CONTRACT No. C204119 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. C204119 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. C204119 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.



State Contract Officer

DocuSigned by:
Ronald E. Davenport, Jr.
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2/14/2018

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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 2, 2018**.

The completion date for this contract is **April 17, 2019**.

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 A

The Contractor shall complete the required work of installing, maintaining, and removing the traffic control devices for lane closures and restoring traffic to the existing traffic pattern. The Contractor shall not close or narrow a lane of traffic on **any road** during the following time restrictions:

DAY AND TIME RESTRICTIONS**After the Week of Labor Day until Easter****Monday through Friday, 5:00 AM to 9:00 AM****Monday through Friday, 3:00 PM to 7:00 PM****Saturday & Sunday, 5:00 AM to 7:00 PM****Easter until the Week of Labor Day****Monday through Sunday, 5:00 AM to 7:00 PM****During Step #2 Only (See Intermediate Contract Time No. 5)****Monday through Thursday, 5:00 AM to 9:00 PM****Friday at 5:00 AM to Sunday at 9:00 PM**

In addition, the Contractor shall not close or narrow a lane of traffic on **any road**, detain and/or alter the traffic flow on or during holidays, 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 AM** December 31st and **7:00 PM** January 2nd. If New Year's Day is on a Friday, Saturday, Sunday or Monday, then until **7:00 PM** the following Tuesday.
3. For the **MLK Parade**, between the hours of **5:00 AM** the Sunday before the third Monday of January and **7:00 PM** the following Tuesday.
4. For **Easter**, between the hours of **5:00 AM** Thursday and **7:00 PM** Monday.
5. For **Memorial Day**, between the hours of **5:00 AM** Friday and **7:00 PM** Tuesday.
6. For **Independence Day**, between the hours of **5:00 AM** the day before Independence Day and **7:00 PM** the day after Independence Day.

If **Independence Day** is on a Friday, Saturday, Sunday or Monday, then between the hours of **5:00 AM** the Thursday before Independence Day and **7:00 PM** the Tuesday after Independence Day.
7. For the **YMCA Tri-Span Race**, between the hours of **5:00 AM** the Friday after Independence Day to **7:00 PM** the following Sunday.
8. For **Labor Day**, between the hours of **5:00 AM** Friday and **7:00 PM** Tuesday.
9. For the **IRONMAN Triathlon**, between the hours of **5:00 AM** Friday October 12, 2018 and **7:00 PM** Sunday, October 14, 2018.
10. For the **Battleship Half-Marathon**, between the hours of **5:00 AM** Saturday, November 3, 2018 and **7:00 PM** Monday, November 5, 2018.
11. For **Thanksgiving**, between the hours of **5:00 AM** Tuesday and **7:00 PM** Monday.
12. For the **Holiday Parade and the Wilmington Historic Half-Marathon**, between the hours of **5:00 AM** Friday, November 30, 2018 and **7:00 PM** Monday, December 3, 2018.
13. For **Christmas**, between the hours of **5:00 AM** the Friday before the week of Christmas Day and **7:00 PM** the following Tuesday after the week of Christmas Day.
14. For **The Azalea Festival**, between the hours of **5:00 AM** the **Tuesday** before the weekend of the **Azalea Festival** and **7:00 PM** 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 will not be 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 above and place traffic in the existing traffic pattern.

The liquidated damages are **One Thousand Two Hundred Fifty Dollars (\$ 1,250.00)** per fifteen (15) minute time period.

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 **any road** during the following time restrictions:

DAY AND TIME RESTRICTIONS

After the Week of Labor Day unit Easter

Monday through Thursday, 5:00 AM to 9:00 PM

Friday 5:00 AM to Sunday 9:00 PM

Easter to the Week of Labor Day

No Road Closures Allowed

During Step #2 Only (See Intermediate Contract Time No. 5)

Monday through Thursday, 5:00 AM to 9:00 PM

Friday at 5:00 AM to Sunday at 9:00 PM

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 Day and Time Restrictions contained in this intermediate contract time will apply to Intermediate Contract Time No. 3.

The liquidated damages are **Two Thousand Five Hundred Dollars (\$ 2,500.00)** per fifteen (15) minute time period.

INTERMEDIATE CONTRACT TIME NUMBER 3 AND LIQUIDATED DAMAGES:

(2-20-07) (Rev. 6-18-13)

108

SP1 G14 H

The Contractor shall complete the work which requires **road closure(s) not associated with the two-week bridge closure described in Intermediate Contract Time No. 4** and shall place and maintain traffic on same.

The date of availability for this intermediate contract time will be the **first night** the Contractor begins **to install traffic control devices required for road closures according to the time restrictions stated in Intermediate Contract Time No. 2.**

The completion date for this intermediate contract time is the date which is **forty-two (42)** consecutive calendar days after and including the date the Contractor begins this work.

The liquidated damages are **One Thousand Dollars (\$ 1,000.00)** per calendar day. **The liquidated damages described in Intermediate Contract Time No. 2 will not apply to the number of consecutive days required to complete this intermediate contract time.**

INTERMEDIATE CONTRACT TIME NUMBER 4 AND LIQUIDATED DAMAGES:

(2-20-07) (Rev. 6-18-13)

108

SP1 G14 H

The Contractor shall complete the work which requires **closing both directions of the Memorial Bridge** as shown on Sheet **TMP-3** and shall place and maintain traffic on same.

The date of availability for this intermediate contract time is **the date that the Contractor elects to begin work, but no sooner than September 10, 2018 and no later than April 3, 2019.**

The completion date for this intermediate contract time is the date which is **fourteen (14)** consecutive calendar days after and including the date the Contractor begins this work.

The liquidated damages are **Ten Thousand Dollars (\$ 10,000.00)** per calendar day.

INTERMEDIATE CONTRACT TIME NUMBER 5 AND LIQUIDATED DAMAGES:

(6-18-13)

108

SP1 G14 L

The Contractor shall complete the work required of **Step #2** as shown on Sheet **TMP-3** and shall place and maintain traffic on same.

The date of availability for this intermediate contract time is **the date the Contractor completes Step #1.**

The completion date for this intermediate contract time is **June 22, 2018.**

The liquidated damages are **Five Hundred Dollars (\$ 500.00)** per calendar day.

MAJOR CONTRACT ITEMS:

(2-19-02)

104

SP1 G28

The following listed items are the major contract items for this contract (see Article 104-5 of the *2018 Standard Specifications*):

Line #	Description
31	— PPC Materials
38	— Placing & Finishing PPC Overlay

NO SPECIALTY ITEMS:

(7-1-95)

108-6

SP1 G34

None of the items included in this contract will be specialty items (see Article 108-6 of the *2018 Standard Specifications*).

SCHEDULE OF ESTIMATED COMPLETION PROGRESS:

(7-15-08) (Rev. 5-16-17)

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:

	<u>Fiscal Year</u>	<u>Progress (% of Dollar Value)</u>
2018	(7/01/17 - 6/30/18)	34% of Total Amount Bid
2019	(7/01/18 - 6/30/19)	66% 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. 1-17-17)

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 either the MBE or WBE goal. No submittal of a Letter of Intent is required, unless the additional participation is used for banking purposes.

Committed MBE/WBE Subcontractor - Any MBE/WBE submitted at the time of bid that is being used to meet either the MBE or 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 Goals Requirement - The approved MBE and WBE participation at time of award, but not greater than the advertised contract goals for each.

Goal Confirmation Letter - Written documentation from the Department to the bidder confirming the Contractor's approved, committed MBE and WBE 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 Goal - A portion of the total contract, expressed as a percentage, that is 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.

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 Goal - A portion of the total contract, expressed as a percentage, that is 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 amount 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 this MBE and WBE goals. This form is for paper bids only.

[http://connect.ncdot.gov/municipalities/Bid%20Proposals%20for%20LGA%20Content/09%20MBE-WBE%20Subcontractors%20\(State\).docx](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>

MBE and WBE Goal

The following goals for participation by Minority Business Enterprises and Women Business Enterprises are established for this contract:

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

- (1) *If the MBE goal 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 as the MBE goal.
- (2) *If the MBE goal 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 WBE goal 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 as the WBE goal.
- (2) *If the WBE goal 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.

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 MBE and WBE goals respectively. 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 all MBE and WBE participation that they anticipate to use during the life of the contract. Only those identified to meet the MBE goal and the 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 for which letters of intent are received 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 Expedite, the bidding software of Bid Express®.

- (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 Expedite, 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 either the MBE or WBE goal.

(B) Paper Bids

- (1) *If either the MBE or 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 corresponding goal.
- (2) *If either the MBE or 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 MBE and WBE goals, the firm is responsible for meeting the goals or making good faith efforts to meet the goals, just like any other bidder. In most cases, a MBE or WBE bidder on a contract will meet one of the goals 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 goals.

For example, on a proposed contract, the WBE goal is 10%, and the MBE goal is 8%. A WBE bidder puts in a bid where they will perform 40% of the contract work and have a WBE subcontractor which will perform another 5% of the work. Together the two WBE firms submit on the *Listing of MBE and WBE Subcontractors* a value of 45% of the contract which fulfills the WBE goal. The 8% MBE goal shall be obtained through MBE participation with MBE certified subcontractors or documented through a good faith effort. It should be noted that you cannot combine the two goals to meet an overall value. The two goals shall remain separate.

MBE/WBE prime contractors shall also follow Sections A and B listed under *Listing of MBE and 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 MBE and WBE goals 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 MBE and WBE goals, or if the form is incomplete (i.e. both signatures are not present), the MBE/WBE participation will not count toward meeting the MBE/WBE goal. If the lack of this participation drops the commitment below either the MBE or WBE goal, the Contractor shall submit evidence of good faith efforts for the goal not met, 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 by Letter of Intent exceeds the algebraic sum of the MBE or 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 firms to meet the contract goal, as part of the good faith effort, the Department will consider allowing the bidder to withdraw funds to meet the MBE goal as long as there are adequate funds available from the bidder's MBE bank account.

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

Submission of Good Faith Effort

If the bidder fails to meet or exceed either the MBE or the WBE goal, the apparent lowest responsive bidder shall submit to the Department documentation of adequate good faith efforts

made to reach that specific goal(s).

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 9 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 MBE/WBE Goals 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 MBE and WBE goals 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 contract MBE/WBE goals 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 contract goals 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 MBE or WBE goals, 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 DBE@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 MBE and WBE 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 MBE and WBE goals.
- (2) The bidders' past performance in meeting the MBE and WBE goals.
- (3) The performance of other bidders in meeting the MBE and WBE goals. For example, when the apparent successful bidder fails to meet the goals, but others meet it, you may reasonably raise the question of whether, with additional reasonable efforts the apparent successful bidder could have met the goals. If the apparent successful bidder fails to meet the MBE and WBE goals, 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 MBE and WBE goals can be met or that an adequate good faith effort has been made to meet the MBE and WBE goals.

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 MBE/WBE Goals

- (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 MBE contract goal requirement. The same holds for work that a WBE subcontracts to another WBE firm. Work that a MBE subcontracts to a non-MBE firm does not count toward the MBE contract goal requirement. Again, the same holds true for the work that a WBE subcontracts to a non-WBE firm. 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. The MBE/WBE may present evidence to rebut this presumption to the Department. The Department's decision on the rebuttal of this presumption may be subject to review by the Office of Inspector General, NCDOT.

(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 or 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 or 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.

(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 MBE or 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 goal requirement. 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 liable for meeting the goal.

- (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 firm (or an approved substitute MBE or WBE firm) to meet all or part of a contract goal requirement, the contractor shall not terminate the MBE/WBE 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. A MBE/WBE may only be terminated after receiving the Engineer's written approval based upon a finding of good cause for the termination. The prime contractor must give the MBE/WBE firm five (5) calendar days to respond to the prime contractor's notice of termination and advise the prime contractor and the Department of the reasons, if any, why the firm objects to the proposed termination of its subcontract and why the Department should not approve the action. All requests for replacement of a committed MBE/WBE firm shall be submitted to the Engineer for approval on Form RF-1 (*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.

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

(A) Performance Related Replacement

When a committed MBE is terminated for good cause as stated above, an additional MBE that was submitted at the time of bid may be used to fulfill the MBE commitment. The same holds true if a committed WBE is terminated for good cause, an additional WBE that was submitted at the time of bid may be used to fulfill the WBE goal. A good faith effort

will only be required for removing a committed MBE/WBE if there were no additional MBEs/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 MBEs/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 MBEs/WBEs for specific subbids including, at a minimum:
 - (a) The names, addresses, and telephone numbers of MBEs/WBEs who were contacted.
 - (b) A description of the information provided to MBEs/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 MBEs/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 similarly certified MBE/WBE subcontractor to perform at least the same amount of work to meet the 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).

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 and 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).

MAINTENANCE OF THE PROJECT:

(11-20-07) (Rev. 1-17-12)

104-10

SP1 G125

Revise the *2018 Standard Specifications* as follows:

Page 1-39, Article 104-10 Maintenance of the Project, line 25, add the following after the first sentence of the first paragraph:

All guardrail/guiderail within the project limits shall be included in this maintenance.

Page 1-39, Article 104-10 Maintenance of the Project, line 30, add the following as the last sentence of the first paragraph:

The Contractor shall perform weekly inspections of guardrail and guiderail and shall report damages to the Engineer on the same day of the weekly inspection. *Where damaged guardrail or guiderail is repaired or replaced as a result of maintaining the project in accordance with this article, such repair or replacement shall be performed within 7 consecutive calendar days of such inspection report.*

Page 1-39, Article 104-10 Maintenance of the Project, lines 42-44, replace the last sentence of the last paragraph with the following:

The Contractor will not be directly compensated for any maintenance operations necessary, except for maintenance of guardrail/guiderail, as this work will be considered incidental to the work covered by the various contract items. The provisions of Article 104-7, Extra Work, and Article 104-8, Compensation and Record Keeping will apply to authorized maintenance of guardrail/guiderail. Performance of weekly inspections of guardrail/guiderail, and the damage reports required as described above, will be considered to be an incidental part of the work being paid for by the various contract items.

COOPERATION BETWEEN CONTRACTORS:

(7-1-95)

105-7

SPI G133

The Contractor's attention is directed to Article 105-7 of the *2018 Standard Specifications*.

16-16066-01A (NCDOT Roadway Lighting Construction) is currently under construction and is located within the project limits.

2018CPT.03.04.10101, etc. (C204135) is anticipated to be let on February 20, 2018 and is located adjacent to this project.

The Contractor on this project shall cooperate with the Contractor working within or adjacent to the limits of this project to the extent that the work can be carried out to the best advantage of all concerned.

OUTSOURCING OUTSIDE THE USA:

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

SPI 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.

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 Tuesday, February 6th 2018 at 1:00pm at:

NCDOT Division 3 Traffic Services Conference Room
5504 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.

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

ERRATA

(2-12-18)

Z-4

Revise the *2018 Standard Specifications* as follows:

Division 7

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

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

Division 10

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

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

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

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

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**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.

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**NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
PROJECT NO. 15BPR.15
NEW HANOVER COUNTY
CAPE FEAR RIVER MEMORIAL LIFT BRIDGE**

PROJECT SPECIAL PROVISIONS - STRUCTURE

- PSP 010 - Epoxy Resin Injection (12-05-12)
- PSP 012 - Shotcrete Repairs (12-05-12)
- Under Structure Work Platform (Special)
- PSP 018 - Falsework and Formwork (04-05-12)
- PSP 019 – Foam Joint Seals (09-27-12)
- PSP 020 - Crane Safety (8-15-05)
- PSP 022 - Maintenance of Water Traffic (12-05-12)
- PSP 023 - Work in, Over or Adjacent to Navigable Waters (12-05-12)
- PSP 024 - Securing of Vessels (10-12-01)
- PSP 026 – Concrete Deck Repair for Epoxy Overlay (12-12-13)
- Epoxy Overlay System (Special)
- PSP 030 - Submittal of Working Drawings (06-28-17)

- Coast Guard Coordination (Special)
- Replacement of Steel Grid Deck (Special)
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- Overlay Surface Preparation for Polyester Polymer Concrete (Special)
- Polyester Polymer Concrete Bridge Deck Overlay (Special)
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- Repairs to Prestressed Concrete Girders (Special)
- Structural Steel for Repairs (Special)

- SP03 R030 – Flowable Fill (1-17-12)
- Operator House Renovation (Special)



2/13/2018

DocuSigned by:
Jason R Doughty
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EPOXY RESIN INJECTION**(12-5-12)****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

A token quantity for this work has been included in the project. In the event that the Engineer identifies cracks in existing substructure components or other components, that require repair, use Epoxy Resin Injection to repair those crack(s). The Engineer will determine a minimum crack width to repair. Interior bent columns and caps, and end bent caps, 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. If the failure plane is located at the repaired crack, a minimum compressive strength of 3000 psi is required of these cores.

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:

	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 x 10 ⁵ psi
Compressive Yield Strength	ASTM D695	11,000 psi (min.)
Compressive Modulus	ASTM D695	2.0 - 3.5 x 10 ⁵ psi
Heat Deflection Temperature Cured 28 days @ 77 ± 3°F	ASTM D648*	125°F min. 135°F min.
Slant Shear Strength, 5000 psi (34.5 MPa)	AASHTO T237	

compressive strength concrete		
Cured 3 days @ 40°F wet concrete		3500 psi (min.)
Cured 7 days @ 40°F wet concrete		4000 psi (min.)
Cured 1 day @ 77°F dry concrete		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 $\pm 5\%$ 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.
- 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.

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.

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 1/2" 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

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.

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.

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

UNDER STRUCTURE WORK PLATFORM**(SPECIAL)**

Prior to performing any repairs on the structure (fixed spans or lift 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

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.

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. Screenshot 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 1/2" 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.

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 $\frac{3}{4}$ ".

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.

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.

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		

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.

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.

FOAM JOINT SEALS**(9-27-12)****1.0 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 $1/8'' \pm$ wide by $1/8'' \pm$ deep and spaced between $1/4''$ and $1/2''$ 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 $1/4''$. 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 D3575-08, 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 Strength	ASTM D624 (D3575-08, Suffix G)	14 – 20 pli
Density	ASTM D3575-08, 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.

2.0 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	3000 psi (min.)
Compressive strength	ASTM D695	7000 psi (min.)
Hardness	Shore D Scale	75-85 psi
Water Absorption	ASTM D570	0.25% by weight max.
Elongation to Break	ASTM D638	5% (max.)
Bond Strength	ASTM C882	2000 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.

3.0 SAWING THE JOINT

The joint opening shall be initially formed to the width shown on the plans including the blockout for the elastomeric concrete.

The elastomeric concrete shall have sufficient time to cure such that no damage can occur to the elastomeric 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 or two passes of the saw by placing and spacing two metal blades on the saw shaft to the desired width for the joint opening.

The desired depth is the depth of the seal plus 1/4" 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 1/4" 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.

4.0 PREPARATION OF SAWED JOINT FOR SEAL INSTALLATION

The elastomeric concrete shall cure a minimum of 24 hours prior to seal installation.

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.

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 elastomeric concrete may be exposed after sandblasting.

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.

5.0 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 insure 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. After opening both cans of the bonding agent, stir each can using separate stirring rods for each component to prevent premature curing of the bonding agent. Pour the two 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 elastomeric concrete as well as both sides of the joint seal, making certain to completely fill 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 1/4" 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. Do not place pavement markings on top of foam joint seals.

6.0 BASIS OF PAYMENT

Payment for all foam joint seals will be at the lump sum contract price bid for "Foam Joint Seals". Prices and payment will be full compensation for furnishing all material, including elastomeric concrete, labor, tools and equipment necessary for installing these units in place and accepted.

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.

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.

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.

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.

CONCRETE DECK REPAIR FOR EPOXY OVERLAY**(12-12-13)****1.0 GENERAL**

This provision addresses concrete deck repairs prior to placing an epoxy overlay. Work shall begin within 60 days of notification. After surface preparation, the Engineer sounds the deck using a chain drag or other acceptable means and marks areas to be repaired.

2.0 MATERIALS

Concrete deck repair material shall be epoxy based material with a minimum modulus of elasticity of 2500 ksi. The repair material must be on the NCDOT Approved Product List (APL) and recommended by the manufacturer for use with an epoxy overlay system. Materials containing cement mortar are acceptable; however, a 28 day curing period will be required before placing the epoxy overlay. The curing period may be adjusted if approved by the epoxy overlay manufacturer and the Engineer. Submit the proposed repair material and schedule of repairs to the Engineer for approval prior to beginning the work.

3.0 CLASS II SURFACE PREPARATION (PARTIAL DEPTH)

Saw cut a perimeter surrounding the repair to a depth not less than 1 inch and remove all loose, unsound and contaminated material by chipping with hand tools to an average depth of approximately one-half the deck thickness, but no less than 3/4 inch below the top mat of steel. Clean, repair or replace rusted or loose reinforcing steel. Care shall be taken not to cut, stretch, or damage any exposed reinforcing steel. Thoroughly clean the newly exposed surface. Use a bonding agent in accordance with the manufacturer's recommendations.

4.0 APPLICATION

Refill areas where concrete is removed with repair material up to the finished deck surface and cure in accordance with the material manufacturer's recommendations. Provide a raked finish.

5.0 MEASUREMENT & PAYMENT

Concrete Deck Repair for Epoxy Overlay will be measured and paid for at the contract unit price per square feet for the appropriate areas repaired. The price shall include materials, labor, equipment, tools and any incidentals necessary to complete the work.

Payment will be made under:

Pay Item

Concrete Deck Repair for Epoxy Overlay

Pay Unit

Square Feet

EPOXY OVERLAY SYSTEM**(SPECIAL)****1.0 GENERAL**

This work shall consist of furnishing and applying an epoxy overlay system over the concrete bridge deck in accordance with the contract documents. Epoxy overlay system consists of a minimum of two (2) layers of hybrid polymer resins, with a special blend of extremely hard aggregate designed to provide a 3/8 inch thick overlay for the purpose of crack treatment, complete waterproofing, and providing a non-skid surface. The overlay system shall be formulated and applied to withstand continuous heavy traffic, extreme changes in weather conditions, and deformations due to structure loading and temperature changes.

2.0 PERFORMANCE GUARANTEE

The Contractor shall provide a warranty bond to the Department, guaranteeing the wearing surface for a period of 36 months against the following defects: delamination of the epoxy overlay from the deck surface, and skid resistance less than 40 as measured by AASHTO T242. The performance bond will be invoked if 25 square feet of the deck surface meets the defect criteria prior to the end of the warranty. The guarantee period will start on the date of Department final acceptance of the project. At the end of the guarantee period, the warranty bond will be invoked if any part of deck surface meets the defect criteria, regardless of quantity.

The Contractor shall replace defective materials and workmanship at no cost to the Department. The Contractor will not be responsible for damage due to normal wear and tear, negligence on the part of the Department, or use in excess of the design.

The warranty bond amount shall be the bid quantity of epoxy overlay multiplied by the statewide average unit bid price for the epoxy overlay. The guarantee period of 36 months and bond value shall be specified in the warranty bond provided to the Department prior to final acceptance of the project.

3.0 MATERIALS

This two-part epoxy polymer overlay system shall be on the NCDOT Approved Products List (APL) and be free of any fillers or volatile solvents and shall be formulated to provide a simple volumetric mixing ratio of two components such as one to one or two to one by volume. The epoxy overlay system shall be formulated to provide flexibility in the system without any sacrifice of the hardness, chemical resistance, or strength of the system. Use of external/conventional flexibilizers will not be accepted. Flexibility shall be by interaction of elastomers, which chemically link during the process of curing so the flexibility of the molecule is least affected during the low temperature conditions that are confronted in actual use.

Epoxy

When the two-component system is mixed at the appropriate ratio, the cured resin shall conform to the following requirements:

EPOXY PROPERTIES		
Property	Requirement	Test Method
Viscosity-Poises at 77°F ± 2°F	7-25	ASTM D2393 (Spindle No.3 at 20 rpm)
Pot Life	15-45 minutes @ 75° F	ASTM C881
Min. Tensile Strength at 7 days	2000 psi	ASTM D638
Tensile Elongation at 7 days	30-70%	ASTM D638
Min. Compressive Strength @ 3 hrs.	1,000 psi	ASTM C109
Min. Compressive Strength @ 24 hrs.	5000 psi	ASTM C109
Min. adhesion strength @ 24 hrs.	250 psi @ 75° F	ASTM C1583
Max. Water Absorption	1%	ASTM D570

Aggregate

Aggregate used for all layers shall be non-friable, non-polishing, clean, and free from surface moisture. The aggregate shall be flint rock, 100% fractured, thoroughly washed and kiln dried to a maximum moisture content of 0.2% by weight, measured in accordance with ASTM C566. The fracture requirements shall be at least one mechanically fractured face and will apply to materials retained on a U.S. No. 10 sieve. Aggregate shall conform to the following requirements:

AGGREGATE PROPERTIES		
Property	Value	Test Method
Moisture Content, max.	0.2% by weight	AASHTO T255
Mohs Hardness, min.	7	
Soundness Loss, 5 cycles in Sodium Sulfate, max.	5.4%	AASHTO T104
Micro-Deval, max.	10%	AASHTO TP58

AGGREGATE GRADATION	
Sieve	Percent Passing
No. 4	100
No. 8	30-75
No. 16	Max. 5
No. 30	Max. 1

4.0 SURFACE PREPARATION

Remove all existing overlays if applicable, and all loose, disintegrated, unsound or contaminated concrete from the bridge deck. Prepare the bridge deck prior to applying the

overlay system, in accordance with the manufacturer's recommendations, the special provision *Concrete Deck Repair for Epoxy Overlay*, and this provision.

Prior to overlay placement and upon completion of the deck repairs, clean the entire deck surface by steel shot blasting and other means to remove asphaltic material, oils, dirt, rubber, curing compounds, pavement markings, paint carbonation, laitance, weak surface mortar and other materials that may interfere with the bonding or curing of the overlay. Do not begin shotblasting until all grinding or milling operations are completed. Use sandblasting equipment on areas that cannot be reached by the shotblasting operation. If expansion joints are not being replaced or have been replaced prior to shotblasting they shall be protected from damage from the shotblasting operation. Pavement markings shall be considered clean when the concrete has exposed aggregate showing through the paint stripe. Deck drains and areas of curb or railing above the proposed surface shall be protected from the shotblasting operation. Mortar that is soundly bonded to the coarse aggregate shall have open pores to be considered adequate for bond. Provide a self-propelled vacuum capable of picking up dust and other loose material from the shotblasting operation. Provide air compressors equipped with oil/water separator capable of drying all moisture from the bridge deck. Care shall be taken and methods used to fully capture and collect the excess material.

Prior to overlay placement and upon completion of surface preparation, perform bond testing of the epoxy overlay material in accordance with ASTM C1583 on two pre-selected 1.5' x 3' test patches. Test locations will be determined by the Engineer. The tensile strength shall be at least 250 psi and the depth of failure into the concrete deck for 50% of the test patch area shall be 1/4" or greater. Install test sections with the same materials, equipment, personnel, timing, and sequence of operations and curing time that will be used for the installation of the overlay. Test locations shall be repaired with approved repair materials.

If the cleaning method, materials, and installation procedure do not produce acceptable test results, the contractor must remove failed test patches, make the necessary adjustments, and retest all patches at no additional cost to the Department until satisfactory test results are obtained.

Epoxy based overlays shall not be placed on hydraulic cement concrete that is less than 28 days old. Patching and cleaning operations shall be inspected and approved prior to placing each layer of the overlay. Any contamination of the deck or intermediate courses, after initial cleaning, shall be removed.

The deck shall be completely dry at the time of application of the epoxy concrete overlay. Deck drains shall be closed off during application of epoxy overlay.

5.0 EQUIPMENT

For mechanical applications, equipment shall consist of no less than an epoxy distribution system, aggregate spreader, application squeegee, and vacuum truck. The distribution system shall accurately measure and mix the epoxy resin and hardening agent, and shall uniformly

and accurately apply the epoxy materials at the specified rate to the bridge deck, in such a manner as to cover 100% of the work area. The aggregate spreader shall be propelled in such a manner as to uniformly and accurately apply the aggregate to cover 100% of the epoxy material. Aggregate shall be sprinkled or dropped vertically in a manner such that the level of the epoxy mixture is not disturbed. The vacuum truck shall be self-propelled.

For hand applications, equipment shall consist of calibrated containers, a "jiffy" type paddle mixer or other paddle designed specifically for epoxy mixing, squeegees, rollers and brooms, which are suitable for mixing the epoxy and applying the epoxy and aggregate. Paddle shall remain submerged when mixing to avoid entraining air. Equipment shall uniformly and accurately apply the epoxy materials at the specified rate to the bridge deck, in such a manner as to cover 100% of the work area. The aggregate shall be applied in such a manner as to uniformly and accurately cover 100% of the epoxy material. Aggregate shall be sprinkled or dropped vertically in a manner such that the level of the epoxy mixture is not disturbed

A source of lighting shall be provided by Contractor, when work is to be performed during times of diminished light.

6.0 APPLICATION

Handling and mixing of the epoxy resin and hardening agent shall be performed in a safe manner to achieve the desired result in accordance with the manufacturer's recommendations as approved and as directed by the Engineer. Epoxy overlay materials shall not be placed when weather or surface conditions are such that the material cannot be properly handled, placed, spread, and cured within the specified requirements of traffic control.

The application rates of the liquid and stone in the two layers shall be as recommended by the manufacturer, but not less than the following rate of application.

TABLE 4		
APPLICATION RATES		
Course	Min. Epoxy Rate (Gal./100 SF)	Min. Aggregate Rate (Lbs./Sq.Yd)
1	2.5	10
2	5	14

The final overlay thickness shall be a minimum of 3/8". Once the epoxy mixture has been prepared, immediately and uniformly apply it to the surface of the bridge deck. There shall be no longitudinal joints of the epoxy overlay in the wheel path. The temperature of the bridge deck surface and all epoxy and aggregate components shall be 60°F or above at the time of application. Epoxy shall not be applied if the air temperature is expected to drop below 55°F within 8 hours after application or if air temperatures would cause the gel time to be less than 10 minutes. Consult with the manufacturer when placing overlay at temperatures above 90°F. The dry aggregate shall be applied in such a manner as to completely cover the epoxy mixture, so that no wet spots appear and before epoxy begins to gel. First course applications that do not receive enough aggregate prior to gel shall be removed and replaced. A second course

insufficiently covered with aggregate may be left in place, but will require additional applications before opening to traffic. After each course is fully cured, all loose aggregate shall be removed by vacuuming or brooming. Traffic shall not be allowed on the first course of the overlay. Traffic and equipment shall not be permitted on the overlay surface during the curing period. The minimum curing periods shall be as follows:

Course: Average temperature of deck, epoxy, and aggregate components in °F

	<u>60-64</u>	<u>65-69</u>	<u>70-74</u>	<u>75-79</u>	<u>80-84</u>	<u>85+</u>
Course 1	4 hrs.	3 hrs.	2.5 hrs.	2 hrs.	1.5 hrs.	1 hr.
Course 2	6.5 hrs.*	5 hrs.	4 hrs.	3 hrs.	3 hrs.	3 hrs.

*Course 2 shall be cured for 8 hrs. if the air temperature drops below 60°F during the curing period.

The Contractor shall plan and execute the work to provide the curing periods as specified herein, or manufacturer proposed curing periods may be submitted to the Engineer for review and approval.

Do not apply epoxy overlay courses over modular joints, metal expansion joints, or foam joint seals. A bond breaker shall be placed on all expansion joints.

In the event the Contractor's operation damages the epoxy overlay, the Contractor shall remove the damaged areas by saw-cutting in rectangular sections to the top of the concrete deck surface and replacing the various courses in accordance with this Specification at no additional cost to the Department.

Prior to acceptance, perform bond testing for each span or 300 square yards, whichever is smaller, in accordance with ASTM C1583 on 1.5' x 3' test patches. Test locations will be determined by the Engineer. The tensile strength shall be at least 250 psi and the depth of failure into the concrete deck for 50% of the test patch area shall be ¼" or greater. Unacceptable test results will require removal and replacement of overlay as directed by the Engineer at no cost to the Department. Test locations shall be repaired with approved repair materials.

7.0 MEASUREMENT & PAYMENT

Epoxy Overlay System will be measured and paid for at the contract unit price per square feet. The price shall include surface preparation, furnishing, and placing the overlay system, providing a 36-month warranty bond, and all tools, labor, materials, bond strength testing, and any incidentals necessary to complete the work.

Payment will be made under:

Pay Item

Epoxy Overlay System

Pay Unit

Square Feet

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:

comile@ncdot.gov (Emmanuel Omile)

mrorie@ncdot.gov (Madonna Rorie)

For submittals to the Geotechnical Engineering Unit, use the following addresses:

For projects in Divisions 1-7, use the following Eastern Regional Office address:

Via US mail:

Mr. Chris Kreider, P. E.
Eastern Regional Geotechnical
Manager
North Carolina Department
of Transportation
Geotechnical Engineering Unit
Eastern Regional Office
1570 Mail Service Center
Raleigh, NC 27699-1570

Via other delivery service:

Mr. Chris Kreider, P. E.
Eastern Regional Geotechnical
Manager
North Carolina Department
of Transportation
Geotechnical Engineering Unit
Eastern Regional Office
3301 Jones Sausage Road, Suite 100
Garner, NC 27529

Via Email: EastGeotechnicalSubmittal@ncdot.gov

For projects in Divisions 8-14, use the following Western Regional Office address:

Via US mail or other delivery service:

Mr. Eric Williams, P. E.
Western Regional Geotechnical
Manager
North Carolina Department
of Transportation
Geotechnical Engineering Unit
Western Regional Office
5253 Z Max Boulevard
Harrisburg, NC 28075

Via Email: WestGeotechnicalSubmittal@ncdot.gov

The status of the review of structure-related submittals sent to the Structures Management Unit can be viewed from the Unit's website, via the "Drawing Submittal Status" link.

The status of the review of geotechnical-related submittals sent to the Geotechnical Engineering Unit can be viewed from the Unit's website, via the "Geotechnical Construction Submittals" link.

Direct any questions concerning submittal review status, review comments or drawing markups to the following contacts:

Primary Structures Contact:

James Bolden (919) 707 – 6408
(919) 250 – 4082 facsimile

jlbolden@ncdot.gov

Secondary Structures Contacts: Emmanuel Omile (919) 707 – 6451
Madonna Rorie (919) 707 – 6508

Eastern Regional Geotechnical Contact (Divisions 1-7):
Chris Kreider (919) 662 – 4710
ckreider@ncdot.gov

Western Regional Geotechnical Contact (Divisions 8-14):
Eric Williams (704) 455 – 8902
ewilliams3@ncdot.gov

3.0 SUBMITTAL COPIES

Furnish one complete copy of each submittal, including all attachments, to the Engineer. At the same time, submit the number of hard copies shown below of the same complete submittal directly to the Structures Management Unit and/or the Geotechnical Engineering Unit.

The first table below covers “Structure Submittals”. The Engineer will receive review comments and drawing markups for these submittals from the Structures Management Unit. The second table in this section covers “Geotechnical Submittals”. The Engineer will receive review comments and drawing markups for these submittals from the Geotechnical Engineering Unit.

Unless otherwise required, submit one set of supporting calculations to either the Structures Management Unit or the Geotechnical Engineering Unit unless both units require submittal copies in which case submit a set of supporting calculations to each unit. Provide additional copies of any submittal as directed.

STRUCTURE SUBMITTALS

Submittal	Copies Required by Structures Management Unit	Copies Required by Geotechnical Engineering Unit	Contract Reference Requiring Submittal ¹
Arch Culvert Falsework	5	0	Plan Note, SN Sheet & “Falsework and Formwork”
Box Culvert Falsework ⁷	5	0	Plan Note, SN Sheet & “Falsework and Formwork”
Cofferdams	6	2	Article 410-4
Foam Joint Seals ⁶	9	0	“Foam Joint Seals”

Expansion Joint Seals (hold down plate type with base angle)	9	0	“Expansion Joint Seals”
Expansion Joint Seals (modular)	2, then 9	0	“Modular Expansion Joint Seals”
Expansion Joint Seals (strip seals)	9	0	“Strip Seals”
Falsework & Forms ² (substructure)	8	0	Article 420-3 & “Falsework and Formwork”
Falsework & Forms (superstructure)	8	0	Article 420-3 & “Falsework and Formwork”
Girder Erection over Railroad	5	0	Railroad Provisions
Maintenance and Protection of Traffic Beneath Proposed Structure	8	0	“Maintenance and Protection of Traffic Beneath Proposed Structure at Station ____”
Metal Bridge Railing	8	0	Plan Note
Metal Stay-in-Place Forms	8	0	Article 420-3
Metalwork for Elastomeric Bearings ^{4,5}	7	0	Article 1072-8
Miscellaneous Metalwork ^{4,5}	7	0	Article 1072-8
Disc Bearings ⁴	8	0	“Disc Bearings”
Overhead and Digital Message Signs (DMS) (metalwork and foundations)	13	0	Applicable Provisions
Placement of Equipment on Structures (cranes, etc.)	7	0	Article 420-20
Precast Concrete Box Culverts	2, then 1 reproducible	0	“Optional Precast Reinforced Concrete Box Culvert at Station ____”
Prestressed Concrete Cored Slab (detensioning sequences) ³	6	0	Article 1078-11
Prestressed Concrete Deck Panels	6 and	0	Article 420-3

	1 reproducible		
Prestressed Concrete Girder (strand elongation and detensioning sequences)	6	0	Articles 1078-8 and 1078-11
Removal of Existing Structure over Railroad	5	0	Railroad Provisions
Revised Bridge Deck Plans (adaptation to prestressed deck panels)	2, then 1 reproducible	0	Article 420-3
Revised Bridge Deck Plans (adaptation to modular expansion joint seals)	2, then 1 reproducible	0	“Modular Expansion Joint Seals”
Sound Barrier Wall (precast items)	10	0	Article 1077-2 & “Sound Barrier Wall”
Sound Barrier Wall Steel Fabrication Plans ⁵	7	0	Article 1072-8 & “Sound Barrier Wall”
Structural Steel ⁴	2, then 7	0	Article 1072-8 Article 400-3 & “Construction, Maintenance and Removal of Temporary Structure at Station _____”
Temporary Detour Structures	10	2	
TFE Expansion Bearings ⁴	8	0	Article 1072-8

FOOTNOTES

- References are provided to help locate the part of the contract where the submittals are required. References in quotes refer to the provision by that name. Articles refer to the *Standard Specifications*.
- Submittals for these items are necessary only when required by a note on plans.
- Submittals for these items may not be required. A list of pre-approved sequences is available from the producer or the Materials & Tests Unit.
- The fabricator may submit these items directly to the Structures Management Unit.
- The two sets of preliminary submittals required by Article 1072-8 of the *Standard Specifications* are not required for these items.
- Submittals for Fabrication Drawings are not required. Submittals for Catalogue Cuts of Proposed Material are required. See Section 5.A of the referenced provision.
- Submittals are necessary only when the top slab thickness is 18” or greater.

GEOTECHNICAL SUBMITTALS

Submittal	Copies Required by Geotechnical Engineering Unit	Copies Required by Structures Management Unit	Contract Reference Requiring Submittal ¹
Drilled Pier Construction Plans ²	1	0	Subarticle 411-3(A)
Crosshole Sonic Logging (CSL) Reports ²	1	0	Subarticle 411-5(A)(2)
Pile Driving Equipment Data Forms ^{2,3}	1	0	Subarticle 450-3(D)(2)
Pile Driving Analyzer (PDA) Reports ²	1	0	Subarticle 450-3(F)(3)
Retaining Walls ⁴	1 drawings, 1 calculations	2 drawings	Applicable Provisions
Temporary Shoring ⁴	1 drawings, 1 calculations	2 drawings	“Temporary Shoring” & “Temporary Soil Nail Walls”

FOOTNOTES

- References are provided to help locate the part of the contract where the submittals are required. References in quotes refer to the provision by that name. Subarticles refer to the *Standard Specifications*.
- Submit one hard copy of submittal to the Engineer. Submit a second copy of submittal electronically (PDF via email), US mail or other delivery service to the appropriate Geotechnical Engineering Unit regional office. Electronic submission is preferred.
- The Pile Driving Equipment Data Form is available from:
https://connect.ncdot.gov/resources/Geological/Pages/Geotech_Forms_Details.aspx
See second page of form for submittal instructions.
- Electronic copy of submittal is required. See referenced provision.

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 at (910)-772-2212 or email ncmarineevents@uscg.mil. The contractor must also contact the 5th Coast Guard District Bridges Branch, Mr. Hal 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.

REPLACEMENT OF STEEL GRID DECK**SPECIAL****Description**

This work involves the removal of the existing 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; painting the new grid deck; 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.

There is approximately 23,656 square feet of steel 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, 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

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.

Materials

The grid decking shall consist of panels fabricated from ASTM A588 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 7-1/2", and weigh 5.3 lbs./ft.
2. Supplemental bars shall be 1" x 1/4" , one between the main bars.
3. Cross bars: 2-1/2" x 1/4" spaced at 4" c/c.
4. Diagonal bars shall be 1" x 1/4", 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, prior to painting.
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 painted according to Section 442 of the Standard Specifications.
9. All steel shall be weathering ASTM A-588, Grade 50.
10. Steel grid decking shall have a minimum section modulus of:

$$S_{\text{top}} = 4.038 \text{ in}^3/\text{ft}; S_{\text{bot}} = 4.321 \text{ in}^3/\text{ft}$$

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 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 1/4" clearance between adjacent sections.

All welding shall use E70XX electrodes. Electrodes shall be compatible with A588 steel.

Installation

Install the steel grid decking in accordance with the drawings, specifications, approved shop drawings, and manufacturer's installation standards.

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.

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 of each adjacent panel. Measure from fixed points to avoid cumulative error.

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

Measurement and Payment

Replacement of 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 old 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, installation and painting of the new steel grid floor.

MODIFIED ALASKA BARRIER RAIL

(SPECIAL)

DESCRIPTION

This provision addresses the replacement of the existing metal bridge barrier railing with a new barrier rail as specified herein and as shown on plans.

MATERIAL

Refer to the plans for railing materials not described herein.

A rubber pad shall be installed between the existing metal curb and the proposed rail post base plate on the lift span. A rubber pad shall be installed between the existing concrete median curb and the proposed rail post base plate on the approach spans.

Rubber pads shall be SA-47® Bearing Pads as manufactured by Fabreeka International (www.fabreeka.com) or approved equal.

Adhesive anchors shall conform to Section 420-13 of the Standard Specifications.

CONSTRUCTION DETAILS

Railing post alignment shall be as shown on the plans.

Existing bolt holes for bolts connecting the existing median railing to the steel curb on the lift span shall be left open and the proposed base plate shall cover those open holes.

Except for work performed during the two week full bridge closure, Contractor shall only remove the amount of existing bridge railing that can be replaced in a single shift. No openings in the median railing are permitted when the bridge is open to traffic. Median barrier railing replacement operations shall be coordinated with the traffic management plans.

New railing post locations shall match existing railing post locations unless otherwise noted on the plans.

MEASUREMENT AND PAYMENT

Measurement and payment will be for the actual number of linear feet of new bridge barrier rail installed, measured along the top of the new top railing tube. Unit price bid and full compensation shall be for all materials, labor, equipment, tools, fabrication, and incidentals necessary to construct the bridge railing and its connections to the existing structure, including transitions to the existing roadway barrier rail.

Payment will be made under:

Modified Alaska Barrier Rail.....Linear Feet

**OVERLAY SURFACE PREPARATION FOR
POLYESTER POLYMER CONCRETE**

(SPECIAL)

DESCRIPTION

This provision addresses the surface preparation activities required prior to the placement of polyester polymer concrete (PPC). Unless specifically mentioned below, all requirements specified for the bridge deck are also required for the approach slabs.

Work includes: removal of unsound and sound bridge deck concrete and existing patches in deck repair areas; preparation of repair areas prior to placement of PPC bridge deck repair material; bridge deck surface preparation prior to placement of PPC overlay; and any incidentals necessary to prepare the bridge deck for placement of PPC repair material or PPC overlay, as specified or as shown on the plans.

DEFINITIONS

Scarification shall consist of the removal of any asphalt wearing surface and concrete surface to the uniform depth and limits shown on the plans.

Shotblasting shall consist of steel beads (or other materials as approved by the Engineer) “shot” out of a machine onto the bridge concrete deck concrete floor to remove soft or deteriorated concrete, and to clean the concrete deck surface for the application of the PPC overlay. Contractor shall vary the speed of the shotblaster or make multiple passes, as necessary, to achieve the required surface preparation for the PPC overlay. Areas inaccessible with shotblasting equipment may require surface preparation with sandblasting equipment and hand equipment.

EQUIPMENT

All equipment for cleaning the existing concrete surface and mixing and applying the overlay system shall be in accordance with the System Provider’s recommendations, as approved by the Engineer prior to commencement of any work:

- Scarifying equipment that is a power-operated, mechanical grinder capable of removing a minimum depth of ¼” for each pass.
- Shotblasting and sandblasting equipment to adequately prepare the bridge deck substrate, as required in this provision. Provide equipment to supply oil-free and moisture-free compressed air for final surface preparation.
- Equipment capable of sawing concrete to the specified plan depth.
- 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 scarification, shotblasting, sandblasting, and any other 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 other items.

OSP PLAN SUBMITTAL

Prior to beginning surface preparation activities, the Contractor shall submit for review and approval the Overlay Surface Preparation (OSP) Plan. The OSP Plan shall detail the type of equipment that is intended to be used and the means by which the Contractor will achieve the following requirements:

- Estimate depth of reinforcing steel.
- Scarification of deck to depth required.
- Measure depth of scarification to show completed within limits.
- Measure depth of shotblasting to show completed within limits.

SURFACE PREPARATION

Prior to any construction, take the necessary precautions to ensure debris from bridge deck preparation and repairs 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 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.

- A. Sealing of Bridge Deck: Seal all expansion joints subject to run-off water from the scarification, shotblasting, and PPC placement process with material approved by the Engineer, prior to beginning any demolition. The expansion joints shall remain sealed until it has been determined that water and materials from the scarification, shotblasting, and PPC placement operations cannot be discharged through them any longer. Take all steps necessary to eliminate the flow of water or materials through the expansion joints, and any other locations water or materials could leak from the deck.

All deck drains in the immediate work area and other sections of the bridge affected by the work being performed shall be sealed prior to beginning scarification. Drains shall remain sealed until it has been determined that water and materials from the scarification, shotblasting, and PPC placement operations cannot be discharged through them any longer.

- B. Scarifying Bridge Deck: Remove any asphalt wearing surface from the bridge deck and scarify the concrete deck to remove the entire concrete surface of the deck to the uniform depth and limits shown on the plans.

It will be the Contractor's responsibility to determine amount of cover for the reinforcing steel. Use a pachometer or other approved device, as approved by Engineer, prior to scarification. Readings shall be read and recorded in the presence of the Engineer. Readings shall be recorded for each span at 1/5 points longitudinally and 1/3 points transversely. The cost for this work will be considered incidental to the cost of surface preparation of the bridge deck.

Estimated average cover to top mat:

Bridge Number: 13 +/-1.75"

The above top mat cover dimensions are an estimate based on the best available information. Calibrate scarifying equipment in order to avoid damaging the reinforcing steel in the bridge floor or the approach slab. Care shall be taken not to cut, stretch, or damage any exposed reinforcing steel. If reinforcing bars or bridge drainage devices are pulled up or snagged during scarification operations, cease work and consult with the Engineer to determine any necessary adjustments to the roto-milling operation.

Remove and dispose of all concrete and asphalt, and thoroughly clean the scarified surface. In areas where reinforcing steel is located in the depth to be scarified, use another method with the Engineer's approval.

The Engineer will re-inspect after each removal and require additional removals until compliance with plans and specifications are met.

Regardless of the method of removal, the removal operation shall be stopped if it is determined that sound concrete is being removed to a depth greater than required by the plans.

- C. Class II Surface Preparation (Partial Depth): At locations specified on the plans or identified by the Engineer for Class II Surface Preparation, verify the depth of removal achieved by the scarification. Remove by additional scarification or chipping with hand tools all existing patches and unsound concrete. No additional payment will be made for Class II Surface Preparation depths achieved by the initial scarification.

All patches shall be removed under Class II surface preparation. If any patch cannot be removed by means of scarification, 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 not removed by scarification 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 ft²/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 ft²/ft length of bridge. Submit details of overhang support to the Engineer for approval prior to beginning the work.

- D. 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 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.

- E. Concrete Deck Repair: Repair and fill the Class II surface preparation areas of the existing bridge concrete deck prior to the final surface preparation and application of the PPC overlay, at locations shown in the plans, or as determined by the Engineer, if necessary. Materials other than PPC may be used for concrete deck repairs, but shall be approved by the PPC System Provider's Technical Representative and shall be applied and prepared as required by the PPC System Provider. For concrete deck repairs with PPC:
- removal and surface preparation of the repair area shall be in accordance with and shall be paid for under pay items in this special provision.

- materials, equipment, placement, and finishing of PPC used for concrete deck repairs shall meet the requirements of and shall be paid for under pay items in the Polyester Polymer Concrete Bridge Deck Overlay special provision.

PPC repair material may be placed up to one (1) hour prior to overlay placement.

All repairs shall be placed and finished to match substrate deck grade prior to PPC placement, in order to provide a uniform overlay thickness.

Concrete deck repairs with PPC may be utilized as a stand-alone item where required on structures not to receive a PPC overlay.

- F. Surface Cleaning: The surface of concrete substrate and repaired areas shall be prepared for application of the overlay 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 of the overlay system. The final prepared surface shall adhere to the following requirements:
1. 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.
 2. The areas to receive overlay shall be cleaned by shotblasting, or abrasive sandblasting in the event that the shotblaster cannot access areas to be prepared. Do not begin shotblasting until all grinding or milling operations are completed. Cleaning shall not commence until all work involving the repair of the concrete deck surface has been completed and the deck is dry. All contaminants shall be picked up and stored in the vacuum unit and no dust shall be created during the blasting operation that will obstruct the view of motorists in adjacent roadways. The travel speed and/or number of passes of the shotblasting unit shall be adjusted, so as to result in all weak or loose surface mortar being removed, aggregates within the concrete being exposed, and open pores in the concrete exposed, as well as a visible change in the concrete color. Cleaned surfaces shall not be exposed to vehicular traffic unless approved by the Engineer. If the deck becomes contaminated before placing the overlay, the Contractor shall shotblast or abrasive sandblast the contaminated areas to the satisfaction of the Engineer at no additional cost.
 3. Prior to the overlay placement, any loose particles shall be removed by magnets and oil free compressed air and vacuuming, such that no trapped particles remain. Power washing will not be allowed.
 4. The areas to be overlaid shall be blown off with oil and moisture free compressed air just prior to placement of the primer and shall be completely dry.
 5. Cleaning methods other than those detailed by specification may be suggested by the PPC System Provider and approved by the Engineer.
 6. All steel surfaces that will be in contact with the PPC overlay shall be cleaned in accordance with SSPC-SP No. 10, Near-White Blast Cleaning, except that wet blasting methods shall not be allowed.
- G. 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

Scarifying Bridge Deck will be measured and paid for at the contract unit price per square yard and will be full compensation for the milling of existing asphalt wearing surface from the bridge deck or approaches, milling of the entire concrete bridge deck, repairing or replacing any damaged reinforcing steel, and the cleaning and disposal of all waste material generated.

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.

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

Scarifying Bridge Deck
Shotblasting Bridge Deck
Class II Surface Preparation

Pay Unit

Square Yard
Square Yard
Square Yard

POLYESTER POLYMER CONCRETE BRIDGE DECK OVERLAY**(SPECIAL)****DESCRIPTION**

This work consists of furnishing and placing a Polyester Polymer Concrete (PPC) overlay system with a High Molecular Weight Methacrylate (HMWM) resin primer on concrete surfaces. The surface of the concrete shall be prepared and the PPC overlay system shall be applied in accordance with this provision in conformity with the lines, grades, thickness, and typical cross-sections shown on the plans or as approved by the Engineer. Unless specifically mentioned below, all requirements specified for the bridge deck are also required for the approach slabs.

Work includes: placement of HMWM primer; placement of PPC surface patching and/or overlay; and any incidentals necessary to complete the project as specified or as shown on the plans.

The System Provider is the manufacturer that will provide the PPC system for the PPC overlay. System shall include the necessary and appropriate PPC components, as well as the necessary and appropriate HMWM resin primer components. Contractor shall not change System Provider during project, without approval from the Engineer.

QUALIFICATIONS AND SUBMITTALS

The Contractor shall submit the following requested items and any other relevant documents at least two weeks prior to the PPC Overlay Pre-placement Conference. These submittals are for approval and shall be directed to the Engineer.

- A. Overlay System: The Contractor shall submit two copies of the System Provider's material information, written installation instructions, safety data sheets, and independent test results for approval.
- B. System Provider Qualifications: The Contractor shall install an overlay system with all components provided through a single System Provider with documented experience successfully supplying at least 5 PPC overlay projects of similar size and scope within the past 5 years. The Contractor shall submit documentation of the System Provider's project experience including the following:
 - 1) Project Location
 - 2) Owner Agency
 - 3) Project construction date
 - 4) Overlay quantities
 - 5) Reference name and contact information for owner representative
- C. Contractor Qualifications: The Contractor shall submit documentation of successful projects placing structural concrete bridge decks, modified concrete bridge deck overlays, or PPC overlay systems to finished grade using similar equipment as specified herein within the past 5 years. A minimum of two (2) employees on site must have the equivalent work experience qualifications of the Contractor. The documentation of Contractor's qualifications shall include the following:
 - 1) Project Location
 - 2) Owner Agency
 - 3) Project construction date
 - 4) Overlay quantities
 - 5) Reference name and contact information for owner representative

D. System Provider Technical Representative Qualifications: The System Provider Technical Representative shall have a minimum of 5 years of experience with PPC and be completely competent in all aspects of the work, including surface preparation, mixing, placement, curing, and testing of the PPC Overlay System. The Technical Representative shall have experience on a minimum of 5 successful projects of similar size and scope. The Contractor shall submit documentation of the System Provider Technical Representative's experience including the following:

- 1) Years of Experience with PPC
- 2) Project location
- 3) Project construction date
- 4) Overlay quantities
- 5) Reference name and contact information for owner representative

The Technical Representative shall be available on site, for a minimum of three (3) days per project, to give the installer advice and guidance on the installation of PPC. This includes, but not limited to deck concrete surface preparation, PPC application, and PPC cure.

E. Overlay Placement Plan: The Contractor shall submit an Overlay Placement Plan that includes the following:

- 1) Schedule of overlay work and testing for each bridge
- 2) Anticipated concrete deck repair locations and repair method
- 3) Staging plan describing overlay placement sequence including:
 - a) Construction joint locations. Longitudinal construction joints between passes shall be located along the centerline or edge of travel lanes.
 - b) Sequence of placement
 - c) Placement widths
 - d) Anticipated placement lengths
 - e) Placement direction
 - f) Joint locations
 - g) Location of proposed trial overlay(s)
- 4) Description of equipment used for:
 - a) Surface preparation including grinding and shotblasting
 - b) Applying HMWM Primer resin
 - c) Measuring, mixing, placing, and finishing the PPC
 - d) Applying surface finish sand
- 5) Method of protecting and finishing inlets and bridge drains
- 6) Method for isolating expansion joints
- 7) Method for measuring and maintaining overlay thickness and profile
- 8) Cure time for PPC
- 9) Storage and handling of HMWM resin and PPC components
- 10) Procedure for disposal of excess HMWM resin, PPC, and containers
- 11) Procedure for cleanup of mixing and placement equipment

F. Equipment: The Contractor shall submit documentation of current certification that mixing equipment has been calibrated (Caltrans California test CT 109 or similar accepted). The Contractor shall submit a documented history of the use of the placement equipment to successfully place PPC overlays on bridge projects for review and approval by the Engineer.

MATERIALS

The PPC shall consist of polyester resin binder and aggregate as specified below. It shall also include a compatible primer which when mixed with other specified ingredients and applied as specified herein, is capable of producing a PPC meeting the requirements of this specification.

- 1) Verification. The Contractor shall submit a Certified Test Report from independent labs for all of the materials associated with the PPC overlay in accordance with this special provision.
 - 2) Packaging and Shipment. All components shall be shipped in strong, substantial containers, bearing the manufacturer's label specifying batch/lot number, brand name, and quantity. If bulk resin is to be used, the contractor shall notify the Engineer in writing 10 days prior to the delivery of the bulk resin to the job site. Bulk resin is any resin that is stored in containers in excess of 55 gallons.
 - 3) Sampling. NCDOT reserves the right to retain and test samples of components of the PPC Overlay system. This includes requiring submittal of samples prior to the first installation or on-site sampling during construction.
- A. Polyester Resin Binder: Polyester resin binder shall have the following properties:
- 1) Be an unsaturated isophthalic polyester-styrene co-polymer. The resin content shall be 12% +/-1% of the weight of the dry aggregate.
 - 2) Contain at least 1 percent by weight gamma-methacryloxypropyltrimethoxysilane, an organosilane ester silane coupler.
 - 3) Be used with a promoter that is compatible with suitable methyl ethyl ketone peroxide and cumene hydroperoxide initiators.
 - 4) Meet the required values for the material properties shown in Table 1, below.

Accelerators or inhibitors may be required to achieve proper setting time of PPC. They shall be used as recommended by the overlay System Provider.

Table 1
POLYESTER RESIN BINDER PROPERTIES
(Each lot sent to job shall be tested)

Property	Test Method	Requirement
Viscosity*	ASTM D 2196	75 – 200 cps (RVT No.1 Spindle, 20 RPM at 77 °F)
Specific Gravity*	ASTM D 1475	1.05 to 1.10 at 77 °F
Elongation	ASTM D 638	35 percent, minimum Type I specimen, thickness 0.25 ± 0.03" at Rate = 0.45 inch/minute.
	ASTM D 618	Sample Conditioning: 18/25/50+5/70
Tensile Strength	ASTM D 638	2,500 psi, minimum Type I specimen, thickness 0.25 ± 0.03" at Rate = 0.45 inch/minute.

	ASTM D 618	Sample Conditioning: 18/25/50+5/70
* Test shall be performed before adding initiator.		

- B. High Molecular Weight Methacrylate (HMWM) Primer: Primer for the substrate concrete surface shall be a wax-free, low odor, high molecular weight methacrylate primer, and consist of a resin, initiator, and promoter. The primer shall conform to requirements indicated in Table 2, below, and all components shall be supplied by the System Provider.

Initiator for the methacrylate resin shall consist of a metal drier and peroxide. If supplied separately from the resin, the metal drier shall not be mixed with the peroxide directly; a VIOLENT EXOTHERMIC REACTION will occur. The containers and measuring devices shall not be stored in a manner that allows leakage or spilling to contact the containers or materials of the other.

Table 2
HIGH MOLECULAR WEIGHT METHACRYLATE RESIN PROPERTIES
(Tested yearly)

Property	Test Method	Requirement
Viscosity**	ASTM D 2196	25 cps maximum (Brookfield RVT with UL adapter, 50 RPM at 77 °F)
Volatile Content**	ASTM D 2369	30 percent, maximum
Specific Gravity**	ASTM D 1475	0.90 minimum at 77 °F
Flash Point	ASTM D 3278	180 °F minimum
Vapor Pressure**	ASTM D 323	1.0 mm Hg, maximum at 77 °F
PCC Saturated Surface-Dry Bond Strength (Adhesive)	California Test 551, part 5	700 psi, minimum at 24 hours and 70 ± 1°F (with PPC at 12% resin content by weight of the dry aggregate), primed surface
**Test shall be performed before initiator is added		

- C. Aggregates: PPC aggregate shall have the following properties:
- 1) No more than 45 percent crushed particles retained on the No. 8 sieve when tested in accordance with AASHTO Test Method T335.
 - 2) Fine aggregate consists of natural sand only.
 - 3) Weighted-average aggregate absorption of no more than 1.0 percent when tested under AASHTO Test Methods T84 and T85.
 - 4) At the time of mixing with resin, have moisture content of not more than one-half of the weighted-average aggregate absorption when tested under AASHTO Test Method T255.
 - 5) Moh's hardness of 7 or greater.
 - 6) Comply with the requirements for the aggregate gradation indicated in Table 3, below:

Table 3
AGGREGATE GRADATION
(Tested yearly)

Sieve Size	Percent Passing
3/8"	100
No. 4	60-85
No. 8	55-65
No. 16	29-50
No. 30	16-36
No. 50	5-20
No. 100	0-7
No. 200	0-3

Sand for abrasive sand finish shall have the following properties:

- 1) Commercial-quality blast sand.
- 2) Not less than 95 percent pass the No. 8 sieve and not less than 95 percent retained on the No. 20 sieve when tested under AASHTO Test Method T27.
- 3) Shall be dry at the time of application.

D. Composite system: The composite PPC system shall have the following properties indicated in Table 4, below:

Table 4
COMPOSITE PROPERTIES
(Tested every 2 years)

Property	Test Method	Requirement
PCC Saturated Surface Dry Bond Strength	CT 551	500 psi minimum at 24 hrs. and 70° F (without primer, at 12% resin content by weight of the dry aggregate, on Saturated Surface Dry Specimen)
Abrasion Resistance	CT 550	<2g weight loss (at 12% resin content by weight of the dry aggregate)
Modulus of Elasticity	ASTM C 469	1,000,000 psi to 2,000,000 psi (at 12% resin content by weight of the dry aggregate)

CONSTRUCTION REQUIREMENTS

- A. PPC Overlay Pre-placement Conference: A Pre-placement Conference shall be held before any overlay operations begin. Attendees shall include representatives from all parties involved in the work. If necessary, teleconferencing of attendees may be approved by the Engineer.
- B. Trial Application: Prior to constructing the overlay, one or more trial applications shall be placed on a previously constructed concrete base to demonstrate proper initial set time and the

effectiveness of the mixing, placing, and finishing equipment proposed. The set time can be determined as the time elapsed from resin catalyzation until the in-place PPC cannot be deformed by pressing with a finger, indicating the resin binder is no longer in a liquid state. Each trial application shall be the planned paving width, at least 10 feet long, and the same thickness as the specified overlay. Conditions during the construction of the trial application(s) and equipment used shall be similar to those to be used for construction of the overlay. The location of the trial application(s) shall be approved by the Engineer. Trial applications shall be properly disposed of off-site by the Contractor, if removal is necessary.

The number of trial applications required shall be as many as necessary for the Contractor to demonstrate the ability to construct an acceptable trial overlay section and competency to perform the work. However, the installer or proposed equipment/techniques may be rejected if not shown to be acceptable after three (3) trials.

Overlay tensile bond testing shall be performed in accordance with the acceptance testing herein. Vertical axis pull bond tests shall be performed after 24 hours by the Contractor in accordance to ACI 503R-30. At a minimum, 2 pull bond tests shall be performed on each Trial Application. Acceptable test results shall be achieved on a Trial Application before the installation may proceed. Tensile bond testing shall be performed by an independent testing firm and shall be arranged by the Contractor, cost to be included in bid price for *Placing and Finishing PPC Overlay* item.

- C. Equipment: All equipment for cleaning the existing concrete surface and mixing and applying the overlay system shall be in accordance with the System Provider's recommendations, as approved by the Engineer prior to commencement of any work.
- 1) Surface Preparation Equipment: Provide appropriate scarifying, shotblasting, sandblasting and other equipment to adequately prepare the bridge deck substrate, as required in the Overlay Surface Preparation for Polyester Polymer Concrete special provision.
 - 2) Mixing Equipment: A continuous automated mixer shall be used for all PPC overlay applications. The continuous mixer shall:
 - a. Employ an auger screw/chute device capable of sufficiently mixing catalyzed resin with dry aggregate.
 - b. Employ a plural component pumping system capable of handling polyester binder resin and catalyst while maintaining proper ratios to achieve set/cure times within the specified limits. Catalyzed resin shall flow through a static mix tube for sufficient duration to completely mix the liquid system.
 - c. Be equipped with an automatic metering device that measures and records aggregate and resin volumes. Record volumes at least every five minutes, including time and date. Submit recorded volumes at the end of the work shift.
 - d. Have a visible readout gage that displays volumes of aggregate and resin being recorded.
 - e. Produce a satisfactory mix consistently during the entire placement.

A portable mechanical mixer of appropriate size for proposed batches, as recommended by the System Provider and approved by the Engineer, may be used for all PPC patching applications and for smaller area overlay applications if approved by the Engineer.
 - 3) Finishing Equipment: Finishing may be accomplished with a Self-Propelled Slip-Form Paving Machine.

Self-Propelled Slip-Form Paving Machine

A self-propelled slip-form paving machine, which is modified or specifically built to effectively place the PPC overlay in a manner that meets the objectives and requirements of the project, shall be used for major PPC overlay applications. The paving machine shall:

- a. Employ a vibrating pan to consolidate and finish the PPC.
- b. Be fitted with hydraulically controlled grade automation to establish the finished profile. The automation shall be fitted with substrate grade averaging devices on both sides of the new placement; the device shall average 15 feet in front and behind the automation sensors; or the sensor shall be constructed to work with string-line control. It is acceptable to match grade when placing lanes adjacent to previously placed PPC.
- c. Have sufficient engine power and weight to provide adequate vibration of the finishing pan while maintaining consistent forward placement speed.
- d. Be capable of both forward and reverse motion under its own power.

Vibratory Screed

A vibratory screed may be used for finishing PPC on smaller projects (generally less than 6000 ft² of bridge deck area), but must be approved by the Engineer at least two weeks prior to PPC placement.

- D. Concrete Deck Repairs and Surface Preparation: All areas that require removal of existing patches or unsound concrete shall be removed and prepared in accordance with the requirements of the Overlay Surface Preparation for Polyester Polymer Concrete special provision. Placement of concrete deck repair material shall be in accordance with this special provision. Prepare all concrete deck and repaired deck surfaces in accordance with the requirements of the Overlay Surface Preparation for Polyester Polymer Concrete special provision.
- E. Application of Overlay: Methods indicated in this specification are typical of general installations and may be modified per the System Provider's recommendations as approved by the Engineer. The application of the overlay shall not begin until the concrete deck is completely surface dry in accordance with ASTM D4263, with a wait time revised from 16 hours to 2 hours, or as directed by the System Provider's Technical Representative. The concrete surface temperature shall be between 40° and 100° F. Night work may be required when temperatures cannot be met during the day.

During overlay application, precaution shall be taken to assure that traffic is protected from rebound, dust, and construction activities. Appropriate shielding shall be provided as required and directed by the Engineer.

During overlay application, the Contractor shall provide suitable coverings (e.g. heavy duty drop cloths) as needed to protect all exposed areas not to receive overlay, such as curbs, sidewalks, parapets, etc. All damage or defacement resulting from this application shall be cleaned and/or repaired to the Engineer's satisfaction at no additional cost.

- 1) HMWM Primer Application: Immediately before placing primer, all exposed surfaces shall be completely dry and blown clean with oil-free compressed air. Exposed surfaces shall be protected from precipitation and heavy dew during and after the application of the primer.

After the exposed surfaces have been prepared and are dry, primer shall be applied in accordance with the System Provider's recommendations. Primer shall be placed within 5 minutes of mixing at approximately 90 ft²/ gal or the rate acceptable to the Engineer.

Primer shall be applied by flooding and uniformly spread to completely cover surfaces to receive overlay. Care shall be taken to avoid heavy application that results in excess puddling. Excess material shall be removed or distributed to meet the required application rate. Primer shall be reapplied to any areas that appear dry prior to overlay placement.

Primer shall not be allowed to leak onto areas that have not received surface preparation.

- 2) PPC Application: The PPC shall be applied during the interval between 15 minutes and 2 hours after the primer has been applied. The PPC shall be placed prior to gelling and within 15 minutes following addition of initiator, unless otherwise recommended by the System Provider's Technical Representative.

The polyester resin binder shall be initiated and blended completely. Aggregate shall be added and mixed sufficiently when a portable mechanical mixer is used.

PPC shall have an initial set time of at least 30 minutes and at most 90 minutes. The set time can be determined in the field when the in-place PPC cannot be deformed by pressing with a finger, indicating that the resin binder is no longer in a liquid state. If the initial set is not within 30 to 90 minutes, the material shall be removed and replaced.

The overlay shall be consolidated and finished to the required grade and cross-section using PPC placement equipment as defined herein.

If a vibratory screed is used, prior to placing the PPC, place and fasten screed rails in position to ensure finishing the new surface to the required profile. Do not treat screed rails with parting compound to facilitate their removal. Prior to placing the overlay, attach a filler block to the bottom of the screed and pass it over the overlay area to check the thickness. The filler block thickness shall be equal to the design overlay thickness as shown in the plans. Remove all concrete that the block does not clear.

Place the PPC in one operation. Provide a minimum overlay thickness as shown in the plans.

Although the paver or screed may yield a finished or nearly finished surface, additional finishing may be necessary. PPC shall be finished, as necessary, through traditional concrete finishing methods, producing a slight resin bleed indicating complete consolidation of aggregates.

Finishing of PPC used as patching of an existing deck surface or overlay shall be completed and finished using traditional concrete hand finishing methods and hand concrete finishing tools. Such patches shall be placed flush with the top of the existing deck surface.

Resin content shall be as specified in the Materials section of this special provision and to yield a PPC consistency that requires surface applied consolidation and finishing to consolidate aggregates and yield a slight sheen of bleed resin on top surface, yet does not yield excess bleed resin.

A surface friction sand finish of at least 2.2 lbs/ yd² shall be broadcast onto the glossy surface immediately after sufficient finishing and before resin gelling occurs. To ensure

adequate pavement friction, the completed PPC overlay surface shall be free of any smooth or "glassy" areas such as those resulting from insufficient quantities of surface aggregate. Any such surface defects shall be repaired by the Contractor in the manner recommended by the System Provider and approved by the Engineer at no additional cost.

After application of surface friction sand, unless otherwise indicated on the plans, groove the bridge floor in accordance with Article 420-14(B) of the Standard Specifications. Vehicular traffic may travel across a deck surface that has not been grooved; however, the entire deck area shall be grooved after the PPC overlay achieves design strength and no later than seven days after completion of the overlay unless otherwise approved by the Engineer.

All working deck joints shall be extended through the overlay and be sealed according to the details in the plans.

If traffic is to be returned to the site, but the overlay is not completed within the allowable lane closure time and is more than $\frac{3}{4}$ inch higher in elevation than the adjacent pavement, the PPC overlay edges shall be tapered. Tapered edges transverse to the direction of traffic and on the leading edge of the overlay shall be at a 4:1 (horizontal: vertical) slope. Tapered edges transverse to the direction of traffic and on the trailing edge of the overlay and tapered edges longitudinal to the direction of traffic shall be at a 45 degree slope. Tapers of 45 degrees may remain, and PPC overlay may be placed adjacent. Tapers with a slope gentler than 45 degrees shall be sawcut square to the overlay surface, prior to placing adjacent PPC overlay.

The Contractor shall collect a ticket for each pass or portion of a pass that is provided by each mixer, and ensure that the following information is shown on each ticket:

- a. Project Number
- b. Bridge Number
- c. Date and Time
- d. Location of Placement (Lane and Station Limits or location and length of placement along the length of the bridge)
- e. Aggregate Weight
- f. Polyester Resin Binder Weight

The tickets shall be available on site for Inspection personnel to use in tabulating quantities.

Curing: The Contractor shall allow the overlay to cure sufficiently before subjecting it to loads or traffic of any nature that may damage the overlay. Cure time depends upon the ambient and deck temperatures as well as initiator/accelerator levels.

The overlay shall be considered cured to a traffic ready state when a minimum reading of 25 on a properly calibrated Swiss hammer is achieved. Other rebound hammers may be use as approved by the Engineer.

- F. **Acceptance Testing:** Acceptance of the deck repairs, surface preparation, and PPC overlay will be determined by the Engineer based on vertical axis bond tests, and smoothness quality testing performed by the Engineer, assisted by the Contractor.
- 1) **Overlay Direct Tension Bond Testing:** Vertical axis pull bond tests shall be performed after 24 hours by the Contractor in accordance to ACI 503R-30. At a minimum, 2 pull bond tests shall be performed on each bridge overlay. For bridges with deck areas greater than

25,000 square feet, additional tests shall be performed at a frequency of one test per 25,000 square feet of additional deck area, rounded up. Additional testing may be required as directed by the Engineer.

The test result shall be the average of the tests for each structure. Test cores shall be drilled a minimum of 0.25" but no greater than 0.50" below the bond line.

The minimum bond strength of the PPC overlay system on normal weight concrete shall be 250 psi. An acceptable test will demonstrate that the overlay bond strength is sufficient by producing a concrete subsurface failure area greater than 50% of the test surface area. The Contractor shall repair all bond test locations with PPC overlay in accordance with this specification.

- 2) Smoothness Quality Testing: As soon as practical after the PPC has hardened sufficiently, test the finished surface with an approved rolling straightedge that is designed, constructed, and adjusted, so that it will accurately indicate or mark all deck areas which deviate from a plane surface by more than 1/8" in 10'. Remove all high areas in the hardened surface in excess of 1/8" in 10' with an approved grinding or cutting machine. Additionally, the final PPC deck surface shall not deviate from the line and elevation indicated on the plans by more than 0.3" over any 50' length. If approved by the Engineer, correct low areas in an acceptable manner.

G. Corrective Work

- 1) Repair of Surface Defects: The repair materials and finishing methods for surface defects in the overlay shall be in accordance to those used for the application of the overlay. All surface defects shall be repaired to the satisfaction of the Engineer before acceptance of the work is made.
- 2) Correction for Smoothness: Areas showing high spots of more than 1/8 inch in 10 feet shall be marked and diamond ground until the high spot does not exceed 1/8 inch in 10 feet. Ground surface may be sawcut grooved to restore the texture if ordered by the Engineer. Areas showing low spots of more than 1/8 inch in 10 feet shall be marked and prepared with shot blasting or sandblasting, primed, and filled with either catalyzed resin and broadcast sand or mixed PPC slurry material. The use of resin or mixed slurry material shall be as recommended by the System Provider and approved by the Engineer.
- 3) Replacement of Defective Overlay: A defective overlay, or portion thereof, resulting in failing overlay pull bond test results shall be removed and replaced at the Contractor's expense. The Contractor shall submit a written corrective work proposal to the Engineer, which shall include the methods and procedures that will be used. The Contractor shall not commence corrective work until the methods and procedures have been approved in writing by the Engineer. The Engineers approval shall not relieve the Contractor of the responsibility of producing work in conformity with the Contract.
- 4) Repair of Cracking: After a one-week cure period, if cracks are in the overlay, the Contractor shall fill the cracks with properly catalyzed and mixed HMWM primer material at his own expense. Care shall be taken to fill the cracks only, and ensure minimal HMWM primer is left on the finished surface of the overlay.

MEASUREMENT AND PAYMENT

Concrete Deck Repair for PPC Overlay will be measured and paid for at the contract unit price bid per square yard and will be full compensation for placement of concrete deck repair material and shall include the cost of labor, tools, equipment and incidentals necessary to complete the work.

PPC Materials will be measured as the actual volume of PPC material complete-in-place. The volume shall include material used for overlay, patching of existing unsound concrete deck surface or overlays, and bridge deck concrete repairs as directed by the Engineer. Tickets provided to the project inspector, showing quantities of PPC produced, shall be sufficient to calculate volume of material placed. Materials placed for Trial Overlay shall be included in Pay Quantity if placed and remaining on the bridge deck as part of the permanent overlay. *PPC Materials* will be paid for at the contract unit price per cubic yard and will be full compensation to furnish the PPC material, including HMWM primer, freight to the project site, receiving, storage, and disposal of any unused PPC overlay material. Payment by cubic foot will be based on a 135 lbs/ ft³ unit weight and quantities recorded by calibrated mixer unit readouts.

Placing and Finishing PPC Overlay will be measured and paid for as the quantity of final surface finishing. Payment will be full compensation for all labor, equipment, and all incidentals necessary to complete the PPC overlay placement. Construction and removal (if required) of Trial Overlay, including concrete base surfaces, will not be measured and paid for separately, but shall be included in the work.

Payment will be made under:

Pay Item

Concrete Deck Repair for PPC Overlay
 PPC Materials
 Placing and Finishing PPC Overlay

Pay Unit

Square Yard
 Cubic Yard
 Square Yard

HYDRO-DEMOLITION OF BRIDGE DECK**(SPECIAL)****DESCRIPTION**

The contractor can elect to use hydro-demolition or chipping with hand tools, or a combination of both, for Class III surface preparation areas shown on the plans or as ordered by the Engineer.

Hydro-demolition shall consist of the removal of the deck surface by means of high pressure water blasting, which will remove concrete, asphalt, oil, dirt, concrete laitance and rust from the exposed reinforcing bars by direct impact, pressurization of micro and macro cracks and cavitation produced by jet instability. If reinforcing bars or bridge drainage devices are pulled up or snagged during scarification milling operations, the Contractor shall cease operations and consult with the Engineer to determine what adjustments, if any, need to be made to the roto- milling operations.

The Contractor shall submit for approval prior to beginning work, his Hydro-demolition Management Plan. This plan shall include how the Contractor shall provide for the collection, treatment, and disposal of all run-off water generated by the scarification and hydro-demolition processes. This Water Management Plan shall be prepared in accordance the NCDOT Guidelines for Managing Hydro-demolition Water (a copy of which is included in the Appendix). The contractor shall comply with applicable regulation concerning such water disposal.

Managing Hydro-Demolition Water

Prior to beginning work, submit for approval a Hydro-demolition Management Plan. This plan shall describe the collection, treatment, and disposal of run-off water generated by the scarification and hydro-demolition processes. Prepare the plan in accordance to the NCDOT Guidelines for Managing Hydro-demolition Water (a copy of which is included in the Appendix). The contractor shall comply with applicable regulation concerning such water disposal.

EQUIPMENT

Use the following surface preparation equipment:

- Hydro-demolition machine, self-propelled with a minimum orifice pressure of 17,000 psi.
- All water used for hydro demolition shall be potable.
- Equipment capable of sawing concrete to the specified plan depth.
- Hand-held high velocity (7,500 psi minimum) water-jet equipment capable of removing rust scale from reinforcing steel, removing small chips of concrete partially loosened by scarifying or chipping operation, and for removing rehydrated dust left from scarification.
- 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.

The hydro-demolition machine shall be self-propelled and capable of producing a water-jet through an orifice at a pressure of at least 17,000 psi. The machine shall move the jet transversely across the area and forward and backward so that the entire deck is covered with the water-jet and operated at a pressure sufficient to remove the unsound concrete.

The machine shall have sufficient means to control and vary the following functions:

- (1) Water pressure.
- (2) Angle and distance of the orifice in relation to the surface to be blasted.
- (3) Limits of transverse and longitudinal movement of the orifice.
- (4) Speed of the orifice in the transverse and longitudinal direction.

High pressure pump(s) shall be equipped with over-pressurization relief valves and rupture disc systems. All high pressure components shall be rated at full working pressure of the hydro-demolition system. The complete hydro-demolition system must be capable of depressurization from a single point.

The equipment must operate at a noise level less than 90 decibels at a distance of 50 feet.

CONSTRUCTION METHODS

Remove all existing asphalt overlays and all loose, disintegrated, unsound or contaminated concrete from the bridge deck in accordance with the following surface preparation classifications shown below:

Seal all expansion joints subjected to run-off water from the hydro-demolition process with material approved by the Engineer, prior to beginning the surface preparation. The expansion joints shall remain sealed until water from the hydro-demolition process no longer passes over them. The contractor shall take all steps necessary to eliminate the flow of water through the expansion joints, and any other locations water could leak from the deck.

All deck drains in the immediate work area and the other sections of the bridge affected by the work being performed in the immediate work area shall be sealed prior to beginning the Deck Scarification. They shall remain sealed until it has been determined that materials from the hydro-demolition and concrete overlay operations cannot be discharged through them any longer.

- A. Class III Surface Preparation (Full Depth): Remove by hydro-demolition or chipping with hand tools the full depth of slab. Dispose of the removed concrete, clean, repair or replace damaged reinforcing steel and thoroughly clean the newly exposed surface. Care shall be taken not to cut, stretch, or damage any exposed reinforcing steel.

For areas of less than 3 ft² suspending forms from existing reinforcing steel using wire ties is permitted. For larger areas, support forms by blocking from the beam flanges, or other approved method.

Overhang support is required for full depth removal adjacent to bridge rails. Submit details of overhang support to the Engineer for approval prior to beginning the work.

Under Deck Containment: Under deck containment shall be installed where Class III surface preparation occurs. The containment shall be installed prior to hydro-demolition in the areas where full depth removal is required or blow thru may occur during the hydro-demolition process.

Submit for approval detailed plans for the under deck containment system. Detail how waste, debris, and wastewater are contained.

Concrete for Full Depth Repair: Fill the Class III surface preparation areas with Class AA, high early strength structural concrete or latex modified concrete in accordance with the methods described below:

Refill areas with Class AA concrete to the bottom of the proposed concrete overlay in accordance with Section 420 of the *Standard Specifications*. Any of the methods for curing Class AA concrete as stated in the *Standard Specifications* are permitted except the membrane curing compound method.

Provide a raked finish to the surface of the Class AA concrete which provides a minimum relief of 1/16" and a maximum relief of 1/4". Place the overlay course after the Class AA concrete has attained a minimum compressive strength of 2500 psi. The strength shall be verified by an approved, non-destructive test method.

Refill the areas where concrete was removed with high early strength concrete as described in the Concrete for Deck Repair and Volumetric Mixer special provisions.

Refilling the areas from which concrete has been removed with latex modified concrete during the Class III repair is permitted if any of the following conditions are met:

- The reinforcing steel cover is 1½ inches or less for the top mat of steel.
- The area being repaired is less than 1 yd².
- The Engineer directs the fill.

SURFACE PREPARATION

Two trial areas shall be designated by the Engineer to demonstrate that the equipment, personnel, and methods of operation are capable of producing results to the satisfaction of the owner's Engineer. The first trial area shall consist of approximately 50 square feet of sound concrete as determined by the Engineer. The equipment shall be calibrated to remove the sound concrete from the scarified surface to the depth required to achieve the plan overlay thickness. After completion of this test area, the equipment shall be moved to the second area consisting of deteriorated or defective concrete, to determine whether this unsound concrete will be completely removed with the previous calibration and to establish a baseline for requiring the contractor to place under-deck containment in areas subject to full depth removal, before beginning the hydro-demolition process in a span. Should it be determined that not all defective concrete has been removed, the hydro-demolition system shall be recalibrated to remove an additional 1/4 inch of sound concrete, then re-test on deteriorated concrete. If additional defective concrete is found, the depth of cut will increase in 1/4 inch increments until only sound concrete is found remaining.

When satisfactory results are obtained, the machine parameters shall be used for production removal. The contractor shall make adjustments to the operating parameters, as required, to perform concrete removal as indicated on the drawings and to adjust to the variance in the compressive strength of the concrete.

Hand held water blasting equipment, pneumatic hammers, and hand tools may be substituted for the hydro-demolition unit in areas inaccessible (such as adjacent to the curb) or inconvenient (such as small patch areas).

The Engineer will re-inspect after each removal and require additional removals until compliance with plans and specifications are met.

Regardless of the method of removal, the removal operation shall be stopped if it is determined that sound concrete is being removed. Appropriate recalibration, or change in equipment and methods shall be performed prior to resuming the removal operation.

The Contractor shall take all steps necessary to prevent cutting or otherwise damaging existing steel designated to remain in place. Any such bars damaged (nicks deeper than 20% of the bar diameter) by the Contractor's operation shall be repaired or replaced. Defects in embedded reinforcing steel due to corrosion, which has reduced the cross-sectional area of the steel by 25% or greater, shall have new reinforcing steel of similar cross section area lap-spliced to each side of the damaged area. Reinforcing 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 or approved mechanical connectors.

The Contractor shall support and protect the exposed reinforcing steel, which is left unsupported by the hydro-demolition process, against displacement and damage from loads such as those caused 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.

Rebar exposed and cleaned by hydro-demolition shall not require re-cleaning if encased in concrete within seven (7) days. Rebar exposed for more than seven (7) days shall be cleaned by high velocity water jets (4,000 PSI minimum) prior to placement of the new concrete.

When large areas of the deck on composite bridges are removed resulting in the debonding of the main stress carrying longitudinal 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.

The Contractor shall shield his operations to prevent injury or damage from flying or falling debris. The Contractor shall provide a method of handling expected and unexpected blow-through of the deck where shown on the plans and as directed by the Engineer. This method shall provide for the containment of the runoff water and debris, and the protection of the area under the bridge deck. The Contractor shall be responsible for any injury or damage caused by his operations. The containment shall remain in-place until the latex modified concrete has been cast and reach minimum strength.

The removal area shall be thoroughly cleaned of all dirt, foreign materials and loose concrete to the extent necessary to produce a firm solid surface for adherence of new concrete.

Removal of concrete debris shall be accomplished either by hand or by mechanical means capable of removing wet debris and water all in the same pass and directly follow the hydro-demolition process to prevent the debris from re-setting or re-adhering to the surface of the remaining sound concrete. All concrete debris shall become the property of the Contractor and shall be legally disposed of at the contractor's expense. The contractor shall be responsible for disposing of all debris generated by the scarification operations.

Any debris which is allowed to re-settle or re-adhere to the surface of the sound concrete shall be carefully removed by the Contractor (at no additional cost), and the Contractor shall exercise care to avoid any damage to the remaining sound concrete or exposed reinforcement. Following the removal of the debris and prior to the placement of the overlay, the entire surface shall be blasted clean with high pressure water to remove any bond-breaking residue, loose material from the concrete surface, and/or rust from the reinforcing steel. This residue shall be collected and disposed of by the contractor. The Contractor will not be permitted to allow material to fall from the deck.

All water used for hydro-demolition shall be potable. The Contractor is responsible for furnishing all of the water required for the project.

Any areas of the prepared surface contaminated by oil or other materials detrimental to good bond as a result of the contractor's operations shall be removed to such depth as may be required at the contractor's expense.

The Contractor shall provide adequate lighting as required to allow for the safe conduct of nighttime removal operation if he elects to do hydro-demolition at night. Submit a lighting plan to the Engineer for approval prior to beginning work.

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.

MEASUREMENT AND PAYMENT

Hydro-Demolition of Bridge Deck will be measured and paid for at the contract unit price per square yard and will be full compensation for hydro-demolition, removal and disposal of unsound and contaminated concrete, cleaning, repairing or replacing of reinforcing steel, and furnishing all materials, labor, tools, equipment and incidentals necessary to complete the work.

Class III Surface Preparation will be measured and paid for at the contract unit price per square yard and will be full compensation for Class III deck preparation where required by the plans. The cost will also include removal and disposal of unsound and contaminated concrete, cleaning, repairing or replacing of reinforcing steel, under deck containment, placing and finishing concrete for full depth repair, and for furnishing all materials, labor, tools, equipment and incidentals necessary to complete the work.

Payment will be made under:

Pav Item

Hydro-Demolition Bridge Deck
Class III Surface Preparation

Pav Unit

Square Yard
Square Yard

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 *2012 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 *2012 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.

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 *2012 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 1080-13 of the *2012 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

- (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

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).

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/ncribridges/#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.

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.

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

exceed $20 \mu\text{g}/\text{m}^3$ corrective measures shall be taken and monitoring shall be continued until 2 consecutive sample results are less than $20 \mu\text{g}/\text{m}^3$.

TWA may suspend the work if there are visible emissions outside the containment enclosure or pump monitoring results exceeding the level of $30 \mu\text{g}/\text{m}^3$.

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 $1.5 \mu\text{g}/\text{m}^3$.

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.

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 1080-13 of the *2012 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 $7 \mu\text{g}/\text{cm}^2$ 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.

PAINTING OF STEEL

Paint System 1, as specified in these special provisions and Section 442 of the *2012 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 *2012 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

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 2012 *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.

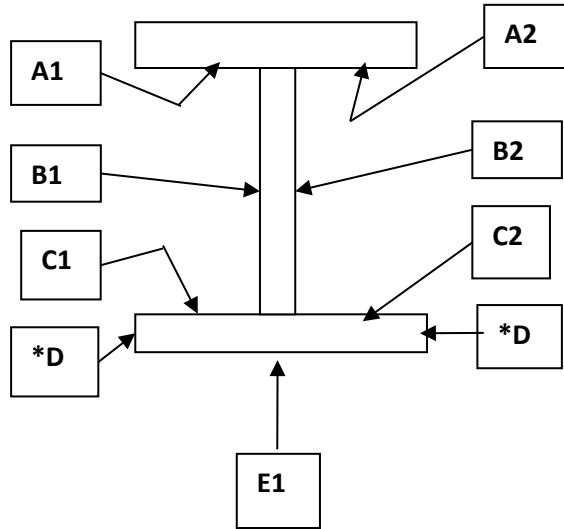
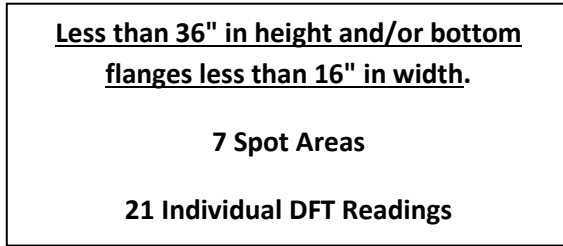
- (1) Measure DFT at each spot on the attached diagram and at the required number of locations as specified below:

- (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.

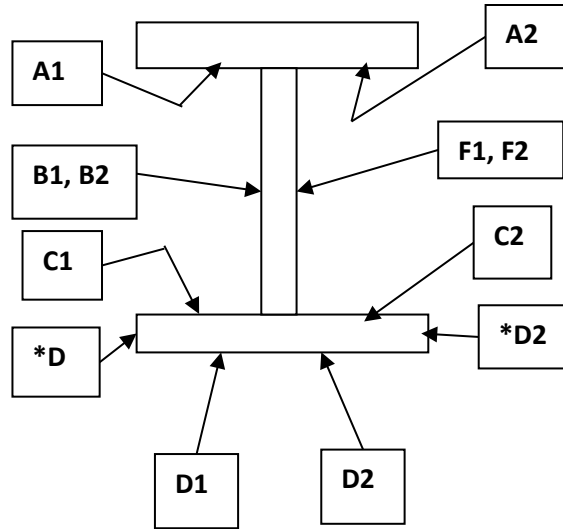
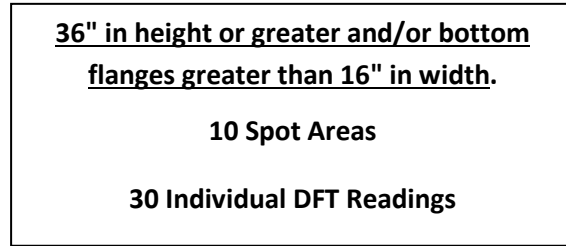
DFT measurements for the prime coat shall not be taken for record until the zinc primer has cured in accordance with ASTM D4752 (MEK Rub Test) with no less than a four resistance rating.

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.



***D areas are only included when
flange thickness is one inch (1") or
greater.**



***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

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 *2012 Standard Specifications*.

Comply with Subarticle 442-14(D) of the *2012 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.

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 #13*. 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 #13 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 #13	Lump Sum
Pollution Control	Lump Sum
Painting Containment for Bridge #13	Lump Sum

DESCRIPTION OF BRIDGE

Bridge #13: This bridge was built in 1969 and carries US 76 / US 421 over Cape Fear River. The superstructure of the fixed approach spans that are to be cleaned and painted consist of simple and multi-span continuous span with varying number of girder lines. The steel girders are welded plate girders with varying spacings with steel diaphragms. Refer to the plans for girder spacings and girder section make-up. The west side fixed approach spans to be cleaned and painted are 99'-0", 124'-0", 123'-0", 124'-0" and 153'-3" for a total length of approximately 623'-3". The east side fixed approach spans to be cleaned and painted are 153'-3", 3 spans @ 136'-0", 81'-6" and 2 spans @ 84'-0" for a total length of approximately 810'-9". Each of these fixed approach spans has a concrete deck that is composite with the steel girders. Transverse steel box girders (cap girders) occur at Bents 24 and 25 and each shall be cleaned and painted on the exterior surfaces only. The existing paint system is assumed to be aluminum over red lead, and the estimated area to be cleaned and painted is 272,500 sq. ft.

REPAIRS TO PRESTRESSED CONCRETE GIRDERS**(SPECIAL)****DESCRIPTION**

Work includes removal of concrete in spalled and/ or delaminated areas of the existing prestressed concrete girders, 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 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 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 ft²) 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, 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 2012 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.

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

STRUCTURAL STEEL FOR REPAIRS**SPECIAL****Description**

This work involves performing structural steel repairs on the lift span and approach spans as shown on the plans. The work includes field measuring existing conditions, fabricating repair steel, installing steel repairs, field drilling bolt holes, field welding, removing deteriorated portions of members and connectors, performing localized cleaning and painting, providing access to repair locations for construction and inspection, and placing sealant at repair locations as described herein and as shown on the plans. The fixed lived load bearing retrofit and shimming/ resetting finger plate are included under this item.

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, nuts and washers 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. Color of finish coat of paint shall match color of existing steel at the respective repair location.

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 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.

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 or as required by the engineer 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.

For Type 1 Repairs, the Contractor shall use caution when cutting the existing floorbeam stiffener to be repaired. Existing floorbeam web plates shall not be gouged or damaged during the cutting and removal process.

For Type 2 Repairs, the Contractor shall submit a procedure for relocating the channel diaphragms to the Engineer for review. A procedure for coping the W-section diaphragms also shall be submitted to the Engineer for review. These procedures shall include a narrative, and detail(s) if needed, describing the method to be used to reposition or modify the existing diaphragms in the lift span floor system as shown on the plans for Type 2 Repair locations. The procedures shall define the traffic control scheme that will be implemented during these operations.

When performing the Fixed Live Load Bearing Retrofit work, the Contractor shall not damage, modify, or affect the existing high-strength rod restraining assembly that exists. Prior to fabricating the proposed beveled shim plate, Contractor shall take field measurements of the existing air gap that is present under the existing masonry plate such that precise dimensional information can be used to fabricate the new beveled shim plate.

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, localized cleaning and painting, placing sealant, providing access to repair locations, and all necessary equipment and labor required to install the structural steel repairs shown on the plans.

FLOWABLE FILL:

(9-17-02) (Rev 1-17-12)

300, 340, 1000, 1530, 1540, 1550

SP3 R30

Description

This work consists of all work necessary to place flowable fill in accordance with these provisions, the plans, and as directed.

Materials

Refer to Division 10 of the *2018 Standard Specifications*.

Item

Flowable Fill

Section

1000-6

Construction Methods

Discharge flowable fill material directly from the truck into the space to be filled, or by other approved methods. The mix may be placed full depth or in lifts as site conditions dictate. The Contractor shall provide a method to plug the ends of the existing pipe in order to contain the flowable fill.

Measurement and Payment

At locations where flowable fill is called for on the plans and a pay item for flowable fill is included in the contract, *Flowable Fill* will be measured in cubic yards and paid as the actual number of cubic yards that have been satisfactorily placed and accepted. Such price and payment will be full compensation for all work covered by this provision including, but not limited to, the mix design, furnishing, hauling, placing and containing the flowable fill.

Payment will be made under:

Pay Item

Flowable Fill

Pay Unit

Cubic Yard

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.

CONSTRUCTION

Construct the Operator house renovation in accordance with the Architectural Specifications for Operator House Renovations.

MEASUREMENT AND PAYMENT

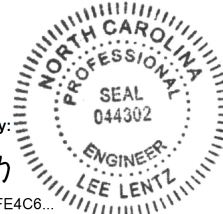
All work shown on the architectural drawings and called for in the Architectural Specifications for Operator House Renovations shall be paid for at the lump sum price bid for Operator House Renovation.

**NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
PROJECT NO. 15BPR.15
NEW HANOVER COUNTY
CAPE FEAR RIVER MEMORIAL LIFT BRIDGE**

PROJECT SPECIAL PROVISIONS – MECHANICAL

- Mechanical Operating Machinery (Special)
- Auxiliary Counterweight and Span Guide Repairs (Special)

DocuSigned by:
Lee Lentz
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2/13/18

MECHANICAL SPECIAL PROVISIONS**MECHANICAL OPERATING MACHINERY**

PART 1. GENERAL

This specification includes:

1. The cleaning and relubrication of the existing main counterweight ropes. The furnishing of all materials and tools required to clean the ropes, and to apply new lubricant.
2. The removal of the existing northeast span lock receiver mounting bolts and shims. The furnishing, testing, and installing of new receiver mounting bolts and full-size shims.
3. The disassembly and cleaning of all span lock machinery couplings, and removal of the existing seals, gaskets, and fasteners. The furnishing, testing, and installing of new seals, gaskets, and fasteners on the span lock machinery couplings, and the reassembly of the couplings, and the lubrication of the couplings after reassembly.
4. The removal of the existing tower-mounted upper air buffers, and all associated hardware. The furnishing, testing, and installing of new overtravel bumpers, and all associated new supports and hardware.
5. The addition of counterweight balance plates to each of the existing counterweights to balance the span. The furnishing, testing, and installing of new counterweight plates, and all associated hardware.

1.1 DESCRIPTION OF WORK

Provide all apparatus, tools, devices, materials and labor to clean, install, erect, align, adjust, lubricate and test the rehabilitated components in an approved manner as provided herein.

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 lift span balance throughout the entire Contract.

Items include the following:

- A. For each tower: wire rope dressing, and any and all equipment necessary for proper cleaning and lubrication of the main counterweight rope assemblies.
- B. For one north corner: span lock receiver mounting bolts and shims, and all other equipment necessary for proper removal, installation, and alignment of the receiver.
- C. For each end: coupling fasteners, seals, and gaskets, and all other equipment necessary for proper removal, cleaning, installation, and lubrication of the couplings.
- D. For each corner: overtravel bumper assemblies, and all other equipment necessary for proper removal and installation of the assemblies.
- E. For each counterweight: steel plate to balance the span, and all equipment necessary for proper installation of the plates in the counterweights.

- F. Shims, bearings, high strength stainless steel pins, bolts, turned bolts, nuts, cotter pins and all other miscellaneous hardware.

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.

Steel Structures Painting Council (SSPC).

North Carolina Department of Transportation's (NCDOT) Standard Specifications

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 not clearly or accurately defined or dimensioned.
- 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 Cape Fear Vertical Lift 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 vertical lift bridges. The experience shall specifically show past projects involving vertical lift bridge wire rope cleaning, as well as working in a United States Coast Guard marine coordination.
2. The on-site supervisory personnel of the mechanical work shall have conducted a minimum of two successful mechanical component rehabilitations on a vertical lift bridge.

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. Pins, bolts, and nuts.
 3. Lubricants as endorsed by manufacturers including the wire rope manufacturer.
 4. Paint.
 5. Standard stocked items.
- 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" 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, 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 counterweight rope cleaning and lubrication – The Contractor shall include all methods to be used to clean the wire ropes, and the field lubricant to be applied after cleaning. The cleaning method and the field lubricant to be applied after cleaning shall be endorsed by the wire rope manufacturer, WireCo, in writing.
- B. Span lock receiver adjustment and alignment – The Contractor shall include all methods to change out the existing bolts and shims, and to install the new bolts and shims. This procedure shall be worked in conjunction with the procedure to shim the live load bearings, and the contractor shall show how the lock bar and receiver alignment will be maintained. This procedure shall be signed and stamped by a North Carolina Professional Engineer.
- C. Coupling rebuild – The Contractor shall include disassembly, cleaning, installation of new seals and gaskets, hand packing with new lubrication, reassembly, and lubrication after assembly. The procedure shall include manufacturer details, tolerances, and other requirements.
- D. Lubrication plan – The Contractor shall include shop and field lubricants and sealants endorsed by manufacturers, including the wire rope manufacturer, in writing as well as application procedures for each. The dates that the lubricant was applied to each component shall be included.
- E. Cleaning and painting procedure. – The Contractor shall include a procedure for cleaning the required components to SSPC-SP 1 and SSPC-SP 2 conditions and for the painting of non-working surfaces.

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 injurious 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.
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. 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.
4. Electrodes for welding shall comply with AWS D1.5.
5. 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.
6. Heavy hexagonal head bolts, heavy hexagonal nuts, and hardened washers shall conform to ASTM F3125 Grade A325, Type 1. ASTM A307 and SAE Grade 1, 2, or 4 bolts shall not be used. All bolts shall conform to the dimensions of ANSI B18.2.1 finished hex bolts.

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.
7. 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. Locking shall preferably be by use of double nuts.

The body of the turned bolts shall be finished to 63 microinches or better. 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 1/16th of an inch 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 may be sub-drilled (in the shop) smaller than the turned bolt diameter and shall be reamed together with supporting structural steel either during assembly or at erection, after the parts are correctly assembled and aligned. Positive type locking shall be provided. Double nuts are preferred. Where double nuts are used, heavy hex and jam nuts shall be used. Alternate locking methods shall be submitted to the Engineer for approval.

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.

8. Stainless steel for fasteners, threaded rods, pins and dowels where specified shall be Type 304 or 316 Stainless Steel, with a minimum tensile strength of 85,000 psi and shall meet or exceed ASTM F593, Alloy Group 1, Condition CW, unless otherwise specified. Stainless steel for hex nuts shall be Type 304 or 316, with a minimum tensile strength of 85,000 psi and shall meet or exceed ASTM F594, Alloy Group 1, Condition CW, unless otherwise specified. Stainless Steel washers where specified shall be Type 304 or 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.

9. Where shown on the drawings, all machinery shims required for leveling and alignment of equipment shall be stainless steel, ASTM A240, Type 316, neatly trimmed to the dimensions of the assembled parts and drilled for all bolts that pass through the shims. In general, total shim pack thickness shall be no less than twice the nominal thickness shown on the drawings, and of sufficient varying thicknesses shall be furnished to secure 0.03125-inch variations of the shim allowance including one shim equal to the full allowance. Shims shall be placed to provide full contact between machinery and machinery supports. Shims shall be shown in detail on the shop drawings.
10. Threads for pins shall be machine cut, and conform to the Unified National (UN) system of threading. The number of threads chosen shall correspond to the closest bolt diameter of the UN system.
11. The paint system shall comply with Section 442 of 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
Hubs on main trunnions	FN3	63
Sliding bearings	RC6	32
Center Disks	-	32
Keys and keyways (top and bottom)	*	63
Keys and keyways (sides)	FN2	63
Machinery parts in fixed contact	-	125
Teeth of open spur gears,		
Under 1 inch circular pitch	-	32
1 inch to 1 3/4 inch circular pitch	-	63
over 1 3/4 inch circular pitch	-	125

* ANSI Standard B17.1, Class II

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 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. Welding required for machinery 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. Completely test all welds used to fabricate machinery by ultrasonic inspection using the methods given by ASTM E164, according to AWS D1.5 for tension members, unless noted otherwise.

All welds shall be complete penetration (cp) welds unless otherwise noted or shown on the Contract Plans. No feather edges allowed on weldments. All free edges of stiffeners, webs, and gussets must be welded.

All welding shall be by certified welders.

Welding for stainless steel shall conform to AWS D1.6.

Welding for aluminum shall conform to AWS D1.2.

Submit all weld procedures and welding qualifications for approval prior to the start of work.

- E. 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.
- F. 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.
- G. Mechanical Component Requirements
 - 1. Galvanized Steel Counterweight Plates. The new counterweight plates shall be ASTM A709 Grade 36, galvanized as per ASTM A123.
 - 2. New Counterweight Steel Plate. Counterweight steel plate shall be galvanized and free of sharp edges. Handles or similar shall be provided for all plates. The plates shall be sized and designed by the Contractor for ease of installation, and for fit in the existing available space in the counterweight. The plates shall all be uniform weight, and shall be between 75lb and 100lb. 25,000lb of counterweight plate shall be provided by the Contractor, to be placed as indicated by the strain gage balance test results and as directed by the Engineer. See also the "Lift Span Balancing" section herein.

PART 3 EXECUTION

3.1 CLEANING AND LUBRICATION OF MAIN COUNTERWEIGHT WIRE ROPE ASSEMBLIES.

- 1. The Contractor shall consult the wire rope manufacturer (WireCo) for guidance on the best method to remove the existing wire rope lubrication without damaging the wire rope.
- 2. Properly and fully clean all main counterweight wire ropes of all lubrication and any foreign material on the entire length of the wire ropes.

3. Inspect the wire ropes during and after cleaning for damage and/or corrosion. Consult with the wire rope manufacturer for guidance on inspection. If deficiencies are found report them to the NCDOT immediately.
 4. The Contractor shall furnish and apply, in an approved manner, and when weather conditions are suitably dry and warm, one coat of lubricant that is compatible with that applied during rope fabrication and recommended by the wire rope manufacturer in writing (Renolin Centiguard 300, or approved equal). The Contractor shall apply an approved sealing compound at the end of the sockets as per the wire rope manufacturers recommendations. The Contractor shall furnish copies of letters from the wire rope manufacturer endorsing the lubricants and sealants used.
- 3.2 REMOVAL AND REPLACEMENT OF SPAN LOCK RECEIVER SHIMS AND MOUNTING BOLTS.
1. Remove existing span lock receiver mounting bolts and shims on the northeast corner.
 2. Clean and examine structural connections for deficiencies. If deficiencies are found report them to the NCDOT immediately.
 3. After the new live load bearing tapered shim is installed at the northeast live load bearing, install all new span lock receiver shims and mounting bolts. Shim thicknesses shall be adjusted as necessary to achieve the proper clearance between the receiver and the lockbar after the live load bearing shim adjustments are completed.
- 3.3 REHABILITATION OF SPAN LOCK MACHINERY COUPLINGS.
1. Support the shafts connected by the couplings to maintain alignment during the work.
 2. Disassemble the coupling by removing the cover bolts. Remove the existing seals and gaskets.
 3. Clean and examine the couplings for deficiencies. If deficiencies are found report them to the NCDOT immediately.
 4. Hand pack the coupling with fresh grease, as directed by the coupling manufacturer.
 5. Install new seals and gaskets, and reassemble the coupling by installing new cover bolts. Torque new bolts to the recommended value by the coupling manufacturer.
 6. Add lubrication through the cover lubrication ports as directed by the manufacturer.
- 3.4 REMOVAL AND REPLACEMENT OF TOWER MOUNTED UPPER AIR BUFFERS.
1. Remove existing tower mounted upper air buffers and all associated mounting hardware at all 4 corners. Deliver to location specified by the NCDOT.
 2. Clean and examine structural connections for deficiencies, including the buffer strike plates mounted to the lift span. If deficiencies are found report them to the NCDOT immediately.
 3. Install new support weldments for the new tower mounted overtravel bumpers.
 4. Adjust the bumper shims as necessary to achieve the required height of the assembly, as shown on the Contract Plans.
- 3.5 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.
- 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; Grofit Plastics of Northbrook, IL; Cromwell-Phoenix 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.

3.6 LIFT SPAN BALANCING

- A. A Licensed Professional Engineer must perform the testing and all balance calculations. Provide evidence of successful strain gage balancing experience on a minimum of three (3) vertical lift 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

After completing the initial and final balance tests, submit a formal 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 lift height

- B. Initial strain gage balancing shall be performed by the Contractor prior to beginning construction to establish a baseline for the balance spreadsheet. Strain gages shall be mounted on the two east and two west cross shafts to record torsional strain which shall be converted into loads to each corner of each tower. 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 lift span height indication for a minimum of three complete lift cycles. Span imbalance for each corner of the lift span shall be determined. The percentage of full load torque of the span drive motor(s) and the friction for the vertical lift system measured for the full operating cycle shall also be determined and submitted.

- C. The Contractor will be responsible for adjusting the span 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 lift span and counterweights. The spreadsheet and all associated calculations shall be submitted to the Engineer for approval prior to the start of work. When weight adjustments are necessary to maintain the balance condition, weight shall be added to or removed from the counterweight pockets in accordance with the approved calculations. 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.
- D. 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):

During Construction, Bridge Operation Not Permitted. Bridge is in the Closed Position, with Span Locks Engaged: The lift span must be span heavy, with a minimum positive reaction for each corner of 3,000 lbs with the bridge in the closed position.

During Construction, Bridge Operation Permitted: The lift span must be span heavy in the closed position, with a positive reaction for each corner between 3,000 lbs and 12,000 lbs.

Final Balance Condition of Bridge Following Construction: The lift span must be span heavy in the closed position, with a positive reaction at for each corner between 11,000 lbs and 12,000 lbs.

- E. Once the desired final lift span balance is achieved and accepted by the NCDOT, the Contractor can proceed with test operating the span. The span shall be tested with at least ten complete full operating cycles, including all necessary systems of the span. Machinery shall be monitored during these openings for leaks, noise, excessive vibration, hot components, and misalignment.

3.7 CONTRACTOR SUPERVISED OPERATION OF THE BRIDGE

- A. This work consists of operation of the bridge during construction activities and supervision of Department personnel in the operation of the bridge.
- B. The Department 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. The Contractor shall perform work in a way that allows for continued operation of the bridge.

3.8 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 will not be measured for payment but the cost thereof shall be included in the prices stipulated.

Payment will be made under:

<u>Description</u>	<u>Units</u>
Mechanical Operating Machinery	Lump Sum

MECHANICAL SPECIAL PROVISIONS**AUXILIARY COUNTERWEIGHT AND SPAN GUIDE REPAIRS**

PART 1. GENERAL

This specification includes:

1. The removal of existing auxiliary counterweight sheave and hitch shaft assemblies, and auxiliary counterweight ropes. The furnishing, testing, and installation of the select mechanical components for the auxiliary counterweight system including rehabilitated sheave and hitch shaft assemblies and new auxiliary counterweight wire ropes.
2. The removal of the existing longitudinal span guide assemblies. The furnishing, testing, and installing of new longitudinal span guide assemblies.

1.1 DESCRIPTION OF WORK

The work shall include removal of existing and furnishing, rehabilitating, manufacture, fabrication, testing, erection, installation, lubricating, and placing into satisfactory service, the auxiliary counterweight sheave assemblies, hitch shaft assemblies, auxiliary counterweight wire rope, and longitudinal span guide assemblies in an approved manner as provided herein. The Contractor shall provide all apparatus, tools, devices, materials and labor necessary to complete the above work. The Contractor shall thoroughly clean all existing associated components to be used. The cleaned/rehabilitated existing components shall be installed on new assemblies that include new shafts, bushings, shims, washers, nuts, pins, and all other associated components necessary to assure proper installation and operation of all new sheave and hitch shaft assemblies, all in accordance with these specifications and contract drawings or as directed by the NCDOT. The jacking, installation, and adjustment shall be by millwrights experienced in this class of work. The Contractor shall maintain the lift span balance throughout the entire Contract.

Items include the following:

- A. For each tower: auxiliary counterweight sheave assemblies, hitch shaft assemblies, ropes, rope sockets, wire rope dressing and all other equipment necessary for proper removal and installation of the assemblies.
- B. For two lower east corners: longitudinal span guide assemblies, temporary longitudinal span guide assemblies, and all other equipment necessary for proper removal and installation of the assemblies.
- C. Shims, bearings, high strength stainless steel pins, bolts, turned bolts, nuts, cotter pins and all other miscellaneous hardware.

1.2 REFERENCES

The issue date of references included in these project specifications 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 INSTITUTE OF STEEL CONSTRUCTION (AISC)

Manual of Steel Construction, "Specifications for Design, Fabrication and Erection of Structural Steel for Buildings"

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI B 1.1 Screw Threads

ANSI B 46.1 Surface Texture

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO Movable Highway Bridge Design Specifications, 2007, 2nd Edition (published by the American Association of State Highway and Transportation Officials).

AASHTO Standard Specifications for Movable Highway Bridges, 1988, Including 1992 Revisions (published by the American Association of State Highway and Transportation Officials).

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A153 Zinc Coating (Hot-Dip) on Iron and Steel Hardware

ASTM A276 Stainless Steel Bars

ASTM A 325 Structural Steel Bolts, Heat Treated

ASTM A 563 Carbon and Alloy Steel Nuts

ASTM A 668 Steel Forgings, Carbon and Alloy, for General Industrial Use

ASTM A 1007 Carbon Steel Wire for Wire Rope

ASTM A 1023 Stranded Carbon Steel Wire Rope

ASTM B 6 Zinc (Slab Zinc)

AMERICAN WELDING SOCIETY (AWS)

D1.5 Structural Welding Code

FEDERAL SPECIFICATIONS (Fed. Spec.)

North Carolina Department of Transportation's Standard Specifications

RR-S-550 Wire Rope Sockets

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 (including auxiliary counterweight rope lengths) 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 not clearly or accurately defined or dimensioned.
- 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 Cape Fear Vertical Lift 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 vertical lift bridges. The experience shall specifically show past projects involving vertical lift bridge wire rope change out as well as working in a United States Coast Guard marine outage.
- 2. The on-site supervisory personnel of the mechanical work shall have conducted a minimum of two successful mechanical component rehabilitations on a vertical lift bridge.
- 3. The Contractor shall provide personnel with industrial motor drive control experience, with a minimum experience of two vertical lift bridges.

1.4 SUBMITTALS

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. Pins, bolts, and nuts.

3. Lubricants as endorsed by manufacturers including the wire rope manufacturer.
4. Results of required rope tests presented herein.
5. Paint.
6. Standard stocked items.

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" indicate a sole-sourced intent on the part of the NCDOT when competitive products exist.
 - e. Quantity required.
 - f. Capacity and normal operating ratings for each rope assembly.
 - g. Dimensions of all principal elements within the item.
 - h. Certified external dimensions affecting interfaces or installations.
 - i. Gross weight.
 - j. Method and recommended type of lubrication.
3. 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. Auxiliary counterweight assembly installation – The Contractor shall include all temporary construction details, false work, jacks, and miscellaneous items required for removal of existing auxiliary sheave, hitch shaft, and rope assemblies, installation of new auxiliary sheave and hitch shaft assemblies, and installation of the new auxiliary counterweight ropes. This procedure shall be signed and stamped by a North Carolina Professional Engineer.
- B. Longitudinal span guide installation – The Contractor shall include all temporary construction details, false work, jacks, and miscellaneous items required for removal of existing longitudinal span guide assemblies, installation of temporary span guide assemblies if necessary, and installation of the new longitudinal span guide assemblies. This procedure shall be signed and stamped by a North Carolina Professional Engineer.
- C. Lubrication plan – The Contractor shall include shop and field lubricants and sealants endorsed by manufacturers, including the wire rope manufacturer, in writing as well as application procedures for each. The dates that the lubricant was applied to each component shall be included.
- D. Cleaning and painting procedure. – The Contractor shall include a procedure for cleaning the required components to SSPC-SP 1 and SSPC-SP 2 conditions and for the painting of non-working surfaces.

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 specifications 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 injurious 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.
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. 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.
4. Electrodes for welding shall comply with AWS D1.5-2010 Code.
5. Steel for weldments and miscellaneous components shall be ASTM A668, Class D, 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.
6. Heavy hexagonal head bolts, heavy hexagonal nuts, and hardened washers shall conform to ASTM F3125, Type 1. ASTM A307 and SAE Grade 1, 2, or 4 bolts shall not be used. All bolts shall conform to the dimensions of ANSI B18.2.1 finished hex bolts.

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.

7. Turned bolts shall be made from a material and have a strength equal to ASTM F3125, Type 1. Heavy hexagonal nuts, and hardened washers complying with A563, Grade C, and F436 respectively shall be used with the turned bolts. Locking shall preferably be by use of double nuts.

The body of the turned bolts shall be finished to 63 microinches or better. 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 1/16th of an inch 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 may be sub-drilled (in the shop) smaller than the turned bolt

diameter and shall be reamed together with supporting structural steel either during assembly or at erection, after the parts are correctly assembled and aligned. Positive type locking shall be provided. Double nuts are preferred. Where double nuts are used, heavy hex and jam nuts shall be used. Alternate locking methods shall be submitted to the Engineer for approval.

8. Flat countersunk head cap screws shall conform to ASTM F835. Stainless steel hex socket flat countersunk head screws shall be Type 316, with a minimum tensile strength of 80,000 psi, and shall meet or exceed ASTM F879, Alloy Group 1, Condition CW, unless otherwise specified. Dimensions shall conform to ANSI B18.3.
9. Stainless steel for fasteners, threaded rods, pins and dowels where specified shall be Type 304 or 316 Stainless Steel, with a minimum tensile strength of 85,000 psi and shall meet or exceed ASTM F593, Alloy Group 1, Condition CW, unless otherwise specified. Stainless steel for hex nuts shall be Type 304 or 316, with a minimum tensile strength of 85,000 psi and shall meet or exceed ASTM F594, Alloy Group 1, Condition CW, unless otherwise specified. Stainless Steel washers where specified shall be Type 304 or 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. All bronze bushings shall be ASTM B22, Alloy C91100 unless otherwise specified. New bushings shall be provided as shown in the contract drawings.
11. Bronze flat head cap screws shall be used to secure all bronze bushings.
12. Where shown on the drawings, all machinery shims required for leveling and alignment of equipment shall be stainless steel, ASTM A167, Type 302/304, neatly trimmed to the dimensions of the assembled parts and drilled for all bolts that pass through the shims. In general, total shim pack thickness shall be no less than twice the nominal thickness shown on the drawings, and of sufficient varying thicknesses shall be furnished to secure 0.03125-inch variations of the shim allowance including one shim equal to the full allowance. Shims shall be placed to provide full contact between machinery and machinery supports. Shims shall be shown in detail on the shop drawings.
13. Threads for pins shall be machine cut, and conform to the Unified National (UN) system of threading. The number of threads chosen shall correspond to the closest bolt diameter of the UN system.
14. The paint system shall comply with Section 442 of the NCDOT's Standard Specifications and shall be submitted for approval.

C. Manufacturer's Recommendations

1. If the Supplier or wire rope Manufacturer requires specific installation procedures to insure long life service of the component or wire ropes, printed copies of these recommendations shall be furnished to the NCDOT prior to shipment. Shipment of the ropes will not be allowed to proceed until such recommendations are received by the NCDOT.

2.2 GENERAL QUALITY OF WORK AND SURFACE FINISH

- 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
Hubs on main trunnions	FN3	63
Sliding bearings	RC6	32
Center Disks	-	32
Keys and keyways (top and bottom)	*	63
Keys and keyways (sides)	FN2	63
Machinery parts in fixed contact	-	125
Teeth of open spur gears,		
Under 1 inch circular pitch	-	32
1 inch to 1 3/4 inch circular pitch	-	63
over 1 3/4 inch circular pitch	-	125

* ANSI Standard B17.1, Class II

The above fits for cylindrical parts shall also apply to the major dimensions of non-cylindrical parts.

- C. 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.
- D. 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.
- E. 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. Shafts 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.

- F. 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 operating speeds.
- G. 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 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.
- H. 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 journal surface or adjoining shoulder fillets.
- I. All hubs shall have an ANSI Class FN2 medium force fit on the shafts unless otherwise specified.
- J. All castings shall be cleaned free of all loose sand and scale. All fins, seams, gates, risers and other irregularities shall be removed. All unfinished edges of castings shall be neatly cast with rounded corners and all inside angles shall have ample fillets. Dimensions of castings shown on the approved shop drawings will be the finished dimensions. Deviations from the dimensions and the thicknesses of the castings, as shown on the drawings, will not be permitted to exceed such amounts as will, in the opinion of the Engineer, impair the strength of the casting as computed from the dimensions shown. Warped or otherwise distorted castings, or castings that are oversize to such an extent as to interfere with the proper fit with other parts of the machinery, will be rejected. All castings shall be manufactured in accordance with ASTM A781 and shall be tested for internal defects using the applicable examination method prescribed under Supplementary Requirements of ASTM A781.
- K. Welding required for machinery shall comply with AWS D1.5 D1.1. 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. Completely test all welds used to fabricate machinery by ultrasonic inspection using the methods given by ASTM E164, according to AWS D1.5 for tension members, unless noted otherwise.

All welds shall be complete penetration (cp) welds unless otherwise noted or shown on the Contract Plans. No feather edges allowed on weldments. All free edges of stiffeners, webs, and gussets must be welded.

All welding shall be by certified welders.

Welding for stainless steel shall conform to AWS D1.6.

Welding for aluminum shall conform to AWS D1.2.

Submit all weld procedures and welding qualifications prior to the start of work.

- L. 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.
- M. 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.
- N. Wire Ropes

Wire rope assemblies shall be finished, assembled, tested, and adjusted in an approved manner and according to the best shop practice as defined by the latest edition of the Wire Rope Users Manual, all applicable ASTM and federal wire rope standards, and these Contract Documents. 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 on the contract drawings or as specified by AASHTO.

1. All auxiliary counterweight wire ropes shall be 7/8" diameter, made of Extra Improved Plow Steel with a minimum ultimate tensile strength of 70,800 pounds, and shall be 6 x 25 filler wire construction with fiber core (FC), and meet all the requirements of ASTM A1023. The wire ropes shall be right regular lay, with a maximum lay length of 6.56". The wire ropes shall be preformed. Each strand shall consist of 19 main wires and 6 filler wires fabricated in one operation, with all wires interlocking. The wire ropes shall comply with ASTM A1023, A1007, and these Contract Documents.
2. The wire ropes shall be made by an established manufacturer, whose facilities and experience have been approved by the NCDOT. Ropes shall be laid in accordance with the best practice. Every effort shall be made to obtain ropes of uniform physical properties. The ropes shall be fabricated in the greatest length practicable, and shall be cut from ropes manufactured with one setting of one stranding machine, and one setting of one closing machine.
3. The actual diameter of the wire rope shall be defined as the diameter of the circumscribed circle. The actual diameter of the rope, measured with the rope under a tension equal to 12 percent of its ultimate tensile strength, shall not be less than its nominal diameter, and not more than 3/64" for the auxiliary counterweight ropes in excess of its nominal diameter.
4. The actual length of each wire rope assembly, measured centerline to centerline of end socket pins, shall not vary from the specified length by more than 1/4" per 100 feet when measured under loading conditions described herein.
5. All portions of the wire rope shall be lubricated during fabrication with a lubricant containing a rust inhibitor.
6. NO splicing of the ropes or individual strands will be permitted.
7. Rope Sockets.
 - a. All rope sockets shall be galvanized open spelter sockets, Type A. The open spelter sockets, the socketing of the wire ropes, and the Inspection and Non-Destructive Testing of all sockets shall conform to Federal Specification RR-S-550, latest revision. The requirements for Type A, open spelter sockets shall apply. Sockets shall be attached to the ropes by using

zinc of a quality not less than that defined in the current specifications for Slab Zinc (Spelter), ASTM B6 High Grade. Maximum socket slip or seating of the zinc cone, with the rope, when tensioned to 80% of its specified ultimate strength, under the test specified previously, shall be 1/6 the nominal diameter of the rope. If a greater slip should occur, the socketing method shall be changed until satisfactory results are obtained.

- b. Variations or substitute designs of sockets will be considered acceptable if they meet or exceed the functional requirements for strength, materials, and other applicable provisions of the Federal Specification.
- c. Sockets shall be stronger than their ropes. If a socket should break during the test specified herein, two other job sockets shall be selected at random and attached to another piece of rope, and the test repeated, and this process shall be continued until the Inspector is satisfied of socket reliability, whereupon the lot shall be accepted. However, if 10% or more of the tested sockets fail at a load less than the specified minimum ultimate strength of the rope, the entire lot of sockets shall be rejected, and new ones shall be furnished which meet specification requirements.
- d. If the pin and socket fits shown on the Plans differ from those specified by the Federal Specification, the fits shown on the Plans shall be met.
- e. Sockets shall be shop galvanized in accordance with ASTM A153.
- f. Sockets for the auxiliary counterweight rope assemblies shall use the standard galvanized clevis pins.

PART 3 EXECUTION

3.1 REHAB OF AUXILIARY COUNTERWEIGHT SHEAVE AND HITCH SHAFT ASSEMBLIES.

A. Removal of Existing Auxiliary Sheave and Hitch Shaft Assemblies

- 1. To remove the auxiliary sheave and hitch shaft assemblies, it is necessary to first support the auxiliary counterweights to relieve tension on the ropes. The structure has no permanent provision to do this. The Contractor shall propose a method to raise and secure the auxiliary counterweight to the tower legs for this portion of the work. Alternatively, removal and reinstallation options may be submitted for approval.
- 2. Remove rope socket pins at span and counterweight and remove existing ropes.
- 3. Remove auxiliary counterweight sheave assemblies and hitch shaft assemblies ensuring that the auxiliary counterweight sheaves and hitches are not damaged (these will be reused). Examine structural connections for deficiencies. If deficiencies are found report them to the NCDOT immediately. Replace any structural fasteners that are removed.
- 4. Clean and remove all sharp edges from auxiliary counterweight sheaves and hitches. Clean, chase, and lubricate anchor rod threads. Machine sheave grooves as shown on the plans. Clean all old lubricant, debris, etc. from existing auxiliary counterweight, sheave, rope grooves, guides, deflectors, connection rods and attachment points to SSPC-SP 1 and SSPC-SP 2 condition. All non-working surfaces

shall be painted with the approved paint system and working surfaces shall be protected with an application of the approved lubricant.

B. Install New Auxiliary Sheave and Hitch Shaft Assemblies

1. The new auxiliary counterweight sheave assemblies and new hitch shaft assemblies shall be installed.
2. The auxiliary counterweight ropes shall be carefully removed from reels or coils by revolving them and shall be erected as to avoid any kinks or bends. The ropes shall not be pulled through dirt or water or over abrasive surfaces. The stripe painted on each rope in the shop shall be straight after the rope is installed. The Contractor shall show the erection procedure for the auxiliary counterweight ropes on the shop drawings. The new ropes shall be installed in the same position as the existing ropes.
3. After installation, the Contractor shall properly clean all new ropes of all foreign material and shall furnish and apply hot, in an approved manner, and when weather conditions are suitably dry and warm, one coat of lubricant that is compatible with that applied during rope fabrication and recommended by the wire rope manufacturer in writing. The Contractor shall remove all seizing at all sockets, properly clean the area, and apply an approved sealing compound at the end of the sockets as per the wire rope manufacturers recommendations. The Contractor shall furnish copies of letters from the wire rope manufacturer endorsing the lubricants and sealants used.
4. Adjust auxiliary counterweight rope tensions using the threaded take-up rods.

3.2 REMOVAL AND REPLACEMENT OF EXISTING LONGITUDINAL SPAN GUIDE ASSEMBLIES.

1. Remove existing span guide shaft assemblies.
2. Clean and examine structural connections for deficiencies. If deficiencies are found report them to the NCDOT immediately.
3. Install temporary span guides. Temporary span guides shall be designed by the Contractor and submitted for approval.
4. Remove temporary span guides and install final span guide assemblies.

3.3 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.
- 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; Grofit Plastics of Northbrook, IL; Cromwell-Phoenix 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.

- E. All wire ropes shall be shipped on reels, the diameter of which is not less than 25 times the diameter of the ropes, which shall be mounted on skids or otherwise crated for protection during shipment and storage.
- F. Material storage on site shall afford easy access for inspection and identification, protection from the ground and prevent distortion or damage.
- G. 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 LIFT SPAN BALANCING

- A. It is anticipated that the imbalance per tower at the beginning of construction will be 8000 lbs +/- 1000 lbs in the fully seated position. Coordinate with the NCDOT to confirm this condition prior to beginning work.
- B. The Contractor will be responsible for adjusting the span 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 lift span and counterweights. The spreadsheet and all associated calculations shall be submitted to the Engineer for approval prior to the start of work. When weight adjustments are necessary to maintain the balance condition, weight shall be added to or removed from the counterweight pockets in accordance with the approved calculations. 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.
- C. The Contractor shall be responsible for all labor and materials required to provide an acceptable balance, as directed by the NCDOT. All weight adjustments shall be carefully documented and formally submitted.
- D. Once the desired final lift span balance is achieved and accepted by the NCDOT, the Contractor can proceed with test operating the span.

3.6 CONTRACTOR SUPERVISED OPERATION OF THE BRIDGE

- A. This work consists of operation of the bridge during construction activities and supervision of Department personnel in the operation of the bridge.
- B. The Department 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 mechanical rehabilitation 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. The Contractor shall perform work in a way that allows for continued operation of the bridge. During the portion of the work when the auxiliary counterweight is removed, the span shall be lifted and lowered at 1/5th of the normal bridge operating speed. During operation of the span during this temporary condition, the span and drive machinery shall be monitored closely by the Contractor. Because the lift span will not remain span heavy during the entire lift, the operating characteristics of the bridge may change, especially after it passes 35 feet of lift and the balance approaches 0 lbs, and then becomes more and more counterweight heavy.

3.8 BASIS OF PAYMENT:

Payment for Auxiliary Counterweight and Span Guide Repairs 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 will not be measured for payment but the cost thereof shall be included in the prices stipulated.

Payment will be made under:

<u>Description</u>	<u>Units</u>
Auxiliary Counterweight and Span Guide Repairs	Lump Sum

**NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
PROJECT NO. 15BPR.15
NEW HANOVER COUNTY
CAPE FEAR RIVER MEMORIAL LIFT BRIDGE**

PROJECT SPECIAL PROVISIONS – ELECTRICAL

- Replace Air Horn (Special)
- Install New Signs (Special)



12/20/2017

REPLACE AIR HORN

1 DESCRIPTION OF WORK

The work shall include removal of existing and furnishing, installation, and testing into satisfactory service, the items of the bridge air horn system in accordance with the contract documents and as directed by the Engineer.

2 MATERIALS

Mounting brackets shall be hot-dipped galvanized steel or stainless steel; hardware shall be stainless steel. Additional material requirements shall be as specified in the contract drawings.

3 CONSTRUCTION DETAILS

Air horn system shall include air horns, solenoid valve, air piping, conduit, wiring, and SO cable as shown in the contract drawings, including all mounting brackets and hardware required for installation.

All equipment shall be installed at locations shown in the contract drawings in accordance with the NEC and the manufacturer's recommendations.

4 SUBMITTALS

The Contractor shall submit copies of producer or manufacturer catalog cut specification sheets for all new materials to the Engineer for approval.

5 BASIS OF PAYMENT

Payment for Replace Air Horn 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 documents.

Payment will be made under:

<u>Description</u>	<u>Units</u>
Replace Air Horn	Lump Sum

INSTALL NEW SIGNS

1 DESCRIPTION OF WORK

The work shall include removal of existing "SLIPPERY WHEN WET" signs and flasher lights and furnishing, installation, and testing into satisfactory service, the new signs, lights and appurtenances in accordance with the contract documents and as directed by the Engineer.

2 MATERIALS

Unless otherwise noted, mounting brackets shall be hot-dipped galvanized steel or stainless steel; hardware shall be stainless steel. Additional material requirements shall be as specified in the contract drawings.

3 CONSTRUCTION DETAILS

All equipment shall be installed at locations shown in the contract drawings in accordance with the NEC and the manufacturer's recommendations. Additional construction requirements shall be as specified in the contract drawings.

4 SUBMITTALS

Unless otherwise noted, the Contractor shall submit copies of producer or manufacturer catalog cut specification sheets for all new materials to the Engineer for approval. Additional submittal requirements shall be as specified in the contract drawings.

5 BASIS OF PAYMENT

Payment for Install New Signs 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 documents.

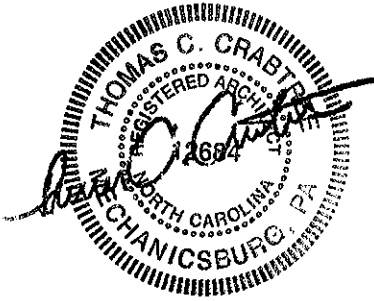
Payment will be made under:

<u>Description</u>	<u>Units</u>
Install New Signs	Lump Sum

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
PROJECT NO. 15BPR.15
NEW HANOVER COUNTY
CAPE FEAR RIVER MEMORIAL LIFT BRIDGE

ARCHITECTURAL SPECIFICATIONS
FOR
OPERATOR HOUSE RENOVATIONS

- Architectural Provisions (Special)



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.

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.

Edit the above as required to suit your project.

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.
- 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.
- 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.
- 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.

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 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.
 - 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

SECTION 028200 – ASBESTOS ABATEMENT

PART 1 - GENERAL

1. STANDARDS:

- 1.1 The contract documents require that each entity performing work be experienced in that part of the work being performed. Each entity is also required to be familiar with recognized industry standards and regulations applicable to that part of the work.
- 1.2 Where copies of standards and/or regulations are needed for proper performance of the work, the Contractor is required to obtain such copies directly from the publication source.
- 1.3 Although certain copies of standards needed for enforcement of the requirements may be required submittals, the Project Manager reserves the right to require the Contractor to submit additional copies of these standards as necessary for enforcement of the requirements.
- 1.4 It is a procedural requirement that the Contractor maintain complete current information on jurisdictional matters, regulatory actions and pending action, as applicable to the work. Discuss new developments at appropriate project meetings at the earliest feasible dates, and record information of relevance along with the action agreed upon. The manner in which Contract documents have been organized and subdivided is not intended to be an indication of jurisdictional or trade union agreements. Assign and sub-contract work, and employee tradesmen and laborers, in a manner which will not unduly risk jurisdictional disputes of a kind which could result in conflicts, delays, claims and losses in the performance of the work.
- 1.5 For the Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for payments, records established in conjunction with compliance with standards and regulations bearing upon performance of the work.

2. CODES AND REGULATIONS:

- 2.1 Except to the extent that more explicit or more stringent requirements are written already into the Contract documents, all applicable codes and regulations have the same force and effect (and are made a part of the contract documents by reference) as if copied directly into the Contract documents, or as if published copies were bound herewith.
- 2.2 Without exception, compliance with current Federal, State and Local regulations codes and/or written procedures is mandatory and it shall be assumed that the Contractor is aware of and familiar with such applicable regulations, codes and/or written procedures.

- 2.3 Where compliance with two or more regulations or sets of requirements is specified, and overlapping of those different regulations or requirements establish different or conflicting minimums or levels of quality, the most stringent requirement is intended and will be enforced.
 - 2.4 The contractor shall maintain current licenses as required by applicable Federal, State or Local jurisdictions for the removal, transportation, disposal or other regulated activity relative to the work of the Contract.
 - 2.5 Three (3) copies of applicable Federal, State and Local regulations shall be obtained by the Contractor. One copy of each shall be posted at the job site. One copy of each shall be on file in the Contractor's office. One copy of each shall be submitted to the Project Manager prior to the start date of the work of this Contract.
 - 2.6 The Contractor shall submit two (2) copies of all Federal, State and Local licenses, permits, codes and regulations applicable to the work to the Project Manager.
3. ABATEMENT NOTICES AND PERMITS:
- 3.1 The Contractor shall be responsible for sending notifications concerning the project to all applicable Federal, State and Local governmental agencies/authorities requiring such notification.
 - 3.2 The Contractor shall submit two (2) copies of all notifications that he/she has submitted to all applicable Federal, State and Local governmental agencies/authorities to the Project Manager
 - 3.3 The Contractor shall be responsible for the packaging, transportation and disposal of all asbestos-containing waste in compliance with all Federal, State and Local regulations governing the packaging, transportation, and disposal of asbestos-containing waste.
 - 3.4 The Owner shall be supplied with all of the documentation required by Federal, State and Local regulations governing the packaging, transportation and disposal of asbestos-containing waste by the Contractor.
 - 3.5 Warning signs that demarcate regulated area shall be provided and displayed at such a distance that an employee is able to read the signs and take necessary steps before entering the area marked by the signs.
 - 3.6 Barrier tape shall be installed between three (3) and four (4) feet above the floor at any potential entrances to the worksite warning of the hazard and advising that entry is prohibited.
 - 3.7 Labels shall be affixed to all containers containing asbestos waste. Labels shall be used in accordance with the requirements of all applicable Federal, State and Local regulations.
4. PRE-AWARD MEETING:

- 4.1 After the bids have been opened, the Project Manager shall arrange for a Pre-Award Meeting. At this meeting, the apparent low bidder shall present in detail the following:
- A. Plans and drawings of the decontamination facilities and their proposed locations;
 - B. The work area isolation plan with layout of engineering controls;
 - C. A description of stripping, removal, encapsulation and personal decontamination methods to be used;
 - D. Proposed time table and work schedule;
 - E. Security Program;
 - F. Routing plan for removal of contaminated material from the building;
 - G. Plan for the storage of contaminated materials;
 - H. Plan for the transportation and disposal of contaminated materials;
 - I. Emergency Action Plan; and

5. PERSONNEL QUALIFICATIONS:

- 5.1 All personnel of the Contractor involved with the asbestos abatement work shall be trained and certified/licensed in accordance with all applicable Federal, State and Local regulations.
- 5.2 All personnel of the Contractor involved with the asbestos abatement work shall be included under the Contractor's Medical Monitoring Program and Respiratory Protection Program.
- 5.3 The Contractor shall provide a sufficient number of qualified workers, foreman and superintendents to accomplish the work within the required schedule.

6. PROJECT STAFFING:

- 6.1 All asbestos supervisors assigned to this project shall be employees of the Contractor. A sub-contracted asbestos supervisor shall not be assigned to this project.
- 6.2 All asbestos supervisors assigned to this project shall be fluent in both the written and spoken English language.
- 6.3 The Contractor shall insure that all asbestos workers assigned to this project that are not fluent in both the written and spoken English language, shall be accompanied by a employee who can fluently interpret the written or spoken communications from the

English language for them into the language in which they are fluent. To satisfy this requirement, the interpreter shall be within sight and within normal speaking and at all times while within the work zone/work area by an asbestos worker or supervisor hearing distance of the worker for whom they are providing such interpretation.

7. STANDARD OPERATING PROCEDURES:

- 7.1 The contractor shall develop and implement a standard operating procedure during the abatement work to ensure maximum protection and safeguard from asbestos exposure of the workers, visitors to the site, employees, and the environment. The standard operating procedure shall ensure:
- A. Tight security of the work area on a 24-hour basis from unauthorized entry.
 - (1) The regulated area shall be restricted to only authorized, trained, and protected personnel. These may include the Contractor's employees, employees of sub-contractors, the Building Owner's employees and representatives, local inspectors and any other designated individuals.
 - (2) The Contractor shall lock all entrances to the work area when they are not occupied for abatement activities.
 - (3) The Contractor shall report entry into the regulated area by unauthorized individuals, immediately to the Building Owner or representative.
 - (4) The Contractor shall have control of site security during abatement operations wherever possible in order to protect the work efforts and equipment.
 - (5) The Contractor shall maintain a record of the arrival and departure times for all personnel. The log shall include the worker's printed name, social security number, work area assignment, time on the site, time off the site and the worker's initials.
 - B. Proper protective clothing and respiratory protection prior to entering the work space from the outside.
 - C. Safe work practices in the work place including provisions for inter-room communications, exclusion of eating, drinking, smoking or in any way breaking the respiratory protection.
 - D. Proper exit practices from the work area to the outside through showering and decontamination practices.
 - E. Removing, encapsulating or enclosing asbestos in ways that minimize the release of fibers.
 - F. Packing, labeling, loading, transporting and disposing of contaminated materials in a way that minimizes exposure and contamination.

- G. Emergency evacuation for medical or safety (fire and smoke) so that exposure will be minimized.
 - H. Safety from accidents in the workspace, especially from electrical shocks, slippery surfaces and entanglements in hoses and equipment.
 - I. Engineering systems that minimize exposure to fibers and dust in the work area.
8. NOTIFICATIONS, PERMITS, WARNINGS, SIGNS, LABELS AND POSTERS:
- 8.1 Post copies of all regulations, permits and notifications applicable to the Project at the work site.
 - 8.2 Erect warning signs around the work area and at every potential entry point from the outside. At a minimum, warning signs and barriers shall be in compliance with all applicable Federal, State and Local regulations.
9. EMERGENCY ACTION PLAN:
- 9.1 The Contractor shall establish emergency and fire exits from the work area.
 - 9.2 Local medical emergency personnel shall be notified prior to the commencement of abatement operations as to the possibility of having to handle contaminated or injured workmen, and shall be advised on safe decontaminations.
 - 9.3 The Contractor shall be prepared to administer first aid to injured personnel after decontamination. Seriously injured personnel shall be treated immediately or evacuated without delay for decontamination. When an injury occurs, the Contractor shall stop work and implement fiber and dust reduction techniques until the injured person has been removed from the work area.
 - 9.4 Before the Contractor starts the actual removal of the asbestos material, the local police and fire department shall be notified as to the danger of entering the work area and they shall be invited to attend an informal training program to be conducted by the Contractor which shall provide information regarding abatement activities, decontamination practices, etc.
 - 9.5 The Contractor shall make every effort to help these agencies form plans of action should their personnel need to enter the contaminated area.
 - 9.6 Emergency planning shall include considerations of fire, explosion, toxic atmospheres, electrical hazards, slips, trips, falls and heat-related injury. Written procedures shall be developed and employee training shall be provided. The Contractor shall maintain copies of the written procedures and certifications of employee training records on site.
 - 9.7 Employees shall be trained in evaluation procedures in the event of workplace emergencies.

- 9.8 Telephone numbers of all emergency response agencies shall be prominently posted at the work site along with the location of the nearest telephone.
10. HEALTH WARNING:
- 10.1 Bidders are warned that unprotected exposure to asbestos has been determined to be dangerous. Care must be taken to avoid releasing or causing to be released asbestos fibers into the atmosphere so that they may be inhaled or ingested.
11. PUBLIC SAFETY AND SECURITY:
- 11.1 The Contractor shall take every reasonable precaution for the safety of persons working in or entering the property, and for the protection of the building, his/her own tools, equipment and materials and those of all other parties working upon the project. Lights, fences, barriers, danger, warning and other signs shall be appropriately placed and every means shall be provided to protect life and property.
- 11.2 In order to protect the lives and health of his/her employees under this Contract, the Contractor shall comply with all pertinent provisions of the Occupational Safety and Health Administration (OSHA) and all other Federal, State and Local regulations governing employee safety.
12. NEWS RELEASES:
- 12.1 News releases pertaining to this project shall not be made without prior Owner approval, and then only in coordination with the Owner.
13. PROTECTION:
- 13.1 The Contractor shall erect and maintain proper protection for all equipment and all parts of the building during all stages of the work of this Contract.
- 13.2 The Contractor shall take special precautions to protect any property of the Owner that is not to be demolished during the course of this project.
- 13.3 The Contractor shall maintain and enforce regulations covering all the hazards including smoking and provide suitable fire extinguishers and other protective measures in proper locations.
- 13.4 The Contractor shall protect all trees, shrubs, lawn and landscape work from damage and provide such guards and covering as necessary.
- 13.5 The Contractor shall take proper and necessary steps to protect streets, private roads and walks.
- 13.6 The Contractor shall provide and maintain guard lights at barricades, railings, obstructions in the streets or sidewalks, and all trenches or pits adjacent to public walks or roads.
- 13.7 The contractor shall be responsible for any damages, injuries, repairs or replacements caused by his/her failure to adhere to these requirements.

- 13.8 The contractor shall make necessary and satisfactory arrangements with the Owner prior to interrupting services and utilities into and from existing buildings.
14. CLEAN-UP:
- 14.1 The contractor shall remove all accumulated asbestos-containing waste from the work site area daily.
- 14.2 If any asbestos-containing debris is to be stored on the Owner's premises overnight, it shall be stored in a locked covered container and such storage shall be approved in writing by the Owner.
15. NATIONAL ELECTRICAL CODE COMPLIANCE:
- 15.1 All equipment using electrical energy or connected to the electrical system shall be wired in accordance with the established standards of the National Fire Protection Association.
- 15.2 A Certificate of Approval of all such equipment shall be submitted in duplicate to the Project Manager. Electrical components of the equipment shall be listed by the Underwriters Laboratories for the appropriate service.
16. UTILITIES:
- 16.1 The contractor shall be responsible for providing a generator to provide adequate power to the work area for the completion of all of the work of this Contract. The Owner may have electrical power available for your use at the work site, but the Owner will not guarantee the availability of electrical power for the duration of this Project or any portion thereof.
- 16.2 The Contractor shall be responsible for providing all heat to the work area necessary for the completion of all of the work of this Contract. This building Owner may have heat supplied to the building, but the Owner will not guarantee the availability of heat to the building for the duration of this Project or any portion thereof. The Contractor shall not utilize any type of heating devise that will create a risk to building occupants/workers from carbon monoxide build-up.
- 16.3 The contractor shall be responsible for providing all water to the work area necessary for the completion of the work of this Contract. The Owner may have water supplied to the building, but the Owner will not guarantee the availability of water to the building for the duration of this Project or any portion thereof.
17. COST OF AIR MONITORING AND PROJECT OVERSIGHT ACTIVITIES:
- 17.1 The air monitoring and project oversight firm for this Project shall be Generations Environmental Consulting, LLC.
- 17.2 The air monitoring/project oversight firm will be contracted directly to the Chambersburg Area School District.

18. DRAWINGS AND SKETCHES:

- 18.1 The Contractor shall be aware that the drawings and sketches included in this Contract are diagrammatic and are not intended to be rigid in details.
- 18.2 General notes appearing on the drawings and sketches are hereby made part of these Specifications. Conflicts between these notes and the Specifications shall be resolved in accordance with the Contract documents.
- 18.3 Drawings are not scaled. Field verification is required, since actual conditions may vary from recorded data.
- 18.4 Should the drawings or sketches not agree in themselves or not agree with the Specifications, the greater quantity or superior quality of work or materials shall be estimated upon and included in the bid price. The Contractor shall call such discrepancies to the attention of the Project Manager as soon as they are noted.

19. SMOKING:

- 19.1 Smoking or other use of tobacco products shall not be permitted on the Owner's premises.

20. CERTIFICATIONS:

- 20.1 These Contract Documents are accurate to the best knowledge of the Asbestos Project Designer. The Asbestos Project Designer and Generations Environmental Consulting, LLC assume no liability whatsoever for financial or health consequences for actions taken or failure to take action by anyone whatsoever as a result of these Contract Documents.

21. DEFINITIONS:

Abatement- Procedures to control fiber release from asbestos-containing materials. Includes removal, encapsulation, enclosure, repair, demolition, and renovation activities.

Addenda – Written or graphic instruments issued by Architect/Engineer/Project Designer prior to receipt of Bids, which modify or interpret the Bidding Document by additions, deletions, clarifications, or corrections. Interpretations, corrections, changes of the Bidding Documents made in any other manner will not be binding, and Bidders may not rely on them. Official Addenda shall take precedence over original Bidding Documents/Technical Specifications and shall be so honored by Bidders in preparing their Bids.

AHERA- Asbestos Hazard Emergency Response Act

Airlock- A system for permitting ingress and egress with minimum air movement between a contaminated area and an uncontaminated area, typically consisting of at least three curtained doorways separated by a distance of at least three feet such that one passes through one doorway into the airlock, allowing the doorway sheeting to overlap and close off the opening before proceeding through the second doorway, thereby minimizing flow-through contamination.

Air Monitoring- The process of measuring the fiber concentration of a known volume of air collected during a specified period of time. The procedure normally used for measuring airborne asbestos follows the NIOSH Standard Analytical Method for Asbestos in Air or Method 7400 (Phase Contrast Microscopy), A Counting Rule.

Amended Water- Water to which a surfactant has been added.

Asbestos- The asbestiform varieties of serpentine (chrysotile), reibeckite (crocidolite), cummingtonite-gruerite (amosite), anthophyllite, actinolite, and tremolite.

Asbestos-Containing Material (ACM)- Material composed of asbestos of any type and in an amount greater than 1% by weight, either alone or mixed with other fibrous or non-fibrous materials.

Asbestos-Containing Waste Material- Asbestos-containing material or asbestos-contaminated objects requiring disposal.

Base Bid- Sum stated in the Bid for which the Bidder offers to perform the work described in the Bidding Documents or Job Specifications as the base, to which may be added or from which work may be deleted for sums stated in unit prices or alternate bids.

Bid- A complete and properly signed proposal to do the work for the sums stipulated therein, submitted in accordance with the Bidding Documents.

Bidder – Person who submits a Bid.

Bidding Documents – Include the Bidding Requirements/Technical Specifications and the proposed Contract Documents.

Building/Facility Owner- The legal entity including a lessee who exercises control over the management and record-keeping functions relating to the building(s) in which activities covered by this Technical Specification take place (The Chambersburg Area School District).

Category I Non-Friable ACM- Asbestos-containing packing, gaskets, resilient floor covering, and asphalt roofing products containing more than one percent asbestos.

Category II Non-Friable ACM- Any material, excluding Category I Non-Friable ACM, containing more than one percent asbestos that, when dry, cannot be crumbled, pulverized, or reduced to powder by hand pressure.

Class I Asbestos Work- Activities involving the removal of TSI and surfacing ACM and presumed ACM.

Class II Asbestos Work- Activities involving the removal of ACM, which is not thermal system insulation of surfacing material. This includes but is not limited to the removal of asbestos containing wallboard, floor tile, and sheeting; roofing and siding shingles; and construction materials.

Clean Room- An uncontaminated area or room, which is a part of the personnel decontamination enclosure system with provisions for storage of workers' street clothes and clean protective equipment.

Competent Person- In addition to the definition in 29 CFR 1926.32 (f), one who is capable of identifying existing asbestos hazards in the work place, and electing the appropriate control strategy for measures to eliminate them. In addition, for Class I and Class II work, the competent person must be specifically trained in a training course which meets the criteria of the U.S. EPA's model accreditation plan (40 CFR 763) for supervisor.

Contractor- The individual or business in which the Building Owner arranges to perform the asbestos abatement. The Contractor is responsible for the proper completion of project activities in accordance with these contract specifications, even where a subcontractor has been retained to perform the actual abatement.

Decontamination Chamber- A system for permitting ingress and egress with minimum air movement between a contaminated area and an uncontaminated area consisting of a clean room, a shower room, and an equipment room separated from each other and from the work area by curtained doorways. This system is used for all personnel entry and exit in the work area and for equipment and asbestos waste transport from the work area.

Demolition- the wrecking or taking out of any load-supporting structural member and any related razing, removing, or stripping of asbestos products.

Encapsulant- A liquid material which can be applied to asbestos containing material which controls the possible release of asbestos fibers from the material either by creating a membrane over the surface (bridging encapsulant) or by penetrating into the material and binding its components together (penetrating encapsulant). The U.S. EPA shall approve all encapsulants.

Encapsulation- The application of an encapsulant to asbestos containing materials, to control the release of asbestos fibers into the air.

Enclosure- The construction of an airtight, impermeable, permanent barrier around asbestos containing material, to control the release of asbestos fibers into the air.

Fiber- A particular form of asbestos, 5 micrometers or longer, with a length-to diameter ratio of at least 3 to 1.

Friable Asbestos Containing Material- Asbestos containing material (greater than 1% asbestos), which can be broken, crumbled, pulverized, or reduced to powder when dry, under hand pressure. This term also includes non-friable ACM after it has become damaged to the extent that when dry it may be crumbled, pulverized, or reduced to powder by hand pressure.

Glovebag- An impervious plastic bag-like enclosure affixed around an asbestos containing material with glove-like appendages through which material and tools may be handled.

HEPA Filter- A high-efficiency particulate air filter capable of removing particles greater than or equal to 0.3 microns in diameter with 99.97% efficiency. Each HEPA filter shall bear a UL 586 label to indicate ability to perform under specified conditions.

HEPA Filtered Fan Unit- A portable exhaust system equipped with HEPA filtration and capable of maintaining a constant filtered airflow from contaminated areas into adjacent

uncontaminated areas. This unit has the ability to create and maintain a pressure of smaller absolute magnitude in the work area as compared to outside of the work area. HEPA filtered fan units shall draw air from the contaminated work area across the HEPA filter and exhaust outside the work area.

HEPA vacuum- A vacuum system equipped with HEPA filtration.

Lockdown- A sticky sealant that is sprayed on beams, decks, ceilings, etc. after asbestos is cleaned off. Lockdown seals in any invisible fibers that were not cleaned up.

NESHAPS- The National Emissions Standards for Hazardous Air Pollutants (40 CFR Part 61).

OSHA- The Occupational Safety and Health Administration, 200 Constitution Avenue, Washington, D.C. 20210.

PCM- Phase Contrast Microscopy

PLM- Polarized Light Microscopy

Presumed Asbestos Containing Material (PACM)- Thermal system insulation and surfacing material found in buildings constructed no later than 1980.

Regulated Area- An area established by the Contractor to demarcate areas where Classes I and II asbestos work are conducted.

Regulated Asbestos Containing Material (RACM)- Friable ACM. Category I Non-Friable ACM that has become friable. Category I Non-Friable ACM that will be or has been subjected to sanding, grinding, cutting, or abrading. Category II Non-Friable ACM that has a high probability of becoming or has become crumbled, pulverized, or reduced to a powder by forces expected to act on the material in the course of demolition operations.

Removal- The stripping of any asbestos containing materials from surfaces or components of a facility. All facets of industry-accepted procedures (notification, establishing regulated work areas, performing OSHA-required air sampling, etc.) are included in this definition.

Strip- To take off friable asbestos materials from any part of the facility.

Surfacing Material- Material that is sprayed, troweled-on, or otherwise applied to surfaces.

Surfactant- A chemical wetting agent added to water to improve penetration.

TEM- Transmission Electron Microscopy

TSI- Thermal System Insulation- ACM applied to pipes, fittings, boilers, breeching, tanks, ducts or other structural components to prevent heat loss or gain. Thermal System Insulation ACM is thermal insulation, which contains more than 1% asbestos.

Unit Price – Amount proposed by the Bidder and stated on the Bid Form as a price per unit of measurement for materials that will be added to or deducted from the Contract Sum by Change Order in the event that the estimated quantities of work are increased or decreased.

U.S. EPA- United States Environmental Protection Agency, 401 M Street, S.W., Washington, D.C. 20460.

Visible Emissions- Any emissions containing, particulate asbestos materials, that are visually detectable without the aid of instruments. This does not include condensed, uncombined water vapor.

Fluorescent Light Ballasts/Capacitors:

All light ballasts/capacitors that are not marked "NO PCB's," shall be assumed to contain PCB's and shall be removed and disposed of by the Contractor in accordance with all Federal, State and Local regulations. Light ballasts/capacitors that are discovered to be leaking, shall be removed by workers wearing protective clothing, including chemically resistant gloves selected for PCB resistance, disposable shoe covers, and disposable overalls as prescribed by the Occupational Safety and Health Administration (OSHA). The Contractor shall determine the proper disposal method based upon all State and Local regulations and the Toxic Substances Control Act (TSCA) Storage Disposal Requirements for Fluorescent Light Ballasts.

Lead-Coated Materials:

The Contractor shall comply with OSHA's Lead in Construction Regulation. Toxicity Characteristic Leaching Procedure (TCLP) testing of the demolition waste stream shall be performed to determine if the waste can be disposed of as construction waste.

PART 2 - ASBESTOS ABATEMENT SCOPE OF WORK

1. Description:

This section covers the furnishing of all labor, materials, facilities, equipment, services, employee training, permits and agreements necessary to perform the work required for the asbestos removal in accordance with the Contract documents and all applicable Federal, State and Local regulations.

Whenever there is a conflict or overlap of the above references, the most stringent provisions are applicable.

2. Initial Work:

Background air quality must be established by the Consultant prior to commencement of the work in the building. The Contractor shall coordinate such work with the Consultant and shall not commence the work in the building until such samples have been taken and analyzed.

3. Owner Occupancy:

The Owner may award general construction contracts for additional work within the building.

The Owner will retain partial occupancy of the building during the abatement procedures.

Special attention must be given to the security of the work areas to prevent unauthorized access.

4. Scope of Work:

The scope of the work consists of, but is not limited to the following:

Perform the work and provide the services as follows:

A. Work area preparation.

- 1) A negative air filtration system shall be used. The Contractor shall be responsible for obtaining any licenses or permits required for the use of the negative air system that they use. The Contractor shall be aware of and is responsible for complying with any patent rights that may apply to the system that is used.

B. Worker training, respiratory protection and medical examination.

C. Asbestos abatement to be performed in the Memorial Bridge House:

a) Remove all of the transite-type panels in the Memorial Bridge House

1) At a minimum:

- (a) Establish a regulated area.
- (b) Carefully remove the panels in full pieces, keeping the material wet.
- (c) Wrap the panels with two (2) layers of individually sealed six (6) mil. minimum polyethylene sheeting prior to disposal.
- (d) All of this work, including the achievement of final clearance air criteria, the removal of work area barriers and equipment, shall be commenced and completed in accordance with the phasing time schedules established in the Contract Documents. If the work of any phase is not completed by the established completion date for the phase, liquidated damages will be assessed for each calendar day until the work of the phase is successfully completed.

- D. The work of this Contract shall be commenced and completed in accordance with the phasing time schedules established by the Architect and the Owner's Construction Project Manager. Each phase of the work of this Contract shall be performed on consecutive weekdays, excluding legal holidays, until all of the work of the phase has been completed.

The work of this Contract being ahead of schedule shall not void the requirement for the work to be performed on consecutive week days. The Owner reserves the right to alter the start date of each phase of this work based upon their needs. If such alteration to the start date is made, the Owner will notify the Contractor a minimum of fifteen (15) calendar days in advance.

- E. The Contractor shall be responsible for performing additional work as change order work as may be directed by the Owner. This additional work shall be started no later than 24 hours after the Contractor receives such notice from the Owner, and shall continue on consecutive days until all of the work of the change order has been completed. The Contractor shall perform change order work as directed by the Owner and such work may include the requirement to work weekends and evenings/nights.
- F. The Contractor shall be responsible for obtaining all measurements necessary for the satisfactory completion of the work of this Contract.
- G. If additional (not previously discovered suspect asbestos-containing material is identified during abatement activities, the Contractor shall immediately notify the Building Owner or representative. If the suspect asbestos-containing material is determined to be asbestos containing material by laboratory analysis, the Contractor shall remove any additional asbestos-containing material in accordance with and agreed upon change of scope in writing at agreed upon wages and material costs and in accordance with applicable Local, State and Federal regulations and these specifications.
- H. The Contractor shall be responsible for the removal, temporary supporting of, and the reinstallation of mechanical and electrical fixtures/equipment supported by any of the material that is being removed as a part of this Contract.
- I. All of the Contractor's employees assigned to work in any area that could be defined as a confined space shall be adequately trained in entering and working in confined spaces and shall understand the potential hazards of working in such areas. The Contractor shall provide the Owner with a certified statement indicating that such training has taken place. The Contractor shall monitor the confined space areas continuously while work is being performed in those areas for oxygen, carbon monoxide and combustible gases.
- J. The start date for any additional phases of work and the hours of that work will be as stipulated by the Project Manager and may include nights and weekends.
- K. Salvage and/or reuse of any materials removed as a part of this project shall be prohibited.
- L. The Contractor shall turn the building over to the Owner free of all odors associated with the work of this Contract.
- M. All sketches provided to the bidders are not to scale.
- N. The work of this Contract shall be phased as stipulated by the Architect and the Owner's Construction Project Manager.

PART 3 - ASBESTOS ABATEMENT NEGATIVE PRESSURE SYSTEM**General:**

Provide supply air to and exhaust air from the work area to maintain a negative pressure of 0.02 inches of water. The ventilation system shall operate on a 24-hour basis throughout the abatement process through the achievement of the final clearance criteria. The ventilation system shall be in accordance with the US EPA recommendations included in the "Guidance for Controlling Friable Asbestos-Containing Materials in Buildings", Appendix F.

If requested by the Project Manager, the Contractor shall provide an automatic recording instrument to monitor the negative pressure differential in a representative location. The instrument shall continuously generate a permanent record.

In a multi-room abatement project, provide a sufficient number of supply and exhaust units to create a stream of air away from the faces of the workers in each room and in such a way as to not damage or compromise the integrity of the plastic isolation barriers.

Negative Air Units:

The negative air units shall have cabinets constructed of steel or other durable materials able to withstand damage from rough handling and transportation.

The rate capacity of the fans shall be according to usable air-moving capacity under actual operating conditions. Use centrifugal-type fans.

The final filter shall be the High Efficiency Particulate Air (HEPA) type. The filter media folded into closely pleated panels must be completely sealed on all edges with a structurally rigid frame.

Prefilters which protect the final filter by removing the larger particles are required to prolong the operating life of the HEPA filter. Two stages of prefiltration are required. The first stage prefilter shall be a low-efficiency type for particles 10 um or larger. The second-stage or intermediate prefilter shall have a medium efficiency rating effective for particles down to 5 um. Prefilters and intermediate filters shall be installed either on or in the intake grid of the unit and held in place with special housings or clamps.

Each unit shall have an electrical or mechanical lockout to prevent the fan from operating without a HEPA filter. Units shall be equipped with an automatic shutdown system to stop the fan in the event of a major rupture in the HEPA filter or blocked air discharge. Warning lights are required to indicate normal operation, too high a pressure drop across the filters, and too low of a pressure drop.

Electrical components shall be approved by the National Electrical Manufacturers Association and Underwriter's Laboratories. Each unit shall be equipped with overload protection sized for the equipment. The motor, fan, housing and cabinet shall be grounded.

Preparation of the Work Area:

Provide fully operational negative pressure systems supplying a minimum of one air change every 15 minutes.

Add one additional unit as a backup in case of equipment failure or machine shutdown for filter changing.

These requirements will generally produce satisfactory negative pressure in the work area. However, prior to the start of abatement operations, the Contractor shall check to assure satisfactory performance and change the number, type and location of units if required.

Locate exhaust units so that makeup air enters the work area primarily through the decontamination unit and traverses the work area as much as possible. This may be accomplished by positioning the exhaust units at a maximum distance from the worker access opening or other makeup air sources.

Place the end of the unit or its exhaust duct through an opening in the plastic barrier or wall covering. The plastic around the unit or duct shall then be sealed with tape.

Vent to the outside of the building unless authorized in writing by the Project Manager.

Spiral wire-reinforced flex duct shall be used to vent HEPA exhaust.

Provide supplemental makeup air inlets where required for proper air flow through the work space in locations approved by the Project Manager by making openings in the plastic sheeting that allow air from the outside of the work space to enter.

Demonstration of the successful operation of the negative pressure to the Project Manager will include, but not be limited to:

Plastic barriers and sheeting moving lightly in toward the work area.

Curtain of the decontamination unit moves lightly in towards the work area.

There is a noticeable movement of air through the decontamination unit. Use a smoke tube to demonstrate air movement from the clean room to the shower room to the equipment room and from there to the work area.

Use a differential pressure meter or manometer, if requested to do so by the Project Manager, to demonstrate pressure difference of at least 0.02 inches of water across every barrier separating the work area from the balance of the building or the outside.

The Contractor shall modify the negative pressure system as necessary to successfully demonstrate the above.

Use of the Negative Pressure System During Removal Operations:

The exhaust units shall be started before beginning the asbestos-containing material removal. After removal has begun, the units shall be run continuously to maintain a

constant negative pressure until decontamination of the work area is complete. The units shall not be turned off at the end of the work shift or when removal operations temporarily stop. The units shall run continuously until the final clearance criteria is achieved.

The removal work shall start at a location farthest from the exhaust units and proceed toward them.

If an electrical power failure occurs, removal shall stop immediately and shall not resume until power is restored and exhaust units are operating. The work area shall be sealed until electricity is restored.

PART 4 - ASBESTOS ABATEMENT AIR MONITORING

General:

Air monitoring shall be performed by a consultant contracted by the Owner.

Background:

Prior to any preparation or abatement work, background air samples will be collected by the air monitoring firm as a base level.

Work in Progress Air Monitoring:

The work shall be continuously monitored by a consultant contracted by the Owner. The monitoring shall be inside the work area and the surroundings for compliance with these specifications and all applicable regulations. The Contractor shall provide full cooperation and support to the air monitoring personnel throughout the abatement process. The continuous monitoring and checking will include air samples in the work space, air samples in the area surrounding the work area and the outside, observing the standard operating procedures, engineering control systems, respiratory protection systems, packing, packaging, and transportation of waste, decontamination facilities and procedures, and any other aspects of the abatement process that may impact the health and safety of the people and the environment.

The Contractor may request copies of all laboratory reports of the air monitoring and observation program. All information shall be recorded in the Contractor's air monitoring log.

Clearance Air Monitoring:

Final clearance air samples shall be analyzed via Phase Contrast Microscopy (PCM) and shall yield results of less than 0.01 fibers per cubic centimeter (<0.01 f/cc).

PART 5 - ASBESTOS ABATEMENT TEMPORARY FACILITIES**Materials and Equipment:**

The Contractor shall provide new or used materials and equipment that are undamaged and in serviceable condition. Provide only materials and equipment that are recognized as being suitable for the intended use by compliance with appropriate standards.

Water Service:

For temporary water service connections, all connections to the Owner's water system shall include backflow protection. Valves shall be temperature and pressure rated for operation of the temperatures and pressures encountered. After completion of use, connections and fittings shall be removed without damage or alteration to existing water piping and equipment. Leaking or dripping valves shall be piped to the nearest drain, or located over an existing sink or grade where water will not damage existing finishes or equipment.

Employ heavy-duty abrasion-resistant water hoses with a pressure rating greater than the maximum pressure of the water distribution system to provide water into each work area and to each decontamination unit. Provide fittings as required to allow for connection to existing wall hydrants or spouts, as well as temporary water heating equipment, branch piping, showers, shutoff nozzles and equipment.

Hot water for the decontamination unit shower may be secured from the building hot water system if available, provided backflow protection is installed at the point of connection as described in this section. However, if hot water is not available from the building hot water system, the Contractor shall provide an alternate means of supplying hot water to the decontamination unit shower.

Electrical Service:

Comply with applicable NEMA, NECA, and UL standards and governing regulations for materials and layouts of temporary electric services, including those requirements included elsewhere in the Contract documents.

The Contractor shall shut down and disconnect all electric power to the work area, so that there is no possibility of reactivation and electrical shock during the entire abatement process. Temporary electrical power shall be in accordance with the Occupational Safety and Health Administration and the National Electrical Code for Wet Environments.

The Contractor shall provide identification warning signs at power outlets which are other than 110-120 volt power. Provide polarized outlets for plug-in type outlets to prevent insertion of 110-120 volt plugs into higher voltage outlets.

Temporary Heat:

The Contractor shall provide temporary heating units when the inside temperature is less than 50 degrees Fahrenheit. The temporary heating units shall have been tested and labeled by Underwriters Laboratories or another recognized trade association related to the

fuel being consumed. Use steam or hot water radiant heat where available. Under no circumstances shall forced air or fan-type units be utilized. Under no circumstances shall "torpedo-type" heaters be utilized.

Fire Extinguishers:

The Contractor shall provide Type "ABC" dry chemical extinguishers at a minimum of one extinguisher in each work area, in the equipment room and in the clean room.

Temporary Lighting:

The Contractor shall provide temporary lighting where natural light or existing building lighting does not meet the required light level. One 200-watt incandescent lamp per 1,000 square feet of floor area, uniformly distributed, for general construction lighting, or, equivalent illumination of a similar nature. In corridors and similar traffic areas, provide one 100-watt incandescent lamp every 50 feet. In stairways and in ladder runs, provide one lamp minimum per story, located to illuminate each landing and flight. Provide sufficient temporary lighting to ensure proper workmanship everywhere, by combined use of daylight, general lighting and portable plug-in task lighting. Provide lighting in the decontamination unit as required to supply a 50 foot candle minimum light level.

Parking and Building Access:

Parking and access to the building for the Contractor's personnel will be arranged at the Pre-Construction meeting.

Facilities:

The Contractor's personnel's access to the Owner's facilities shall be limited to the area where the work is being performed. All other areas shall be off limits.

PART 6 - ASBESTOS ABATEMENT DECONTAMINATION UNITS

General:

For each abatement area, provide decontamination facilities located in an area agreed upon with the Project Manager. The decontamination facilities shall include a decontamination enclosure system for workers and visitors and a decontamination enclosure system for loading of waste into trucks for transportation to the landfill.

The decontamination enclosure system for the workers and visitors shall consist of a clean room at the entrance followed by an air lock followed by a shower room followed by an air lock followed by an equipment room leading to the work area.

An air lock is a system permitting ingress and egress without permitting air movement. It consists of two curtained doorways at least three (3) feet apart. Each curtained doorway shall be constructed by placing three overlapping sheets of plastic over a framed doorway, securing each along the top of the doorway. The first and third sheet shall be secured on one side of the doorway and the middle sheet shall be secured on the other side of the doorway.

Provide lockers for storage of street clothes of the workers in the clean room. Provide in the same room uncontaminated disposable protective clothing and equipment. This room shall be used by workers and visitors to change from street clothes to disposable protective clothing and gear prior to entering into the contaminated area and to dress into street clothing after they have showered and dried in the shower rooms as they exit from the contaminated area.

Provide the shower room showering facilities with hot and cold water so arranged as to provide complete showering of workers and visitors as they exit from the contaminated area. A factory-made shower head producing a spray of water which can be adjusted for spray size and intensity shall be provided. The shower shall be arranged so that the control of water temperature, flow rate and shut off is from inside the shower without requiring outside aid. Make provisions to prevent any contaminated run-off from the shower room. If type C respirators are used, the shower room facilities and size shall be adequate to allow decontamination and thorough washing of all the workers and visitors within the 15 minute escape time allowed under air compressor failure.

Provide the equipment room with storage for contaminated clothing and equipment. In this room, workers and visitors dispose of their disposable protective clothing except the respirator as they prepare to enter the shower room.

The bag wash and wipe room will be equipped with the facilities to wash and wipe the outside of the bag prior to the loading into trucks for transportation to a landfill. Make provisions to prevent any contaminated run-off from the work space.

Provide heating and ventilation in the entire decontamination system so that air flow will be from the outside towards the work space.

Decontamination chambers shall be attached directly to the work area unless the use of a remote decontamination chamber has been approved in writing by the Owner's Representative. When the use of remote decontamination chambers has been approved by the Owner's Representative, the workers shall double-suit. The Contractor shall ensure that employees remove asbestos contamination from their work suits using a HEPA vacuum. The outer suit shall be removed immediately before proceeding to the remote decontamination chamber. The inner suit shall be worn while traversing to the remote decontamination chamber.

A decontamination chamber shall not be moved and reused without the permission of the Owner's Representative. If the Owner's Representative grants permission to reuse a decontamination chamber, the dirty room chamber and the clean room chamber shall be used for the same purpose at the new location; and, the use thereof shall not be interchanged. In no instance shall a decontamination chamber be reused if mastic/mastic removal agent or a combination thereof is present on the exterior of the chamber. Decontamination chambers shall remain in place until the final clearance air criteria have been met.

Execution:

All persons, without exception, shall pass through this decontamination unit for entry into and exiting from the work area for any purpose. Parallel routes for entry or exit shall not be

allowed. No equipment or materials shall be removed through the personal decontamination units. Provide temporary lighting within the decontamination units as indicated in the Contract documents or as required by site conditions.

Construction:

The decontamination unit shall be constructed using polyethylene sheeting, at least 6 mil. In thickness attached to existing building components or a temporary framework.

Two layers minimum of 6 mil. Polyethylene sheeting shall be used to cover floors in the equipment, shower and changing rooms. An additional layer in the equipment room shall be added for every shift change expected. One layer of plastic shall be rolled from the equipment room into the work area after each shift change. A minimum of two (2) layers of plastic shall remain at all times. All plastic used on floors shall be clear.

Provide an electrical sub-panel at the changing room to accommodate all removal equipment. The power source for the panel shall come directly from a building electrical panel. All electrical branch circuits in the decontamination units and particularly any pumps in the shower room shall be connected to a ground-fault circuit protection device.

Decontamination Sequence:

Entering the work area, the worker enters the clean/changing room and removes street clothing, puts on clean disposable overalls and respirator, and passes through the shower room into the equipment room.

Any additional clothing and equipment left in the equipment room required by the worker is put on. These items must be treated as contaminated clothing and left in the equipment room or work area.

The worker then proceeds to the work area.

Before exiting the work area, the worker shall remove all gross contamination and debris from coveralls and feet.

The worker then proceeds to the work area.

Before exiting the work area, the worker shall remove all gross contamination and debris from coveralls and feet.

The worker then proceeds to the equipment room and removes all clothing except respiratory protection equipment. Extra work clothing may be stored in the contaminated end of the equipment room. Disposable coveralls are placed in a bag for disposal with other contaminated material.

After showering, the worker moves to the clean/changing room and dresses in either new coveralls for another entry or street clothes for leaving the work site.

An enclosed shower unit shall be provided for cleaning of bagged or containerized waste material passed from the work area. It shall be constructed of wood framing and polyethylene sheeting, at least 6 mil. In thickness, and located so that packaged materials, after being wiped clean, can be passed to the holding room. This room shall be separated from the work area by a single flap 6 mil. Polyethylene sheeting, flap entrance to work area.

A holding room shall be provided as a drop location for bagged waste containing materials passed from the wash room. It shall be constructed of wood framing and polyethylene sheeting at least 6 mil. in thickness and located so that bagged materials cannot be passed from the wash room through the holding room to the clean room. This room shall be separated from the adjacent rooms by a double flap fabricated from 1/16" thick single ply rubber roofing material.

A clean room shall be provided to isolate the holding room from the building exterior. It shall be constructed of wood framing and polyethylene sheeting, at least 6 mil. In thickness, and located to provide access to the holding room from the exterior by a single piece of 6 mil. Polyethylene flap entrance way.

Equipment and material shall be taken from the work area through the equipment decontamination unit. At the wash-down station, it shall be thoroughly wet-cleaned or passed through in sealed polyethylene bags to the wash room. When passing equipment or containers into the wash room, all doorways of the equipment decontamination unit other than the doorway between the wash-down station and the wash room shall be closed, and all outside personnel clear of the equipment decontamination unit.

Once inside the washroom, the bags and/or equipment shall be wet-cleaned. When cleaning is complete, pass items into the holding room. All doorways shall be closed except the doorway between the holding room and the clean room. Workers from the building exterior enter the holding area and remove decontaminated equipment and/or containers for disposal. These workers shall be in full protective clothing and wearing appropriate respiratory protection. At no time is a worker from an uncontaminated area to enter the enclosure when a removal worker is inside.

Waste shall be removed from the premises on a daily basis and shall not remain in the wash room or holding room over night.

Cleaning of Decontamination Units:

Debris and residue shall be cleaned from inside the decontamination units on a daily basis or as otherwise indicated in the Contract documents. Damp wipe or hose down all surfaces after each shift change. Clean debris from shower pans on a daily basis. If the clean/changing room of the personnel decontamination unit becomes contaminated with waste-containing-debris, the entire decontamination unit shall be abandoned and a new decontamination unit shall be erected with the former changing room being used as an inner section of the new equipment room.

Warning Signs:

Post warning signs as required by all applicable Federal, State and Local regulations.

PART 7 - ASBESTOS ABATEMENT EQUIPMENT AND MATERIALS**Scaffolding:**

Provide all scaffolding, ladders and/or staging, etc. as necessary to accomplish the work of this Contract. Scaffolding may be of suspension type or standing type such as metal tube and coupler, tubular welded frame, pole or outrigger type or cantilever type. The type, erection and use of all scaffolding shall comply with all applicable Occupational Safety and Health Administration provisions and other applicable safety regulations. During the erection and/or moving of scaffolding, care must be exercised so that the polyethylene floor covering is not damaged.

No metal ladders shall be allowed in the work area during wet removal operations.

Tools and Equipment:

An airless sprayer, suitable for application of encapsulating material, shall be used.

Asbestos filtration devices shall utilize High Efficiency Particulate Absolute (HEPA) filtration systems.

Transportation equipment, as required, shall be suitable for loading, temporary storage, transit and unloading of contaminated waste without exposure to persons or property.

All vacuum equipment utilized in the work area shall utilize HEPA filtration systems.

The water sprayer shall be an airless sprayer for amended water application.

All power tools shall be equipped with HEPA filtration systems.

The Contractor shall provide other suitable tools for the stripping, removal, encapsulation and disposal activities including but not limited to hand-held scrapers, wire brushes, sponges, rounded edge shovels, brooms and carts.

Materials:

The encapsulating agents shall be bridging sealants and shall meet the following criteria:

They shall withstand most impacts or abrasions and protect the encapsulant's surface.

Encapsulants selected for use by the Contractor shall be one of those demonstrating probable effective performance under the test conducted by independent testing laboratory and are approved by the Project Manager.

They shall have high flame retardant characteristics, and a low toxic fume and smoke emission rating.

They shall have some permeability to water vapor to prevent condensation accumulation, and resist dilution by common cleaning agents.

They shall not be noxious or toxic to application workers, or subsequent users of the building.

They shall have acceptable weathering and aging characteristics.

They shall be acceptable by architectural standards.

They shall be compatible with all insulating material and acoustical plaster likely to be applied to the stripped surfaces.

They shall be demonstrably capable of adhering to the surfaces of the substrate.

The Contractor shall provide all other materials required to provide a safe and satisfactory job.

PART 8 - ASBESTOS ABATEMENT PRE-ABATEMENT PREPARATIONS

General:

Prior to any abatement work in the area, seal off the entire area to anybody other than trained personnel and authorized visitors. Erect signs around the perimeter in accordance with all applicable Federal, State and Local regulations and the requirements of this Contract. Provide 24-hour security against unauthorized entry during abatement process. Maintain a log of all people entering and exiting the work place.

Prior to preparing the area for abatement, the Contractor shall clean any existing dust from floors, walls, and other surfaces in the immediate location by HEPA vacuuming or wet-cleaning methods. Seal all walls with two (2) layers of four mil. minimum plastic sheeting and the floors and ceilings with two (2) layers of 6 mil. Plastic. Ensure that barriers are effectively sealed and taped. Repair damaged barriers and remedy defects immediately and visually inspect enclosures prior to each work day. Use smoke methods to test effectiveness of barriers.

Disassemble all removable items from the work area such as lights, grills, registers, bench seats, etc. Thoroughly decontaminate through wet cleaning and HEPA vacuuming all furniture, carpets, lighting fixtures and other removables. Store the decontaminated removables in a clean storage room until the completion of the abatement work. All furniture, fixtures, and equipment that cannot be removed from the work area shall be sealed with two layers of six (6) mil. minimum plastic sheeting.

Impermeable drop cloths shall be placed on surfaces beneath all removal activity.

Secure the approval of the Project Manager prior to the start of the work for the following: enclosures, showers and toilets, personnel protection and decontamination procedures, exposure control system, notification and permits, standard operating procedures, personnel training and testing, removable decontamination and storage, sealing off and securing of the work area and equipment for inter-room communications.

Products for Temporary Enclosures:

Polyethylene Sheet – a single polyethylene film in the largest sheet size possible to minimize seams, 4.0 or 6.0 mils thick as indicated, clear, frosted, or black as indicated.

In areas where there is hot equipment or a potential for fire, or when indicated on the plans or specifications, provide fire-resistant, UL labeled polyethylene film with a flame-spread rating of 15 or less, in largest size possible to minimize seams, 4.0 or 6.0 mils thick as indicated, clear, frosted or black as indicated.

Outside or where height of suspended plastic is greater than 20 feet, provide translucent fire-resistant, UL labeled, nylon reinforced laminated polyethylene with a flame-spread rating of 15 or less, in largest size possible to minimize seams.

Provide duct tape in 2" or 3" widths as indicated, with an adhesive which is formulated to aggressively stick to sheet polyethylene.

Provide spray adhesives in aerosol cans which are specifically formulated to stick tenaciously to sheet polyethylene.

Execution for Temporary Enclosures:

Work Area is the location where abatement work occurs. It is a variable of the extent of work of the Contract. It may be a portion of a room, a single room, or a complex of rooms. A work area is considered contaminated during the work, and must be isolated from the remainder of the building, and decontaminated at the completion of the work.

Completely isolate the work area from other parts of the building, so as to prevent dust or debris or material from passing beyond the isolated area.

Place all tools, scaffolding, staging, etc. necessary for the work in the area to be isolated prior to erection of plastic sheeting temporary enclosure.

Clean and remove all contaminated removable furniture, equipment, and/or supplies from the work area before commencing work and store as indicated.

Disable the ventilating system or any other system bringing air into or out of the work area. Disable system by disconnecting wires, removing circuit breakers, by lockable switch or other positive means that will prevent accidental premature restarting of equipment.

All heating, ventilation and air conditioning system filters shall be removed and disposed of as contaminated materials. Replace all filters with new at the end of the decontamination work.

Control Access:

Permit access to the work area only through the decontamination unit. All other means of access shall be closed off and sealed and warning signs displayed on the clean side of the sealed access.

Where the work is immediately adjacent to or within view of occupied areas, provide a visual barrier of opaque polyethylene sheeting at least 4 mil. In thickness so that the work

procedures are not visible to building occupants. Where this visual barrier would block natural light, substitute frosted sheet plastic in locations approved by the Owner's Representative.

Where the area adjacent to the work area is accessible to the public, construct a solid barrier on the public side of the sheeting to protect the sheeting. Construct barrier with normal 2" X 4" wood or metal studs 16" centers, securely anchored to prevent movement, covered with minimum ¼ inch thick hardboard, ½" gypsum wall board, or ½" plywood.

Provide warning signs at each visual and physical barrier.

Alternate methods of containing the work area may be submitted to the Project Manager for approval. Do not proceed with any such methods without prior written approval of the Owner.

Respiratory and Worker Protection:

Before proceeding beyond this point in providing temporary enclosures, provide respiratory protection and work protection as per the Contract documents.

Critical Barriers:

Completely separate the work area from other portions of the building and the outside by two layers of sheet plastic barriers at least 6 mil. each in thickness.

Individually seal all ventilation openings, lighting fixtures, clocks, doorways, windows, converters and speakers, and other openings into the work area with two layers of polyethylene sheeting at least 6 mil. in thickness, taped securely in place with duct tape. Maintain seal until all work including project decontamination is completed. Take care in sealing off lighting fixtures to avoid melting or burning of sheeting.

Provide sheet plastic two layer barriers at least 6 mil. each in thickness as required to completely seal openings from the work area into adjacent areas. Seal the perimeter of all sheet plastic barriers with duct tape.

Mechanically support sheet plastic independently of duct tape or spray cement seals so that seals do not support the weight of the plastic barriers. Alternative support methods may be used if approved in writing by the Owner.

Cover floor of the work area with two (2) individual layers of clear polyethylene sheeting, each at least 6 mil. in thickness, turned up walls at least 12 inches. Form a sharp right angle bend at junction of floor and wall so that there is no radius which could be stepped on causing the wall attachment to be pulled loose. Both spray-glue and duct tape all seams in floor covering. Locate seams in top layer six feet (6') from, or at right angles to, seams in bottom layer. Install sheeting so that the top layer can be removed independently of bottom layer. Cover carpeting, which is not removable with three (3) layers of polyethylene sheeting at least 6 mil. in thickness. Place corrugated cardboard sheets between the top and middle layers of polyethylene. Remove all electrical and mechanical items, such as lighting fixtures, clocks, diffusers, registers, escutcheon plates, etc. which cover any part of the surface to be worked on within the work area.

Cover all walls in the work area including "critical barrier" sheet plastic barriers with two layers of polyethylene sheeting, at least 4 mil. in thickness, mechanically supported and sealed with duct tape or spray-glue in the same manner as "critical barrier". Tape all joints including the joining with the floor covering with duct tape or as otherwise indicated in the Contract documents or in writing by the Owner's Representative.

Do not cover stairs or ramps with unsecured sheet plastic. Where stairs or ramps are covered with plastic, provide $\frac{3}{4}$ " exterior grade plywood treads securely held in place, over plastic. Do not cover rungs or rails with any type of protective materials.

Extension of Work Area:

At any point, should the enclosure barrier be breached in any manner that could allow the passage of debris or airborne fibers, then the affected area shall be added to the work area and be subject to enclosure as required by this section of the Specifications and decontamination as described in the Specifications.

Secondary Barrier:

A secondary layer of plastic as a drop cloth to protect the primary layer from debris generated by the abatement work shall be provided as required in the Contract documents.

Contingency Plans:

Prepare a contingency plan for safe evacuation of the work area in case of fire or injury. Submit for the Owner's approval this plan. Coordinate with police all security aspects of the project and with the fire department all emergency evacuation and safety aspects. Secure a certificate from both the police and fire department that they approve of the established security and safety procedures.

PART 9 - ASBESTOS ABATEMENT WORKER TRAINING

Training:

All workers exposed to the dangers inherent in handling asbestos or breathing asbestos fibers shall have successfully completed all worker training requirements as specified by all applicable Federal, State and Local regulations and this Contract.

Medical Examinations:

The Contractor shall provide medical examinations for all workers as specified by all applicable Federal, State and Local regulations. The Contractor shall provide the Project Manager with a notarized statement that each of the workers assigned to the work of this Contract is able to wear and use the type of respiratory protection proposed for the project, and is able to work safely in an environment capable of producing heat stress in the worker.

Protective Clothing:

The Contractor shall provide all of the workers assigned to the work of this Contract, the Project Manager and all authorized visitors protective disposable clothing consisting of Tyvek full body coveralls, head covers, gloves and boot-type reusable footwear.

The Contractor shall provide all of the workers assigned to the work of this Contract with work boots with non-skid soles, and where required, OSHA approved foot protectives.

The Contractor shall provide all of the workers assigned to the work of this Contract with OSHA approved hard hats.

The Contractor shall provide all of the workers assigned to the work of this Contract with OSHA approved eye protectives.

The Contractor shall provide all of the workers assigned to the work of this Contract with work gloves.

Reusable footwear, hard hats and eye protection devices shall be left in the contaminated equipment room until the end of the asbestos abatement work.

All disposable protective clothing shall be discarded and disposed of as waste every time the wearer exits from the work space to the outside through the decontamination facilities.

Respirators, disposable coveralls, head covers and footwear covers shall be provided by the Contractor for the Owner, Project Manager and other authorized representatives who may inspect the job site.

Execution:

Requirements of the most stringent OSHA and EPA standards for worker protection shall be met. The following procedures are to be considered minimum procedures to be followed regardless of fiber counts in the work area.

Preparations for Entering the Work Area:

Each time the work area is entered, all street clothes shall be removed in the changing/clean room of the personnel decontamination unit and new disposable coveralls, new head covers, new footwear covers and a clean respirator shall be put on.

Decontamination Procedures:

When exiting the work area, disposable footwear covers and/or boots shall be removed in the equipment room and all protective clothing shall be removed and placed in plastic bags labeled for asbestos waste disposal.

Still wearing the respirator, proceed to showers. Showering is mandatory. Care must be taken to follow reasonable procedures in removing the respirator to avoid asbestos fibers while showering. Thoroughly wet the body including the hair and face. If using a powered air-purifying respirator (PAPR), hold the blower unit above the head to keep the canisters dry.

With the respirator still in place, thoroughly wash the body, hair, respirator face piece, and all parts of the respirator except the blower unit and battery pack on a PAPR. Pay particular attention to the seal between the face and the respirator and under the straps.

Take a deep breath, hold it and/or exhale slowly, completely wet hair, face, and respirator. While still holding breath, remove the respirator and hold it away from the face before starting to breathe.

Carefully wash the face piece of the respirator inside and out.

If using a PAPR, shut it off, cap the inlets to the cartridges and thoroughly wash the blower unit and hoses. Carefully wash the battery pack with a wet cloth. Be extremely cautious of getting water in the battery pack as this will short it out and destroy the battery.

If wearing an air-purifying negative pressure respirator, take a deep breath, hold and/or exhale slowly, completely wetting hair, thoroughly wetting face, respirator and filter. While still holding breath, remove respirator and hold it away from face before starting to breathe. Dispose of wet filters from the respirator.

Shower completely with soap and water.

Rinse thoroughly.

Rinse shower room walls and floor prior to exiting the shower.

Proceed from the shower to the clean/changing room and change into street clothes or into new disposable work clothes.

Workers are not to eat, drink, apply cosmetics, smoke, chew gum or use tobacco in the work area.

Miscellaneous Requirements:

The Contractor shall post written procedures in the work place and train all personnel on procedures for the evacuation of the injured and the handling of potential fires. Provide aid to a seriously injured worker without delay for decontamination. Make provisions to minimize exposure of rescue workers and to minimize spreading of contamination during evacuation and fire procedures.

The Contractor shall instruct all employees and workers in the proper care of their personally issued respiratory equipment, including daily maintenance, sanitizing procedures, etc.

All respiratory equipment shall be inspected by the Contractor's project supervisory personnel at the beginning of each work period, including breaks and lunch periods.

Submittals:

A copy of each worker and supervisor's current E.P.A. training certificate shall be submitted to the Owner's Representative prior to the start of the project and the Contractor shall maintain a copy at the work site.

A copy of a report for the current asbestos medical examination for each employee assigned to this project shall be submitted to the Owner's Representative prior to the start of the project. This report shall clearly indicate that the employee was given an asbestos physical and shall contain the employee's name, social security number, any recommended limitations on the employee's activity or on the use of personal protective equipment, a statement that the employee is capable of wearing a negative-pressure respirator, and shall contain a legible typed version of the physician's name, signature and date of examination. Clearance to wear a respirator by a physician without an asbestos physical having been performed will not meet the requirements of this paragraph.

The Contractor shall submit to the Owner's Representative prior to the start of the project a fully executed copy of the Certificate of Worker's Acknowledgement form for each employee assigned to this project. A blank Certificate of Worker's Acknowledgement form follows this section.

CERTIFICATE OF EMPLOYEE'S ACKNOWLEDGMENT

PROJECT NAME: _____
CONTRACTOR'S NAME: _____

Working with asbestos can be dangerous. Inhaling asbestos fibers has been linked with various types of cancer. If you smoke and inhale asbestos fibers, the chance that you will develop lung cancer is greatly increased over that of the non-smoking public.

Your employer's contract with the Owner for the above project requires that:

- You be supplied with the proper respirator and be trained in its use.
- You be supplied with a powered air purifying respirator (PAPR) in lieu of a half-mask or full-mask negative pressure respirator if you request one and if one will provide adequate protection.
- You be trained in safe work practices and in the use of the equipment found on the job.
- You receive an asbestos medical examination.
- The above are to have been provided to you at no cost to you.

RESPIRATORY PROTECTION: You are required to have been trained in the proper use of respirators and informed of the type of respirator to be used on the above referenced project. Your employer is required to have given you a copy of your company's respiratory protection manual. Your employer is required to provide you with the respirator to be used on the above project.

TRAINING: You shall have completed either a U.S. EPA approved asbestos worker or asbestos supervisor training course. You shall have attended the entire training course.

ASBESTOS PHYSICAL EXAMINATION: You shall have had an asbestos physical examination within the past 12 months. Your employer is required to have provided this to you at no cost. This examination shall have included a health history, general physical examination, pulmonary function tests and may have included a chest x-ray.

PERSONAL PROTECTIVE EQUIPMENT AND DECONTAMINATION FACILITIES:
You shall be provided with Tyvek full-body disposable coveralls that include head and foot covers. You shall be provided with a secure place to store your street clothes. You shall be provided with decontamination facilities that include a shower with hot and cold running water, soap, shampoo, and disposable towels.

ACKNOWLEDGMENT OF ADVISEMENT:

By signing this document, you are acknowledging that the Owner of the building/buildings/property where the work of this project will take place has advised you of the rights listed above, relative to the danger of working with asbestos, respiratory protection, training, physical examination, protective equipment, decontamination facilities and prevailing wage rates.

Signature: _____ Social Security #: _____
Printed Name: _____ Date: _____
Witness Signature: _____
Printed Name: _____
Notary Seal: _____

PART 10 - ASBESTOS ABATEMENT RESPIRATORY PROTECTION**General:**

The Contractor shall provide all workers, foremen, superintendents, authorized visitors and inspectors personally issued and marked respiratory equipment approved by NIOSH and OSHA. When respirators with disposable filters are employed, the Contractor shall provide sufficient filters for replacement as necessary.

Workers shall be clean shaven in all areas that may impact the respirator seal.

When type C respirators are used, they shall be used in compliance with all applicable Federal, State and Local regulations.

Minimum Respiratory Protection Required for this Project:

At a minimum, high efficiency air-purifying respirators shall be used for pre-construction sealing of walls if the background air samples yielded results greater than 0.01 fibers/cc. and less than 0.1 fibers/cc. At a minimum, high efficiency air-purifying respirators shall be used for decontamination of removables including furniture, draperies, carpeting, etc., floors and openings with plastic sheeting, loading waste for transportation and unloading of waste at the landfill, and the final wipe down of the work space if the air sample results shows exposure in the work area is below 0.1 fibers/cc. If air sample results are greater than 0.1 fibers/cc, all of the aforementioned activities listed in this paragraph shall, at a minimum, be performed via the use of high efficiency powered air-purifying respirators (PAPR).

At a minimum, high efficiency powered air-purifying respirators (PAPR) shall be used for removing and cleaning of contaminated electrical fixtures, mechanical equipment and suspended ceilings, removal operations, encapsulation and enclosure operations prior to plastic sheeting removal, gross cleanup and plastic sheeting removal, loading of bags and drums and cleaning of bags and drums prior to loading for transportation.

Description of Work:

Each worker shall be instructed and trained in proper respiratory use and shall always wear a respirator, properly fitted on the face in the work area from the start of any operation which may cause airborne asbestos fibers until the work area is completely decontaminated. Respiratory protection shall be appropriate for the fiber level encountered in the work place or as required for other toxic or oxygen deficient situations encountered.

Standards:

Requirements of the most stringent Federal, State or Local standards for respiratory protection shall be met.

Submittals:

The Contractor shall submit to the Project Manager the manufacturer's product information for each component used including NIOSH and MSHA certifications for each component in each assembly.

When a type C supplied air respiratory system is required by the work, submit drawings showing the assembly of components into a complete supplied air respiratory system.

Submit complete operating and maintenance instructions for all components and systems as a whole.

Submit the level of respiratory protection intended for each operation required by the project.

Submit airborne asbestos fiber count data from an independent air monitoring firm to substantiate the selection of respiratory protection proposed.

Submit resume and information on training for the individual monitoring the operation of supplied air respiratory systems. Submit training certifications where applicable.

Submit a current respirator fit test certificate for each worker assigned to this project, prior to the start of the project.

Submit a statement, signed by each worker assigned to this project, that they have been offered the use of a powered-air purifying respirator (PAPR) in lieu of a half-face or full-face respirator for situations where such respirator will provide sufficient protection.

Equipment:

Air purifying respirator bodies shall be half-face or full-face type with removable cartridges. Single use, disposable or quarter face respirators shall not be used. Full-face respirators shall be equipped with a nose cup or other anti-fogging devices as would be appropriate for use in air temperatures less than 32 degrees F. Filter cartridges shall, at a minimum, be HEPA type filters labeled with NIOSH and MSHA certification for "Radionuclides, Radon Daughters, Dust, Fumes, Mists and color coded in accordance with ANSI Z228.2 (1980). In addition, a chemical cartridge section may be added, if required, for solvents, etc. in sue. In this case, each section of the combination canister shall be labeled with the appropriate color code and NIOSH/OSHA certification.

The equipment used for supplied air respirator systems shall be capable of producing air of the quality and volume required by the most stringent applicable Federal, State or Local regulations. Each face piece and hose shall be the same manufacture and shall be certified by NIOSH/OSHA as an approved type C respirator assembly for continuous flow or pressure demand with a positive pressure face piece.

Backup air supply shall be provided that is adequate to allow a minimum of one-half hour escape time for each individual on a six-man crew. The one-half hour shall be based upon all connections to the backup air supply being in use by an average sized adult male engaged in moderately strenuous activity or by the air requirements of the particular respirator in use, whichever is greater.

Warning devices shall be located in the work area which will be clearly audible in all parts of the work area and can be heard above the noise level produced by equipment and work procedures in use. The warning device shall warn of compressor shut down or other fault requiring use of backup air supply, carbon monoxide levels in excess of 5 ppm/v.

A carbon monoxide monitor shall continually monitor carbon monoxide levels. This monitor shall be placed in the air line between backup air supply and workers and shall also sound an alarm as specified under the warning devices. The compressor shall automatically be shut down and the alarms sounded if carbon monoxide or concentrations exceed 5 ppm/v in the air line between the filter bank and backup air supply, or the compressor temperature exceeds normal operating range.

The compressor motor shall be an electric motor. Compressor driven by gas or diesel engines shall not be used.

An after cooler shall be provided at the entry to the filter system which is capable of reducing temperatures to outside ambient air temperatures.

The system configurations shall permit the recharging of ½ hour 2260 PSI SCBA cylinders.

Execution:

A respiratory protection program shall be carried out that is in compliance with all applicable Federal, State and Local regulations.

Respiratory protection shall be used at all times when there is any possibility of disturbance of asbestos-containing materials whether intentional or accidental.

Initial fitting of respiratory protection shall be provided in the course of a respiratory protection course of training set up and administered by a Certified Industrial Hygienist.

On an annual basis, each worker shall have the fit of his respirator checked by having irritant smoke blown onto the respirator from a smoke tube. Each time an air-purifying respirator is put on, it shall be checked for fit with a positive and negative pressure fit test in accordance with the manufacturer's instructions.

The type of respiratory protection required shall be in accordance with all applicable Federal, State and Local regulations.

PART 11 - ASBESTOS ABATEMENT PROCEDURES

Removal:

Except as noted and/or in drawings, spray the asbestos-containing material with a wetting agent designed to control asbestos fibers including amosite. The wetting agent shall be mixed according to the manufacturer's instructions and applied with a low-pressure fine spray to minimize fiber release. The Contractor shall submit the Material Safety Data Sheet (MSDS) and the manufacturer's instructions for mixing for this wetting agent to the Owner's Representative prior to the start of the project. Saturate sufficiently the material throughout the removal process so that there will, at no time during the removal process, be fiber

release from dry asbestos. In many areas, it may be necessary to pre-saturate asbestos materials the day prior to removal.

Immediately following removal, the wetted asbestos shall be packed into labeled six mil. plastic bags. The waste bags shall contain an amount of water sufficient to prevent the material from drying. Double bag, neck down the bag and collapse it with the HEPA vacuum. Twist the bag shut, bend the neck over (gooseneck) and seal with duct tape by wrapping around bag neck at least 3 times. Thoroughly clean the exterior of the sealed bags prior to loading for transportation to the landfill.

All floor tile and any other waste which may puncture waste bags, shall be disposed of in reinforced waste bags or drums that are leak tight.

All used plastic, tapes, cleaning material and clothing shall be treated as asbestos waste material. After the final clearance air monitoring criteria have been met, work area containment barrier material, i.e. polyethylene sheeting, tape, etc. shall be treated as asbestos waste material.

A minimum of two (2) persons shall be used to perform a glovebag removal operation.

A glovebag shall be used only one time.

When glovebagging is performed in a work area that is not under negative pressure and that is not covered with two layers of six (6) mil polyethylene sheeting on the walls, ceiling and floor, glovebagging shall be performed via the negative-pressure glovebag method.

A device shall be installed or a method initiated to prevent glovebags from collapsing during the removal process.

Glovebags shall not be moved/slid from place to place.

The Contractor shall demonstrate that glovebags are installed air tight via the use of a smoke tube and aspirator bulb. The smoke tube shall be placed into the water sleeve/port. The bag shall be filled with visible smoke. The smoke tube shall be removed and the water sleeve/port twisted closed. While holding the water sleeve/port tightly, the bag shall be gently squeezed and inspected for any area where smoke may be leaking out. If leaks are discovered, re-seal the glovebag in that area and repeat the smoke test.

Throughout a glovebag removal process, spray amended water on the asbestos-containing material to keep the material adequately wet.

Pieces of asbestos-containing material shall be placed in the bottom of glovebags without dropping, insofar as is possible.

The interior of glovebags shall be thoroughly washed and wiped down to a point below the location where the bag will be twisted and taped to seal the waste in the bottom of the bag.

Glovebags shall be collapsed via the use of a HEPA vacuum.

Responsibility for Damage:

Prior to the start of any related work, and at a time agreed upon by all concerned, the Contractor, the Project Manger and the Owner or his/her representative shall perform a walk through to identify any/all existing damage to the finishes, floors, walls or any other item or fixture within the designated work areas.

Any further damage to the same shall be deemed as the result of actions by the Contractor and/or his/her personnel and shall be repaired to their original condition at the Contractor's expense.

Further damage shall be determined by a post abatement walk through conducted by the same parties as for the pre abatement walk through.

PART 12 - DISPOSAL OF ASBESTOS-CONTAINING WASTE MAERIAL

Disposal:

It is the responsibility of the Contractor to determine current waste handling, transportation and disposal regulations for the work site and for each waste disposal landfill. The Contractor shall comply fully with these regulations and all US Department of Transportation and Environmental Protection Agency requirements and all applicable State and Local regulations.

Execution:

All containerized waste shall be carefully loaded on sealed trucks for transport. Before and during transport, care shall be exercised to insure that no unauthorized persons have access to the material.

No bagged asbestos-containing waste material shall be stored outside of the work area within the building. Waste shall be removed from the work area periodically and not allowed to accumulate within the work area. No waste shall be left in the work area at the end of each shift. The bags/waste shall be taken from the work area directly to a sealed and locked truck or dumpster. If a dumpster is used, the dumpster shall be capable of being locked and totally secured. A tarp placed upon the top of a dumpster shall not meet this requirement.

Trucks and dumpsters used to store and/or transport asbestos-containing waste shall be lined with two (2) layers of six (6) mil. minimum polyethylene sheeting.

No disposal bagged materials shall be transported on open trucks.

Advise the sanitary landfill operator, at least twenty-four hours in advance of transport, of the quantity of material to be delivered.

A copy of the partially completed waste manifest shall be provided to the Project Manager prior to the transport of each load of waste leaving the worksite.

At the waste site, the sealed plastic bags may be carefully dumped from the truck. If bags are broken or damaged, they shall be left in the truck and the entire truck and contents treated as a contaminated area to be cleaned as required by these specifications.

Retain receipts from the landfill for materials disposed of. Receipts shall be submitted to the Owner's Representative prior to final payment and a maximum of 30 days after the waste is transported from the worksite. Receipts shall list the quantities of materials delivered in bags, drums, tons or cubic yards. Failure by the Contractor to provide completed waste manifests within the time specified in this paragraph will be reported to the U.S. EPA.

The waste from this project shall not be combined in a dumpster with waste from any other project.

The Contractor shall submit a notarized statement stating all asbestos-containing materials have been disposed in a facility permitted in accordance with all applicable Federal, State and Local regulations.

Waste manifests shall be submitted to the Owner's Representative in accordance with all applicable Federal, State and Local regulations.

PART 13 - ASBESTOS PROJECT DECONTAMINATION

General:

If the asbestos abatement work is on damaged friable materials, then the building space is deemed contaminated before the start of the work and in need of decontamination. This work is a four-step procedure with two cleanings of the primary barrier plastic prior to removal and two cleanings of the room surfaces to remove any new or existing contamination.

If the asbestos abatement work is on undamaged materials, then the building space is deemed uncontaminated before the start of the work. This work is a two-step procedure with two cleanings of the primary barrier plastic to remove contamination, thus preventing contamination of the building when the work area isolation barriers are removed.

In both cases, the operation of the negative pressure system is used to remove airborne fibers/dust generated by the abatement work.

The removal of gross debris is integral with the performance of abatement work.

Execution:

The work of this section includes the decontamination of air in the work area which has been, or may have been contaminated by the elevated airborne asbestos fiber levels generated during abatement activities, or which may previously have had elevated fiber or dust levels due to friable asbestos-containing materials in the space.

The work in this section also includes the cleaning, decontamination, and removal of temporary facilities installed prior to abatement work including primary and critical barriers

erected, the decontamination units erected and the negative-pressure systems installed by the work of this Contract.

During the completion of the asbestos abatement work specified in the Contract, the secondary barrier of polyethylene sheeting will have been removed and disposed of along with any gross debris generated by the asbestos abatement work. The work of this section begins with the cleaning of the primary barrier. At the start of the work of this section, the primary barrier consisting of two layers of polyethylene sheeting on the floors and walls, the critical barrier sheeting over lighting fixtures, clocks, ventilation openings, doorways, convectors, speakers and other openings, the decontamination units for personnel and equipment and the negative pressure system will be in place.

A first cleaning of all surfaces of the work area including items or remaining sheeting, tools, scaffolding and/or staging shall be carried out by use of damp-cleaning and mopping, and/or a high efficiency particulate absolute (HEPA) filtered vacuum. Dry dusting or dry sweeping shall not be permitted. Each surface of a cleaning cloth shall be used one time only and disposed of as contaminated waste. This cleaning shall be continued until there is no visible debris from removed materials or residue on the plastic sheeting or other surfaces.

Remove all filters in the air handling systems and dispose of them as asbestos-containing waste.

A second cleaning of all surfaces in the work area shall be carried out in the same manner as the first cleaning.

Encapsulation of the substrate shall be performed at this time. The negative air system shall remain in operation during the encapsulation work.

A complete visual inspection shall be performed of the entire work area including the decontamination unit, all plastic sheeting, seals over ventilation openings, doorways, windows, and other openings looking for debris from any sources, residue, dust or other matter. If any such debris, residue, dust or other matter is found, repeat the final cleaning and continue decontamination procedures from that point. When the area is visually clean, complete the certification at the end of this section. The visual inspection is not complete until confirmed in writing on the certification by the Project Manager.

Final Air Sampling:

Approximately 24 hours after the work area is found to be visually clean, air samples will be taken and analyzed via Transmission Electron Microscopy (TEM). The release criteria shall be 70 Structures/mm² or less.

If the release criteria are met, remove the work area barriers separating the work area from the rest of the building and shut down and remove the negative pressure system.

SECTION 075323 - EPDM MEMBRANE ROOFING**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. Adhered membrane-roofing system.
 - 2. Roof insulation
- B. Related sections include the following:
 - 1. Division 6 Section "Rough Carpentry" for wood nailers, curbs, and blocking.
 - 2. Division 7 Section "Sheet Metal Flashing and Trim" for flashings and counterflashing.
 - 3. Division 7 Section "Joint Sealants".
 - 4. Division 15 Section "Plumbing Specialties" for roof drains.

1.3 SUBMITTALS

- A. General: Submit the following.
- B. Product data, installation instructions, and general recommendations from manufacturer of single-ply membrane system for types of roofing required. Include data substantiating that materials comply with requirements.
- C. Pre-roofing conference records.
- D. Test data for pullout resistance of fastening system.
- E. Certification that materials comply with local VOC limitations.

1.4 QUALITY ASSURANCE

- A. Manufacturer: Obtain primary single-ply membrane roofing from a single manufacturer. Provide secondary materials as recommended by manufacturer of primary materials.
- B. Installer: Engage an experienced Installer that has specialized in installing roofing systems similar to those required for this Project. Installer must be licensed by

manufacturer of primary roofing material.

1. Work associated with single-ply membrane roofing, including (but not limited to) insulation, flashing, and membrane sheet joint sealers, is to be performed by Installer of this Work.
- C. **Manufacturer's Technical Representative Qualifications:** An authorized full-time employee representative of manufacturer experienced in the installation and maintenance of the specified roofing system and qualified to determine Installer's compliance with the requirements of this Project.
- D. **Testing Agency Qualifications:** An independent testing agency with the experience and capability to conduct the testing and inspection indicated, as documented according to ASTM E 548.
1. Inspection personnel shall be certified as a Registered Roof Observer by the Roof Consultants Institute, and shall be experienced in the installation and maintenance of the specified roofing system and qualified to determine Installer's compliance with the requirements of this Project.
- E. **Preinstallation Conference:** Conduct conference at Project site. Comply with requirements in Division 1 Section "Project Management and Coordination." Review methods and procedures related to roofing system including, but not limited to, the following:
1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, and installers whose work interfaces with or affects roofing including installers of roof accessories and roof-mounted equipment.
 2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
 3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
 5. Review structural loading limitations of roof deck during and after roofing.
 6. Review flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.
 7. Review governing regulations and requirements for insurance and certificates if applicable.
 8. Review temporary protection requirements for roofing system during and after installation.
 9. Review roof observation and repair procedures after roofing installation.
- F. **UL Listing:** Provide labeled materials that have been tested and listed by UL in "Building Materials Directory" or by other nationally recognized testing laboratory for Class A rated materials/system.
1. The complete installation, including flashing, spacing of fasteners, etc...,

shall comply with all FMRC Class 1 fire rated system requirements.

1.5 PROJECT CONDITIONS

- A. Weather: Proceed with roofing work when existing and forecasted weather conditions permit work to be performed in accordance with manufacturers' recommendations and warranty requirements.
- B. Substrate Conditions: Do not begin roofing installation until substrates have been inspected and are determined to be in satisfactory condition.

1.6 WARRANTY

- A. Manufacturer's Warranty: Submit executed copy of single-ply membrane manufacturer's "Limited Service Warranty" agreement including flashing endorsement, signed by an authorized representative of manufacturer. Provide form that was published with product literature as of date of Contract Documents.
- B. Warranty Period: 20 years from date of Substantial Completion.
- C. Manufacturer will provide, at no cost to owner, the following services in Years 2, 5, 10 and 15:
 - 1. Inspection by a Technical Service Representative and delivery of a written inspection report documenting roof conditions.
 - 2. Preventative maintenance and necessary repairs, including splits, tears, or breaks in the roof membrane system and flashings which threaten the integrity of the roof system and are not exempt from coverage due to neglect, negligence, vandalism, or other exclusion.
 - 3. General rooftop housekeeping and clean-up, subject to limits, but generally including removal of incidental debris.
- D. Special Project Warranty: Submit roofing Installer's warranty, on warranty form at end of this Section, signed by Installer, covering Work of this Section, including all components of roofing system such as roofing membrane, base flashing, roof insulation, fasteners, cover boards, substrate, and walkway products, for the following warranty period:
 - 1. Warranty Period: Two years from date of Substantial Completion.
- E. 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 GENERAL

- A. Performance: Provide roofing materials identified to be of generic type indicated and tested to show compliance with required performances.
- B. Compatibility: Provide products recommended by manufacturers to be fully compatible with indicated substrates. Provide separation materials as required to eliminate contact between incompatible materials.

2.2 EPDM MEMBRANE

- A. General: Ethylene propylene diene monomers formed into uniform, flexible sheets, complying with ASTM D 4637, Type 1.
 - 1. Thickness: 60 mils
 - 2. Exposed Face Color: Black
 - 3. Roof system must be capable of withstanding a wind force of 130mph
- B. Fully adhered EPDM Membrane: Manufacturer's standard installation.
- C. Available Products: Subject to compliance with requirements, products that may be incorporated in the work include, but not necessarily limited to, the following:
 - 1. Carlisle Syntec Systems
 - 2. Firestone Building Products
 - 3. Versico Roofing Systems

2.3 AUXILIARY MATERIALS

- A. Sheet Seaming System: Manufacturer's standard materials for sealing lapped joints, including edge sealer to cover exposed spliced edges as recommended by membrane manufacturer.
- B. Flashing Accessories: Types recommended by membrane manufacturer, including adhesive tapes, flashing cements, and sealants.
- C. Flashing Material: Manufacturer's standard system compatible with single-ply membrane.
- D. Slip Sheet: Type recommended by membrane manufacturer for protecting membrane from incompatible substrates.
- E. Membrane Adhesive: As recommended by membrane manufacturer for particular substrate and project conditions, formulated to withstand minimum 60-psf uplift force.
 - 1. Provide adhesives that comply with local requirements limiting amounts of volatile organic compounds.

2.4 INSULATING MATERIALS

- A. General: Provide insulating materials to comply with requirements indicated for materials and with referenced standards in sizes to fit applications indicated, selected from manufacturer's standard thickness', widths, and lengths.
1. Provide tapered boards where indicated for sloping to drain. Fabricate with a taper of 1/4" per foot, unless otherwise indicated.
- B. Polyisocyanurate Board Insulation: Rigid, cellular polyisocyanurate thermal insulation with core formed by using hydrochlorofluorocarbons as blowing agent, to comply with referenced standards and with other requirements indicated below:
1. Federal Standard: FS HH-I-1972/1, Class 1 (nonreinforced core) or 2 (reinforced core).
 2. ASTM Standard: ASTM C 1289, Type I, Class 1 or 2.
 3. Surface-Burning Characteristics: Maximum flame-spread and smoke-developed indices of 75 and 450, respectively, based on tests performed on unfaced core on thicknesses up to 4 inches.
 4. Thermal Resistivity: 7.2 deg F x h x sq. ft./Btu x in. at 75 deg F. Provide insulation in minimum thickness as required to achieve an insulating value of R-20.

2.5 AUXILIARY INSULATION MATERIALS

- A. Adhesive for Bonding Insulation: Type recommended by insulation manufacturer and complying with fire-resistance requirements.
- B. Mastic Sealer: Type recommended by insulation manufacturer for bonding edge joints and filling voids.
- C. Mechanical Anchors: Corrosion-resistant type as recommended by insulation manufacturer for deck type and complying with fire and insurance wind-uplift rating requirements.
1. Provide system tested and approved for I-72 wind-uplift rating.

PART 3 - EXECUTION

3.1 PREPARING SUBSTRATE

- A. General: Comply with manufacturers' instructions to prepare substrate to receive single-ply membrane system.
1. Verify that penetrations and blocking are in place and secured and that roof drains are properly clamped into position.
- B. Clean substrate of dust, debris, and other substances detrimental to single-ply system installation. Remove sharp projections.

- C. Install flashings, and accessory items as shown and as recommended by manufacturer.
- D. Prime substrate where recommended by manufacturer of materials being installed.
- E. Prevent compounds from entering and clogging drains and conductors and from spilling or migrating onto surfaces of other work.

3.2 INSTALLING INSULATION

- A. General: Extend insulation full thickness in two layers, or in multiple layers over entire surface to be insulated, cutting and fitting tightly around obstructions. Form crickets, saddles, and tapered areas with additional material as shown and as required for proper drainage or membrane.
 - 1. Stagger joints in one direction for each course. For multiple layers, stagger joints in both directions between courses with no gaps, to form a complete thermal envelope. Insulation shall be no less than 4" thick in any area on the roof.
 - 2. Provide tapered units to suit drainage pattern indicated.
- B. Do not install more insulation in a day than can be covered with membrane before end of day or before start of inclement weather.
- C. Set insulation units on substrate with mechanical fasteners or spot adhesives and cover immediately with loose membrane for installation.
- D. Provide protection sheet between insulation and membrane when recommended by membrane manufacturer.
- E. Perimeter and Corner Attachment: Decrease spacing of fasteners for a distance of 16' around the perimeter of the building and at the corners.
 - 1. Any whole or partial insulation board which is located within the perimeter or at corners must have increased fasteners applied over the entire board, including any portion of the board that falls outside the perimeter or corner.
 - 2. At roof perimeter, a 50% increase in insulation fasteners is required (1.5 times as many fasteners as required in the main field of the roof).
 - 3. At roof corners, a 75% increase in insulation fasteners is required (1.75 times as many fasteners).

3.3 INSTALLATION, GENERAL

- A. Install roofing system in accordance with manufacturer's recommendations.
- B. Install roofing membrane, base flashings, and component materials in compliance with requirements in FMG 4450 and FMG 4470 as part of a membrane roofing

system as listed in FMG's "Approval Guide" for fire/windstorm classification indicated. Comply with recommendations in FMG Loss Prevention Data Sheet 1-49.

- C. Install roofing system in accordance with the following NRCA Manual Plates and NRCA recommendations; modify as required to comply with requirements of FMG references above:
1. Base Flashing at Parapet Wall: Plates BUR-1 and BUR-1S. Install single ply CSPE flashing in lieu of multiple ply flashing.
 2. Perimeter Edge, Raised: Plates BUR- and BUR-2S.
 3. Gutter at Draining Edge: Plates BUR-22 and BUR-22S.
 4. Curb Detail at Rooftop HVAC Units, Premanufactured: Plates BUR-12 and BUR-12S.
 5. Curb Detail at Rooftop HVAC Units, Job-Built, Wood: Plates BUR-13 and BUR-13S.
 6. Curb Detail at Skylight, Roof Hatch, and Smoke Vents: Plates 14 and 14S
 7. Penetration, Structural Member: Plates BUR-14 and BUR-14S.
 8. Penetration, Sheet Metal Enclosure: Plates 15 and 15S
 9. Penetration, Stack Flashing: Plates BUR-17 and BUR-17S.
 10. Penetration, Pocket: Plates BUR-19 and BUR-19S.
 11. Roof Drain: Plates BUR-20 and BUR-22S.

3.4 INSTALLING MEMBRANE

- A. Install EPDM sheet over area to receive roofing according to roofing system manufacturer's written instructions. Unroll sheet and allow to relax for a minimum of 30 minutes.
- B. Accurately align sheets and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.
- E. Bonding Adhesive: Apply bonding adhesive to substrate and underside of roofing membrane at rate required by manufacturer and allow to partially dry before installing roofing membrane. Do not apply bonding adhesive to splice area of roofing membrane.
- D. Spread sealant or mastic bed over deck drain flange at deck drains and securely seal roofing sheet in place with clamping ring.
- E. Mechanically or adhesively fasten roofing membrane securely at terminations, penetrations, and perimeter of roofing.
- F. Apply roofing membrane with side laps shingled with slope of roof deck.
- G. Adhesive Seam Installation: Clean both faces of splice areas, apply splicing cement, and firmly roll side and end laps of overlapping roofing membranes according to manufacturer's written instructions to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of roofing membrane terminations.
1. Apply a continuous bead of in-seam sealant before closing splice if required by

membrane roofing system manufacturer.

- H. Repair tears, voids, and lapped seams in roofing that does not meet requirements.

3.5 FLASHING INSTALLATION

- A. Install sheet flashings and performed flashing accessories and adhere to substrates according to roofing system manufacturer's written instructions.
- B. Apply bonding adhesive to substrate and underside of flashing sheet at required rate and allow to partially dry. Do not apply bonding adhesive to seam area of flashing.
- C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing as recommended by manufacturer.
- D. Clean splice areas, apply splicing cement, and firmly roll side and end laps of overlapping sheets according to manufacturer's written instructions to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of sheet flashing termination's.
- E. Terminate and seal top of sheet flashings.
- F. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

3.6 FIELD QUALITY CONTROL

- A. Manufacturer's Technical Representative: Contractor will engage a qualified manufacturer's technical representative acceptable to Owner for a minimum of one (1) full-time day per 40 hour work week on site to perform roof tests and inspections and to prepare test reports.
- B. Testing Agency: Contractor will engage a qualified independent testing and inspecting agency acceptable to Owner for a minimum of one (1) full-time day per 40 hour work week on site to perform roof tests and inspections and to prepare test reports.
- C. Test Cuts: Before flood coating and surfacing built-up roofing membrane, test specimens will be removed to evaluate problems observed during quality-assurance inspections of roofing membrane as follows:
 - 1. Approximate quantities of components within roofing membrane will be determined according to ASTM D 3617.
 - 2. Test specimens will be examined for interply voids according to ASTM D 3617 and to comply with criteria established in Appendix 3 of ARMA/NRCA's "Quality Control Guidelines for the Application of Built-up Roofing."

- D. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion and submit report to Architect.
 - 1. Notify Architect or Owner 48 hours in advance of date and time of inspection.
- E. Repair or remove and replace components of roofing system where test results or inspections indicate that they do not comply with specified requirements.
- F. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.7 PROTECTING ROOFING

- A. After completing roofing (including associated work), institute appropriate procedures for surveillance and protection of roofing during remainder of construction period. At the end of the construction period, or at a time when remaining construction will in no way affect or endanger roofing, make a final inspection of roofing and prepare a written report to Owner, describing nature and extent of deterioration or damage found.
- B. Repair or replace (as required) deteriorated or defective work found at the time of final inspection to a condition free of damage and deterioration at the time of Substantial Completion and according to the requirements of the specified warranty.

END OF SECTION

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:

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.

- 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.

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.

- 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.

- 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.

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.

- 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.

- B. Clean joint surfaces of residual sealant and other contaminants 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.

- 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.

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 1/4 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.

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.

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

SECTION 085113 ALUMINUM WINDOWS

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 Kawneer Architectural Aluminum Windows including perimeter trims, stools, accessories, shims and anchors, and perimeter sealing of window units.
 - 1. Types of aluminum windows include:
 - a. Kawneer Series NX-5000 Windows
 - b. Double Hung Tilt Window
 - c. 3-1/4" (83 mm) frame depth
 - d. CW-PG35-H

1.3 Definitions

- A. Definitions: For fenestration industry standard terminology and definitions refer to American Architectural Manufacturers Association (AAMA) – AAMA Glossary (AAMA AG).

1.4 Performance Requirements

- A. General Performance: Aluminum-framed window system shall withstand the effects of the following performance requirements without failure due to defective manufacture, fabrication, installation, or other defects in construction.
- B. Window Performance Requirements:
 - 1. Provide aluminum windows of performance indicated that comply with AAMA/WDMA/CSA 101/I.S.2/A440 (NAFS).
 - a. Performance Class and Grade: CW-PG35 - 56" x 91" (1422 mm x 2311 mm) -H.
 - 2. Wind loads: Provide window system; include anchorage, capable of withstanding wind load design pressures of a 130 mph windgust inward and outward. The design pressures are based on the current North Carolina approved International Building Code edition.
 - 3. Air Leakage: The test specimen shall be tested in accordance with ASTM E283. Air leakage rate shall not exceed 0.30 cfm/ft² (1.5 L/s·m²) at a static air pressure differential of 1.6 psf (75 Pa).
 - 4. Water Resistance: The test specimen shall be tested in accordance with ASTM E547 and ASTM. There shall be no leakage as defined in the test method at a static air pressure differential of 5.25 psf (251 Pa).
 - 5. Uniform Load Deflection: A minimum static air pressure difference of 35 psf (1676 Pa) shall be applied in the positive and negative direction in accordance

with ASTM E330. There shall be no deflection in excess of L/175 of the span of any framing member.

6. Uniform Structural Load: no glass breakage or permanent damage to fasteners, and maximum .3% permanent deformation of the span of any frame member when tested per ASTM E330 at a static air pressure difference of 52.5 psf (2514 Pa).
7. Component Testing: Window components shall be tested in accordance with procedures described in AAMA/WDMA/CSA 101/I.S.2/A440 (NAFS).
8. Forced Entry Resistance: All windows shall conform to ASTM F588, Grade 10.
9. Thermal Barrier Test: Thermal break shall be designed in accordance with AAMA TIR-A8 and tested in accordance with AAMA 505.

1.5 Submittals

- A. Product Data: Include construction details, material descriptions, fabrication methods, dimensions of individual components and profiles, hardware, finishes, and operating instructions for each type of aluminum window indicated.
- B. Shop Drawings: Include plans, elevations, sections, details, hardware, attachments to other work, operational clearances and installation details.
- C. Samples for Initial Selection: For units with factory-applied color finishes including samples of hardware and accessories involving color selection.
- D. Samples for Verification: For aluminum windows and components required.
- E. Product Schedule: For aluminum windows. Use same designations indicated on Drawings.
- F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency for each type, class, grade, and size of aluminum window. Test results based on use of downsized test units will not be accepted.

1.6 Quality Assurance

- A. Installer Qualifications: An installer which has had successful experiences with installation of the same or similar units required for this project and other projects of similar size and scope.
- B. Manufacturer Qualifications: A manufacturer capable of fabricating aluminum windows that meet or exceed performance requirements indicated and of documenting this performance by inclusion of test reports, and calculations.
- C. Source Limitations: Obtain aluminum windows through one source from a single manufacturer.
- D. Product Options: Drawings indicate size, profiles, and dimensional requirements of aluminum windows and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements." Do not modify size and dimensional requirements.
 1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

- E. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Build mockup for type(s) of window(s) indicated, in location(s) shown on Drawings.
- F. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.7 Project Conditions

- A. Field Measurements: Verify aluminum window openings by field measurements before fabrication and indicate measurements on Shop Drawings.

1.8 Warranty

- A. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty.
 - 1. Warranty Period: Two (2) years from Date of Substantial Completion of the project provided however that the Limited Warranty shall begin in no event later than six months from date of shipment by manufacturer.

PART 2 - PRODUCTS

2.1 Manufacturers

- A. Basis-of-Design Product:
 - 1. Kawneer Company Inc.
 - 2. Series NX-5000 Windows - Double Hung Tilt
 - 3. 3-1/4" (83 mm) frame depth
 - 4. CW-PG35-H

Subject to compliance with requirements, provide a comparable product by the following:

 - 1. Winco Series
 - 2. EFCO Corporation
 - 3. Wausau
 - 4. YKK AP YWW
 - 5. Keystone Industries
- B. Substitutions: Refer to Substitutions Section for procedures and submission requirements.
 - 1. Pre-Contract (Bidding Period) Substitutions: Submit written requests ten (10) days prior to bid date.
 - 2. Post-Contract (Construction Period) Substitutions: Submit written request in order to avoid window installation and construction delays.
 - 3. Product Literature and Drawings: Submit product literature and drawings modified to suit specific project requirements and job conditions.
 - 4. Certificates: Submit certificate(s) certifying substitute manufacturer (1) attesting to adherence to specification requirements for window system performance criteria, and (2) has been engaged in the design, manufacturer and fabrication of aluminum windows for a period of not less than ten (10) years. (Company Name)
 - 5. Test Reports: Submit test reports verifying compliance with each test requirement required by the project.

6. Samples: Provide samples of typical product sections and finish samples in manufacturer's standard sizes.
- C. Substitution Acceptance: Acceptance will be in written form, either as an addendum or modification, and documented by a formal change order signed by the Owner and Contractor.

2.2 Materials

- A. Aluminum Extrusions: Alloy and temper recommended by aluminum window manufacturer for strength, corrosion resistance, and application of required finish and not less than 0.070" (1.8 mm) wall thickness at any location for the main frame and sash members.
- B. Thermal Barrier: The thermal barrier shall consist of integral structural thermal break made with glass-reinforced nylon strips installed continuously and mechanically bonded to the aluminum.
- C. Fasteners: Aluminum, nonmagnetic stainless steel or other materials to be non-corrosive and compatible with aluminum window members, trim, hardware, anchors, and other components.
- D. Anchors, Clips, and Accessories: Aluminum, nonmagnetic stainless steel, or zinc-coated steel or iron complying with ASTM B633 for SC3 severe service conditions; provide sufficient strength to withstand design pressure indicated.
- E. Reinforcing Members: Aluminum, nonmagnetic stainless steel, or nickel/chrome-plated steel complying with ASTM B456 for Type SC3 severe service conditions, or zinc-coated steel or iron complying with ASTM B633 for SC3 severe service conditions; provide sufficient strength to withstand design pressure indicated.
- F. Sealant: For sealants required within fabricated windows, provide window manufacturer's standard, permanently elastic, non-shrinking, and non-migrating type recommended by sealant manufacturer for joint size and movement.

2.3 Window System

- A. Series NX-5000 Windows - Double Hung Tilt (basis of design)

2.4 Glazing

- A. Glass and Glazing Materials: Refer to Division 08 Section "Glazing" for glass units and glazing requirements applicable to glazed aluminum window units.
- B. Glazing System: Glazing method shall be a wet/dry type in accordance with manufacturer's standards. Exterior glazing shall be silicone back bedding sealant. Interior glazing shall be snap-in type glazing beads with an interior gasket in accordance with AAMA 702 or ASTM C864.

2.5 Hardware

- A. General: Provide manufacturer's standard hardware fabricated from aluminum, stainless steel, or other corrosion-resistant material compatible with aluminum; designed to smoothly operate, tightly close, and securely lock aluminum windows, and sized to accommodate sash weight and dimensions.
- B. Double Hung Window Typical Hardware:

1. Typical Hardware:
 - a. Black zinc die cast Sweep Lock
 - b. Aluminum Automatic Head Lock
 - c. Zinc Pivot Sash Bars
 - d. Black nylon Finger Button tilt releases

2.6 Accessories

- A. Spacers, Setting Blocks, Gaskets, and Bond Breakers: Manufacturer's standard permanent, non-migrating types in hardness recommended by manufacturer, compatible with sealants, and suitable for system performance requirements.
- B. Framing system gaskets, sealants, and joint fillers as recommended by manufacturer for joint type.
- C. Sealants and joint fillers for joints at perimeter of window system as specified in Division 7 Section "Joint Sealants".
- D. Perimeter Anchors: When steel anchors are used, provide insulation between steel material and aluminum material to prevent galvanic action.
- E. Optional Muntin Grids: Extruded aluminum profiles, 6063-T6 alloy and temper and as follows:
 1. True muntins.
 2. Between the glass muntins.
- F. Optional Exterior Panning and Interior Trims: Extruded aluminum, 6063-T6 alloy and temper, extruded to profiles and details indicated. Seal exterior joints with manufacturer's standard sealant to assure water-tight joints.
 1. Exterior Panning and Trims: All panning profiles shall be a minimum thickness of 0.062" (1.57 mm) to match the profiles as shown the drawings. Any profile variations shall be submitted to the architect and/or owner for approval 10 days prior to bid date. All panning shall be factory fabricated for field assembly. All corner joinery shall be factory cut. Joinery at the sill shall be coped and butt-type construction. All preparations for assembly shall be completed by the window manufacturer. Upon assembly, panning frame joints shall be back-sealed to prevent moisture penetration.
 2. Interior Trims: The interior face trim minimum wall thickness shall be 0.062" (1.57 mm). The face trim shall snap-fit onto concealed mounting clip. Exposed fasteners shall not be accepted. The mounting clip shall be extruded aluminum of 6063-T6 alloy and temper. The minimum wall thickness shall be 0.062" (1.57 mm). The trim clips shall be provided in 3" (76.2 mm) lengths and spaced a maximum of 18" (457.2 mm) center to center.
- G. Coupling Mullions: Shall be extruded aluminum of 6063-T6 alloy and temper of profile and dimensions indicated on drawings. Mullions shall provide structural properties to resist wind pressure required by performance criteria and standards.
- H. Insect Screens: (Half Screen) Held in exterior tracks with stainless steel leaf springs; 5/16" x 1-1/2" x .045" extruded tubular aluminum frame with finish to match window in color and performance; corners mitered, gusset reinforced, and crimped; 18 x 16 dark fiberglass mesh; PVC splines.

2.7 Fabrication

- A. Framing Members, General: Fabricate components that, when assembled, have the following characteristics:
 - 1. Profiles that are sharp, straight, and free of defects or deformations.
 - 2. Accurately fit joints; make joints flush, hairline and weatherproof.
 - 3. Means to drain water passing joints, condensation within framing members, and moisture migrating within the system to exterior.
 - 4. Physical and thermal isolation of glazing from framing members.
 - 5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
 - 6. Provisions for field replacement of glazing.
 - 7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
- B. Window Frame Joinery: Mitered and Mechanically clipped and/or staked. Factory sealed frame and corner joints.
- C. Fabricate aluminum windows in sizes indicated. Include a complete system for assembling components and anchoring windows.
- D. Fabricate aluminum windows that are re-glazable without dismantling sash or framing.
- E. Thermally Broken Construction: Fabricate aluminum windows with an integral, concealed, low-conductance thermal barrier. Thermal barriers shall be designed in accordance with AAMA TIR A8.
 - 1. Thermal Barrier: The thermal barrier shall consist of integral structural thermal break made with glass-reinforced nylon strips installed continuously and mechanically bonded to the aluminum.
- F. Mullions: Provide mullions and cover plates as shown, matching window units, complete with anchors for support to structure and installation of window units. Allow for erection tolerances and provide for movement of window units due to thermal expansion and building deflections, as indicated. Provide mullions and cover plates capable of withstanding design loads of window units.
- G. Sub frames: Provide sub frames with anchors for window units as shown, of profile and dimensions indicated but not less than 0.093" (2.4 mm) thick extruded aluminum. Miter or cope corners, and join with concealed mechanical joint fasteners. Finish to match window units. Provide sub frames capable of withstanding design loads of window units.
- H. Factory-Glazed Fabrication: Glaze aluminum windows in the factory where practical and possible for applications indicated. Comply with requirements in Division 08 Section "Glazing" and with AAMA/WDMA/CSA 101/I.S.2/A440 (NAFS).
- I. Glazing Stops: Provide snap-on glazing stops coordinated with Division 08 Section "Glazing" and glazing system indicated. Provide glazing stops to match frame.

2.8 Aluminum Finishes

- A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- B. Factory Finishing:

1. Kawneer Permanodic™ AA-M10C21A44 / AA-M45C22A44, AAMA 611, Architectural Class I Color Anodic Coating - Color to be selected by the Architect from the full range.

PART 3 - EXECUTION

3.1 Examination

- A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work. Verify rough opening dimensions, levelness of sill plate and operational clearances. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components to ensure a coordinated, weather tight window installation.
 1. Masonry Surfaces: Visibly dry and free of excess mortar, sand, and other construction debris.
 2. Wood Frame Walls: Dry, clean, sound, well nailed, free of voids, and without offsets at joints. Ensure that nail heads are driven flush with surfaces in opening and within 3 inches (76.2 mm) of opening.
 3. Metal Surfaces: Dry; clean; free of grease, oil, dirt, rust, corrosion, and welding slag; without sharp edges or offsets at joints.
 4. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 Installation

- A. Comply with Drawings, Shop Drawings, and manufacturer's written instructions for installing windows, hardware, accessories, and other components.
- B. Install aluminum framed window system level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction.
- C. Set sill members in bed of sealant or with gaskets, as indicated, for weather tight construction.
- D. Install aluminum framed window system and components to drain condensation, water penetrating joints, and moisture migrating within system to the exterior.
- E. Separate aluminum from dissimilar materials to prevent corrosion or electrolytic action at points of contact.

3.3 Field Quality Control

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.
 1. Testing and inspecting agency will interpret tests and state in each report whether tested work complies with or deviates from requirements.
- B. Testing Services: Testing and inspecting of installed windows shall take place as follows:
 1. Testing Methodology: Testing Standard shall be per AAMA 502 including reference to ASTM E783 for Air Infiltration Test and ASTM E1105 for Water Penetration Test.

- a. Air Leakage Test: Conduct test in accordance with ASTM E783 at a minimum uniform static test pressure of 1.6 psf (75 Pa). The maximum allowable rates of air leakage for field testing shall not exceed 1.5 times the project specifications.
 - b. Water Infiltration Test: Water penetration resistance tests shall be conducted in accordance with ASTM E1105 at a static test pressure equal to 2/3 the specified water test pressure.
2. Testing Extent: Architect shall select window units to be tested as soon as a representative portion of the project has been installed, glazed, perimeter caulked and cured. Conduct tests for air infiltration and water penetration with manufacturer's representative present.
 3. Test Reports: Shall be prepared according to AAMA 502.

3.4 Adjusting, Cleaning, And Protection

- A. Adjust operating sashes, screens, hardware, and accessories for a tight fit at contact points and weather stripping for smooth operation and weather tight closure. Lubricate hardware and moving parts.
- B. Clean aluminum surfaces immediately after installing windows. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.
- C. Clean glass immediately after installing windows. Comply with manufacturer's written recommendations for final cleaning and maintenance. Remove nonpermanent labels, and clean surfaces.
- D. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.
- E. Protect window surfaces from contact with contaminating substances resulting from construction operations. In addition, monitor window surfaces adjacent to and below exterior concrete and masonry surfaces during construction for presence of dirt, scum, alkaline deposits, stains, or other contaminants. If contaminating substances do contact window surfaces, remove contaminants immediately according to manufacturer's written recommendations.

DISCLAIMER STATEMENT

This guide specification is intended to be used by a qualified construction specifier. The guide specification is not intended to be verbatim as a project specification without appropriate modifications for the specific use intended. The guide specification must be used and coordinated with the procedures of each design firm, and the particular requirements of a specific construction project.

END OF SECTION 085113

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

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.

- 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 1/2-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

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: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."

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.

- 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).

- 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

- 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.

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, 1/2-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, 1/2-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.

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.

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.

- 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

SECTION 092550 GYPSUM BOARD ASSEMBLIES

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. Nonload-bearing steel framing members for gypsum board assemblies.
 - 2. Gypsum board assemblies attached to steel framing.
 - 3. Gypsum board bonded adhesively to interior concrete and masonry substrates.
 - 4. Metal trim and accessories for finishing gypsum board.
 - 5. Sound Attenuation Blankets
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 4 Section "Unit Masonry" for vapor retarder installed over gypsum sheathing.
 - 2. Division 5 Section "Cold-Formed Metal Framing" for load-bearing steel framing.
 - 3. Division 6 Section "Rough Carpentry" for wood framing and furring.
 - 4. Division 7 Section "Through-Penetration Firestop Systems" for firestopping systems and fire-resistance-rated joint sealants.

1.3 DEFINITIONS

- A. Gypsum Board Construction Terminology: Refer to ASTM C 11 and GA-505 for definitions of terms for gypsum board assemblies not defined in this Section or in other referenced standards.

1.4 ASSEMBLY PERFORMANCE REQUIREMENTS

- A. Sound Transmission Characteristics: For gypsum board assemblies with STC ratings provide materials and construction identical to those of assemblies whose STC ratings were determined according to ASTM E 90 and classified according to ASTM E 413 by a qualified independent testing agency.
- B. Fire Resistance: Provide gypsum board assemblies with fire-resistance ratings indicated.

1.5 ACTION SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product Data for each type of product specified.
- C. Product certificates signed by manufacturers of gypsum board assembly components certifying that their products comply with specified requirements.

1.6 QUALITY ASSURANCE

- A. Single-Source Responsibility for Steel Framing: Obtain steel framing members for gypsum board assemblies from a single manufacturer, unless otherwise indicated.
- B. Single-Source Responsibility for Panel Products: Obtain each type of gypsum board and other panel products from a single manufacturer.
- C. Single-Source Responsibility for Finishing Materials: Obtain finishing materials from either the same manufacturer that supplies gypsum board and other panel products or from a manufacturer acceptable to gypsum board manufacturer.
- D. Fire-Test-Response Characteristics: Where fire-resistance-rated gypsum board assemblies are indicated, provide gypsum board assemblies that comply with the following requirements:
 - 1. Fire-Resistance Ratings: As indicated by GA File Numbers in GA-600 "Fire Resistance Design Manual" or design designations in UL "Fire Resistance Directory" or in the listing of another testing and inspecting agency acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.
- B. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes. Neatly stack gypsum panels flat to prevent sagging.

1.8 PROJECT CONDITIONS

- A. Environmental Conditions, General: Establish and maintain environmental conditions for applying and finishing gypsum board to comply with ASTM C 840 requirements or gypsum board manufacturer's recommendations, whichever are more stringent.
- B. Room Temperatures: For nonadhesive attachment of gypsum board to framing, maintain not less than 40 deg F. For adhesive attachment and finishing of gypsum board, maintain not less than 50 deg F for 48 hours before application and continuously after until dry. Do not exceed 95 deg F when using temporary heat sources.

- C. Ventilation: Ventilate building spaces as required to dry joint treatment materials. Avoid drafts during hot, dry weather to prevent finishing materials from drying too rapidly.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:

1. Steel Framing and Furring:

- a. Dale Industries, Inc.
- b. Dietrich Industries, Inc.
- c. Marino/Ware (formerly Marino Industries Corp.).
- d. National Gypsum Co.; Gold Bond Building Products Division.
- e. Unimast, Inc.

2. Gypsum Board and Related Products:

- a. United States Gypsum Co.
- b. National Gypsum Co.; Gold Bond Building Products Division.
- c. Georgia-Pacific Corp.
- d. Domtar Gypsum.

3. Drywall Trims

- a. United States Gypsum Co.
- b. National Gypsum Co.
- c. Georgia Pacific Corp.
- d. Fry Reglet - Heavy Cuty Corner Trim
- e. Amico

- B. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:

General: Complying with ASTM C 36/C 36M or ASTM C 1396/C 1396M, as applicable to type of gypsum board indicated and whichever is more stringent.

- a. American Gypsum Co.
- b. BPB America Inc.
- c. Lafarge North America Inc.
- d. National Gypsum Company.
- e. PABCO Gypsum.
- f. Temple.
- g. USG Corporation.

1. Impact Resistant Gypsum Wallboard

- a. SHEETROCK AR Board; United States Gypsum Company.
 - b. High Impact 2000; National Gypsum Co.
 - c. GyProc Abuse Resistant Gypsum Board; Georgia-Pacific Corp.
2. Gypsum Sheathing (for exterior soffits)
- a. "Dens-Glass Gold" by G-P Gypsum Corporation.
3. Moisture Resistant Gypsum Wallboard
- a. SHEETROCK Water Resistant Gypsum Panels; United States Gypsum Company.
 - b. Gold Bond M. R. Board; National Gypsum Co.
 - c. GyProc Moisture Guard; Georgia-Pacific Corp.

2.2 STEEL FRAMING COMPONENTS FOR SUSPENDED AND FURRED CEILINGS

- A. General: Provide components complying with ASTM C 754 for conditions indicated.
- B. 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 hangers of type indicated, and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing according to ASTM E 1190 conducted by a qualified independent testing agency.
- C. Wire Ties: ASTM A 641, Class 1 zinc coating, soft temper, 0.062 inch thick.
- D. Wire Hangers: ASTM A 641, Class 1 zinc coating, soft temper, 0.162-inch diameter.
- E. Channels: Cold-rolled steel, 0.0598-inch minimum thickness of base (uncoated) metal and 7/16-inch- wide flanges, and as follows:
1. Carrying Channels: 1-1/2 inches deep, 475 lb/1000 feet, unless otherwise indicated.
 2. Furring Channels: 3/4 inch deep, 300 lb/1000 feet, unless otherwise indicated.
 3. Finish: ASTM A 653, G 60 hot-dip galvanized coating for framing for exterior soffits and where indicated.
- F. Steel Studs for Furring Channels: ASTM C 645, with flange edges of studs bent back 90 degrees and doubled over to form 3/16-inch- wide minimum lip (return), and complying with the following requirements for minimum thickness of base (uncoated) metal and for depth:
1. Thickness: 0.0179 inch, unless otherwise indicated.
 2. Depth: 2-1/2 inches, unless otherwise indicated.
 3. Protective Coating: ASTM A 653, G 40 hot-dip galvanized coating.
 4. Protective Coating: Manufacturer's standard corrosion-resistant coating.

- G. Steel Rigid Furring Channels: ASTM C 645, hat shaped, depth of 7/8 inch, and minimum thickness of base (uncoated) metal as follows:
1. Thickness: 0.0179 inch, unless otherwise indicated.
 2. Protective Coating: ASTM A 653, G 40 hot-dip galvanized coating.
 3. Protective Coating: Manufacturer's standard corrosion-resistant coating.
- H. Steel Resilient Furring Channels: Manufacturer's standard product designed to reduce sound transmission, fabricated from steel sheet complying with ASTM A 653 or ASTM A 568 to form 1/2-inch- deep channel of the following configuration:
1. Single- or Double-Leg Configuration: Asymmetric-shaped channel with face connected to a single flange by a single-slotted leg (web) or hat-shaped channel, with 1-1/2-inch- wide face connected to flanges by double-slotted or expanded-metal legs (webs).

2.3 STEEL FRAMING FOR WALLS AND PARTITIONS

- A. General: Provide steel framing members complying with the following requirements:
1. Protective Coating: Manufacturer's standard corrosion-resistant coating.
- B. Steel Studs and Runners: ASTM C 645, with flange edges of studs bent back 90 degrees and doubled over to form 3/16-inch- wide minimum lip (return), and complying with the following requirements for minimum thickness of base (uncoated) metal and for depth:
1. Thickness: 0.0179 inch, unless otherwise indicated.
 2. Thickness: 0.0312 inch as follows:
 - a. For head runner, sill runner, jamb, and cripple studs at door and other openings.
 - b. Where indicated.
 3. Depth: 3-5/8 inches, where indicated.
 4. Depth: 6-inches where indicated.
- C. Deflection Track: Manufacturer's standard top runner designed to prevent cracking of gypsum board applied to interior partitions resulting from deflection of the structure above fabricated from steel sheet complying with ASTM A 653 or ASTM A 568. Thickness as indicated for studs, and width to accommodate depth of studs, and of the following configuration:
1. Top runner with 2-1/2-inch- deep flanges that either have V-shaped offsets that compress when pressure is applied from construction above or have slots 1 inch o.c. that allow fasteners attached to studs through the slots to accommodate structural movement by slipping.
 - a. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:

- a. Superior Flex Track System (SFT); Delta Star, Inc.
 - b. SLP-TRK; Metal-Lite, Inc.
- D. Deflection and Firestop Track: Top runner designed to allow partition heads to expand and contract with movement of structure above while maintaining continuity of the assembly. Comply with requirements of ASTM C 645 except configuration, of thickness indicated for studs and width to accommodate depth of studs indicated with flanges offset at midpoint to accommodate gypsum board thickness.
 1. Offset Configuration: Reveal design with offset recessing in from depth of stud.
 - a. Available Product: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to:
 - a. "Fire Trak"; Fire Trak Corp.
- E. Steel Rigid Furring Channels: ASTM C 645, hat shaped, depth and minimum thickness of base (uncoated) metal as follows:
 1. Thickness: 0.0179 inch, unless otherwise indicated.
 2. Depth: 7/8 inch.
- F. Furring Brackets: Serrated-arm type, adjustable, fabricated from corrosion-resistant steel sheet complying with ASTM C 645, minimum thickness of base (uncoated) metal of 0.0329 inch, designed for screw attachment to steel studs and steel rigid furring channels used for furring.
- G. Steel Resilient Furring Channels: Manufacturer's standard product designed to reduce sound transmission, fabricated from steel sheet complying with ASTM A 653 or ASTM A 568 to form 1/2-inch- deep channel of the following configuration:
 1. Single- or Double-Leg Configuration: Asymmetric-shaped channel with face connected to a single flange by a single-slotted leg (web) or hat-shaped channel, with 1-1/2-inch- wide face connected to flanges by double-slotted or expanded-metal legs (webs).
- H. Steel Channel Bridging: Cold-rolled steel, 0.0598-inch minimum thickness of base (uncoated) metal and 7/16-inch- wide flanges, 1-1/2 inches deep, 475 lb/1000 feet, unless otherwise indicated.
- I. Steel Flat Strap and Backing Plate: Steel sheet for blocking and bracing complying with ASTM A 653 or ASTM A 568, length and width as indicated, and with a minimum base metal (uncoated) thickness as follows:
 1. Thickness: 0.0598 inch unless indicated otherwise.
- J. Fasteners for Metal Framing: Provide fasteners of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel framing and furring members securely to substrates involved; complying with the recommendations of gypsum board manufacturers for applications indicated.

2.4 GYPSUM BOARD PRODUCTS

- A. General: Provide gypsum board of types indicated in maximum lengths available that will minimize end-to-end butt joints in each area indicated to receive gypsum board application.
1. Widths: Provide gypsum board in widths of 48 inches.
- B. Gypsum Wallboard: ASTM C 36 and as follows:
1. Type: Regular for vertical surfaces, unless otherwise indicated.
 2. Type: Type X where required for fire-resistance-rated assemblies.
 3. Type: Sag-resistant type for ceiling surfaces.
 4. Type: Proprietary type as required for specific fire-resistance-rated assemblies
 5. Type: Abuse Resistant for Vertical Surfaces where indicated.
 6. Edges: Tapered.
 7. Thickness: 5/8 inch, unless otherwise indicated.
- C. Water-Resistant Gypsum Backing Board: ASTM C 630 and as follows:
1. Type: Regular, unless otherwise indicated.
 2. Type: Type X where required for fire-resistance-rated assemblies and where indicated.
 3. Thickness: 5/8 inch unless otherwise indicated.
- D. Glass-Reinforced Gypsum Wallboard: ASTM C 1177. ASTM E 136, ASTM D3273 and as follows:
1. Type: Regular, unless otherwise indicated.
 2. Thickness: 5/8" unless otherwise indicated.

2.5 TRIM ACCESSORIES

- A. Accessories for Interior Installation: Cornerbead, edge trim, reveals, and control joints complying with ASTM C 1047 and requirements indicated below:
1. Material: Formed metal or plastic, with metal complying with the following requirements:
 - a. Steel sheet zinc coated by hot-dip process or rolled zinc.
 - b. Steel sheet zinc coated by hot-dip or electrolytic process, or steel sheet coated with aluminum or rolled zinc.
 2. Shapes indicated below by reference to Fig. 1 designations in ASTM C 1047:
 - a. Heavy duty outside corner trim as manufactured by Fry Reglet for all vertical outside corners in traffic areas.
 - b. Cornerbead on outside corners, in non-traffic areas.

- c. LC-bead with both face and back flanges; face flange formed to receive joint compound. Use LC-beads for edge trim, unless otherwise indicated.
- d. L-bead with face flange only; face flange formed to receive joint compound. Use L-bead where indicated.
- e. U-bead with face and back flanges; face flange formed to be left without application of joint compound. Use U-bead where indicated.
- f. One-piece control joint formed with V-shaped slot and removable strip covering slot opening.
- g. $\frac{1}{2}$ " reveal trim and accessories as manufactured by Fry Reglet.

2.6 JOINT TREATMENT MATERIALS

- A. General: Provide joint treatment materials complying with ASTM C 475 and the recommendations of both the manufacturers of sheet products and of joint treatment materials for each application indicated.
- B. Joint Tape for Gypsum Board: Paper reinforcing tape, unless otherwise indicated.
- C. Setting-Type Joint Compounds for Gypsum Board: Factory-packaged, job-mixed, chemical-hardening powder products formulated for uses indicated.
 1. Where setting-type joint compounds are indicated as a taping compound only or for taping and filling only, use formulation that is compatible with other joint compounds applied over it.
 2. For topping compound, use sandable formulation.
- D. Drying-Type Joint Compounds for Gypsum Board: Factory-packaged vinyl-based products complying with the following requirements for formulation and intended use.
 1. Ready-Mixed Formulation: Factory-mixed product.
 - a. Taping compound formulated for embedding tape and for first coat over fasteners and face flanges of trim accessories.
 - b. Topping compound formulated for fill (second) and finish (third) coats.
 - c. All-purpose compound formulated for both taping and topping compounds.

2.7 ACOUSTICAL SEALANT

- A. Acoustical Sealant for Exposed Joints: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834 and the following requirements:
 1. Product is effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
- B. Acoustical Sealant for Concealed Joints: Manufacturer's standard nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber sealant

recommended for sealing interior concealed joints to reduce transmission of airborne sound.

- C. Available Products: Subject to compliance with requirements, acoustical sealants that may be incorporated in the Work include, but are not limited to, the following:
1. Acoustical Sealant for Exposed Joints:
 - a. PL Acoustical Sealant; ChemRex, Inc.; Contech Brands.
 - b. AC-20 FTR Acoustical and Insulation Sealant; Pecora Corp.
 - c. SHEETROCK Acoustical Sealant; United States Gypsum Co.
 2. Acoustical Sealant for Concealed Joints:
 - a. BA-98; Pecora Corp.
 - b. Tremco Acoustical Sealant; Tremco, Inc.

2.8 MISCELLANEOUS MATERIALS

- A. General: Provide auxiliary materials for gypsum board construction that comply with referenced standards and recommendations of gypsum board manufacturer.
- B. Spot Grout: ASTM C 475, setting-type joint compound recommended for spot-grouting hollow metal door frames.
- C. Steel drill screws complying with ASTM C 1002 for the following applications:
1. Fastening gypsum board to steel members less than 0.033 inch thick.
- D. Steel drill screws complying with ASTM C 954 for fastening gypsum board to steel members from 0.033 to 0.112 inch thick.
- E. Asphalt-Saturated Organic Felt: ASTM D 226, Type I (No. 15 asphalt felt), nonperforated.
- F. Foam Gaskets: Closed-cell vinyl foam adhesive-backed strips that allow fastener penetration without foam displacement, 1/8 inch thick, in width to suit metal stud size indicated.
- G. Sound-Attenuation Blankets: Unfaced mineral-fiber blanket insulation produced by combining mineral fibers of type described below with thermosetting resins to comply with ASTM C 665 for Type I (blankets without membrane facing).
1. Mineral-Fiber Type: Fibers manufactured from glass.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates to which gypsum board assemblies attach or abut, installed hollow metal frames, cast-in-anchors, and structural framing, with Installer present,

for compliance with requirements for installation tolerances and other conditions affecting performance of assemblies specified in this Section. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Ceiling Anchorages: Coordinate installation of ceiling suspension systems with installation of overhead structural assemblies to ensure that inserts and other provisions for anchorages to building structure have been installed to receive ceiling hangers that will develop their full strength and at spacing required to support ceilings.

3.3 INSTALLING STEEL FRAMING, GENERAL

- A. Steel Framing Installation Standard: Install steel framing to comply with ASTM C 754 and with ASTM C 840 requirements that apply to framing installation.
- B. Install supplementary framing, blocking, and bracing at terminations in gypsum board assemblies to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction. Comply with details indicated and with recommendations of gypsum board manufacturer or, if none available, with United States Gypsum Co.'s "Gypsum Construction Handbook."
 - 1. Use steel flat strap and backing plate as blocking and bracing for the support of above listed items.
- C. Isolate steel framing from building structure at locations indicated to prevent transfer of loading imposed by structural movement. Comply with details shown on Drawings.
 - 1. Where building structure abuts ceiling perimeter or penetrates ceiling.
 - 2. Where partition framing and wall furring abut structure, except at floor.
 - a. Install deflection track top runner to attain lateral support and avoid axial loading.
 - b. Install deflection and firestop track top runner at fire-resistance-rated assemblies.
 - a. Attach jamb studs at openings to tracks using manufacturer's standard stud clip.
- D. Do not bridge building control and expansion joints with steel framing or furring members. Independently frame both sides of joints with framing or furring members as indicated.

3.4 INSTALLING STEEL FRAMING FOR SUSPENDED AND FURRED CEILINGS

- A. Suspend ceiling hangers from building structural members and as follows:
 - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or ceiling suspension system. Splay hangers only where required to miss obstructions

and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.

2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with the location of hangers required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.
 3. Secure wire hangers by looping and wire-tying, either directly to structures or to inserts, eyescrews, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause them to deteriorate or otherwise fail.
 4. Secure flat, angle, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eyescrews, or other devices and fasteners that are secure and appropriate for structure as well as for type of hanger involved, and in a manner that will not cause them to deteriorate or otherwise fail.
 5. Do not attach hangers to steel deck tabs.
 6. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 7. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- B. Sway-brace suspended steel framing with hangers used for support.
- C. Install suspended steel framing components in sizes and at spacings indicated, but not less than that required by the referenced steel framing installation standard.
1. Wire Hangers: 48 inches o.c.
 2. Carrying Channels (Main Runners): 48 inches o.c.
 3. Furring Channels (Furring Members): 16 inches o.c.
- D. Installation Tolerances: Install steel framing components for suspended ceilings so that cross-furring or grid suspension members are level to within 1/8 inch in 12 feet as measured both lengthwise on each member and transversely between parallel members.
- E. Wire-tie or clip furring members to main runners and to other structural supports as indicated.
- F. Grid Suspension System: Attach perimeter wall track or angle where grid suspension system meets vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

3.5 INSTALLING STEEL FRAMING FOR WALLS AND PARTITIONS

- A. Install runners (tracks) at floors, ceilings, and structural walls and columns where gypsum board stud assemblies abut other construction.
1. Where studs are installed directly against exterior walls, install asphalt felt strips or foam gaskets between studs and wall.

- B. Installation Tolerances: Install each steel framing and furring member so that fastening surfaces do not vary more than 1/8 inch from the plane formed by the faces of adjacent framing.
- C. Extend partition framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at, or within 12 inches above, suspended ceilings. Continue framing over frames for doors and openings and frame around ducts penetrating partitions above ceiling to provide support for gypsum board.
 - 1. Cut studs short of full height in accordance with deflection track manufacturer's installation instructions to provide perimeter relief.
 - 2. For STC-rated and fire-resistance-rated partitions that extend to the underside of floor/roof slabs and decks or other continuous solid structural surfaces to obtain ratings, install framing around structural and other members extending below floor/roof slabs and decks, as needed, to support gypsum board closures needed to make partitions continuous from floor to underside of solid structure.
- D. Terminate partition framing at, or within 12 inches above, suspended ceilings where indicated.
- E. Install steel studs and furring in sizes and at spacings indicated.
 - 1. Single-Layer Construction: Space studs and furring 16 inches o.c., unless otherwise indicated.
- F. Install steel studs so flanges point in the same direction and leading edge or end of each gypsum board panel can be attached to open (unsupported) edges of stud flanges first.
- G. Frame door openings to comply with GA-219, and with applicable published recommendations of gypsum board manufacturer, unless otherwise indicated. Attach vertical studs at jambs with screws either directly to frames or to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
 - 1. Install 2 studs at each jamb, unless otherwise indicated.
 - 2. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint.
 - 3. Extend jamb studs through suspended ceilings and attach to underside of floor or roof structure above.
- H. Frame openings other than door openings to comply with details indicated or, if none indicated, as required for door openings. Install framing below sills of openings to match framing required above door heads.

3.6 APPLYING AND FINISHING GYPSUM BOARD, GENERAL

- A. Gypsum Board Application and Finishing Standards: Install and finish gypsum panels to comply with ASTM C 840 and GA-216.

- B. Install sound-attenuation blankets, where indicated, prior to installing gypsum panels unless blankets are readily installed after panels have been installed on one side.
- C. Install ceiling board panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in the central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- D. Install gypsum panels with face side out. Do not install imperfect, damaged, or damp panels. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.
- E. Locate both edge or end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Avoid joints other than control joints at corners of framed openings where possible.
- F. Attach gypsum panels to steel studs so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- G. Attach gypsum panels to framing provided at openings and cutouts.
- H. Spot grout hollow metal door frames for solid-core wood doors, hollow metal doors, and doors over 32 inches wide. Apply spot grout at each jamb anchor clip and immediately insert gypsum panels into frames.
- I. Form control and expansion joints at locations indicated and as detailed, with space between edges of adjoining gypsum panels, as well as supporting framing behind gypsum panels.
- J. Cover both faces of steel stud partition framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases that are braced internally.
 - 1. Except where concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
 - 2. Fit gypsum panels around ducts, pipes, and conduits.
 - 3. Where partitions intersect open concrete coffers, concrete joists, and other structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by coffers, joists, and other structural members; allow 1/4- to 3/8-inch- wide joints to install sealant.
- K. Isolate perimeter of nonload-bearing gypsum board partitions at structural abutments, except floors. Unless detailed otherwise, provide 1/4- to 1/2-inch- wide spaces at these locations and trim edges with U-bead edge trim where edges of gypsum panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- L. Where STC-rated gypsum board assemblies are indicated, seal construction at perimeters, behind control and expansion joints, openings, and penetrations with a continuous bead of acoustical sealant including a bead at both faces of the partitions.

Comply with ASTM C 919 and manufacturer's recommendations for location of edge trim and closing off sound-flanking paths around or through gypsum board assemblies, including sealing partitions above acoustical ceilings.

- M. Space fasteners in gypsum panels according to referenced gypsum board application and finishing standard and manufacturer's recommendations.

1. Space screws a maximum of 12 inches o.c. for vertical applications.

- N. Space fasteners in panels that are tile substrates a maximum of 8 inches o.c.

3.7 GYPSUM BOARD APPLICATION METHODS

- A. Single-Layer Application: Install gypsum wallboard panels as follows:

1. On ceilings, apply gypsum panels prior to wall/partition board application to the greatest extent possible and at right angles to framing, unless otherwise indicated.

2. On partitions/walls, apply gypsum panels horizontally (perpendicular to framing), unless parallel application is required for fire-resistance-rated assemblies. Use maximum-length panels to minimize end joints.

- a. Stagger abutting end joints not less than one framing member in alternate courses of board.

- B. Single-Layer Fastening Methods: Apply gypsum panels to supports as follows:

1. Fasten with screws.

- C. Direct-Bonding to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's recommendations, and temporarily brace or fasten gypsum panels until fastening adhesive has set.

3.8 INSTALLING TRIM ACCESSORIES

- A. General: For trim accessories with back flanges, fasten to framing with the same fasteners used to fasten gypsum board. Otherwise, fasten trim accessories according to accessory manufacturer's directions for type, length, and spacing of fasteners.

- B. Install cornerbead at external corners. Install heavy duty corner beads at all vertical outside corners.

- C. Install edge trim where edge of gypsum panels would otherwise be exposed. Provide edge trim type with face flange formed to receive joint compound, except where other types are indicated.

1. Install LC-bead where gypsum panels are tightly abutted to other construction and back flange can be attached to framing or supporting substrate.

2. Install L-bead where edge trim can only be installed after gypsum panels are installed.

3. Install U-bead where indicated.
- D. Install control joints according to ASTM C 840 and manufacturer's recommendations and in specific locations approved by Architect for visual effect.

3.9 FINISHING GYPSUM BOARD ASSEMBLIES

- A. General: Treat gypsum board joints, interior angles, flanges of cornerbead, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration.
- B. Prefill open joints, rounded or beveled edges, and damaged areas using setting-type joint compound.
- C. Apply joint tape over gypsum board joints and to flanges of trim accessories as recommended by trim accessory manufacturer.
- D. Levels of Gypsum Board Finish: Provide the following levels of gypsum board finish per GA-214.
 1. Level 1 for ceiling plenum areas, concealed areas, and where indicated, unless a higher level of finish is required for fire-resistance-rated assemblies and sound-rated assemblies.
 2. Level 2 where panels form substrates for tile and where indicated.
 3. Level 4 for gypsum board surfaces exposed to view, unless otherwise indicated.
- E. Use one of the following joint compound combinations as applicable to the finish levels specified:
 1. Embedding and First Coat: Setting-type joint compound. Fill (Second) Coat: Setting-type joint compound. Finish (Third) Coat: Sandable, setting-type joint compound.
 2. Embedding and First Coat: Setting-type joint compound. Fill (Second) Coat: Setting-type joint compound. Finish (Third) Coat: Ready-mixed, drying-type, all-purpose or topping compound.
 3. Embedding and First Coat: Ready-mixed, drying-type, all-purpose or taping compound. Fill (Second) Coat: Ready-mixed, drying-type, all-purpose or topping compound. Finish (Third) Coat: Ready-mixed, drying-type, all-purpose or topping compound.
- F. Where Level 1 gypsum board finish is indicated, embed tape in joint compound.
- G. Where Level 2 gypsum board finish is indicated, embed tape in joint compound and apply a separate first coat of joint compound to tape, fasteners and trim flanges.
- H. Where Level 4 gypsum board finish is indicated, embed tape in joint compound and apply first, fill (second), and finish (third) coats of joint compound over joints, angles, fastener heads, and accessories. Touch up and sand between coats and after last coat as needed to produce a surface free of visual defects and ready for decoration.

3.10 FIELD QUALITY CONTROL

- A. Above-Ceiling Observation: Architect will conduct an above-ceiling observation prior to installation of gypsum board ceilings and report any deficiencies in the Work observed. Do not proceed with installation of gypsum board to ceiling support framing until deficiencies have been corrected.
1. Notify Architect one week in advance of the date and the time when the Project, or part of the Project, will be ready for an above-ceiling observation.
 2. Prior to notifying Architect, complete the following in areas to receive gypsum board ceilings:
 - a. Installation of 80 percent of lighting fixtures, powered for operation.
 - b. Installation, insulation, and leak and pressure testing of water piping systems.
 - c. Installation of air duct systems.
 - d. Installation of air devices.
 - e. Installation of mechanical system control air tubing.
 - f. Installation of ceiling support framing.

3.11 CLEANING AND PROTECTION

- A. Promptly remove any residual joint compound from adjacent surfaces.
- B. Provide final protection and maintain conditions, in a manner acceptable to Installer, that ensure gypsum board assemblies are without damage or deterioration at the time of Substantial Completion.

END OF SECTION 092550

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.

- 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.

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 (ACT1)

- 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 acoustics No. 1714

2. USG Interiors, Inc.; Radar ClimaPlus High-NRC, No.22441
- 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: .84
 4. NRC: Not less than .70.
 5. CAC: Not less than 35.
 6. Edge Detail: Square
 7. Thickness: 3/4 inch
 8. 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.
- E. Warranty: Provide 10 year warranty for product installed.
- F. Suspension System Type: As specified in Part 2.7.C.
- 2.4 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.

2.5 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.
 - 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.

2.6 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 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.
 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.
 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

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.

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.

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:

- 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

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.

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.

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.

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.

- 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.

- 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

SECTION 096813 – TILE CARPETING

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 modular carpet tile.
- B. Related Sections:
 - 1. Division 9 Section "Resilient Base and Accessories.
 - 2. Division 9 Section "Resilient Tile Flooring" for resilient wall base and accessories installed with carpet tile.

1.3 PREINSTALLATION MEETINGS

- A. Pre-installation Conference: Conduct conference at Project site
 - 1. Review methods and procedures related to carpet tile installation including, but not limited to, the following:
 - a. Review delivery, storage, and handling procedures.
 - b. Review ambient conditions and ventilation procedures.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include manufacturer's written data on physical characteristics, durability, and fade resistance.
 - 2. Include installation recommendations for each type of substrate.
- B. Shop Drawings: Show the following:
 - 1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
 - 2. Carpet tile type, color, and dye lot.
 - 3. Type of subfloor.
 - 4. Type of installation.
 - 5. Pattern of installation.
 - 6. Pattern type, location, and direction.

7. Pile direction.
8. Type, color, and location of insets and borders.
9. Type, color, and location of edge, transition, and other accessory strips.
10. Transition details to other flooring materials.

C. Samples: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.

1. Carpet Tile: Full-size Sample.

D. Product Schedule: For carpet tile. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For carpet tile, for tests performed by a qualified testing agency.
- C. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For carpet tiles to include in maintenance manuals. Include the following:
 1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
 2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Carpet Tile: Full-size units equal to 3 percent of amount installed for each type indicated, but not less than 10 sq. yd.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is certified by the International Certified Floor covering Installers Association at the Master II certification level.

- B. Fire-Test-Response Ratings: Where indicated, provide carpet tile identical to those of assemblies tested for fire response according to NFPA 253 by a qualified testing agency.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Comply with CRI 104.

1.10 FIELD CONDITIONS

- A. Comply with CRI 104 for temperature, humidity, and ventilation limitations.
- B. Environmental Limitations: Do not deliver or install carpet tiles until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at occupancy levels during the remainder of the construction period.
- C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.
- D. Where demountable partitions or other items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.

1.11 WARRANTY

- A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.
 - 1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
 - 2. Failures include, but are not limited to, more than 10 percent edge raveling, snags, runs, dimensional stability, excess static discharge, loss of tuft bind strength, loss of face fiber, and delamination.
 - 3. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CARPET TILE (CPT1)

- A. Products: Subject to compliance with requirements, provide one of the following:
 - 1. Mannington Commercial -
 - a. Pattern: Carthage Brights
 - b. Colors: as selected by Architect by the full range of colors
- B. Construction: Graphic Loop Pile

- C. Face Fiber: Invista Antron Legacy Type 6,6
- D. Gauge: 1/10
- E. Pile Thickness: .108 inches
- F. Yarn Weight: 20 Ounces
- G. Primary Backing: 100% Woven Synthetic
- H. Secondary Backing: Infinity RE Modular
- I. Size: 24"x24"

2.2 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.
- B. Adhesives: Carpet shall be installed with manufactures recommended adhesive.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance. Examine carpet tile for type, color, pattern, and potential defects.
- B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:
 - 1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by carpet tile manufacturer.
 - 2. Subfloor finishes comply with requirements specified in Division Section 3 "Cast-in-Place Concrete" for slabs receiving carpet tile.
 - 3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.
- C. For wood subfloors, verify the following:
 - 1. Underlayment over subfloor complies with requirements specified in Division Section 6 "Rough Carpentry."
 - 2. Underlayment surface is free of irregularities and substances that may interfere with adhesive bond or show through surface.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. General: Comply with CRI 104, Section 6.2, "Site Conditions; Floor Preparation," and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile installation.
- B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch wide or wider and protrusions more than 1/32 inch unless more stringent requirements are required by manufacturer's written instructions.
- C. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by carpet tile manufacturer.
- D. Clean metal substrates of grease, oil, soil and rust, and prime if directed by adhesive manufacturer. Rough sand painted metal surfaces and remove loose paint. Sand aluminum surfaces, to remove metal oxides, immediately before applying adhesive.
- E. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.3 INSTALLATION

- A. General: Comply with CRI 104, Section 14, "Carpet Modules," and with carpet tile manufacturer's written installation instructions.
- B. Installation Method: As recommended in writing by carpet tile manufacturer.
 - 1. Carpet installation shall begin at the centerpoint of the room and work out to the perimeter walls.
- C. Maintain dye lot integrity. Do not mix dye lots in same area.
- D. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.
- E. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.
- G. Install pattern parallel to walls and borders.

- H. Stagger joints of carpet tiles so carpet tile grid is offset from access flooring panel grid. Do not fill seams of access flooring panels with carpet adhesive; keep seams free of adhesive.

3.4 CLEANING AND PROTECTION

- A. Perform the following operations immediately after installing carpet tile:
 - 1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet tile manufacturer.
 - 2. Remove yarns that protrude from carpet tile surface.
 - 3. Vacuum carpet tile using commercial machine with face-beater element.
- B. Protect installed carpet tile to comply with CRI 104, Section 16, "Protecting Indoor Installations."
- C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION 096813

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.
 - 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

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.

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

- 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 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.
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.
 - 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.
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.
- 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.
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:

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

- 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

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

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

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.
 - 3. Division 16 - Electrical: Electrical supply, conduit, and wiring for motorized window shades.

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.

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.

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

- 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.
- C. Blackout Fabric: Woven fabric, stain and fade resistant.
 1. Source: SheerWeave 7000
 2. Type: Vinyl Coated polyester
 3. Weight: 12 oz per yard.
 4. Color: As selected by Architect from manufacturer's full range.

2.4 MOTORIZED WINDOW SHADES

- A. Type: Motorized vertical roll-up, fabric, window shade with motors, controls, mounting brackets, low voltage switch plates and other components necessary for complete installation; Motorized FlexShade as manufactured by Draper, Inc. Refer to drawings for details.
- B. Roller: Fabricated from extruded aluminum or steel. Diameter, wall thickness, and material selected by manufacturer to accommodate shade size. Provide with

roller idler assembly of molded nylon and zinc-plated steel pin. Sliding pin to allow easy installation and removal of roller. Fabric connected to the roller tube with LSE (low surface energy) double sided adhesive specifically developed to attach coated textiles to metal. Adhesive attachment to eliminate horizontal impressions in fabric.

- C. Coupling system: Couplings to join motorized shade rollers to allow operation by single motor. FlexShade Coupling System as manufactured by Draper, Inc. Provide endcaps to receive couplers and support multiple shades.
- D. One motorized band, with four panels.
- E. Shade slat: Slat encased in heat seamed hem.
- 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.
 - 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.

2.5 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 inch Length 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.
- 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

142400 RACK AND PINION PASSENGER / SERVICE ELEVATOR

PART 1 – GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Rack and Pinion Passenger / Service Elevator

1.2 APPLICABLE CODES

- A. All elevators shall be designed and supplied in accordance with ASME 17.1, Safety Code for Elevators and Escalators, latest edition. Elevators 1000 lbs capacity and less may be designed under Part 5.7 “Special Purpose” Elevators. Elevators exceeding 1,000 lbs capacity must be designed to comply with Part 4.1 (Rack & Pinion) and Part 2 of the code requirements. Any variances from these codes must be clearly stated and offered only as options to a fully code compliant design.
- B. Elevator supplier to furnish copies of elevator controller and door interlock systems certified to ANSI code by UL, CSA, or ETL as recognized organizations.
- C. Materials are to be supplied to standard ASTM specifications or Western Europe equivalent standards. Motors to be NEMA rated or the Western European IEC equivalent ratings.

1.3 MINIMUM SUPPLIER EXPERIENCE

- A. Rack & pinion elevators are specialty machines designed for many locations unsuitable for “conventional” elevators. As such, proven designs with rugged components and proven performance should be a main consideration in the specification process. Typical machines should be designed to last 15 to 20 years or more, depending upon the environment. Minimum supplier operating experience is to be 10 elevators operating for 5 or more years (experience with each unit condition verified in the field by a condition assessment).

1.4 QUALITY ASSURANCE

- A. Services, materials and equipment provided by the Contractor shall be in accordance with the Contractor’s Quality Program. At a minimum the quality program shall be developed per applicable national codes, standards and provide requirements for the control of design, document and data control, procurement, inspection and test, corrective actions, handling, storage, packaging/ delivery quality records, audits and training. Manufacturing facilities to be ISO 9001 certified.
- B. All materials, equipment and products furnished by the Contractor shall be new and for the service intended. Any defective material found during the progress of the work shall be promptly replaced or corrected by the Contractor at its own expense.

- C. Rack & pinion supplier shall have a local organization in the US with a reasonable level of required spare parts to support the elevator system over its useful life. Also, supplier is to demonstrate it possesses a secure level of service technician support resources to ensure support during the elevator life.

1.5 INSURANCE REQUIREMENTS

- A. Due to the nature of the elevator installation work, and the operating environment in which rack & pinion products generally should be designed to function, the following insurance coverage should be provided:

General Liability – Minimum \$1 million per occurrence
Automobile Liability – Minimum \$1 million per occurrence
Completed Products Liability Insurance from Elevator Manufacturer– Umbrella coverage, including this - at least \$10 million

1.6 SUBMITTALS

- A. Necessary general arrangement drawings and wiring schematics covering the elevator installation are to be provided by the elevator contractor. No work shall commence before these drawings are approved by the owner or his agent. The following minimum documentation should be supplied during the design, manufacture and installation of the elevator system:

Standard General Layouts
Standard hoist way conduit layout
Proof of code labeled car and landing door interlocks and controllers by certified testing lab
Applicable MSDS sheets
CPM Schedules (updates as applicable)
Ships list & documentation
Standard wiring diagrams – As Built
Standard Operator's manuals
As built drawings
Elevator manufacturer's field test report + State or other governing body inspection and signoff certificate

- B. Drawing dimensions must be in US or a combination of US and metric. Metric units alone will not be acceptable. All wiring diagrams, drawings, manuals and other documentation to be furnished in English language.

1.7 WARRANTY

- A. The elevator contractor shall guarantee the materials and workmanship of the apparatus furnished under these specifications, and will make good any defects not due to ordinary

wear and tear or improper use or carelessness which may develop within one (1) year from date of completion of each elevator, including labor and traveling expenses.

1.8 PERMITS & INSPECTIONS:

- A. The elevator contractor shall furnish all licenses and permits and shall arrange for and make all inspections and tests required when installation is included in this scope.
- B. Testing and Commissioning
- C. Contractor shall perform necessary tests as required by applicable codes to obtain a certificate of operation. Contractor shall comply with the commissioning schedule set forth by this specification.

1.9 GUARANTEED SERVICE

- A. The elevator shall be supplied with one year of quarterly service visits by factory trained technicians to assure acceptable first year "run-in" and maintenance.
- B. Scheduling of the Elevator Work and Preparatory Work Not Included in the Elevator Contractor Scope (to be supplied by General Contractor):
 - 1. Legal hoist way, fascia, dry pit, machine room or base control area, and hoist way ventilation. Landings to be plumb to ½ inch per 100 feet of elevation.
 - 2. Adequate foundation to support footprint as shown in plan at bottom landing. See data on this drawing for foundation forces.
 - 3. Minimum clear pit required (or pad) across entire pit area including footings and other vertical or horizontal protrusions.
 - 4. Minimum clear overhead required across entire clear hoist way area including roof supports and other vertical or horizontal protrusions.
 - 5. Adequate supports for guide mast fastening per tie in schedule. See data on drawing for guide mast forces.
 - 6. Fused Disconnect (or circuit breaker), suitable for motor starting, 480 Volt main line disconnect for each elevator with feeder or branch wiring circuit located within 5 feet of base control cabinet. If temporary power is provided for installation, it must be of permanent characteristics with main line switch, and brought to within 5 feet of elevator base control cabinet. Permanent power required for final testing of elevator.
 - 7. Fused Disconnect (or circuit breaker), 120 Volt ac single-phase SPST disconnect switch adjacent to the main line switch for car lighting supply. Separate 120 Volt circuit for pit lighting supply. See Alimak Hek conduit layout drawing.
 - 8. Properly sized ground wire from the elevator controller to the primary building ground.
 - 9. Lighting at landings, base controller and related areas as required by applicable codes.
 - 10. A dedicated phone line from telephone service to elevator base panel. Line must be monitored 24 hours a day.
 - 11. Remote wiring to outside alarm bell as required by the safety code where applicable. Remote wiring to any remote equipment or monitoring devices.
 - 12. Adequate support for landing doors and enclosure panels.
 - 13. Code compliant hoist way enclosure protection, near the elevator shaft other than at landing door side enclosures, which Alimak Hek supplies as standard. Base landing

- enclosure protection is also provided by Alimak Hek. Hoist way protection between landings is by others and is governed by code.
14. Provide OSHA compliant hoist way protection during construction. Solid panels, a minimum of 48" high at each opening/landing. Hoist way protection to be maintained during installation by installer.
 15. Location of mast centerline.
 16. Electric power required for lights, tools, hoists, etc. during installation.
 17. Locate equipment in secure area within 30 feet of the hoist way at ground level at time of installation. Long term storage, if applicable, shall be in accordance with manufacturer's instructions. Adequate ingress and egress will also be provided.
 18. Any governmentally required safety provisions not directly involved with the actual installation of the elevator.
 19. Lifting equipment with operator including crane for unloading and erection of base, car, mast tower and landing doors. Man lift or basket for access to tie in support surface if required.
 20. Certified drop test weights for final inspection and test.
 21. Fire watch personnel if required for hot work.
 22. Approval of Alimak Hek submittals. Approval will supersede all other documents.
 23. Smoke detectors with normally open dry contacts required at each floor, in hoist way and associated machine room or base control cabinet location in accordance with N.P.F.A. #72E chapter #4 with required wiring to properly marked terminals in elevator controller (applicable only if application requires Fire Service).
 24. Furnish and install hoist way conduit and wiring material (applicable only if installation is not included in the Alimak Hek proposal.)
 25. Purged Air Supply (only on XP with Variable Frequency Drives)

PART 2 - PRODUCTS

2.1 SPECIFICATION FOR ELEVATOR WORK

- | | |
|--------------------------------------|---|
| A. Furnish and Install: | Electric Elevator(s) |
| B. Type of Machine: | Rack & Pinion |
| C. Load (Capacity): | 800lbs |
| D. Car Speed: | to be determined by Owner |
| E. Operation: | Full-Collective |
| F. Motor Control : | Variable Frequency Control. |
| G. Rise (Lifting Height): | 200ft |
| H. Number of Stops (including Base): | Two (2) Top & Bottom |
| I. Number of Openings: | 3 |
| J. Maintenance:
turnover | Quarterly maintenance for 1 year required after |

- K. Power Supply: 440-480 Volts, 3 Phase, 60 Hertz
- L. Lighting Supply: 120 Volts, 1 Phase, 60 Hertz (by electrician)
- M. Car Enclosure: Aluminum; Marine Grade, Anodized Extruded
- N. Clear Car Inside: 3'deep x 7' wide minimum
- O. Inside Car Height: 7'1" Minimum
- P. Type of Car Door: Folding gate (code minimum)
- Q. Car Operating Panel: Located in car wall or on top of car

2.2 COMPLETE SYSTEM:

- A. Elevator system to be a complete factory engineered and manufactured system to meet design, performance and code requirements. All structure required for installation must be provided as part of the installation. Local distributor or field modifications shall not be permitted.
- B. Manufacturer may be required to submit proof of design conformance prior to shipment from the primary
- C. Manufacturing facility.

2.3 MACHINERY:

- A. The complete drive consists of an appropriate number of squirrel cage TEFC motors, reduction gear(s), drive pinions, and an over speed governor/safety device, all mounted on a machinery plate. Drives also to include an electric disc brake provided with an external manual brake release mounted on the reduction gear. Measures shall be considered in the design to reduce vibration and noise transmission to the building structure. The machine shall be mounted on the car frame. For capacities under 1,000 lbs, single motor drives shall be supplied.
- B. Elevator cars to be made from galvanized carbon steels, aluminum or stainless steel. Cars to be fully enclosed with no mesh or expanded metal walls. Panels must comply with 16CFR part 1201 along with ASME 17.1, Part 2.14.2.5 and 2.11.7.1. Windows in cars must not exceed 155 square inches.

2.4 MOTOR: WITH VARIABLE FREQUENCY CONTROL

- A. The motor shall be alternating current, reversible type designed for elevator service with high starting torque and low starting current. Overload relays shall be provided. Space heater for motor is included in this offering.

2.5 ELECTRICAL ENCLOSURES

- A. For duty in exposed environments, all enclosures shall be of 304 stainless steel, and NEMA 4X design. This includes interior car operating panels, car top enclosure panels, hoist way junction boxes, base enclosure panels and floor hall call station boxes.

2.6 RACK AND DRIVE PINIONS

- A. Rack and pinions used to drive the elevator car shall be designed with a minimum safety factor of 8:1 between drive pinions and the rack (per elevator codes).

2.7 BRAKES:

- A. The brake shall be spring applied and electrically released and designed to provide smooth stops under variable loads.

2.8 EMERGENCY LOWERING DEVICE

- A. The emergency lowering device feature applies during a potential power failure. Should a power failure take place, this allows the passengers in the car to lower the car under reduced and controlled speed to the next lowest landing. With other lifts, passengers must call for help, remaining in the stopped car until help arrives. The emergency lowering device only works when due to a power failure and the car is stopped in-between landings.

2.9 COMMUNICATION

- A. Elevator Contractors standard elevator phone shall be provided. This phone shall be wired to the elevator control panel at the base of the elevator. Site telephone wiring from the base of the elevator to the telephone system will be by the Owner.

2.10 CAR FRAME AND GOVERNOR / SAFETY DEVICE:

- A. A car frame fabricated from formed or structural steel members shall be provided with adequate bracing to support the platform and car enclosures. The car safety shall be of integral design with car frame and shall be of the Rack & Pinion type designed to stop the car should it attain excessive descending speed.
- B. The car safety shall be operated by an integral centrifugal speed governor. The governor shall actuate a switch when excessive speeds occur, disconnecting power to the motor and applying the brake before application of the safety.
- C. Safety device pinion design to be in accordance with ASME 17.1 and thus shall have a safety factor of not less than 3.5 to 1 in accordance with these elevator code requirements.

2.10 HOIST WAY WIRING:

- A. All wiring and electrical interconnections shall comply with the governing codes. Insulated wiring shall have flame retardant and moisture-proof outer covering, and shall be run in galvanized rigid conduit, tubing or electrical wire ways. Traveling cables shall be flexible and suitably suspended to relieve strain on individual conductors.

2.11 TRAVELLING CABLE TROLLEY:

- A. Tension on the hoist way travelling cable shall be maintained with a weighted trolley system that follows the cable as the elevator travels. Cable guides shall be placed every 15 – 20 feet to further protect the cable from wind and damage. No free hanging cables or winding type reels shall be allowed.

2.12 HOIST WAY OPERATING DEVICES:

- A. Normal terminal stopping devices shall be provided to slow down and stop the car automatically at the terminal landings. Final terminal stopping devices shall automatically cut off the power and apply the brake, should the car travel beyond the terminal landings.

2.13 PIT SWITCH:

- A. An emergency stop switch shall be located in the pit accessible from the pit access door.

2.14 BUFFERS:

- A. Buffers shall be installed in the pit as a means for stopping the car and counterweight (if provided) at the bottom limits of travel.

2.15 GUIDE MASTS:

- A. Steel elevator guide masts shall be furnished to guide and support the car and counterweight, erected plumb and securely fastened to the building structure. They shall be hot dipped galvanized.

2.16 ROLLER GUIDES:

- A. Steel, iron or polyurethane lined roller guides shall be mounted on top and bottom of the car frame to engage the guide masts and to provide for smooth operation. Structural steel safety back up tabs should be mounted on the elevator car frame to assure car remains on the mast with pinion engaged in case of roller failure.

2.17 PLATFORM:

- A. The car back frame to hold the car shall be of all galvanized steel (or aluminum) construction. The cap floor shall be heavy duty aluminum or hot dipped galvanized checker plate or other non-skid pattern.

2.18 ELEVATOR CAR

- A. Elevator car to be made of aluminum panels for long life and rust & corrosion resistance. The walls shall be firmly braced to meet maximum deflection criteria stated in the ASME 17.1 code.

2.19 EMERGENCY CAR LIGHTING:

- A. An emergency power unit employing a rechargeable battery shall illuminate the elevator car and provide current to the alarm bell in the event of normal power failure. The equipment shall comply with the requirements of the latest revision of the ASME A17.1.

2.20 HALL BUTTONS:

- A. At each landing, a push button fixture shall be provided to correspond to control system used. NEMA 4X boxes are required.

2.21 INSPECTION AND/OR MAINTENANCE OPERATION:

- A. An enabling key switch shall be provided in the car-operating panel to permit operation of the elevator from on top of the car, for inspection purposes, and make car and hall buttons inoperative.
- B. On top of the car an operating fixture shall be provided containing "UP" and "DOWN" buttons, an emergency stop button, and a switch that makes the fixture operable and, at the same time, makes the door operator and car and hall buttons inoperable.

2.22 PIT AREA

- A. In accordance with code, a pit conforming to ASME 17.1 shall be provided. In absence of such a pit, Elevator contract shall be required to supply a raised base platform that allows the same pit refuge space. All pits need to be supplied with a pit ladder and pit light conforming to code.

2.23 CONTROLLER: ALIMAK ALCII

- A. A modern, microprocessor based, programmable elevator controller shall be provided in or on the car including necessary starting switches of adequate size together with all relays, switches and hardware required to accomplish operation specified. Remote monitoring capability shall be provided. System shall provide the option of real time reporting of specific faults and systems monitoring via internet based system.

2.24 DOOR OPERATION:

- A. Manually operated car doors and manually operated landing doors to be provided. Door/gate shall meet all code requirements for protection of persons riding in the car or standing on the landing.

- B. A proven electrical & mechanical interlock, labeled by a code recognized body, shall be provided for each hoist way entrance that shall prevent operation of the elevator unless all doors for that elevator are proven closed and locked and shall maintain the doors in their closed position while the elevator is away from the landing. Emergency access to the hoist way as required by governing codes shall be provided.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Before starting elevator installation, inspect hoistway, hoistway openings, pits and machine rooms/control space, as constructed and verify all critical dimensions, and examine supporting structures and all other conditions under which elevator work is to be installed. Do not proceed with elevator installation until unsatisfactory conditions have been corrected in a manner acceptable to the installer.
- B. Installation constitutes acceptance of existing conditions and responsibility for satisfactory performance.

3.2 INSTALLATION

- A. Install elevator systems components and coordinate installation of hoistway wall construction.
1. Work shall be performed by competent elevator installation personnel in accordance with ASME A17.1, manufacturer's installation instructions and approved shop drawings.
 2. Comply with the National Electrical Code for electrical work required during installation.
- B. Perform work with competent, skilled workmen under the direct control and supervision of the elevator manufacturer's experienced foreman.
- C. Supply in ample time for installation by other trades, inserts, anchors, bearing plates, brackets, supports, and bracing including all setting templates and diagrams for placement.
- D. Jack unit excavation: Drill or otherwise excavate below elevator pit construction as required to install the jack unit.
1. Install casing for jack unit.
 2. Provide HDPE jack protection system for all in ground jacks.
 3. Set casing for jack unit assembly plumb, and partially fill with water-settled sand, eliminating voids. Back fill depth shall be sufficient to hold the bottom of the jack in place over time.

- E. Set jack unit-cylinder assembly plumb, centered accurately and shimmed to proper elevation, using centering lugs to prevent dislocation during filling. Fill space between casing and cylinder with clean, dry, compacted sand.
- F. Welded construction: Provide welded connections for installation of elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance, and replacement of worn Parts. Comply with AWS standards for workmanship and for qualification of welding operators.
- G. Coordination: Coordinate elevator work with the work of other trades, for proper time and sequence to avoid construction delays. Use benchmarks, lines, and levels designated by the Contractor, to ensure dimensional coordination of the work.
- H. Install machinery, guides, controls, car and all equipment and accessories to provide a quiet, smoothly operating installation, free from side sway, oscillation or vibration.
- I. Sound isolation: Mount rotating, vibrating elevator equipment and components on vibration-absorption mounts, designed to effectively prevent the transmission of vibrations to the structure, and eliminate sources of structure-borne noise from the elevator system.
- J. Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with cars. Where possible, delay final adjustment of sills and doors until car is operable in shaft. Reduce clearances to minimum safe, workable dimensions at each landing.
- K. Erect hoistway sills, headers, and frames before erection of rough walls and doors; erect fascias and toe guards after rough walls are finished. Set sill units accurately aligned and slightly above finish floor at landings.
- L. Lubricate operating parts of system where recommended by manufacturer.

3.3 FIELD QUALITY CONTROL

- A. Acceptance testing: Upon completion of the elevator installation and before permitting use of elevator, perform acceptance tests as required by A17.1 Code and local authorities having jurisdiction. Perform other tests, if any, as required by governing regulations or agencies.
- B. Advise Owner, Contractor, Architect, and governing authorities in advance of dates and times tests are to be performed on the elevator.

3.4 ADJUSTING

- A. Make necessary adjustments of operating devices and equipment to ensure elevator operates smoothly and accurately.

3.5 CLEANING

- A. Before final acceptance, remove protection from finished surfaces and clean and polish surfaces in accordance with manufacturer's recommendations for type of material and finish provided. Stainless stall shall be cleaned with soap and water and dried with a non-abrasive surface; shall not be cleaned with bleached-based cleansers.
- B. At completion of elevator work, remove tools, equipment, and surplus materials from site. Clean equipment rooms and hoistway. Remove trash and debris.

3.6 PROTECTION

- A. At time of Substantial Completion of elevator work, or portion thereof, provide suitable protective coverings, barriers, devices, signs, or other such methods or procedures to protect elevator work from damage or deterioration. Maintain protective measures throughout remainder of construction period.

3.7 DEMONSTRATION

- A. Instruct Owner's personnel in proper use, operations, and daily maintenance of elevators. Review emergency provisions, including emergency access and procedures to be followed at time of failure in operation and other building emergencies. Train Owner's personnel in normal procedures to be followed in checking for sources of operational failures or malfunctions.
- B. Make a final check of each elevator operation, with Owner's personnel present, immediately before date of substantial completion. Determine that control systems and operating devices are functioning properly.

END OF SECTION 14240

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.

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.

- 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.

- 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.

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.

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

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.

- 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.

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.

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.
- 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.
- 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

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.

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.

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."

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:
 - 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

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.

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

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.

- 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.

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.

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.

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.

- 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.

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."

- 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.
 - 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.

- 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-joint 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.
 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

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.

- 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

- 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 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.

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.

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.

END OF SECTION 230548

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.

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.

- 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.

- 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.

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

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.

- 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.

- 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.
 - 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:

- 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:

- 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.

- 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:

- 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.
- 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.
 - 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.
- 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.
 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 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 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:
 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.
- 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

SECTION 232113 - HYDRONIC 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 pipe and fitting materials, joining methods, special-duty valves, and specialties for the following:
 - 1. Condensate-drain piping.

1.3 DEFINITIONS

- A. PTFE: Polytetrafluoroethylene.
- B. RTRF: Reinforced thermosetting resin (fiberglass) fittings.
- C. RTRP: Reinforced thermosetting resin (fiberglass) pipe.

1.4 PERFORMANCE REQUIREMENTS

- A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature:
 - 1. Condensate-Drain Piping: 150 deg F.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of the following:
 - 1. Plastic pipe and fittings with solvent cement.
- B. Shop Drawings: Detail, at 1/4 scale, the piping layout, fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to the building structure. Detail location of anchors, alignment guides, and expansion joints and loops.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Welding certificates.
- C. Field quality-control test reports.
- D. Water Analysis: Submit a copy of the water analysis to illustrate water quality available at Project site.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air control devices, hydronic specialties, and special-duty valves to include in emergency, operation, and maintenance manuals.

1.8 MAINTENANCE MATERIAL SUBMITTALS

- A. Water-Treatment Chemicals: Furnish enough chemicals for initial system startup and for preventive maintenance for one year from date of Substantial Completion.
- B. Differential Pressure Meter: For each type of balancing valve and automatic flow control valve, include flowmeter, probes, hoses, flow charts, and carrying case.

1.9 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Installers of Pressure-Sealed Joints: Installers shall be certified by the pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.
 - 2. Fiberglass Pipe and Fitting Installers: Installers of RTRF and RTRP shall be certified by the manufacturer of pipes and fittings as having been trained and qualified to join fiberglass piping with manufacturer-recommended adhesive.
- B. Steel Support Welding: Qualify processes and operators according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
 - 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.
- D. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

PART 2 - PRODUCTS

2.1 PLASTIC PIPE AND FITTINGS

- A. PVC Plastic Pipe: ASTM D 1785, Schedules 40 and 80, plain ends as indicated in Part 3 "Piping Applications" Article.
- B. PVC Plastic Pipe Fittings: Socket-type pipe fittings, ASTM D 2466 for Schedule 40 pipe; ASTM D 2467 for Schedule 80 pipe.

2.2 JOINING MATERIALS

- A. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- B. Solvent Cements for Joining Plastic Piping:
 - 1. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
 - a. 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).
 - b. 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).
 - c. Solvent cement and 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."

2.3 TRANSITION FITTINGS

- A. Plastic-to-Metal Transition Fittings:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Charlotte Pipe and Foundry Company.
 - b. IPEX Inc.
 - c. KBi.
 - 2. PVC one-piece fitting with one threaded brass or copper insert and one Schedule 80 solvent-cement-joint end.
- B. Plastic-to-Metal Transition Unions:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Charlotte Pipe and Foundry Company.
 - b. IPEX Inc.
 - c. KBi.
 - d. NIBCO INC.

2. MSS SP-107, PVC union. Include brass or copper end, Schedule 80 solvent-cement-joint end, rubber gasket, and threaded union.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Condensate-Drain Piping: Type DWV, drawn-temper copper tubing, wrought-copper fittings, and soldered joints or Schedule 40 PVC plastic pipe and fittings and solvent-welded joints.

3.2 PIPING INSTALLATIONS

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such 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.
- 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. Select system components with pressure rating equal to or greater than system operating pressure.
- K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
- L. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

- M. Identify piping as specified in Section 230553 "Identification for HVAC Piping and Equipment."
- N. 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."
- O. 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."
- P. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."

3.3 HANGERS AND SUPPORTS

- A. Hanger, support, and anchor devices are specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment." Comply with the following requirements for maximum spacing of supports.
- B. Install the following pipe attachments:
 - 1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
 - 2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
 - 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
 - 4. Spring hangers to support vertical runs.
 - 5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.

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.

END OF SECTION 232113

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.

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:
 - 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.
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.
 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.

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.
- 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.

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.
- 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.
 - 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.

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

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."

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.

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.

- 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."

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."

- 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:

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.
 - 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

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.

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.
 - 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

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.

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.

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:
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.
- 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.
 - 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

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.

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.

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.
- 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
 - 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
 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

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
- 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
- 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.
 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.

END OF SECTION 238126

SECTION 238239 - UNIT HEATERS

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. Wall heaters with propeller fans and electric-resistance heating coils.

1.3 DEFINITIONS

- A. BAS: Building automation system.
- B. CWP: Cold working pressure.
- C. PTFE: Polytetrafluoroethylene plastic.
- D. TFE: Tetrafluoroethylene plastic.

1.4 ACTION SUBMITTALS

- A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each product indicated.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Plans, elevations, sections, and details.
 - 2. Location and size of each field connection.
 - 3. Details of anchorages and attachments to structure and to supported equipment.
 - 4. Equipment schedules to include rated capacities, operating characteristics, furnished specialties, and accessories.
 - 5. Location and arrangement of piping valves and specialties.
 - 6. Location and arrangement of integral controls.
 - 7. Wiring Diagrams: Power, signal, and control wiring.
- C. Samples for Initial Selection: Finish colors for units with factory-applied color finishes.

- D. Samples for Verification: Finish colors for each type of cabinet unit heater and wall and ceiling heaters indicated with factory-applied color finishes.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Floor plans, reflected ceiling plans, and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
 - 1. Suspended ceiling components.
 - 2. Structural members to which unit heaters will be attached.
 - 3. Method of attaching hangers to building structure.
 - 4. Size and location of initial access modules for acoustical tile.
 - 5. Items penetrating finished ceiling, including the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
 - 6. Perimeter moldings for exposed or partially exposed cabinets.
 - 7. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 8. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- B. Field quality-control test reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For cabinet unit heaters to include in emergency, operation, and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Cabinet Unit Heater Filters: Furnish one spare filter(s) for each filter installed.

1.8 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

- B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- C. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

PART 2 - PRODUCTS

2.1 WALL HEATERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - 1. Berko Electric Heating; a division of Marley Engineered Products.
 - 2. Chromalox, Inc.; a division of Emerson Electric Company.
 - 3. Indeeco.
 - 4. QMark Electric Heating; a division of Marley Engineered Products.
 - 5. Trane.
- B. Description: An assembly including chassis, electric heating coil, fan, motor, and controls. Comply with UL 2021.
- C. Cabinet:
 - 1. Front Panel: Extruded-aluminum bar grille, with removable panels fastened with tamperproof fasteners.
 - 2. Finish: Baked enamel over baked-on primer with manufacturer's standard color selected by Architect, applied to factory-assembled and -tested wall and ceiling heaters before shipping.
- D. Surface-Mounting Cabinet Enclosure: Steel with finish to match cabinet.
- E. Electric-Resistance Heating Coil: Nickel-chromium heating wire, free from expansion noise and hum, embedded in magnesium oxide refractory and sealed in corrosion-resistant metallic sheath. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware, and limit controls for high temperature protection. Provide integral circuit breaker for overcurrent protection.
- F. Fan: Aluminum propeller directly connected to motor.
 - 1. Motor: Permanently lubricated. Comply with requirements in Division 15 Section "Common Motor Requirements for HVAC Equipment."
- G. Controls: Unit-mounted thermostat.
- H. Electrical Connection: Factory wire motors and controls for a single field connection with disconnect switch.

PART 3 - EXECUTION**3.1 EXAMINATION**

- A. Examine areas to receive unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in for piping and electrical connections to verify actual locations before unit heater installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install wall boxes in finished wall assembly; seal and weatherproof. Joint-sealant materials and applications are specified in Section 079200 "Joint Sealants."
- B. Install cabinet unit heaters to comply with NFPA 90A.
- C. Install propeller unit heaters level and plumb.
- D. Suspend cabinet unit heaters from structure with elastomeric hangers. Vibration isolators are specified in Section 230548 "Vibration Controls for HVAC Piping and Equipment."
- E. Suspend propeller unit heaters from structure with all-thread hanger rods and elastomeric hangers. Hanger rods and attachments to structure are specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment." Vibration hangers are specified in Section 230548 "Vibration Controls for HVAC Piping and Equipment."
- F. Install wall-mounting thermostats and switch controls in electrical outlet boxes at heights to match lighting controls. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.
- G. Install new filters in each fan-coil unit within two weeks of Substantial Completion.

3.3 CONNECTIONS

- A. Comply with safety requirements in UL 1995.
- B. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- C. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

- A. **Manufacturer's Field Service:** Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
- B. Perform the following field tests and inspections and prepare test reports:
 - 1. **Operational Test:** After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 2. Operate electric heating elements through each stage to verify proper operation and electrical connections.
 - 3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.
- C. Remove and replace malfunctioning units and retest as specified above.

3.5 ADJUSTING

- A. Adjust initial temperature set points.
- B. **Occupancy Adjustments:** When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain cabinet unit heaters.

END OF SECTION 238239

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.

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.
- 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 Crawlspace: **Type THHN-2-THWN-2, single conductors in raceway.**
- C. Exposed Branch Circuits, Including in Crawlspace: **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.
- 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.
- 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

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**.

- 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.
- 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.
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.
- 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.
- 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

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:

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.
 - 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:
 - 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.
 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.
- 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

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:

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.**

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.
- 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.](#)
- 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**.

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.**

- 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.

- 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.
- 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.
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."

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

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.

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.

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.
 - 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.
- 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.
- 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 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

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.

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.](#)
- 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.
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.

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."
- 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

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.
 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.
- 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.

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.

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.

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.

- 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:

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."

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

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.

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.

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.
 - 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.
- 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.

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.
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.
- 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:

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.
- 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.
 - 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.
- 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.

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.

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.
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.

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.

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:
 - 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.

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.

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.

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

Line #	Item Number	Sec #	Description	Quantity	Unit Cost	Amount
ROADWAY ITEMS						
0001	0000100000-N	800	MOBILIZATION	Lump Sum	L.S.	
0002	4400000000-E	1110	WORK ZONE SIGNS (STATIONARY)	676 SF		
0003	4405000000-E	1110	WORK ZONE SIGNS (PORTABLE)	576 SF		
0004	4410000000-E	1110	WORK ZONE SIGNS (BARRICADE MOUNTED)	30 SF		
0005	4415000000-N	1115	FLASHING ARROW BOARD	4 EA		
0006	4420000000-N	1120	PORTABLE CHANGEABLE MESSAGE SIGN	11 EA		
0007	4430000000-N	1130	DRUMS	175 EA		
0008	4445000000-E	1145	BARRICADES (TYPE III)	104 LF		
0009	4480000000-N	1165	TMA	3 EA		
0010	4810000000-E	1205	PAINT PAVEMENT MARKING LINES (4")	3,825 LF		
0011	4847010000-E	1205	POLYUREA PAVEMENT MARKING LINES (4", 20 MILS)	12,176 LF		
0012	4847050000-E	1205	POLYUREA PAVEMENT MARKING LINES (8", 20 MILS)	630 LF		
0013	4900000000-N	1251	PERMANENT RAISED PAVEMENT MARKERS	145 EA		
STRUCTURE ITEMS						
0014	8161000000-E	420	GROOVING BRIDGE FLOORS	149,300 SF		
0015	8296000000-N	442	POLLUTION CONTROL	Lump Sum	L.S.	
0016	8559000000-E	SP	CLASS II, SURFACE PREPARATION	10 SY		
0017	8566000000-E	SP	CLASS III, SURFACE PREPARATION	13.5 SY		

County : New Hanover

Line #	Item Number	Sec #	Description	Quantity	Unit Cost	Amount
0018	8664000000-E	SP	SHOTCRETE REPAIRS	125 CF		
0019	8678000000-E	SP	EPOXY RESIN INJECTION	1 LF		
0020	8692000000-N	SP	FOAM JOINT SEALS	Lump Sum	L.S.	
0021	8860000000-N	SP	GENERIC STRUCTURE ITEM CLEANING & REPAINTING OF BRIDGE #13	Lump Sum	L.S.	
0022	8860000000-N	SP	GENERIC STRUCTURE ITEM INSTALL NEW SIGNS	Lump Sum	L.S.	
0023	8860000000-N	SP	GENERIC STRUCTURE ITEM MECHANICAL OPERATING MACHINERY	Lump Sum	L.S.	
0024	8860000000-N	SP	GENERIC STRUCTURE ITEM OPERATOR HOUSE RENOVATION	Lump Sum	L.S.	
0025	8860000000-N	SP	GENERIC STRUCTURE ITEM PAINTING CONTAINMENT FOR BRIDGE #13	Lump Sum	L.S.	
0026	8860000000-N	SP	GENERIC STRUCTURE ITEM REPLACE AIR HORN	Lump Sum	L.S.	
0027	8860000000-N	SP	GENERIC STRUCTURE ITEM REPLACEMENT OF STEEL GRID DECK	Lump Sum	L.S.	
0028	8860000000-N	SP	GENERIC STRUCTURE ITEM UNDER STRUCTURE WORKPLATFORM	Lump Sum	L.S.	
0029	8867000000-E	SP	GENERIC STRUCTURE ITEM MODIFIED ALASKA BARRIER RAIL	3,034 LF		
0030	8881000000-E	SP	GENERIC STRUCTURE ITEM FLOWABLE FILL	8 CY		
0031	8881000000-E	SP	GENERIC STRUCTURE ITEM PPC MATERIALS	495 CY		
0032	8882000000-E	SP	GENERIC STRUCTURE ITEM REPAIRS TO PRESTRESSED CONC- RETE GIRDERS	1.5 CF		
0033	8889000000-E	SP	GENERIC STRUCTURE ITEM STRUCTURAL STEEL FOR REPAIRS	25,000 LB		

County : New Hanover

Line #	Item Number	Sec #	Description	Quantity	Unit Cost	Amount
0034	8892000000-E	SP	GENERIC STRUCTURE ITEM CONCRETE DECK REPAIR FOR EPOXY OVERLAY	52 SF		
0035	8892000000-E	SP	GENERIC STRUCTURE ITEM EPOXY OVERLAY SYSTEM	7,390 SF		
0036	8893000000-E	SP	GENERIC STRUCTURE ITEM CONCRETE DECK REPAIR FOR PPC OVERLAY	10 SY		
0037	8893000000-E	SP	GENERIC STRUCTURE ITEM HYDRO-DEMOLITION OF BRIDGE DEC K	13.5 SY		
0038	8893000000-E	SP	GENERIC STRUCTURE ITEM PLACING & FINISHING PPC OVER- LAY	17,655 SY		
0039	8893000000-E	SP	GENERIC STRUCTURE ITEM SCARIFYING BRIDGE DECK	17,655 SY		
0040	8893000000-E	SP	GENERIC STRUCTURE ITEM SHOTBLASTING BRIDGE DECK	18,574 SY		
0041	8897000000-N	SP	GENERIC STRUCTURE ITEM SPLICING OF PRESTRESSING STRAN D	1 EA		
0042	8860000000-N	SP	GENERIC STRUCTURE ITEM AUXILIARY COUNTERWEIGHT & SPAN GUIDE REPAIRS	Lump Sum	L.S.	

0917/Jan30/Q257705.5/D309711160000/E42

Total Amount Of Bid For Entire Project :

MBE GOAL SET: 0.00%
MBE GOAL OBT: 0.00%
WBE GOAL SET: 0.00%
WBE GOAL OBT: 0.00%

Vendor 1 of 4: PCL CIVIL CONSTRUCTORS INC (3452)
Call Order 002 (Proposal: C204119)

Bid Information

Proposal County: NEW HANOVER

Vendor Address: 5440 Wade Park Blvd
Suite 102
Raleigh , NC , 27607

Signature Check: Jim_Schneiderman_3452

Time Bid Received: February 20, 2018 01:45 PM

Amendment Count: 1

Bid Checksum: 2A317EAC

Bid Total: \$12,999,991.28

Items Total: \$12,999,991.28

Time Total: \$0.00

Bidding Errors:

None.

Vendor 1 of 4: PCL CIVIL CONSTRUCTORS INC (3452)
Call Order 002 (Proposal: C204119)

Bid Bond Information

Projects:	Bond Maximum:
Counties:	State of Incorporation:
Bond ID: SNC18318542	Agency Execution Date: 2/16/2018 5
Paid by Check: No	Surety Name: surety2000
Bond Percent: 5%	Bond Agency Name: Fidelity and Deposit Company of Maryland

Bidder 1 of 4

Vendor 3452's Bid Information for Call 002, Letting L180220, 02/20/18

PCL Civil Constructors, Inc. (3452)
Call Order 002 (Proposal ID C204119)

Miscellaneous Data Info - Contractor Responses:
=====

NON-COLLUSION AND DEBARMENT CERTIFICATION

Explanation of the prospective bidder that is unable to certify to any of the statements in this certification:

Explanation:
NOT ANSWERED
NOT ANSWERED
NOT ANSWERED
NOT ANSWERED

AWARD LIMITS ON MULTIPLE PROJECTS

By answering YES to this statement, the bidder acknowledges that they are using the award limits on multiple projects. No

It is the desire of the Bidder to be awarded contracts, the value of which will not exceed a total of NOT ANSWERED 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
NOT ANSWERED	
NOT ANSWERED	
NOT ANSWERED	
NOT ANSWERED	
NOT ANSWERED	
NOT ANSWERED	

Bid Bond Data Info - Contractor Responses:
=====

BondID: SNC18318542
Surety Registry Agency: surety2000
Verified?: Yes
Surety Agency: Fidelity and Deposit Company of Maryland
Bond Execution Date: 2/16/2018 5
Bond Amount: \$649,999.56 (Five Percent of Bid)

Contract ID: C204119

Project(s): STATE FUNDED

Letting Date: 02-20-18 Call Order: 002

Bidder: 3452 - PCL Civil Constructors, Inc.

Line No.	Item Description	Approx. Quantity and Units	Unit Price Dollars Cts	Bid Amount Dollars Ct
Section 0001 ROADWAY ITEMS				
Alt Group				
0001	0000100000-N MOBILIZATION	LUMP	LUMP	650,000.00
0002	4400000000-E WORK ZONE SIGNS (STATIONARY)	676.000 SF	6.25000	4,225.00
0003	4405000000-E WORK ZONE SIGNS (PORTABLE)	576.000 SF	6.25000	3,600.00
0004	4410000000-E WORK ZONE SIGNS (BARRICADE MOUNTED)	30.000 SF	6.00000	180.00
0005	4415000000-N FLASHING ARROW BOARD	4.000 EA	2,500.00000	10,000.00
0006	4420000000-N PORTABLE CHANGEABLE MESSAGE SIGN	11.000 EA	10,000.00000	110,000.00
0007	4430000000-N DRUMS	175.000 EA	40.00000	7,000.00
0008	4445000000-E BARRICADES (TYPE III)	104.000 LF	20.00000	2,080.00
0009	4480000000-N TMA	3.000 EA	15,000.00000	45,000.00
0010	4810000000-E PAINT PAVEMENT MARKING LINES (4")	3,825.000 LF	0.80000	3,060.00
0011	4847010000-E POLYUREA PAVEMENT MARKING LINES (4", 20 MILS)	12,176.000 LF	1.28000	15,585.28

Contract ID: C204119

Project(s): STATE FUNDED

Letting Date: 02-20-18 Call Order: 002

Bidder: 3452 - PCL Civil Constructors, Inc.

Line No.	Item Description	Approx. Quantity and Units	Unit Price Dollars Cts	Bid Amount Dollars Ct
0012	4847050000-E POLYUREA PAVEMENT MARKING LINES (8", 20 MILS)	630.000 LF	2.56000	1,612.80
0013	4900000000-N PERMANENT RAISED PAVEMENT MARKERS	145.000 EA	8.00000	1,160.00
Section 0001 Total				853,503.08
Section 0004 STRUCTURE ITEMS				
Alt Group				
0014	8161000000-E GROOVING BRIDGE FLOORS	149,300.000 SF	0.25000	37,325.00
0015	8296000000-N POLLUTION CONTROL	LUMP	LUMP	100,000.00
0016	8559000000-E CLASS II, SURFACE PREPARATION	10.000 SY	1,500.00000	15,000.00
0017	8566000000-E CLASS III, SURFACE PREPARATION	13.500 SY	4,135.00000	55,822.50
0018	8664000000-E SHOTCRETE REPAIRS	125.000 CF	1,400.00000	175,000.00
0019	8678000000-E EPOXY RESIN INJECTION	1.000 LF	750.00000	750.00
0020	8692000000-N FOAM JOINT SEALS	LUMP	LUMP	87,500.00
0021	8860000000-N GENERIC STRUCTURE ITEM CLEANING & REPAINTING OF BRIDGE #13	LUMP	LUMP	1,350,000.00

Contract ID: C204119

Project(s): STATE FUNDED

Letting Date: 02-20-18 Call Order: 002

Bidder: 3452 - PCL Civil Constructors, Inc.

Line No.	Item Description	Approx. Quantity and Units	Unit Price Dollars Cts	Bid Amount Dollars Ct
0022	8860000000-N GENERIC STRUCTURE ITEM INSTALL NEW SIGNS	LUMP	LUMP	10,000.00
0023	8860000000-N GENERIC STRUCTURE ITEM MECHANICAL OPERATING MACHINERY	LUMP	LUMP	225,000.00
0024	8860000000-N GENERIC STRUCTURE ITEM OPERATOR HOUSE RENOVATION	LUMP	LUMP	1,588,780.45
0025	8860000000-N GENERIC STRUCTURE ITEM PAINTING CONTAINMENT FOR BRIDGE #13	LUMP	LUMP	886,000.00
0026	8860000000-N GENERIC STRUCTURE ITEM REPLACE AIR HORN	LUMP	LUMP	5,000.00
0027	8860000000-N GENERIC STRUCTURE ITEM REPLACEMENT OF STEEL GRID DECK	LUMP	LUMP	3,600,000.00
0028	8860000000-N GENERIC STRUCTURE ITEM UNDER STRUCTURE WORKPLATFORM	LUMP	LUMP	0.01
0029	8867000000-E GENERIC STRUCTURE ITEM MODIFIED ALASKA BARRIER RAIL	3,034.000 LF	250.00000	758,500.00
0030	8881000000-E GENERIC STRUCTURE ITEM FLOWABLE FILL	8.000 CY	1,000.00000	8,000.00
0031	8881000000-E GENERIC STRUCTURE ITEM PPC MATERIALS	495.000 CY	2,600.00000	1,287,000.00
0032	8882000000-E GENERIC STRUCTURE ITEM REPAIRS TO PRESTRESSED CONC- RETE GIRDERS	1.500 CF	2,000.00000	3,000.00

Contract ID: C204119

Project(s): STATE FUNDED

Letting Date: 02-20-18 Call Order: 002

Bidder: 3452 - PCL Civil Constructors, Inc.

Line No.	Item Description	Approx. Quantity and Units	Unit Price Dollars Cts	Bid Amount Dollars Ct
0033	8889000000-E GENERIC STRUCTURE ITEM STRUCTURAL STEEL FOR REPAIRS	25,000.000 LB	24.00000	600,000.00
0034	8892000000-E GENERIC STRUCTURE ITEM CONCRETE DECK REPAIR FOR EPOXY OVERLAY	52.000 SF	50.00000	2,600.00
0035	8892000000-E GENERIC STRUCTURE ITEM EPOXY OVERLAY SYSTEM	7,390.000 SF	4.00000	29,560.00
0036	8893000000-E GENERIC STRUCTURE ITEM CONCRETE DECK REPAIR FOR PPC OVERLAY	10.000 SY	750.00000	7,500.00
0037	8893000000-E GENERIC STRUCTURE ITEM HYDRO-DEMOLITION OF BRIDGE DECK	13.500 SY	0.01000	0.14
0038	8893000000-E GENERIC STRUCTURE ITEM PLACING & FINISHING PPC OVER-LAY	17,655.000 SY	18.90000	333,679.50
0039	8893000000-E GENERIC STRUCTURE ITEM SCARIFYING BRIDGE DECK	17,655.000 SY	12.90000	227,749.50
0040	8893000000-E GENERIC STRUCTURE ITEM SHOTBLASTING BRIDGE DECK	18,574.000 SY	2.65000	49,221.10
0041	8897000000-N GENERIC STRUCTURE ITEM SPLICING OF PRESTRESSING STRAND	1.000 EA	3,500.00000	3,500.00
0042	8860000000-N GENERIC STRUCTURE ITEM AUXILIARY COUNTERWEIGHT & SPAN GUIDE REPAIRS	LUMP	LUMP	700,000.00
Section 0004 Total				12,146,488.20

NON-COLLUSION AND DEBARMENT CERTIFICATION

The bidder certifies that neither he, nor any official, agent or employee of the bidder 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 bid, and that the bidder intends to do the work with its own bonafide employees or subcontractors and is not bidding for the benefit of another contractor. In addition, submitting this electronic bid constitutes the bidder's certification of Status under penalty of perjury under the laws of the United States and in accordance with the Debarment Certification on file with the Department.

By submitting this bid, the 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.

Where the prospective bidder is unable to certify to any of the statements in this certification, the bidder shall submit an explanation in the blanks provided herein. The explanation will not necessarily result in denial of participation in a contract.

Explanation:
NOT ANSWERED
NOT ANSWERED
NOT ANSWERED
NOT ANSWERED

If the prequalified bidder's status changes, he shall immediately submit a new fully executed non-collusion affidavit and debarment certification with an explanation of the change to the Contract Office prior to submitting the bid.

Failure to furnish a certification or an explanation will be grounds for rejection of a bid

AWARD LIMITS ON MULTIPLE PROJECTS

By answering YES to this statement, the bidder acknowledges that they are using the award limits on multiple projects. 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 NOT ANSWERED 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
NOT ANSWERED	
NOT ANSWERED	
NOT ANSWERED	
NOT ANSWERED	
NOT ANSWERED	
NOT ANSWERED	

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

00001 01-30-18 ADDITION OF AUX COUNTERWEIGHT & GUIDE REPAIRS

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

Contract Item Sheets For C204119

Line #	ItemNumber	Sec #	Description	Quantity Unit	Unit Bid Price	Amount Bid
ROADWAY ITEMS						
0001	0000100000-N	800	MOBILIZATION	Lump Sum LS	650,000.00	650,000.00
0002	4400000000-E	1110	WORK ZONE SIGNS (STATIONARY)	676 SF	6.25	4,225.00
0003	4405000000-E	1110	WORK ZONE SIGNS (PORTABLE)	576 SF	6.25	3,600.00
0004	4410000000-E	1110	WORK ZONE SIGNS (BARRICADE MOUNTED)	30 SF	6.00	180.00
0005	4415000000-N	1115	FLASHING ARROW BOARD	4 EA	2,500.00	10,000.00
0006	4420000000-N	1120	PORTABLE CHANGEABLE MESSAGE SIGN	11 EA	10,000.00	110,000.00
0007	4430000000-N	1130	DRUMS	175 EA	40.00	7,000.00
0008	4445000000-E	1145	BARRICADES (TYPE III)	104 LF	20.00	2,080.00
0009	4480000000-N	1165	TMA	3 EA	15,000.00	45,000.00
0010	4810000000-E	1205	PAINT PAVEMENT MARKING LINES (4")	3,825 LF	0.80	3,060.00
0011	4847010000-E	1205	POLYUREA PAVEMENT MARKING LINES (4", 20 MILS)	12,176 LF	1.28	15,585.28
0012	4847050000-E	1205	POLYUREA PAVEMENT MARKING LINES (8", 20 MILS)	630 LF	2.56	1,612.80
0013	4900000000-N	1251	PERMANENT RAISED PAVEMENT MARKERS	145 EA	8.00	1,160.00

Line #	ItemNumber	Sec #	Description	Quantity Unit	Unit Bid Price	Amount Bid
0014	8161000000-E	420	GROOVING BRIDGE FLOORS	149,300 SF	0.25	37,325.00
0015	8296000000-N	442	POLLUTION CONTROL	Lump Sum LS	100,000.00	100,000.00
0016	8559000000-E	SP	CLASS II, SURFACE PREPARATION	10 SY	1,500.00	15,000.00
0017	8566000000-E	SP	CLASS III, SURFACE PREPARATION	13.5 SY	4,135.00	55,822.50
0018	8664000000-E	SP	SHOTCRETE REPAIRS	125 CF	1,400.00	175,000.00
0019	8678000000-E	SP	EPOXY RESIN INJECTION	1 LF	750.00	750.00
0020	8692000000-N	SP	FOAM JOINT SEALS	Lump Sum LS	87,500.00	87,500.00
0021	8860000000-N	SP	GENERIC STRUCTURE ITEM CLEANING & REPAINTING OF BRIDGE #13	Lump Sum LS	1,350,000.00	1,350,000.00
0022	8860000000-N	SP	GENERIC STRUCTURE ITEM INSTALL NEW SIGNS	Lump Sum LS	10,000.00	10,000.00
0023	8860000000-N	SP	GENERIC STRUCTURE ITEM MECHANICAL OPERATING MACHINERY	Lump Sum LS	225,000.00	225,000.00
0024	8860000000-N	SP	GENERIC STRUCTURE ITEM OPERATOR HOUSE RENOVATION	Lump Sum LS	1,588,780.45	1,588,780.45
0025	8860000000-N	SP	GENERIC STRUCTURE ITEM PAINTING CONTAINMENT FOR BRIDGE #13	Lump Sum LS	886,000.00	886,000.00
0026	8860000000-N	SP	GENERIC STRUCTURE ITEM REPLACE AIR HORN	Lump Sum LS	5,000.00	5,000.00
0027	8860000000-N	SP	GENERIC STRUCTURE ITEM REPLACEMENT OF STEEL GRID DECK	Lump Sum LS	3,600,000.00	3,600,000.00
0028	8860000000-N	SP	GENERIC STRUCTURE ITEM UNDER STRUCTURE WORKPLATFORM	Lump Sum LS	0.01	0.01
0029	8867000000-E	SP	GENERIC STRUCTURE ITEM MODIFIED ALASKA BARRIER RAIL	3,034 LF	250.00	758,500.00
0030	8881000000-E	SP	GENERIC STRUCTURE ITEM FLOWABLE FILL	8 CY	1,000.00	8,000.00

Line #	ItemNumber	Sec #	Description	Quantity Unit	Unit Bid Price	Amount Bid
0031	8881000000-E	SP	GENERIC STRUCTURE ITEM PPC MATERIALS	495 CY	2,600.00	1,287,000.00
0032	8882000000-E	SP	GENERIC STRUCTURE ITEM REPAIRS TO PRESTRESSED CONC- RETE GIRDERS	1.5 CF	2,000.00	3,000.00
0033	8889000000-E	SP	GENERIC STRUCTURE ITEM STRUCTURAL STEEL FOR REPAIRS	25,000 LB	24.00	600,000.00
0034	8892000000-E	SP	GENERIC STRUCTURE ITEM CONCRETE DECK REPAIR FOR EPOXY OVERLAY	52 SF	50.00	2,600.00
0035	8892000000-E	SP	GENERIC STRUCTURE ITEM EPOXY OVERLAY SYSTEM	7,390 SF	4.00	29,560.00
0036	8893000000-E	SP	GENERIC STRUCTURE ITEM CONCRETE DECK REPAIR FOR PPC OVERLAY	10 SY	750.00	7,500.00
0037	8893000000-E	SP	GENERIC STRUCTURE ITEM HYDRO-DEMOLITION OF BRIDGE DEC K	13.5 SY	0.01	0.14
0038	8893000000-E	SP	GENERIC STRUCTURE ITEM PLACING & FINISHING PPC OVER- LAY	17,655 SY	18.90	333,679.50
0039	8893000000-E	SP	GENERIC STRUCTURE ITEM SCARIFYING BRIDGE DECK	17,655 SY	12.90	227,749.50
0040	8893000000-E	SP	GENERIC STRUCTURE ITEM SHOTBLASTING BRIDGE DECK	18,574 SY	2.65	49,221.10
0041	8897000000-N	SP	GENERIC STRUCTURE ITEM SPLICING OF PRESTRESSING STRAN D	1 EA	3,500.00	3,500.00
0042	8860000000-N	SP	GENERIC STRUCTURE ITEM AUXILIARY COUNTERWEIGHT & SPAN GUIDE REPAIRS	Lump Sum LS	700,000.00	700,000.00
TOTAL AMOUNT OF BID FOR ENTIRE PROJECT						\$12,999,991.28

Contract No. C204119
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, Suite 102, Raleigh, NC 27607

Address as Prequalified

Attest



Secretary/Assistant Secretary
Select appropriate title

By



President/Vice President/Assistant Vice President
Select appropriate title

DISTRICT MANAGER

Thomas R. Spangler

Print or type Signer's name

Jim Schneiderman

Print or type Signer's name

CORPORATE SEAL



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.

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. **C204119**

County (ies): **New Hanover**

ACCEPTED BY THE
DEPARTMENT OF TRANSPORTATION

DocuSigned by:
Ronald E. Davenport, Jr.
F81B6038A47A44Z...

Contract Officer

3/9/2018

Date

Execution of Contract and Bonds
Approved as to Form:

DocuSigned by:
Kacy Hunt
78E172257DB0415...

Attorney General

3/9/2018

Date

Contract No. **C204119**
County New Hanover

Bond Number: 6350087, 106779231, 82454739

CONTRACT PAYMENT BOND

Date of Payment Bond Execution March 6, 2018

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: \$12,999,991.28

Contract ID No.: C204119

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
County

C204119

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 Elizabeth Sterling, Attorney-in-Fact

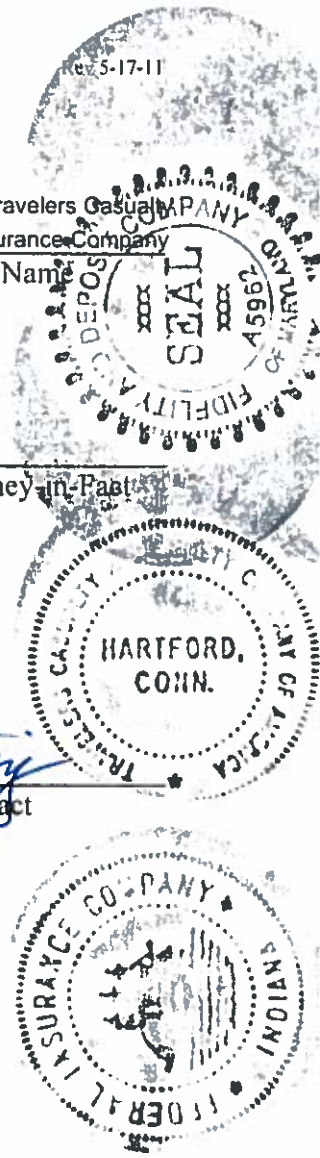
Print, stamp or type name of Attorney-in-Fact

Elizabeth Sterling
Signature of Attorney-in-Fact

Sandra M. Winsted
Signature of Witness

Sandra M. Winsted, Witness
Print or type Signer's name

3550 Lenox Road, NE, Suite 1700, Atlanta, GA 30326
Address of Attorney-in-Fact



Contract No.
County

C204119

New Hanover

Rev 5-17-11

CONTRACT PAYMENT BOND

CORPORATION

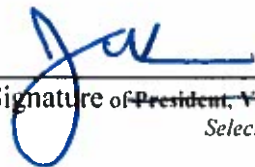
SIGNATURE OF CONTRACTOR (Principal)

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 District Manager

James A. Schneiderman

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. **C204119**
County New Hanover

Rev 5-17-11

Bond Number: 6350087, 106779231, 82454739

CONTRACT PERFORMANCE BOND

Date of Performance Bond Execution: March 6, 2018
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: \$12,999,991.28
Contract ID No.: C204119
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
County

C204119

New Haven

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 Elizabeth Sterling, Attorney-in-Fact

Print, stamp or type name of Attorney-in-Fact



Elizabeth Sterling
Signature of Attorney-in-Fact

Sandra M. Winsted
Signature of Witness



Sandra M. Winsted, Witness
Print or type Signer's name

3550 Lenox Road NE, Suite 1700, Atlanta, GA 30326
Address of Attorney-in-Fact

Contract No.
County

C204119

New Hanover

Rev 5-17-11

CONTRACT PERFORMANCE BOND

CORPORATION

SIGNATURE OF CONTRACTOR (Principal)

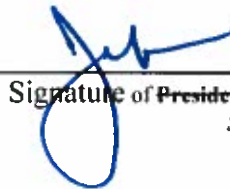
PCL Civil Constructors, Inc.

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 *District Manager*

James A. Schneiderman

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



POWER OF ATTORNEY

Farmington Casualty Company
Fidelity and Guaranty Insurance Company
Fidelity and Guaranty Insurance Underwriters, Inc.
St. Paul Fire and Marine Insurance Company
St. Paul Guardian Insurance Company

St. Paul Mercury Insurance Company
Travelers Casualty and Surety Company
Travelers Casualty and Surety Company of America
United States Fidelity and Guaranty Company

Attorney-In Fact No. 232348

Certificate No. 007284735

KNOW ALL MEN BY THESE PRESENTS: That Farmington Casualty Company, St. Paul Fire and Marine Insurance Company, St. Paul Guardian Insurance Company, St. Paul Mercury Insurance Company, Travelers Casualty and Surety Company, Travelers Casualty and Surety Company of America, and United States Fidelity and Guaranty Company are corporations duly organized under the laws of the State of Connecticut, that Fidelity and Guaranty Insurance Company is a corporation duly organized under the laws of the State of Iowa, and that Fidelity and Guaranty Insurance Underwriters, Inc., is a corporation duly organized under the laws of the State of Wisconsin (herein collectively called the "Companies"), and that the Companies do hereby make, constitute and appoint

Maria Signorile, Elizabeth K. Sterling, Wesley P. Williams, and Benjamin A. Stahl

of the City of Atlanta, State of Georgia, their true and lawful Attorney(s)-in-Fact, each in their separate capacity if more than one is named above, 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 30th day of June, 2017.

Farmington Casualty Company
Fidelity and Guaranty Insurance Company
Fidelity and Guaranty Insurance Underwriters, Inc.
St. Paul Fire and Marine Insurance Company
St. Paul Guardian Insurance Company

St. Paul Mercury Insurance Company
Travelers Casualty and Surety Company
Travelers Casualty and Surety Company of America
United States Fidelity and Guaranty Company



State of Connecticut
City of Hartford ss.

By: [Signature]
Robert L. Raney, Senior Vice President

On this the 30th day of June, 2017, before me personally appeared Robert L. Raney, who acknowledged himself to be the Senior Vice President of Farmington Casualty Company, Fidelity and Guaranty Insurance Company, Fidelity and Guaranty Insurance Underwriters, Inc., St. Paul Fire and Marine Insurance Company, St. Paul Guardian Insurance Company, St. Paul Mercury Insurance Company, Travelers Casualty and Surety Company, Travelers Casualty and Surety Company of America, and United States Fidelity and Guaranty 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.



This Power of Attorney is granted under and by the authority of the following resolutions adopted by the Boards of Directors of Farmington Casualty Company, Fidelity and Guaranty Insurance Company, Fidelity and Guaranty Insurance Underwriters, Inc., St. Paul Fire and Marine Insurance Company, St. Paul Guardian Insurance Company, St. Paul Mercury Insurance Company, Travelers Casualty and Surety Company, Travelers Casualty and Surety Company of America, and United States Fidelity and Guaranty 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 Farmington Casualty Company, Fidelity and Guaranty Insurance Company, Fidelity and Guaranty Insurance Underwriters, Inc., St. Paul Fire and Marine Insurance Company, St. Paul Guardian Insurance Company, St. Paul Mercury Insurance Company, Travelers Casualty and Surety Company, Travelers Casualty and Surety Company of America, and United States Fidelity and Guaranty 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 is in full force and effect and has not been revoked.

IN TESTIMONY WHEREOF, I have hereunto set my hand and affixed the seals of said Companies this 6 day of March, 2018.


Kevin E. Hughes, Assistant Secretary



To verify the authenticity of this Power of Attorney, call 1-800-421-3880 or contact us at www.travelersbond.com. Please refer to the Attorney-In-Fact number, the above-named individuals and the details of the bond to which the power is attached.

**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 Maryland, and the FIDELITY AND DEPOSIT COMPANY OF MARYLAND a corporation of the State of Maryland (herein collectively called the "Companies"), by **GERALD F. HALEY, 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 **Wesley P. WILLIAMS, Maria SIGNORILE, Elizabeth K. STERLING and Benjamin A. STAHL, all of Atlanta, Georgia, 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 27th day of January, A.D. 2017.

ATTEST:

**ZURICH AMERICAN INSURANCE COMPANY
COLONIAL AMERICAN CASUALTY AND SURETY COMPANY
FIDELITY AND DEPOSIT COMPANY OF MARYLAND**



By: *Eric D. Barnes*

Secretary
Eric D. Barnes

Gerald F. Haley

Vice President
Gerald F. Haley

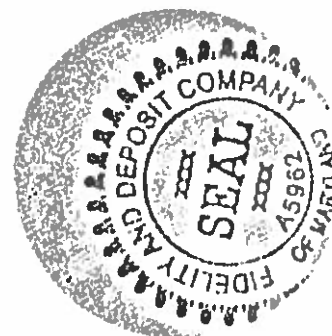
State of Maryland
County of Baltimore

On this 27th day of January, A.D. 2017, before the subscriber, a Notary Public of the State of Maryland, duly commissioned and qualified, **GERALD F. HALEY, Vice President, and ERIC D. BARNES, 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, depose 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

Constance A. Dunn, Notary Public
My Commission Expires: July 9, 2019



EXTRACT FROM BY-LAWS OF THE COMPANIES

"Article V, Section 8, Attorneys-in-Fact. The Chief Executive Officer, the President, or any Executive Vice President or Vice President may, by written instrument under the attested corporate seal, appoint attorneys-in-fact with authority to execute bonds, policies, recognizances, stipulations, undertakings, or other like instruments on behalf of the Company, and may authorize any officer or any such attorney-in-fact to affix the corporate seal thereto; and may with or without cause modify or revoke any such appointment or authority at any time."

CERTIFICATE

I, the undersigned, Vice President of the ZURICH AMERICAN INSURANCE COMPANY, the COLONIAL AMERICAN CASUALTY AND SURETY COMPANY, and the FIDELITY AND DEPOSIT COMPANY OF MARYLAND, do hereby certify that the foregoing Power of Attorney is still in full force and effect on the date of this certificate; and I do further certify that Article V, Section 8, of the By-Laws of the Companies is still in force.

This Power of Attorney and Certificate may be signed by facsimile under and by authority of the following resolution of the Board of Directors of the ZURICH AMERICAN INSURANCE COMPANY at a meeting duly called and held on the 15th day of December 1998.

RESOLVED: "That the signature of the President or a Vice President and the attesting signature of a Secretary or an Assistant Secretary and the Seal of the Company may be affixed by facsimile on any Power of Attorney...Any such Power or any certificate thereof bearing such facsimile signature and seal shall be valid and binding on the Company."

This Power of Attorney and Certificate may be signed by facsimile under and by authority of the following resolution of the Board of Directors of the COLONIAL AMERICAN CASUALTY AND SURETY COMPANY at a meeting duly called and held on the 5th day of May, 1994, and the following resolution of the Board of Directors of the FIDELITY AND DEPOSIT COMPANY OF MARYLAND at a meeting duly called and held on the 10th day of May, 1990.

RESOLVED: "That the facsimile or mechanically reproduced seal of the company and facsimile or mechanically reproduced signature of any Vice-President, Secretary, or Assistant Secretary of the Company, whether made heretofore or hereafter, wherever appearing upon a certified copy of any power of attorney issued by the Company, shall be valid and binding upon the Company with the same force and effect as though manually affixed.

IN TESTIMONY WHEREOF, I have hereunto subscribed my name and affixed the corporate seals of the said Companies, this 6 day of March, 2018



Michael Bond, Vice President

TO REPORT A CLAIM WITH REGARD TO A SURETY BOND, PLEASE SUBMIT ALL REQUIRED INFORMATION TO:

Zurich American Insurance Co.
Attn: Surety Claims
1299 Zurich Way
Schaumburg, IL 60196-1056

CHUBB

Power of Attorney

Federal Insurance Company | Vigilant Insurance Company | Pacific Indemnity Company

Know All by These Presents. That FEDERAL INSURANCE COMPANY, an Indiana corporation, VIGILANT INSURANCE COMPANY, a New York corporation, and PACIFIC INDEMNITY COMPANY, a Wisconsin corporation, do each hereby constitute and appoint Maria Signorile, Benjamin A. Stahl, Elizabeth K. Sterling and Wesley P. Williams of Atlanta, Georgia

each as their true and lawful Attorney-in-Fact to execute under such designation in their names and to affix their corporate seals to and deliver for and on their behalf as surety thereon or otherwise, bonds and undertakings and other writings obligatory in the nature thereof (other than bail bonds) given or executed in the course of business, and any instruments amending or altering the same, and consents to the modification or alteration of any instrument referred to in said bonds or obligations.

In Witness Whereof, said FEDERAL INSURANCE COMPANY, VIGILANT INSURANCE COMPANY, and PACIFIC INDEMNITY COMPANY have each executed and attested these presents and affixed their corporate seals on this 25th day of January, 2017.

Dawn M. Chloros

Dawn M. Chloros, Assistant Secretary

Stephen M. Haney

Stephen M. Haney, Vice President



STATE OF NEW JERSEY

County of Hunterdon

ss.

On this 25th day of January, 2017 before me, a Notary Public of New Jersey, personally came Dawn M. Chloros, to me known to be Assistant Secretary of FEDERAL INSURANCE COMPANY, VIGILANT INSURANCE COMPANY, and PACIFIC INDEMNITY COMPANY, the companies which executed the foregoing Power of Attorney, and the said Dawn M. Chloros, being by me duly sworn, did depose and say that she is Assistant Secretary of FEDERAL INSURANCE COMPANY, VIGILANT INSURANCE COMPANY, and PACIFIC INDEMNITY COMPANY and knows the corporate seals thereof, that the seals affixed to the foregoing Power of Attorney are such corporate seals and were thereto affixed by authority of said Companies; and that she signed said Power of Attorney as Assistant Secretary of said Companies by like authority; and that she is acquainted with Stephen M. Haney, and knows him to be Vice President of said Companies; and that the signature of Stephen M. Haney, subscribed to said Power of Attorney is in the genuine handwriting of Stephen M. Haney, and was thereto subscribed by authority of said Companies and in deponent's presence.

Notarial Seal



KATHERINE J. ADELAAR
NOTARY PUBLIC OF NEW JERSEY
No. 2318885
Commission Expires July 16, 2019

[Signature]
Notary Public

CERTIFICATION

Resolutions adopted by the Boards of Directors of FEDERAL INSURANCE COMPANY, VIGILANT INSURANCE COMPANY, and PACIFIC INDEMNITY COMPANY on August 30, 2016:

RESOLVED, that the following authorizations relate to the execution, for and on behalf of the Company, of bonds, undertakings, recognizances, contracts and other written commitments of the Company entered into in the ordinary course of business (each a "Written Commitment"):

- (1) Each of the Chairman, the President and the Vice Presidents of the Company is hereby authorized to execute any Written Commitment for and on behalf of the Company, under the seal of the Company or otherwise.
(2) Each duly appointed attorney-in-fact of the Company is hereby authorized to execute any Written Commitment for and on behalf of the Company, under the seal of the Company or otherwise, to the extent that such action is authorized by the grant of powers provided for in such person's written appointment as such attorney-in-fact.
(3) Each of the Chairman, the President and the Vice Presidents of the Company is hereby authorized, for and on behalf of the Company, to appoint in writing any person the attorney-in-fact of the Company with full power and authority to execute, for and on behalf of the Company, under the seal of the Company or otherwise, such Written Commitments of the Company as may be specified in such written appointment, which specification may be by general type or class of Written Commitments or by specification of one or more particular Written Commitments.
(4) Each of the Chairman, the President and the Vice Presidents of the Company is hereby authorized, for and on behalf of the Company, to delegate in writing to any other officer of the Company the authority to execute, for and on behalf of the Company, under the Company's seal or otherwise, such Written Commitments of the Company as are specified in such written delegation, which specification may be by general type or class of Written Commitments or by specification of one or more particular Written Commitments.
(5) The signature of any officer or other person executing any Written Commitment or appointment or delegation pursuant to this Resolution, and the seal of the Company, may be affixed by facsimile on such Written Commitment or written appointment or delegation.

FURTHER RESOLVED, that the foregoing Resolution shall not be deemed to be an exclusive statement of the powers and authority of officers, employees and other persons to act for and on behalf of the Company, and such Resolution shall not limit or otherwise affect the exercise of any such power or authority otherwise validly granted or vested.

I, Dawn M. Chloros, Assistant Secretary of FEDERAL INSURANCE COMPANY, VIGILANT INSURANCE COMPANY, and PACIFIC INDEMNITY COMPANY (the "Companies") do hereby certify that

- (i) the foregoing Resolutions adopted by the Board of Directors of the Companies are true, correct and in full force and effect,
(ii) the Companies are duly licensed and authorized to transact surety business in all 50 of the United States of America and the District of Columbia and are authorized by the U.S. Treasury Department; further, Federal and Vigilant are licensed in the U.S. Virgin Islands, and Federal is licensed in Guam, Puerto Rico, and each of the Provinces of Canada except Prince Edward Island; and
(iii) the foregoing Power of Attorney is true, correct and in full force and effect.

Given under my hand and seals of said Companies at Whitehouse Station, NJ, this 6th day of March, 2018



Dawn M. Chloros

Dawn M. Chloros, Assistant Secretary



IN THE EVENT YOU WISH TO NOTIFY US OF A CLAIM, VERIFY THE AUTHENTICITY OF THIS BOND OR NOTIFY US OF ANY OTHER MATTER, PLEASE NOTIFY US AT: Telephone (908) 903-3493 Fax (908) 903-3656 e-mail: surety@chubb.com

ACKNOWLEDGEMENT BY SURETY

STATE OF GEORGIA
COUNTY OF GWINNETT

On this 6th day of March, 2018 before me, Maria Signorile, a Notary Public, within and for said County and State, personally appeared Elizabeth Sterling to me personally known to be the Attorney-in-Fact of and for Fidelity and Deposit Company of Maryland, Travelers Casualty and Surety Company of America, Federal Insurance Company and acknowledged that she executed the said instrument as the free act and deed of said Company.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed my official seal, at my office in the aforesaid County, the day and year in this certificate first above written.



Notary Public in the State of Georgia
County of Gwinnett

Maria Signorile
Notary Public, Gwinnett County, GA
My Commission Expires June 12, 2018

